

GUIDELINES FOR
PROTECTING THE SAFETY AND HEALTH OF
HEALTH CARE WORKERS

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PREFACE

The purpose of the Occupational Safety and Health Act of 1970 (Public Law 91-596) is to ensure safe and healthful working conditions for every working man and woman in the Nation and to preserve our human resources by providing medical and other criteria that will ensure, insofar as practicable, that no workers will suffer diminished health, functional capacity, or life expectancy as a result of their work experience. The Act authorizes the National Institute for Occupational Safety and Health (NIOSH) to develop and establish recommended occupational safety and health standards, and to conduct the necessary research and experimental programs to develop criteria for new and improved occupational safety and health standards. Although this document does not recommend a new standard, it does present guidelines for reducing the incidence of injury and disease among health care workers. Every effort was made to address all major health and safety hazards that might be encountered in hospitals or other health care centers. The document is not intended to affect patients directly, but implementing the guidelines will generally benefit patient care.

The present document is a major revision of an earlier draft and incorporates the most recent NIOSH recommended standards, the Occupational Safety and Health Administration regulations, and Centers for Disease Control guidelines. Also included is specific information from the Joint Commission on Accreditation of Healthcare Organizations (formerly the Joint Commission on Accreditation of Hospitals), the National Fire Protection Association, the U.S. Environmental Protection Agency, and other agencies. State and local regulations are not addressed, however, and should be consulted where applicable.

ABSTRACT

These guidelines provide information needed to protect the health and safety of health care workers in hospitals and other health care facilities. The document includes an overview of hospital hazards; methods for developing hospital safety and health programs; discussions of safety hazards, infectious diseases, and noninfectious health hazards; methods for disposing of hazardous wastes; and a list of occupational safety and health agencies and resource organizations. Because no single set of health and safety regulations applies to all aspects of hospital work or health care delivery, the guidelines presented here were compiled from many sources, including the National Institute for Occupational Safety and Health, the Centers for Disease Control, the Occupational Safety and Health Administration, the U.S. Environmental Protection Agency, the Joint Commission on Accreditation of Healthcare Organizations, and others. Adherence to these guidelines should reduce the risk of injury and disease among health care workers.

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ABBREVIATIONS

AAMI	Association for the Advancement of Medical Instrumentation
ACGIH	American Conference of Governmental Industrial Hygienists
ACIP	Immunization Practices Advisory Committee of the U.S. Public Health Service
ADA	American Dental Association
AHA	American Hospital Association
AIDS	acquired immunodeficiency syndrome
AIHA	American Industrial Hygiene Association
AMA	American Medical Association
ANSI	American National Standards Institute
BCG	bacille Calmette-Guerin
BLS	Bureau of Labor Statistics
CAP	College of American Pathologists
CAT	computerized axial tomography
cc	cubic centimeter
CDC	Centers for Disease Control
CFR	Code of Federal Regulations
CMV	cytomegalovirus
CPC	chemical protective clothing
CPR	cardiopulmonary resuscitation
dB	decibel
DNA	deoxyribonucleic acid

EDTA	ethylene diaminetetraacetic acid
EEG	electroencephalogram
EPA	U.S. Environmental Protection Agency
f	fiber
FA	fluorescent antibody
FDA	Food and Drug Administration
GFCI	ground fault circuit interrupter
HAV	Hepatitis A virus
HBIG	Hepatitis B immune globulin
HBV	Hepatitis B virus
HBeAg	Hepatitis B "e" antigen
HBsAg	Hepatitis B surface antigen
HHE	health hazard evaluation
HI	hemagglutination-inhibition
hr	hour
HRA	Health Resources Administration
HRSA	Health Resources and Services Administration
HSV	herpes simplex virus
HTLV-III/LAV	human T-lymphotropic virus type III lymphadenopathy-associated virus
Hz	hertz
IAHS	International Association of Healthcare Security
IARC	International Agency for Research on Cancer
ICU	intensive care unit
IDLH	immediately dangerous to life or health
IG	immune globulin

IHSSF	International Healthcare Safety and Security Foundation
in	inch
IR	infrared
ISG	immune serum globulin
JCAH	Joint Commission on Accreditation of Hospitals
kHz	kilohertz
LCM	lymphocytic choriomeningitis
LPG	liquid propane gas
LPN	licensed practical nurse
LVN	licensed vocational nurse
m	meter
MeV	million electron volts
mg/m³	milligram per cubic meter
min	minute
mm	millimeter
MMWR	Morbidity and Mortality Weekly Report
M-M-R	measles, mumps, and rubella vaccine
mrem	millirem
MSDS	Material Safety Data Sheet
MSHA	Mine Safety and Health Administration
mW	milliwatt
NANB	non-A, non-B viral hepatitis
NCRP	National Council on Radiation Protection and Measurements
NEC	National Electrical Code
NFPA	National Fire Protection Association
NICU	neonatal intensive care unit

NIH	National Institutes of Health
NIOSH	National Institute for Occupational Safety and Health
nm	nanometer
NMR	nuclear magnetic resonance
NOHS	National Occupational Health Survey
NRC	Nuclear Regulatory Commission
NSC	National Safety Council
NTP	National Toxicology Program
OSHA	Occupational Safety and Health Administration
pa	posterior and anterior view
μ Pa	micropascal
PAA	peracetic acid
PEL	permissible exposure limit
PMR	proportionate mortality ratio
PPD	purified protein derivative
PPD-S	purified protein derivative--standard
ppm	part per million
psi(a)	pound per square inch (absolute)
ptAP	para-tertiary amyphenol
ptBP	para-tertiary butylphenol
QNFT	quantitative fit testing
RAD	radiation absorbed dose
RDL	respirator decision logic
REL	recommended exposure limit
rem	roentgen equivalent man
RF	radiofrequency

RN	registered nurse
RSV	respiratory syncytial virus
RTECS	Registry of Toxic Effects of Chemical Substances
SCE	sister chromatid exchange
SI	Systeme International d'Unites
STEL	short-term exposure limit
TB	tuberculosis
TLD	thermoluminescent dosimeter
TLV®	threshold limit value
TLV-C	threshold limit value - ceiling
TLV-skin	threshold limit value - skin adsorption
TLV-STEL	threshold limit value - short-term exposure limit
TU	tuberculin unit
TWA	time-weighted average
UV	ultraviolet
V	volt
VDT	video display terminal
VZV	varicella zoster virus
μW	microwatt
WBGT	wet bulb globe temperature

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GUIDELINES FOR HEALTH CARE WORKERS

INTRODUCTION

Health care facilities present workers with a myriad of potential health and safety hazards. Compared with the total civilian workforce, hospital workers have a greater percentage of workers' compensation claims for sprains and strains, infectious and parasitic diseases, dermatitis, hepatitis, mental disorders, eye diseases, influenza, and toxic hepatitis.

This document contains guidelines for reducing the incidence of injury and disease among health care workers. Although much of the information here was obtained from studies conducted in hospitals, it can also be applied to health care workers in other settings, including outpatient clinics, nursing homes, acute care centers, physicians' and dentists' offices, blood banks, and private residences. Workers who provide emergency medical services outside health care facilities have not been addressed because of the unique nature of their work, but medical technicians and others who occasionally provide emergency medical treatment (first aid) may benefit from these guidelines.

Hospitals are regulated and guided in their operations by a wide variety of local, State, and Federal agencies and organizations. As a consequence, no single set of health and safety regulations applies to all aspects of hospital work or health care delivery. The health and safety guidelines in this document were compiled from many sources, including the National Institute for Occupational Safety and Health, the Centers for Disease Control (CDC), the Occupational Safety and Health Administration, the Joint Commission on Accreditation of Healthcare Organizations, the National Fire Protection Association, and the U.S. Environmental Protection Agency.

The document has seven sections. Section 1 is an overview of hospital hazards, and Section 2 contains methods for developing hospital safety and health programs. These sections are organized so that the user can follow a logical progression of recognition, evaluation, and control of hazards. Section 3 focuses on safety hazards such as fires, flammable and explosive materials, electricity, and assaults. Section 4 refers readers to CDC guidelines for protecting workers from selected infectious diseases, including acquired immunodeficiency syndrome (AIDS). The applicable CDC guidelines are reprinted in the Appendices. Section 5 contains discussions of noninfectious health hazards, including chemical agents and dusts, physical agents, mutagenic and teratogenic agents, skin irritants, and stress. Section 6 outlines procedures for hazardous waste disposal, and Section 7 contains a directory of occupational safety and health agencies and resource organizations.



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1. OVERVIEW OF HOSPITAL HAZARDS

1.1 OCCUPATIONAL INJURY AND ILLNESS AMONG HOSPITAL WORKERS

Hospitals employ approximately 4.5 million of the 8 million health care workers in the United States, or about 4% of the total U.S. workforce (BLS 1988). The percentage distribution of hospital workers by occupation is shown in Appendix 1.

Few workplaces are as complex as the hospital. Not only does it provide the basic health care needs for a large number of people, but it is often a teaching and research center as well. As a result, the list of potential hazards includes radiation, toxic chemicals, biological hazards, heat, noise, dusts, and stress.

Maintenance workers are potentially exposed to solvents, asbestos, and electrical hazards. Persons working in or around boiler rooms are regularly exposed to high levels of noise and heat.

Housekeepers are exposed to detergents and disinfectants that can cause skin rashes and eye and throat irritation. They risk exposure to hepatitis and other diseases from hypodermic needles that have not been discarded properly. Sprains and strains are also common problems for housekeepers.

Food service workers face problems such as cuts from sharp-edged equipment, burns from hot surfaces and steam lines, falls on slippery floors, and fatigue and stress from long periods of standing on hard surfaces. Nonionizing radiation from improperly maintained microwave ovens is a potential hazard. Skin rashes from fresh foods, detergents, and humidity are also common, and excessive exposure to noise has been documented.

Registered nurses (RN's), nurse practitioners, and licensed vocational/licensed practical nurses (LVN's/LPN's) confront such potential problems as exposure to infectious diseases and toxic substances, back injuries, and radiation exposure. Nurses also deal with less obvious hazards resulting from stress and shift work.

Radiology technicians are potentially exposed to radiation from X-rays and radioactive isotopes. Even with the adequate maintenance of equipment, risks can result from incorrect work practices (such as holding infants under a radiation beam without adequate self-protection) or from infectious diseases transmitted by patients. Radiology technicians may also be exposed to chemical hazards.

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Operating-room workers (both female and male, and the wives of male workers) may face the increased risk of reproductive problems as a result of exposure to waste anesthetic gases. They are also subject to cuts and puncture wounds, infection, radiation, and electrical hazards.

1.1.1 Published Data

A 1972 national survey of occupational health services in more than 2,600 hospitals reported an annual average of 68 injuries and 6 illnesses among workers in each institution (NIOSH 1974-1976). The most frequent injuries were strains and sprains, followed by puncture wounds, abrasions and contusions, lacerations, back injuries, burns, and fractures. The most frequent illnesses were respiratory problems, infections, dermatitis, hepatitis, and drug or medication reactions. Although studies have shown the adverse effects of some hospital hazards such as anesthetic gases, ethylene oxide, and certain cytotoxic drugs, the effects of many others are not well understood. Hazard surveillance data in the hospital industry (NIOSH 1985) have identified 159 known primary skin or eye irritants used in hospitals and 135 chemicals that are potentially carcinogenic, teratogenic, mutagenic, or a combination of these (see Appendix 4).

In 1978, the California State Department of Industrial Relations published injury and illness data for 1976-1977 from an intensive study of hospital personnel (California Department of Industrial Relations, 1978). The work injury rate in convalescent hospitals (8.4 lost workday cases per 100 full-time workers) was almost double that in acute-care hospitals and in all California industries. Major causes of disabling injury and illness were strain or overexertion, falls or slips, being struck by or striking against objects, burns, and exposure to toxic or noxious substances. Workers with the highest reported number of injuries and illnesses were aides, nursing attendants, orderlies, kitchen workers, housekeeping and maintenance workers, laundry room workers, RN's, LVN's/LPN's, clerks and office workers, and technicians. In Florida, the annual rate of illness and injury reported for hospital workers was 10.0 per 100 workers--about the same as that recorded for sheet metal workers, auto mechanics, and paper mill workers (American Journal of Nursing 1982).

Two national data systems have been analyzed by Gun (1983): (1) the National Health Interview Survey (1970-1977), which describes the hospital workforce and compares the rates of acute and chronic conditions for hospital workers with those for the total workforce, and (2) compensation data from the Bureau of Labor Statistics. The study compared disease rates for hospital workers with data for all workers combined from the National Health Interview Survey.

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1.1.2 Chronic Conditions

Gun (1983) noted that an excessive incidence of some chronic conditions among hospital workers was clearly due to primarily female medical conditions in a predominantly female workforce. After allowance was made for this factor, six conditions of interest were found:

1. Hypertension, among service and blue collar workers
2. Varicose veins, among nearly all categories of hospital workers
3. Anemia, mostly among females, but sex bias was not the sole cause of excess incidence
4. Diseases of the kidneys and urinary system, mostly among females (69%), but an excess incidence appeared in all categories of hospital workers
5. Eczema, dermatitis, and urticaria, mostly among females (57%), but an excess incidence appeared in most categories of hospital workers
6. Displacement of intervertebral disc (low-back injury), mostly among females (166% relative risk)

No data were provided on the risks of diseases such as cancer or reproductive impairment.

1.1.3 Acute Conditions

Hospital workers had a significantly greater incidence of acute conditions compared with all workers in all categories of sex, race, age, and occupational status (Gun 1983). Respiratory problems accounted for more than half of all acute conditions in both hospital workers and all workers. The incidence of every major category of acute condition was higher in hospital workers than in all workers. The risk for hospital workers was about 1.5 times greater than that for all workers, and it was statistically significant for all conditions, including infectious and parasitic diseases, respiratory conditions, digestive system conditions, and "other" conditions (diseases of the ear, headaches, genitourinary disorders, problems associated with childbirth, disorders of pregnancy and the puerperium, and diseases of the skin and musculoskeletal system). The risk of injury for hospital workers was only slightly greater than for all workers.

1.1.4 Compensable Injury and Disease

A review of data from the Bureau of Labor Statistics (BLS 1983) for compensable injury and disease showed that sprains and strains (often

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representing low-back injury) were by far the most common type of condition, constituting 51.6% of the total (Table 1-1). The data in Table 1-1 also show that cuts, lacerations, and punctures account for a significant number of hospital workers' compensation claims. Because these injuries also have a potential for contamination with blood and other body fluids, they should be carefully monitored and recorded. Employers should provide medical consultation for workers who sustain puncture wounds involving potentially infectious materials.

The injuries and illnesses listed in Table 1-2 are reported more commonly on hospital workers' compensation claims compared with those of all civilian workers. An excess percentage of hospital workers' compensation claims resulted from the following conditions: strains and sprains, dermatitis, serum and infectious hepatitis, mental disorders, ill-defined conditions, eye diseases, influenza, complications peculiar to medical care, and toxic hepatitis.

1.2 GROWTH OF OCCUPATIONAL SAFETY AND HEALTH PROGRAMS FOR HOSPITAL WORKERS

Until recently, safety and health policies in hospitals were developed mainly for patients, not workers. Traditionally, hospital administrators and workers considered hospitals and health institutions safer than other work environments and recognized mainly infectious diseases and physical injuries as risks in the hospital environment. Administrators have therefore emphasized patient care and have allocated few resources for occupational health. The following factors have contributed to the lack of emphasis on worker health:

- Hospital workers have been viewed as health professionals capable of maintaining their health without assistance.
- The availability of informal consultations with hospital physicians reduces the use of worker health services.
- Hospitals are oriented toward treating disease rather than maintaining health.

1.2.1 Early Attempts to Protect Workers

Although infectious diseases, like most hospital hazards, were first recognized as risks for patients rather than staff, early attempts to protect patients against hospital infections also benefited workers. For example, Florence Nightingale introduced basic sanitation measures such as open-window ventilation and fewer patients per bed; and the Austrian surgeon, Semmelweis, initiated routine hand-washing more than a century ago. New hazards began to appear in the 1900's when physicians experimenting with X-rays were exposed to radiation, and operating-room

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Table 1-1.--Workers' compensation claims for injury or illness among hospital workers (SIC 806)*

Condition	Claims	
	Number†	% of total
Sprains, strains	35,405	51.6
Contusion, crushing, and bruising	7,635	11.1
Cuts, lacerations, and punctures	7,374	10.8
Fractures	3,865	5.6
Multiple injuries	1,473	2.1
Thermal burns	1,343	2.0
Scratches, abrasions	1,275	1.9
Infectious and parasitic diseases	865	1.3
Dermatitis and other skin conditions	850	1.2
All other	8,484	12.4
Total	68,569	100.0

*Adapted from information published in the Supplementary Data System by the U.S. Department of Labor, Bureau of Labor Statistics (1983).

†Figures are adjusted to allow for States that do not provide a sample of their cases.

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Table 1-2.—Conditions reported more commonly on hospital workers' (SIC 806)* compensation claims

Condition	Hospital workers		All civilian workers	
	Number†	%	Number†	%
Sprains, strains	35,405	51.63	649,685	37.76
Infectious and parasitic diseases:				
Unspecified	35	.05	142	.01
Conjunctivitis	102	.15	366	.02
Tuberculosis	87	.13	183	.01
Other	641	.93	2,063	.12
Total	865	1.26	2,754	.16
Dermatitis:				
Unspecified	68	.10	1,291	.08
Contact dermatitis	407	.59	9,180	.53
Allergic dermatitis	106	.15	2,042	.12
Skin infections	223	.33	812	.05
Other	22	.03	402	.02
Skin conditions not elsewhere classified	24	.04	191	.01
Total	850	1.24	13,918	.81
Serum and infectious hepatitis	362	.53	903	.05
Mental disorders	360	.53	5,775	.34
Ill-defined conditions	263	.38	4,880	.28
Eye diseases	250	.36	4,805	.28
Influenza	136	.20	2,389	.14
Complications peculiar to medical care	114	.17	295	.02
Toxic hepatitis	37	.05	95	.01
Total	38,642	56.35	685,499	39.85

*Adapted from information published in the Supplementary Data System by the U.S. Department of Labor, Bureau of Labor Statistics (1983).

†Figures are adjusted to allow for States that do not provide a sample of their cases.

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personnel faced possible explosions during surgery involving anesthetic gases. These hazards finally called attention to the many dangers facing hospital workers, and hospitals began to monitor their workers for tuberculosis and other infectious diseases.

1.2.2 Development of Worker Health Programs

In 1958, the American Medical Association (AMA) and the American Hospital Association (AHA) issued a joint statement in support of worker health programs in hospitals. In addition to describing the basic elements of an occupational health program for hospital workers, they stated that "hospitals should serve as examples to the public at large with respect to health education, preventive medicine, and job safety" (AMA 1958). NIOSH subsequently developed criteria for effective hospital occupational health programs (NIOSH 1974-1976) (see Appendix 2).

1.2.3 The NIOSH Hospital Survey

NIOSH undertook the first comprehensive survey of health programs and services for hospital workers in 1972 (NIOSH 1974-1976). Questionnaires sent to hospitals of all sizes throughout the country were completed at more than 2,600 hospitals. The results demonstrated important deficiencies in the worker health programs of most hospitals, especially hospitals with fewer than 100 beds.

Although 83% of the hospitals surveyed gave new workers at least a general orientation on safety and health, only about half of the hospitals had a regular safety and health education program. Only 35% of the small hospitals had regular safety and health education programs, whereas 70% of the large hospitals had them.

Other inadequacies uncovered by the survey included a lack of immunization programs for infectious disease control (only 39% of surveyed hospitals had such programs) and an absence of in-service training in critical areas (only 18% of surveyed hospitals provided training in six critical areas identified).

Since the NIOSH survey, the number and size of worker health programs in hospitals and health facilities have increased rapidly across the Nation. The number of trained professionals is still limited, however, and although some hospitals have expanded the roles of infection-control committees, others have assigned control duties to security or other administrative personnel who have little training or experience in occupational safety and health.

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1.3 WORKER HEALTH PROGRAMS AND SAFETY AND HEALTH COMMITTEES

Only 8% of the hospitals reporting in the 1972 NIOSH survey (NIOSH 1974-1976) met all nine NIOSH criteria for comprehensive hospital safety and health programs (Appendix 2). Many hospitals have since taken steps to initiate or improve worker health services: (1) Professional organizations have been formed for hospital safety officers and worker health service personnel; (2) the number of articles, books, and other published resources on hospital safety and health have increased dramatically; and (3) several organizations now offer annual conferences on occupational health for hospital workers.

In 1977, NIOSH published a full set of guidelines for evaluating occupational safety and health programs in hospitals (NIOSH 1977). Appendix 2 contains these guidelines. See also Kenyon (1979) for the practical design of a full safety and health program.

Some hospitals have established joint labor-management safety and health committees. Labor unions representing workers in other hospitals have formed safety and health committees that have made important contributions by identifying safety and health problems and by educating the workforce about safety and health issues.

Major functions of safety and health committees include the following:

- Inspecting workplaces regularly to identify safety and health hazards
- Regularly reviewing accident rates, results from prevention activities, and other relevant workplace data
- Preparing information for workers on identified hazards
- Organizing educational classes
- Reviewing safety and health aspects when planning new construction or renovating facilities
- Investigating accidents
- Establishing motivational programs (e.g., recognition, awards, and dinners) to stimulate worker participation in safety and health activities

Strong and effective safety and health committees require the full support and commitment of the hospital administration. Committee functions should not be informal tasks for the members but a regular part of their job responsibilities.

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The safety and health committees of labor unions have played important roles in articulating worker concerns, identifying potential hazards, educating their members, and improving work practices. For example, a union safety and health committee in New York City that was investigating risks associated with handling infectious disease specimens (Stellman et al. 1978) identified clusters of hepatitis cases among personnel in the chemistry laboratory, the intensive care unit, and the blood-gases laboratory. After meeting with hospital representatives and studying the problem, the committee identified several potential problem areas. Specific actions were initiated to correct unsafe work practices and conditions. Such safety and health committees can help ensure safe work environments in hospitals.

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2. DEVELOPING HOSPITAL SAFETY AND HEALTH PROGRAMS

2.1 ADDRESSING DIVERSE NEEDS

The diverse safety and health concerns in hospitals are traditionally divided into hazards that pose an immediate threat and hazards that cause long-term health problems. Safety hazards include sharp-edged equipment, electrical current, and floor surfaces that can contribute to slipping or tripping. Health hazards are often more difficult to identify than safety hazards. They may result in an immediate illness or in the long-term development of disease. Although a needle puncture may result in hepatitis in 90 to 180 days, exposure to excess radiation or to some chemicals may not result in any noticeable health effects for 20 to 30 years. Thus workers may appear and feel healthy when, in fact, their health is being seriously threatened. Because workers are often exposed to hazards for which the effects are not well known, they may have difficulty associating a new illness with past workplace exposures.

This section contains steps for developing safety and health programs to identify and control occupational hazards within the hospital setting. These steps are summarized in Table 2-1. Personnel trained in occupational safety and health are needed to design, implement, and manage such a program. Many organizations listed in this manual offer courses designed specifically to train nurses, safety officers, physicians, and nonprofessional workers (see Section 7).

2.1.1 Enlisting Administrative Support

Developing an appropriate and useful safety and health program for a hospital or health facility requires the involvement of a safety and health committee that represents workers and supervisors from all departments in the hospital. Such involvement is essential because workers frequently observe real and potential hazards that supervisory staff, the employee health service, or other safety and health personnel do not recognize. To be effective, committee members should be knowledgeable in occupational safety and health and have explicit responsibilities and appropriate authorities.

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Table 2-1.—Checklist for developing a hospital safety and health program

Item	Component tasks
1. Administrative support	Form a safety and health committee. Appoint a safety officer, employee health director, and other responsible personnel. Allocate time for surveys and committee meetings. Allocate funds to evaluate and monitor hazards, implement controls, and conduct health examinations.
2. Hazard identification	Conduct periodic walk-through inspections. Obtain material safety data sheets (MSDS's) and other information on potential hazards. Maintain a log of hazardous chemicals and materials that are used or stored in each department.
3. Hazard evaluation	Conduct safety inspections and industrial hygiene monitoring of potential hazards and determine needs for hazard controls. Conduct medical evaluations. Select appropriate medical surveillance programs.
4. Training	Develop and begin a training program for workers, based on job responsibilities.
5. Controls	Select appropriate control measures and implement controls and medical surveillance programs as determined in Item 3.

(continued)

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Table 2-1 (Continued).—Checklist for developing a hospital safety and health program

Item	Component tasks
6. Program review	<p>Preview results of periodic safety inspections, industrial hygiene monitoring, and medical surveillance programs to find patterns of hazards, to measure the success of the safety and health program, and to determine the effectiveness of controls.</p> <p>Change the safety and health program as new materials or procedures are introduced or as new hazards are identified in the review process.</p>
7. Recordkeeping	<p>Maintain records of results for all surveys, evaluations, monitoring, corrective actions, and worker medical examinations. Records must be maintained in accordance with applicable local, State, and Federal regulations.</p>

2.1.2 Identifying Hazards

Hazard identification involves not only recognizing the hazards themselves but also learning their specific characteristics and identifying the population at risk so that control programs can be designed. See also sections 5 and 7 of this document for further details on obtaining necessary hazard information.

2.1.2.1 Walk-Through Inspections

Hospital safety and health personnel should conduct an initial survey of safety hazards such as those outlined in Section 3. The hospital safety and health committee should assist with this in consultation with workers from each department. The first step in identifying hazards is usually a physical inspection called a walk-through survey. Persons conducting the survey actually walk through the unit and note as many hazards as possible.

During a walk-through survey, survey personnel should communicate with supervisors and workers in each department, follow a checklist, and ask any additional questions that may arise. For example, have common health problems been noticed among the workers in the department? Do any hazards

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exist that are not on the checklist? How is the department different from a typical department of its type? A diagram of each department should be developed to include the number and location of workers and the sources of potential exposure. Several organizations listed in Section 7 have developed sample checklists for walk-through inspections.

2.1.2.2 Published Sources of Information

The following references should be consulted when considering the potential toxicity of substances used in the hospital:

1. Occupational Diseases: A Guide to Their Recognition (NIOSH 1977)
2. NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards (NIOSH 1978a)
3. NIOSH Pocket Guide to Chemical Hazards (NIOSH 1985)
4. Chemical Hazards of the Workplace (Proctor and Hughes 1978)

2.1.2.3 Material Safety Data Sheets

In 1975, NIOSH developed a basic format for material safety data sheets (MSDS's) to provide information on the content, potential toxicity, recommended handling methods, and special precautions for substances found in the workplace (NIOSH 1974). In 1986, OSHA promulgated a hazard communication standard requiring that the following information be included on MSDS's (29 CFR* 1910.1200):

- Product identity from the label, including chemical and common names of hazardous ingredients
- Physical and chemical characteristics of ingredients (e.g., vapor pressure and flash point)
- Physical hazards of ingredients (potential for fire, explosion, and reactivity)
- Health hazards associated with ingredients (including signs and symptoms of exposure and any medical conditions generally recognized as being aggravated by exposure to the product)
- Primary routes of entry to the body

*Code of Federal Regulations. See CFR in references.

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- The OSHA permissible exposure limit (PEL), the ACGIH threshold limit value (TLV®), and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the MSDS
- An indication as to whether the product and/or ingredients are listed in the National Toxicology Program (NTP) Annual Report on Carcinogens (latest edition) or are designated as a potential carcinogen by OSHA or in the International Agency for Research on Cancer (IARC) Monographs (latest editions)
- Any generally applicable precautions for safe handling and use known to persons preparing the MSDS (e.g., appropriate hygienic practices, protective measures during repair and maintenance of contaminated equipment, and procedures for cleanup of spills and leaks)
- Any known, generally applicable control measures (e.g., appropriate engineering controls, work practices, or personal protective equipment)
- Emergency and first aid procedures
- Date of MSDS preparation or last amendment
- Name, address, and telephone number of a responsible party who can provide additional information on the hazardous chemical and on appropriate emergency procedures

NIOSH also recommends that MSDS's contain the NIOSH recommended exposure limit (REL). MSDS's must also be updated with any new data on the hazards of a chemical or new methods for protecting workers from the hazards. For further information regarding the identification of hazardous materials, see the OSHA hazard communication standard (29 CFR 1910.1200) and the NIOSH (1974) publication entitled Criteria for a Recommended Standard: An Identification System for Occupationally Hazardous Materials.

Manufacturers are now required by Federal law to provide MSDS's with their products (29 CFR 1910.1200). The regulation requires that a specific chemical identity be made available to health professionals, workers, and their designated representatives in accordance with the provisions given in the occupational safety and health standard. This regulation also requires employers to develop a written hazard communication program and provide workers with training and information. NIOSH also recommends that hospitals provide completed MSDS's or their equivalent to personnel in materials management and purchasing or central supply before products are purchased or reordered. The hospital safety and health committee should also maintain a

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file of MSDS's. Most MSDS's now available do not include information on the chronic health effects of low-level exposure, but they do provide information on the acute effects of relatively high levels.

2.1.2.4 NIOSH Policy Documents

NIOSH has prepared criteria documents and other recommendations on many hazardous substances. These extensive evaluations of the scientific literature include recommendations to the U.S. Department of Labor for controlling exposures. NIOSH documents are available for the following substances and agents that may be found in hospitals:

Asbestos	Formaldehyde
Ammonia	Hot environments
Benzene	Isopropyl alcohol
Benzidine	Noise
Carbon tetrachloride	Phenol
Chloroform	Toluene
Chromium(VI)	Ultraviolet radiation
Dioxane	Waste anesthetic gases and vapors
Ethylene dichloride	Xylene
Ethylene oxide	

2.1.2.5 Occupational Health Organizations

A list of occupational health organizations appears in Section 7 of this document (Directory of Occupational Safety and Health Information for Hospitals).

2.2 EVALUATING HAZARDS

Once hazards have been identified, they should be evaluated to determine how serious the problems are and what changes can be introduced to control them (see Section 2.3). Methods for measuring exposures to hazards in the workplace are recommended in the NIOSH Manual of Analytical Methods (NIOSH 1984). Health hazards posed by chemicals (in the form of dusts, liquids, or gases), radiation, noise, and heat should be evaluated initially by an industrial hygienist. If no industrial hygienist is available, consultation can be obtained from NIOSH, OSHA, private consultants, or in some cases insurance companies.

After controls are installed, they should be checked periodically to see that they are being maintained and are protecting the workers adequately. A chart or grid should be prepared to list hazardous materials and the departments where they are usually found, exposure limits, precautions to follow, and other relevant factors. Such a chart can be a quick reference and a means of tracking program development.

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A hazard evaluation program should consist of the following elements: periodic inspection and monitoring of potential safety and health problems, informal interviewing of workers, medical evaluations, and evaluation of worker exposures and the workplace. The following subsections contain descriptions of each element and definitions of terms commonly used in industrial hygiene standards.

2.2.1 Periodic Inspection and Monitoring of Safety and Industrial Hygiene

When an evaluation reveals a potential hazard and control measures are applied, the hazard should be re-evaluated to determine the effectiveness of the controls. Complex work procedures (e.g., operating-room practices) should be analyzed carefully, noting products and byproducts formed during the procedure.

The frequency with which hazards should be monitored depends, among other things, on the extent of exposure to the agent, the severity of the adverse effects, the complexity of the work process, seasonal variations of temperature and humidity, and protective measures. OSHA regulations mandate inspection schedules for a few substances such as asbestos (29 CFR 1910.1001). Experience and a high degree of awareness will allow each hospital safety and health committee to decide on an appropriate inspection schedule for each department.

2.2.2 Informal Interviews of Workers

In the first assessment of hazards in each work unit, a short questionnaire or informal interview with the workers may identify problems that are not easily noted by visual inspection. For example, questionnaires, informal discussions, or physical inspections may reveal a potential for back strain resulting from poor work practices, stress caused by staffing- or shift-rotation systems, or inadequate training for handling infectious materials. The following general questions should be posed:

- Since starting the job, has the worker developed any new health problems or have existing problems worsened? What symptoms have been observed? When did the symptoms begin or become more severe? When did the problems improve or become less noticeable?
- Has the worker noticed any health problems in the other workers in the same department that may be related to or caused by their work?
- Is there anything in the job that might affect the worker's health or the safety and health of other workers now or in the future?

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The last question will also help identify worker concerns about the future safety and health effects of their current exposures. Remember, however, that workers may not notice a connection between symptoms and causative agents. Thus a negative response to the above questions does not necessarily mean that no safety or health problems exist. A positive response may also indicate a safety or health problem resulting from nonwork activities.

2.2.3 Medical Evaluations

The signs and symptoms that workers experience should be evaluated medically, taking care to avoid preconceptions about which ones are work related. The potential health effects of each exposure should be determined using the references mentioned earlier in this section (Subsection 2.1.2.2). An occupational history should also be maintained for each worker to help evaluate the long-term effects of exposures. This history should contain at least the worker's prior occupations and job titles, the duration of employment at each job, and the name of any substance or agent to which the worker may have been exposed.

2.2.4 Environmental Evaluations

An industrial hygienist may take area samples, personal samples, or wipe samples to help determine the extent of a workplace hazard. Most methods for chemical sampling require laboratory analysis, which should be performed by a laboratory accredited by the American Industrial Hygiene Association. The safety officer should consider using direct-reading instruments that are available. These are discussed in Air Sampling Instruments for Evaluation of Atmospheric Contaminants (ACGIH 1983).

2.2.4.1 Area Samples

Area samples from the general work space can measure the extent of potential worker exposure to chemicals, extreme temperatures, excessive noise, ionizing and nonionizing radiation, and other environmental stressors. Industrial hygienists may monitor work environments with equipment that provides information immediately, or they may use methods that require laboratory analysis of collected samples. Direct-reading sampling devices include colorimetric detector tubes, mercury "sniffers," infrared spectrophotometers, microwave survey meters, and sound-level meters. Air samples for such substances as nitrous oxide, formaldehyde, ethylene oxide, and asbestos may require laboratory analysis. Sometimes both types of sampling devices exist for the same chemical, and the choice depends on the precision and accuracy required.

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2.2.4.2 Personal Samples

Personal samples are used to measure contaminants in the worker's breathing zone. Evaluations of personal exposure to chemical dusts, fumes, gases, and vapors are frequently expressed as an 8-hr time-weighted average (TWA) concentration (which is the average exposure concentration during an 8-hr workday) or as a short-term exposure concentration. The two main types of personal sampling devices are:

1. A pump mounted on the worker's belt that provides suction and draws air from the worker's lapel (breathing zone) through a tube and into the collection medium attached to the pump, and
2. A passive dosimeter (often like a large button), which can be clipped to the worker's lapel and absorbs substances from the surrounding air.

2.2.4.3 Wipe Samples

Wipe samples are analyzed to measure the contamination of work surfaces.

2.2.5 Occupational Safety and Health Standards

Worker safety and health is the responsibility of the Occupational Safety and Health Administration (OSHA), which was established in the U.S. Department of Labor by the Occupational Safety and Health Act of 1970 (Public Law 91-596). The principal function of OSHA is to promulgate and enforce workplace safety and health standards, which are contained in Volume 29 of the Code of Federal Regulations. The Occupational Safety and Health Act also created the National Institute for Occupational Safety and Health (NIOSH). The principal functions of NIOSH are to conduct research and to recommend new and improved safety and health standards to OSHA. Throughout this document, reference is made to OSHA standards and NIOSH recommendations. OSHA standards for exposure to airborne chemicals are generally referred to as permissible exposure limits (PEL's). NIOSH recommendations for controlling airborne contaminants are referred to as recommended exposure limits (REL's). The OSHA PEL's are legally enforceable standards that must also be economically feasible, whereas the NIOSH REL's are recommended standards based solely on public health considerations.

The American Conference of Governmental Industrial Hygienists (ACGIH) is a professional association that recommends limits for airborne contaminants, called threshold limit values (TLVs®). TLVs are intended to serve only as guidelines for the professional industrial hygienist; they are not intended to be enforceable exposure limits.

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2.2.5.1 Terms Used in Industrial Hygiene Standards

The following terms are used in Federal standards or recommendations for the workplace.

PEL	Permissible exposure limit. A PEL is the maximum airborne concentration of a substance regulated by OSHA to which a worker may be exposed. These values are enforced by law.
ppm	Parts per million.
REL	Recommended exposure limit. A NIOSH REL is the maximum recommended exposure to a chemical or physical agent in the workplace. The REL is intended to prevent adverse health effects for all occupationally exposed workers.
TLV®	Threshold limit value. A TLV is the airborne concentration of a substance to which nearly all workers can be exposed repeatedly day after day without adverse effect (ACGIH 1987). ACGIH recommends and publishes these values annually on the basis of the most current scientific interpretations. TLVs are not OSHA standards and are not enforced by law.
TLV-C	Threshold limit value--ceiling. The TLV-C is the airborne concentration of a substance that should not be exceeded--even for an instant--during any part of the working exposure (ACGIH 1987).
TLV-SKIN	Threshold limit value--skin adsorption. TLV-SKIN refers to the potential contribution of absorption through the skin--including mucous membranes and eyes--to a worker's overall exposure by either airborne or direct contact with a substance (ACGIH 1987).
TLV-STEL	Threshold limit value--short-term exposure limit. The TLV-STEL is the maximum exposure concentration allowed for up to 15 min during a maximum of four periods each workday. Each exposure period should be at least 60 min after the last period (ACGIH 1987).

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TWA Time-weighted average. The TWA is the average exposure concentration during an 8-hr workday. Exposure for more than 8 hr per day or more than 40 hr per week, even at or below the TLV or PEL, may represent a health hazard. NIOSH recommendations typically include 10-hr TWA's for up to a 40-hr workweek. The TWA for an 8-hr workday is calculated as follows:

$$\frac{\text{sum of } [(\text{exposure period}) \times (\text{exposure concentration})] \text{ for each exposure period}}{8\text{-hr workday}}$$

For example, formaldehyde exposure in a laboratory might be:

$$\frac{(5 \text{ ppm} \times 2 \text{ hr}) + (1 \text{ ppm} \times 6 \text{ hr})}{8\text{-hr workday}}$$

$$\frac{10 + 6}{8} = 2.0 \text{ ppm TWA}$$

2.3 CONTROLLING HAZARDS

Once potential exposures and safety problems in the hospital have been identified and evaluated, priorities should be established for controlling the hazards. Identified safety hazards should be promptly corrected, and educational programs should be developed on subjects such as correct lifting procedures and the handling of electrical equipment. Workers who are potentially exposed should be fully informed and trained to avoid hazards, and controls should be instituted to prevent exposures. Control methods that can be used for environmental hazards include substitution, engineering controls, work practices, personal protective equipment, administrative controls, and medical surveillance programs. Each of these methods is discussed in the following subsections.

2.3.1 Warning Systems

Any system designed to warn workers of a hazard should

- Provide immediate warnings of potential danger to prevent injury, illness, or death
- Describe the known acute (short-term) or chronic (long-term) health effects of physical, chemical, and biologic agents
- Describe any safety hazards that might be encountered, including chemical exposures that might result in traumatic injuries
- Indicate actions for preventing or reducing exposure to hazards

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- Provide instructions for minimizing injury or illness in the event exposure has already occurred
- Include a plan for dealing with emergency situations
- Identify the population at risk so that information is provided to the correct group of workers
- Identify actions to be taken in the case of illness or injury

2.3.2 Substitution

The best way to prevent occupational safety and health problems is to replace the offending agent or hazard with something that is less hazardous. For example, highly explosive anesthetic gases have been replaced by nonflammable gases. Replacements for asbestos are being used in new construction, and cleaning agents are often changed when workers complain of dermatitis.

2.3.3 Engineering Controls

Engineering controls may involve modifying the workplace or equipment to reduce or eliminate worker exposures. Such modifications include both general and local exhaust ventilation, isolating patients or work processes from the hazard, enclosing equipment or work processes (as in glove-box cabinets), and altering equipment (such as adding acoustic padding to reduce noise levels).

2.3.4 Work Practices

How workers carry out their tasks may create hazards for themselves and others. For example, staff, nurses, or doctors who do not dispose of used needles safely create a severe hazard for housekeepers, laundry workers, and themselves. Workers sometimes perform tasks in ways that create unnecessary exposures. This includes staff members who try to lift patients without assistance and laboratory workers who pipette by mouth rather than by rubber bulb, thereby increasing their risk of injury or contamination.

2.3.5 Personal Protective Equipment

Personal protective equipment includes gloves, goggles, aprons, respirators (not surgical masks), ear plugs, muffs, and boots. Although the use of such equipment is generally the least desirable way to control workplace hazards because it places the burden of protection on the worker, the equipment

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should be available for situations when an unexpected exposure to chemical substances, physical agents, or biologic materials could have serious consequences.

Personal protective equipment is frequently uncomfortable and difficult to work in, and it must be adequately maintained. Maintenance requires constant supervision and training. The use of respirators also requires frequent testing to ensure adequate fit for each wearer. For this reason, the policy of OSHA and NIOSH has been to use personal protective equipment for preventing inadvertent exposures that are threatening to health or life only when (1) engineering and administrative controls are not feasible, (2) such controls are being developed or installed, (3) emergencies occur, or (4) equipment breaks down.

The proper selection of chemical protective clothing (CPC) requires an evaluation by a trained professional such as an industrial hygienist. The selection process must include

- Assessing the job or task
- Determining the body parts that need to be protected
- Determining the necessary flexibility and durability that will allow the worker to perform the job or task
- Assessing the exposure situation in view of the chemicals present, the toxicity of those chemicals, and the concentrations to which workers will be exposed
- Assessing existing laboratory data on the capacity of CPC to withstand contact with the chemicals during use and to prevent penetration by those chemicals (permeation data are available for many chemicals and CPC materials [ACGIH 1985] and should be consulted)
- Evaluating candidate materials in the laboratory and, if possible, at the worksite

Standard operating procedures for the proper use of CPC should be established and should include

- Training in proper ways to put on and take off CPC
- Training in proper disposal methods
- Periodic evaluation of the effectiveness of the CPC

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NIOSH does not recommend reuse of CPC unless data are available that demonstrate the efficacy of decontamination procedures in maintaining the effectiveness of the CPC against the chemicals used.

Recommendations for personal protective equipment for chemical hazards are also discussed in the NIOSH Pocket Guide to Chemical Hazards (NIOSH 1985) and the NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards (NIOSH 1981a).

2.3.5.1 Eye and Face Protection

Eye protection or face shields are required when the worker may be injured by flying particles, chips, or sparks or splashed by such liquids as caustics, solvents, and blood or body fluids. Workers should wear protective equipment and clothing when they use machinery that produces dusts and chips or when they handle toxic and corrosive substances. Eye and face shields should provide adequate protection against the particular hazards to which the worker is exposed. The equipment should be easy to clean and disinfect. If workers who wear glasses must also wear goggles, the goggles should fit over the glasses, or the corrective lenses should be mounted behind the protective lenses.

2.3.5.2 Head Protection

Protective head coverings (hard hats) should be required in situations where workers may be struck on the head by falling or flying objects.

2.3.5.3 Foot Protection

Safety shoes are recommended to prevent injury to the feet from falling objects and other hazards. They are particularly important where heavy materials or parts are handled and during shipping and receiving operations. Appropriate footwear with good traction should be worn for wet or slippery areas. Periodic conductivity checks should be made on footwear worn in surgical areas, and disposable shoe covers should be readily available to minimize the potential for static electricity in surgical areas.

2.3.5.4 Gloves, Aprons, and Leggings

Aprons and leggings may be necessary for workers in some operations, depending on the type of hazard. Gloves and arm protectors should be used to prevent lacerations from sharp edges, to prevent contact with chemical and biologic materials, to prevent burns, and to provide shielding from radiation.

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2.3.5.5 Hearing Protection

If noise levels exceed current standards, workers must be provided with hearing-protection devices and directed to wear them (29 CFR 1910.95).

2.3.5.6 Respiratory Protection

The employer must provide approved respiratory protection (not surgical masks, which do not provide respiratory protection) when the air is contaminated with excessive concentrations of harmful dusts, fumes, mists, gases, vapors, or microorganisms. Respiratory protection may be used as a control only when engineering or administrative controls are not feasible or while these controls are being developed or installed.

Respirators must be selected by individuals knowledgeable about the workplace environment and the limitations associated with each class of respirator. These individuals must also understand the job tasks to be performed. The correct use of a respirator is as important as the selection process. Without a complete respiratory protection program, workers will not receive the protection anticipated even if the respirator has been correctly chosen. Training, motivation, medical evaluation, fit testing, and a respirator maintenance program are critical elements of an adequate respiratory protection program.

NIOSH has recently updated its "Guide to Industrial Respiratory Protection," which covers the selection, use, and maintenance of respiratory protective devices (NIOSH 1987a). NIOSH has also developed a respirator decision logic (RDL) (NIOSH 1987b) to provide knowledgeable professionals with a procedure for selecting suitable classes of respirators. The RDL identifies criteria necessary for determining the classes of respirators that provide a known degree of respiratory protection for a given work environment, assuming the respirators are used correctly.

The criteria and restrictions on respirator usage in the following two subsections were adapted from the NIOSH RDL (NIOSH 1987).

2.3.5.6.1 Criteria for selecting respirators

The first step is to determine which contaminants the workers are exposed to and then to assemble the necessary toxicologic, safety, and other relevant information for each. This information should include

- General use conditions
- Physical, chemical, and toxicologic properties
- Odor threshold data

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- NIOSH recommended exposure limit (REL) or OSHA permissible exposure limit (PEL), whichever is more protective; if no REL or PEL exists, use another recommended exposure limit
- The concentration of the contaminant believed to be immediately dangerous to life or health (IDLH)
- Potential for eye irritation
- Any service life information available for cartridges and canisters

2.3.5.6.2 Restrictions and requirements for all respirator use

The following requirements and restrictions must be considered to ensure adequate protection by the selected respirator under the intended conditions for use:

1. A complete respiratory protection program should be instituted and should include information on regular worker training, use of the respirator in accordance with the manufacturer's instructions, fit testing, environmental monitoring, and maintenance, inspection, cleaning, and evaluation of the respirator. Whenever possible, quantitative evaluation of the protection factor should be performed in the workplace to confirm the actual degree of protection provided by the respirator to each worker. Minimum respiratory protection requirements for air contaminants can be found in the OSHA Safety and Health Standards (29 CFR 1910.134) and in separate sections for specific contaminants (e.g., 1910.1001 for asbestos, and 1910.1025 for lead [see Section 5 of this document]).
2. Qualitative or quantitative fit tests should be conducted as appropriate to ensure that the respirator fits the individual. Periodic evaluations should be made of the effectiveness of each respirator during workplace use. When quantitative fit testing is used, the fit-factor screening level should be chosen with caution, recognizing the uncertainty of its effectiveness (no studies have demonstrated which fit factor values provide adequate acceptance or rejection criteria for quantitative fit screening).
3. Negative-pressure respirators should not be used when facial scars or deformities interfere with the face seal.
4. No respirator (including positive-pressure respirators) should be used when facial hair interferes with the face seal.
5. The respirators should be maintained properly, used correctly, and worn conscientiously.

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6. The usage limitations of air-purifying elements (particularly gas and vapor cartridges) should not be exceeded.
7. All respirators must be approved by the National Institute for Occupational Safety and Health (NIOSH) and the Mine Safety and Health Administration (MSHA).
8. Workers should be instructed to leave a contaminated area immediately if they suspect that the respirator has failed.
9. Workers are usually not exposed to a single, unvarying concentration of a hazardous substance, but exposures may vary throughout a workshift and from day to day. Thus the highest anticipated concentration should be used to compute the required protection factor for each respirator wearer.
10. Respirator wearers should be aware of the variability in human response to the warning properties of hazardous substances. Thus when warning properties must be relied on as part of a respiratory protection program, the employer should screen each prospective wearer for the ability to detect warning properties of the hazardous substance(s) at exposure concentrations below the REL or PEL, whichever is more protective.

2.3.6 Administrative Controls

Administrative controls involve reducing total daily exposure by removing the worker from the hazardous area for periods of time. These controls are used when it is impractical to reduce exposure levels in the workplace through engineering controls. Administrative controls include (1) rescheduling work to reduce the necessity of rotating shifts, and (2) increasing the frequency of rest periods for persons who work in hot environments.

2.3.7 Medical Monitoring Programs

2.3.7.1 Designing the Program

Appropriate medical procedures exist to evaluate the extent of some workplace exposures (e.g., measuring lead levels in blood) or the effects of exposure on the worker's health (e.g., measuring hearing loss).

Section 5 contains the specific tests appropriate for some common hospital hazards. A medical monitoring program should be designed for each department based on information from safety and health walk-through surveys and industrial hygiene evaluations.

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The following questions should be considered for designing medical monitoring programs:

- Are the selected tests specific to the potential exposures? Multiphasic or other general examinations do not target specific hazards.
- Are the selected tests likely to detect adverse health effects? A chest X-ray may detect asbestosis, but asbestosis does not usually develop until 10 or more years after first exposure. Thus a yearly chest X-ray for asbestosis would not help new workers.
- Are there any side effects from the selected test? A chest X-ray may detect some diseases, but it also exposes a worker to radiation. The potential test benefits must be weighed against potential harm.

Specific tests for each job category should be incorporated into the monitoring program of the worker health service. Appendix 2 contains NIOSH recommendations for general safety and health programs, including pre-employment, preplacement, and periodic worker health examinations. In addition, the worker health service may test for conditions that are not necessarily job related but are important for promoting general worker health (e.g., high blood pressure) or are specific to that region (e.g., some hospitals in the southwestern United States routinely administer skin tests for coccidioidomycosis in preplacement physicals).

2.3.7.2 Consent and Confidentiality

Before certain immunizations (e.g., M-M-R [measles, mumps, rubella] and Heptavax-B vaccinations) are given, workers should read, sign, and date informed consent forms designed to alert them to potential side effects. The results of medical testing should be provided directly and confidentially to individual workers. The workers and the safety and health committee should receive group results of testing by work unit (e.g., a table of audiometry results for maintenance workers) to assess the adequacy of worker protection in each unit; individual workers should not be identified.

If a worker must be temporarily or permanently removed from a job for occupational safety or health reasons, the employer should be informed without receiving actual medical information. For example, the notification should read, "Jane Doe may not continue to be exposed to solvents and must be transferred out of the histology section," rather than, "Jane Doe has liver disease and must be transferred out of histology."

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2.3.7.3 Recordkeeping

Adequate recordkeeping is very important: (1) to track the safety and health of individual workers and work groups over time, (2) to provide documentation for future evaluations, (3) to help the hospital administration and the safety and health committee identify problem areas, and (4) to measure the effectiveness of safety and health programs.

Many specific OSHA standards (e.g., for ethylene oxide and asbestos) contain detailed provisions for recordkeeping, monitoring, and medical surveillance. These standards should be consulted. In 29 CFR 1904, the Department of Labor also requires all employers covered by the Occupational Safety and Health Act to maintain logs of all occupational injuries and illnesses that have occurred in their workplaces over the last calendar year. These logs (usually OSHA form 200) must be posted in conspicuous places where notices to workers are usually posted. The employer must maintain these records for at least 5 years and provide access to these records for the Secretary of the Department of Health and Human Services. Workers and their representatives also have the right to access these records. When there is a specific standard for a substance, OSHA generally requires that records be maintained for at least the duration of employment plus 30 years.

2.3.7.4 Preplacement Evaluations

Preplacement physical examinations are very important for establishing baselines (pre-exposure measurements of health) and for ensuring that the worker is physically able to perform the job. The Centers for Disease Control (CDC), the American Hospital Association (AHA), and State hospital codes have developed guidelines for screening new hospital workers. The results of the hazard identification procedures outlined in this section should be used to design appropriate preplacement programs. For example, when a person is hired for a position that may require the use of respiratory protection, the preplacement examination should include an evaluation of the worker's physical ability to wear a respirator.

Because many workers do not have general medical examinations regularly, some worker health services in hospitals include a simplified general medical questionnaire and examination when tests are given for more specific reasons. A report of 3,599 preplacement examinations in a large teaching hospital indicated that the most frequent problems involved (1) susceptibility to communicable diseases such as diphtheria or rubella, or (2) the potential for disease transmission, as indicated by tuberculin-positive skin tests, intestinal parasites in stool examinations, positive serological tests for syphilis, or the presence of the hepatitis B surface antigen. The most frequent noninfectious illnesses were hypertension and anemia (Schneider and Dykan 1978).

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2.4 OCCUPATIONAL SAFETY AND HEALTH AGENCIES AND ORGANIZATIONS

Several agencies and organizations are involved in promoting safety and health in hospitals, and significant differences exist among state agencies that hold enforcement powers. Federal agencies such as NIOSH help assess potential hazards and make recommendations for correction without the threat of citation or penalty. Private organizations such as the AHA and the National Safety Council (NSC) also develop recommendations and provide materials and assistance. The major agencies and organizations that develop regulations, standards, recommendations, and codes for occupational safety and health in hospitals are described briefly below. Other organizations addressing more specific groups of health professionals (e.g., the College of American Pathologists) are listed in Section 7.

2.4.1 Occupational Safety and Health Administration

The Occupational Safety and Health Administration (OSHA) is responsible for promulgating and enforcing standards in most workplaces, including Federal and private sector hospitals. About half of all States have approved State OSHA plans, which must be at least as effective as Federal plans in providing for safe and healthful employment. State plans may also cover hospitals operated by State and local governments. OSHA offices are listed in Section 7.

OSHA has developed specific standards for hazards such as noise, mercury, ethylene oxide, and asbestos. Also, a general duty clause states that employers must provide their workers with "employment and a place of employment which are free from recognized hazards that are likely to cause death or serious physical harm . . ." (Public Law 91-596).

OSHA has the authority to inspect workplaces in response to requests from workers or as part of targeted or routine inspection schedules. Citations and fines may be imposed for violations discovered during these inspections. OSHA also has a free consultation service that provides employers with evaluations of workplace hazards and advice on control methods without the risk of citations or fines--provided the employer agrees to abate any serious hazards identified during a consultation. OSHA has a referral system for serious violations that are not abated after a consultation visit.

2.4.2 National Institute for Occupational Safety and Health

The National Institute for Occupational Safety and Health (NIOSH) conducts research on workplace hazards and recommends new or improved standards to OSHA. NIOSH also investigates specific workplace hazards in response to requests by workers or employers. Although NIOSH has the same right of entry as OSHA to conduct health hazard evaluations (HHE's), NIOSH can only recommend hazard controls and has no enforcement authority. HHE's can be

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particularly useful where the causes of workplace hazards are unknown, where a combination of substances may be causing a problem, or where a newly recognized health effect is suspected for a substance that is already regulated. NIOSH also investigates potential health hazards on an industrywide basis, performs research on methods for controlling safety and health hazards, recommends standards to OSHA for promulgation, publishes and distributes NIOSH studies and investigations, and provides training programs for professionals. For more detailed information on the NIOSH HHE program, refer to A Worker's Guide to NIOSH (NIOSH 1978). NIOSH also assesses and documents new hazard control technology for processes and specific hazards. An article by Kercher and Mortimer (1987) is an example of such an assessment.

In addition to conducting HHE's and control technology assessments, NIOSH investigates the circumstances of fatal accidents and recommends safe work practices and controls to reduce or eliminate hazards.

2.4.3 Centers for Disease Control

The Centers for Disease Control (CDC) is a Federal public health agency based in Atlanta, Georgia. Among other responsibilities, CDC is charged with the surveillance and investigation of infectious diseases in hospitals. CDC collects weekly, monthly, and yearly statistics on many infectious diseases, on control programs and activities for hospital infections, and on new problems as they appear. The Agency is also charged with making recommendations necessary for disease control.

2.4.4 Health Resources and Services Administration

Under the Hill-Burton legislation (Public Law 79-725, as amended), the Health Resources Administration (HRA) (now the Health Resources and Services Administration [HRSA]) published Minimum Requirements of Construction and Equipment for Hospital and Medical Facilities (HRA 1979). Hospitals receiving Federal assistance must comply with these regulations.

2.4.5 Nuclear Regulatory Commission

The Nuclear Regulatory Commission (NRC) adopts and enforces standards for departments of nuclear medicine in hospitals, although some states have agreements with the federal government to assume these responsibilities. In these cases, the responsible state agency is usually the state health department. NRC regulates roentgenogram sources (Title 21) and all radioactive isotope sources except radium (Title 10) (21 CFR 1000-1050 [1985]; 10 CFR 20 and 34 [1985]) but does not have authority to regulate naturally occurring radioactive materials such as radium or radon. The Food

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and Drug Administration (FDA) is responsible for those regulations. NRC publishes and continuously revises guides to describe methods acceptable for implementing specific parts of the Commission's regulations. These guides are published and revised continuously.

2.4.6 State, County, and Municipal Health Agencies

With some variation, state health departments adopt and enforce regulations in the following areas: radiation, nuclear medicine, infectious disease control, infectious disease and hazardous waste disposal, and food handling. In some states, the health department and the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) (formerly the Joint Commission on Accreditation of Hospitals [JCAH]) accredit hospitals jointly. Both the JCAHO and the State health departments have the patient's rather than the worker's safety and health as their primary concern. Thus the accreditation requirements are not fully developed in the area of worker health protection. County and city health departments also have jurisdiction over food handling and some other hospital functions, and they help evaluate many potential hazards regulated at the state level.

2.4.7 Joint Commission on Accreditation of Healthcare Organizations

The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) re-evaluates the accreditation every 3 years for hospitals that choose to apply. The accreditation inspections reflect a primary concern for patients' safety and health, but JCAHO does require hospitals to establish policies and procedures for monitoring and responding to safety and health hazards.

2.4.8 National Fire Protection Association

The National Fire Protection Association Code for Safety to Life from Fire in Buildings and Structures (NFPA 1985) is the most basic and complete code for fire safety in hospitals. OSHA, JCAHO, and HRSA have adopted portions of this and other NFPA codes, although the specific references are often to earlier versions.

2.4.9 National Safety Council

The National Safety Council (NSC) recommends general safety and (in the case of ethylene oxide) health recommendations. The hospital section of NSC is responsible for preparing recommendations for hospitals, whereas the research and development and chemical sections are responsible for laboratory safety guidelines.

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3. RECOMMENDED GUIDELINES FOR CONTROLLING SAFETY HAZARDS IN HOSPITALS

The hospital work environment contains many safety hazards such as wet floors, flammable or explosive liquids, and tasks requiring heavy lifting. The most common hazards are well-recognized, but others can only be recognized and corrected by trained workers. This section covers some of the most common safety hazards in hospitals and the special hazards that can be present in particular hospital departments (see Appendices 5, 6, and 8 for information about needle-puncture wounds)

3.1 TYPES OF SAFETY HAZARDS

3.1.1 Physical Exertion

3.1.1.1 Hernias

Hernias develop when an act of lifting or straining causes increased pressure in the abdomen and bowel or when the tissue that covers the bowel is pushed through a weak area in the abdominal wall. Although pain may be the first symptom, a noticeable bulge in the scrotum, lower abdomen, or thigh may also be observed.

3.1.1.2 Back Injuries

Nearly 50% of all compensation claims for hospital workers involve back injuries (Health Alert 1978). In 1978, back injuries accounted for approximately 25 million lost workdays and about \$14 billion in treatment costs among all workers in the United States (Goldberg et al. 1980). Data from the Bureau of Labor Statistics for 1980 indicate that nurses aides, orderlies, and attendants in New York filed workers' compensation claims for back sprains and strains more frequently than did workers in any other occupation (8.26 claims/1000 eligible workers). Claims from licensed practical nurses ranked third (5.62 claims/1000 eligible workers), while those from registered nurses ranked sixth (2.20 claims/1000 eligible workers). Other health care categories ranked in the top ten included health aides (not nursing aides), radiologic technicians, and health-record technicians (Jensen 1986). Frequently, these workers must lift and move patients without adequate help.

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3.1.1.2.1 Frequent causes of back pain

Lloyd et al. (1987) list the most common causes of all work-related back pain as (1) job performance by a worker who is unfit or unaccustomed to the task, (2) postural stress, and (3) work that approaches the limit of a worker's strength. Factors that contribute to these causes of back pain are understaffing, the lack of regular training programs in proper procedures for lifting and other work motions, and inadequate general safety precautions.

Specific causes of back problems for hospital workers are listed below by type of worker:

- Food service workers: Pushing or pulling carts, lifting heavy food trays, and moving dishes, racks, and containers
- Housekeepers: Lifting and setting down objects, and using scrubbing machines, brooms, and mops
- Clerical workers: Using chairs that are not designed for desk work and do not provide the proper support
- Laundry workers: Pushing or pulling carts
- Maintenance workers: Lifting, moving, and handling large packs, boxes, or equipment
- Patient-care providers: Assisting patients and raising or lowering beds

3.1.1.2.2 Preventing back injuries

Written guides and programs for preventing back injury are available for all workers and specifically for hospital workers. NIOSH has published a general guide, Work Practices Guide for Manual Lifting (NIOSH 1981b), which contains weight-limit recommendations. The Back Pain Association and the Royal College of Nursing in the United Kingdom have together published a comprehensive guide for nurses entitled The Handling of Patients: A Guide for Nurses (Lloyd et al. 1987). This document contains discussions on the anatomy and physiology of the back, the causes of back pain, preventive approaches, principles for handling patients, and aids for lifting patients.

The primary approach to preventing back injury involves reducing manual lifting and other load-handling tasks that are biomechanically stressful. The secondary approach relies on teaching workers how to (1) perform stressful tasks while minimizing the biomechanical forces on their backs, and (2) maintain flexibility and strengthen the back and abdominal muscles.

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The most important elements in a program to prevent back injuries among hospital staff are

- Mechanical devices for lifting patients and transferring cart tops, X-ray tables, and other heavy objects
- Wheels and other devices for transporting heavy, nonportable equipment
- Adequate staffing to prevent workers from lifting heavy patients or equipment alone
- Close supervision for newly trained workers to assure that proper lifting practices have been learned
- In-service education for both new and experienced staff on the proper measures for avoiding back injuries
- Preplacement evaluation of workers. Workers with significant pre-existing back disorders should not be assigned jobs that require lifting. A history of current lower-back pain is the primary basis for excluding workers from jobs that require lifting. Routine lower-back (lumbar) X-rays are not recommended for preplacement evaluations because studies indicate they do not predict which workers will suffer future back injuries. Preplacement strength testing may occasionally help in assigning workers to tasks that routinely involve moving very heavy objects. Several articles listed in the Additional Resources for this section present methods for analyzing the physical demands of a job and the strength of a job applicant.

Training programs for workers should emphasize

- Proper lifting techniques (Lloyd et al. 1987; NIOSH 1981b)
- Preventing initial back injuries. Because a back that has already sustained an injury is much more likely to be reinjured, preventing the first back injury is the most important step.
- Requesting help. When in doubt about whether a task may strain the back, a worker should request help rather than taking a chance.
- Performing back exercises. Some exercises can be used to strengthen the back muscles and help prevent back injuries. A physician or physical therapist should be consulted.

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- **Transferring patients.** Patient transfers are particularly hazardous for hospital workers and are not often covered in general publications on preventing back injury. The following special points should be emphasized to prevent back injuries during transfers
 - Communicate the plan of action to the patient and other workers to ensure that the transfer will be smooth and without sudden, unexpected moves
 - Position equipment and furniture effectively (for example, move a wheelchair next to the bed) and remove obstacles
 - Ensure good footing for the staff and patient (patients should wear slippers that provide good traction)
 - Maintain eye contact and communication with patient; be alert for trouble signs
 - If help is needed, request that a co-worker stand by before attempting the transfer
 - Record any problems on the patient's chart so that other shifts will know how to cope with difficult transfers; note the need for any special equipment, such as a lift.
- **Reducing accident hazards such as wet floors, stairway obstructions, and faulty ladders.** Wet-floor hazards can be reduced by proper housekeeping procedures such as marking wet areas, cleaning up spills immediately, cleaning only one side of a passageway at a time, keeping halls and stairways clear, and providing good lighting for all halls and stairwells. Workers should be instructed to use the handrail on stairs, to avoid undue speed, and to maintain an unobstructed view of the stairs ahead of them--even if that means requesting help to manage a bulky load.

Ladders are especially hazardous. Falls from even low stools and step ladders can cause painful and disabling injuries. Ladder hazards can be reduced before use by performing safety checks to ensure that

- The ladder is in good condition
- The ladder has level and secure footing with nonslip feet and is supported by another worker if necessary
- The ladder is fully opened and is not too far from the wall

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- Neither the rungs of the ladder nor the worker's feet are wet
- The person using the ladder is not working more than a comfortable arm's reach from an upright position
- Not more than one person occupies a ladder at one time

3.1.2 Fires and Natural Disasters

Hospital fires and natural disasters are especially dangerous because workers must evacuate large numbers of patients and also protect themselves. Thus it is important to know both the most common causes of hospital fires and the most common causes of death in these disaster situations.

3.1.2.1 Fires

A survey conducted by the National Fire Protection Association (NFPA) (Fire Journal 1970) revealed that almost one-third of hospital fires originated in patient rooms or worker quarters, with matches and smoking as the most frequent causes. Fires also originate from malfunctioning or misused electrical equipment such as hot plates, coffeepots, and toaster ovens (See 3.1.5).

Deaths during hospital fires were overwhelmingly due to inhaling the toxic products of combustion rather than to direct exposure to the fire (Fire Journal 1970).

The most common fire hazards by hospital setting are:

<u>Setting</u>	<u>Hazard</u>
Patient rooms. . . . .	.Smoking materials, faulty equipment (including the patient's personal grooming devices)
Storage areas. . . . .	.Linens, maintenance equipment, compressed gas cylinders, flammable liquids, smoking materials, welding, heaters, trash removal
Machinery and equipment areas. . .	.Solvents, oily rags, faulty equipment

An effective and ongoing program to educate the staff about the hazards of smoking and electrical fires can help reduce these risks. Patients should be informed about the dangers of smoking when admitted and should be

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reminded frequently. Some States prohibit ambulatory patients from smoking in bed and require that bedridden patients be supervised by either staff or family members while smoking.

The use of oxygen in patient areas is another obvious fire hazard. Fires can occur in an oxygen-enriched atmosphere because of patient smoking, electrical malfunctions, and the use of flammable liquids. Procedures should be developed and strictly enforced to prevent fire hazards in patient areas where oxygen is used.

The basic code for fire safety is the NFPA Life Safety Code (NFPA 1983, Volume 9). Many municipal, State, and Federal agencies and nongovernment organizations have also produced regulations, codes, and recommendations for fire safety. Engineering a Safe Hospital Environment (Stoner et al. 1982) and Safety Guide for Health Care Institutions (AHA/NSC 1983) contain summaries and discussions of the latter. Fire drills should be held regularly and should include training to operate fire extinguishers, locate alarms and identify their codes, assign responsibilities for patient safety, and locate exits.

3.1.2.2 Natural Disasters

Although emergency plans for fires are the most important, disaster plans should also be prepared for natural events (e.g., tornadoes, earthquakes, and hurricanes), gas leaks, and bomb threats. Such plans should be written and readily available, and workers should at least know the exit routes. If all workers are informed and trained, they can help avert panic and enhance a rapid and safe evacuation for themselves and others.

3.1.3 Compressed Gases

Because some compressed gases are flammable and all are under pressure, they must be handled with extreme care. An exploding cylinder can have the same destructive effect as a bomb. Compressed gases used in hospitals include acetylene, ammonia, anesthetic gases, argon, chlorine, ethylene oxide, helium, hydrogen, methyl chloride, nitrogen, and sulfur dioxide. Acetylene, ethylene oxide, methyl chloride, and hydrogen are flammable, as are the anesthetic agents cyclopropane, diethyl ether, ethyl chloride, and ethylene. Although oxygen and nitrous oxide are labeled as nonflammable, they are oxidizing gases that will aid combustion.

The proper handling of compressed gas cylinders requires training and a well-enforced safety program. Engineering a Safe Hospital Environment (Stoner et al. 1982) contains a discussion for developing a hospital-based program with special emphasis on the necessary precautions for handling oxygen cylinders and manifolds.

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Storage areas for compressed gas cylinders should be well ventilated, fireproof, and dry. Compressed gas cylinders should never be subjected to temperatures higher than 125°F (Stoner 1982). Cylinders should not be stored near steam pipes, hot water pipes, boilers, highly flammable solvents, combustible wastes, unprotected electrical connections, open flames, or other potential sources of heat or ignition. Cylinders should be properly labeled. The valve protection cap should not be removed until the cylinder is secured and ready for use.

Stoner (1982) presents the following general precautions for storing and handling compressed gas cylinders:

1. Secure all cylinders and do not place a cylinder of one type against a cylinder of another type.
2. Smoking should not be permitted in any area where gases are being used or stored.
3. Never drop cylinders or allow them to strike each other.
4. If cylinders are temporarily stored outside in the summer, make sure they are shaded from the rays of the sun.
5. Do not drag, roll, or slide cylinders. Use a hand truck and secure cylinders before moving.
6. Never tamper with cylinder safety devices.
7. Do not store empty cylinders with full ones.
8. Do not allow a flame to come into contact with any part of a compressed gas cylinder.
9. Do not place cylinders where they may come in contact with electricity.
10. Never store flammable gases with nonflammable gases.

Workers responsible for transferring, handling, storing, or using compressed gases should review the requirements of 29 CFR 1910.101 through 1910.105; 49 CFR, Parts 171-179; the National Fire Codes (NFPA 1983, Volume 4); and any applicable State or local regulations. Specific OSHA standards should be consulted for the following compressed gases:

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<u>Substance</u>	<u>OSHA Standard in 29 CFR</u>
Acetylene1910.102
Hydrogen.1910.103
Oxygen.1910.104
Nitrous oxide . . . . .	.1910.105

3.1.4 Flammable and Combustible Liquids, Vapors, and Gases

The widespread use and storage of flammable and combustible liquids presents a major fire hazard in all hospitals. Although workers usually recognize this potential hazard, they should also be aware of important facts about flammable liquids that can help to prevent fires.

Many liquids have vapors that are flammable or combustible and can be ignited by a spark from a motor, friction, or static electricity. A liquid may be classified as either combustible or flammable, depending on its flash point, which is the temperature at which it gives off enough vapor to form an ignitable mixture with air. When a liquid reaches its flash point, contact with any source of ignition (e.g., a cigarette or static electricity) will cause the vapor to burst into flame.

OSHA and NFPA have defined the limits for combustibility and flammability as follows: a combustible liquid has a flash point at or above 100°F (37.8°C) (NFPA 1983, Volume 3); a flammable liquid has a flash point below 100°F (37.8°C) and a vapor pressure at or below 40 pounds per square inch (psia) (276 kPa) at 100°F (37.8°C) (NFPA 1983, Volume 3). Because a flammable liquid can reach its flash point even at room temperature, any unrecognized leak can pose a particular hazard. If escaping vapors are heavier than air, they can move for some distance along the ground in an invisible cloud and settle in low areas.

Examples of flammable and combustible liquids are as follows:

<u>Liquid</u>	<u>Flash point (°F)</u>
Flammable liquids:	
Xylene	81
Most alcohols.	50-60
Toluene.	40
Benzene.	12
Tetrahydrofuran.	6
Acetone.	1.4
Ethyl ether.	-49

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Combustible liquids:

Lubricating oils250-475
Ethylene glycol.232
Carbolic acid.175
Some cleaning solvents . . . . .	.140
Most oil-based paints. . . . .	.105-140

Piping systems (including the pipe, tubing, flanges, bolting, gaskets, valves, fittings, and the pressure-containing parts of other components) that contain flammable and combustible liquids must meet the requirements of NFPA 30 (NFPA 1983, Volume 3).

The following precautions must be taken for flammable and combustible liquids:

- The transfer of flammable or combustible liquids from bulk stock containers to smaller containers must be made in storage rooms as described by NFPA 30 or within a fume hood that has a face velocity of at least 100 ft/min (30.5 m/min) (NFPA 1983, Volume 4).
- Spills of flammable and combustible liquids must be cleaned up promptly (NFPA 1983, Volume 3). Cleanup personnel should use appropriate personal protective equipment. If a major spill occurs, remove all ignition sources and ventilate the area. Such liquids should never be allowed to enter a confined space such as a sewer because explosion is possible.
- Flammable or combustible liquids must be used from and stored in approved containers according to NFPA 30 (NFPA 1983, Volume 3).
- Flammable liquids must be kept in closed containers (29 CFR 1910.106).
- Combustible waste material such as oily shop rags and paint rags must be stored in covered metal containers and disposed of daily (29 CFR 1910.106).
- Storage areas must be posted as "NO SMOKING" areas (29 CFR 1910.106).

3.1.4.1 Storage Cabinets

Storage cabinets should be labeled "FLAMMABLE - KEEP FIRE AWAY." The NFPA National Fire Codes (NFPA 1983, Volume 3) details requirements for metal storage cabinets that contain flammable and combustible liquids, including the following:

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- Metal cabinets must be constructed of sheet steel that is at least No. 18 gauge. They must be double-walled with a 1.5-in. (38.1-mm) air space, and they must have joints that have been riveted, welded, or otherwise made tight.
- Doors must have a three-point latch arrangement, and the sill must be at least 2 in. (50.8 mm) above the bottom of the cabinet.

3.1.4.2 Inside Storage Areas

Each inside storage area should be prominently posted as a "NO SMOKING" area. The NFPA National Fire Codes (NFPA 1983, Volume 3) details requirements for inside storage areas for flammable and combustible liquids, including the following:

- Openings to other rooms or buildings must be provided with noncombustible, liquid-tight, raised sills or ramps that are at least 4 in. (101.6 mm) high or are otherwise designed to prevent the flow of liquids to adjoining areas. A permissible alternative to a sill or ramp is an open-grated trench that spans the width of the opening inside the room and drains to a safe location.
- General exhaust ventilation (mechanical or gravity) is required.
- Electrical wiring and equipment in inside rooms used to store flammable and combustible liquids must conform to the requirements of NFPA 70, the National Electrical Code (NFPA 1983, Volume 6). A fire extinguisher must be available.

3.1.4.3 Outside Storage Areas

If flammable and combustible liquids are stored outside, the storage area must either be graded to divert spills from buildings and other potential exposure areas, or it must be surrounded by a curb at least 6 in. (152.4 mm) high (NFPA 1983, Volume 3). The storage area should be posted as a "NO SMOKING" area and kept free of weeds, debris, and other combustible material. A fire extinguisher should be available at the storage area.

3.1.4.4 Liquid Propane Gas Storage Areas

Storage areas for liquid propane gas (LPG) tanks should be posted as "NO SMOKING" areas. A fire extinguisher must be available in the area (NFPA 1983, Volume 5).

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3.1.5 Electrical Equipment

Electrical malfunction is the second leading cause (after matches and smoking) of fires in hospitals. Violations of standards governing the use of electrical equipment are the most frequently cited causes of fires (Fire Journal 1970). Hospital personnel use a wide variety of electric equipment in all areas--general patient care, intensive care units, emergency rooms, maintenance, housekeeping service, food preparation, and research.

Thorough electrical maintenance records should be kept, and considerable effort should be devoted to electrical safety, particularly in areas where patient care is involved.

3.1.5.1 Food Preparation Areas

NIOSH has published an Alert on the prevention of electrocutions in fast food restaurants (NIOSH 1984). The following recommendations from that document also apply to food preparation areas in hospitals:

- Ground-fault circuit interrupters (GFCI's) of the breaker or receptacle type should be installed wherever there is electricity in wet areas. These devices will interrupt the electrical circuit before current passes through a body in sufficient quantities to cause death or serious injury. GFCI's are inexpensive (\$50.00 to \$85.00 for the breaker type or \$25.00 to \$45.00 for the receptacle type), and a qualified electrician can install them in existing electrical circuits with relative ease.
- Exposed receptacle boxes should be made of nonconductive material so that contact with the box will not constitute a ground.
- Plugs and receptacles should be designed so that the plug is not energized until insertion is complete.
- Electrical panels should bear labels that clearly identify the corresponding outlets and fixtures for each circuit breaker or fuse. Breaker switches should not be used as on-off switches.
- Workers should be instructed when hired about safe electrical practices to avoid work hazards. Workers should not contact (1) a victim experiencing electrical shock or (2) the electrical apparatus causing it, until the current has been cut off.
- Workers, whether involved in direct patient care or not, should be encouraged to obtain training in cardiopulmonary resuscitation (CPR) and to know how to call for emergency assistance in their hospital.

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3.1.5.2 Unsafe Equipment and Appliances

Equipment and appliances that are frequently ungrounded or incorrectly grounded include

- Three-wire plugs attached to two-wire cords
- Grounding prongs that are bent or cut off
- Ungrounded appliances resting on metal surfaces
- Extension cords with improper grounding
- Cords molded to plugs that are not properly wired
- Ungrounded, multiple-plug "spiders" that are often found in office areas and at nurses' stations
- Personal electrical appliances, such as radios, coffeepots, fans, power tools, and electric heaters--brought by the workers from home--that are not grounded, have frayed cords or poor insulation, or are otherwise in poor repair.

3.1.5.3 National Electrical Code

OSHA has adopted the National Electrical Code (NEC) in NFPA 70 as a national consensus standard. The NEC is designed to safeguard persons and property from the hazards of using electricity. Article 517 of NFPA 70 (NFPA 1983, Volume 6) and NFPA 76A and 76B (NFPA 1983, Volume 7) contain special electrical requirements for health care facilities. In addition, there may be applicable State and local laws and regulations.

3.1.5.3.1 Electrical requirements for service and maintenance areas

Electricians and maintenance personnel should consult OSHA's electrical safety standards found in 29 CFR 1910.301 through 1910.399 and the NEC in NFPA 70 (NFPA 1983, Volume 6). Some general minimum requirements are listed as follows:

- Each device for disconnection (e.g., circuit breaker or fuse box) should be legibly marked to indicate its purpose (unless the purpose is evident).
- Frames of electrical motors should be grounded regardless of voltage.

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- Exposed, noncurrent-carrying metal parts of fixed equipment, which may become energized under abnormal conditions should be grounded under any of the following circumstances:
 - If the equipment is in a wet or damp location
 - If the equipment is operated in excess of 150 volts
 - If the equipment is in a hazardous location
 - If the equipment is near the ground or grounded metal objects and subject to contact by workers
 - If the equipment is in electrical contact with metal
 - If the equipment is supplied by metal-clad, metal-sheathed, or grounded metal raceway wiring
- Exposed, noncurrent-carrying metal parts of plug-connected equipment that may become energized should be grounded under any of the following circumstances:
 - If the equipment is a portable, hand-held lamp or motor-operated tool
 - If the equipment is a refrigerator, freezer, air conditioner, clothes-washing or drying machine, sump pump, electrical aquarium equipment, hedge clippers, lawn mower, snow blower, wet scrubber, or portable and mobile X-ray equipment)
 - If the equipment is operated in excess of 150 volts
 - If the equipment is in a hazardous location
 - If the equipment is used in a wet or damp location
 - If the equipment is used by workers standing on the ground or on metal floors
- Outlets, switches, junction boxes, etc., should be covered.
- Flexible cords should not be
 - Used as a substitute for fixed wiring
 - Run through holes in walls, ceilings, or floors
 - Run through doors, windows, etc.

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— Attached to building surfaces

- Flexible cords should be connected without any tension on joints or terminal screws.
- Frayed cords or those with deteriorated insulation should be replaced.
- Splices in flexible cords should be brazed, welded, soldered, or joined with suitable splicing devices. Splices, joints, or free ends of conductors must be properly insulated.

3.1.5.3.2 Damp or wet areas

Because hospitals contain many damp or wet areas, electrical safety requirements are particularly important. A switch or circuit breaker in a wet area or outside a building should be protected by a weatherproof enclosure. Cabinets and surface-type cutout boxes in damp or wet areas should be weatherproofed and located to prevent moisture from entering and accumulating in the cabinet or box. The boxes should be mounted with at least 0.25 inches of air space between the enclosure and the wall or supporting surface. Nonmetallic-sheathed cable and boxes made of nonconductive material are recommended.

In areas where walls are washed frequently or where surfaces consist of absorbent materials, the entire wiring system (including all boxes, fittings, conduit, and cable) should be mounted with at least 0.25 inches of air space between the electrical device and the wall or support surface.

3.1.5.3.3 Special requirements

Specific NEC recommendations apply in areas where flammable materials are stored or handled, in operating rooms, and in patient-care areas. Consult Article 517 of the NEC (NFPA 1983, Volume 6) for further details on these requirements.

Orientation and continuing in-service training programs are necessary to maintain worker awareness of electrical hazards. The following work practices can also help prevent shocks to hospital workers:

- Develop a policy for using extension cords; use a sign-out system to list the number and location of all extension cords currently in use.
- Do not work near electrical equipment or outlets when hands, counters, floors, or equipment are wet.

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- Consider defective any device that blows a fuse or trips a circuit breaker, and prohibit its use until it has been inspected.
- Do not use any electrical equipment, appliance, or wall receptacle that appears to be damaged or in poor repair.
- Report all shocks immediately (even small tingles may indicate trouble and precede major shocks). Do not use the equipment again until it is inspected and repaired if necessary.

3.1.6 Assault

Protecting workers from assault in and around hospitals has been a growing problem in recent years. The need for increased hospital security was highlighted by a survey that directors of the International Association of Healthcare Security (IAHS) conducted in 1987 (Stultz 1987). Respondents from 418 hospitals reported a total of 2,118 assaults, 426 suicides, 89 robberies, 63 rapes, 18 kidnappings, 551 bomb threats, and 72 arson incidents for 1986. These incidents occurred in inner city, urban, and rural hospitals. Assaults by patients are particularly common in emergency rooms, state institutions, and the psychiatric wards of hospitals. Patient-care staff should be trained to recognize potentially aggressive behavior in patients and to handle such situations when they arise. Staff should be clearly instructed to avoid dealing on their own with acute violence or physical danger. Security officers and staff should receive special training for such situations. Police and other municipal departments can offer on-site training programs in self-defense.

Personal and property crimes are frequent problems because many hospital personnel must work evening and night shifts at hospitals located in high-crime areas. The IAHS directors and the International Healthcare Safety and Security Foundation (IHSSF) have suggested the following steps (Stultz 1987) to help protect workers:

- Improve staffing and training for hospital security to ensure that
 - security officers and supervisors are trained to meet certain minimum standards within 1 year of employment
 - security directors and managers are trained in hospital management, hospital security, safety, and risk management
 - security procedures are written out for patient restraint, use and detection of weapons, prisoner restraint, and emergency responses

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- Increase worker safety during arrival and departure by encouraging car and van pools and by providing security escorts and shuttle service to and from parking lots and public transportation.
- Improve lighting and eliminate unnecessary bushes or shrubbery near sidewalks, parking areas, and bus stops.
- Install direct-dial emergency telephones in parking lots, underground tunnels, elevators, and locker-rooms. Mark phone locations by a distinctive red light.
- Install locks on all outside doors to bar entrance to (not exit from) the building.
- Improve visibility with increased lighting, stairwell and elevator mirrors, and other physical changes.
- Increase staffing in areas where assaults by patients are likely.
- Install a panic-button alarm system in areas where assaults by patients are likely.
- Install closed-circuit televisions in common areas and rooms where psychiatric patients are treated.
- Increase control over hospital access areas.
- Provide separate emergency room facilities for mentally disturbed patients.
- Provide a secure reception area that has good visibility.
- Provide a physical barrier between receptionists and patients.
- Install a buzzer at the entrance to emergency facilities.
- Post escape and evacuation routes.
- Increase security in pharmacies, cash or storage areas, emergency rooms, nurseries, exits, and parking lots by
 - installing closed-circuit televisions, bullet-proof separation windows, pass-through windows with intercoms, panic alarms, and intrusion alarms
 - locating these areas away from main entrances and major traffic-flow corridors.

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The Joint Commission on Accreditation of Healthcare Organizations also recognizes the importance of improved hospital security and has developed a Security Systems Standard, PL.19.11 (JCAHO 1987).

3.2 SPECIFIC SAFETY HAZARDS BY HOSPITAL DEPARTMENT

The safety hazards discussed in the preceding subsection are found in most or all areas of the hospital, but some hazards are typically found in one or only a few departments. This subsection outlines the most important safety problems in each major hospital department. See Section 5 and Appendices 5, 6, and 8 for the health effects of some of these hazards.

3.2.1 Central Supply

Central supply areas in some hospitals are very similar to small manufacturing plants. Their operations include receiving, packaging, processing, and distributing. The major activities involve some type of material handling.

3.2.1.1 Sterilization Equipment

Improper use of sterilization equipment can result in burns from steam and exposure to ethylene oxide. Detailed operating instructions should be posted on or near the sterilization units. Autoclaves and other steam-pressured vessels should be inspected periodically, and records of the inspections should be maintained. These steps will protect workers and ensure that sterilization is adequate.

Piping ethylene oxide through the hospital from a storage area may increase the potential for exposure to this hazard. During such piping, supply lines from gas cylinders transfer a liquid mixture of 12% ethylene oxide and 88% Freon® under pressure to the sterilizers. Ethylene oxide is usually supplied with Freon® so that the mixture is nonflammable. If supply lines are not drained before the tanks are changed, the gaseous mixture can spray the maintenance worker before the pressure is released. Long supply lines from the cylinders to the sterilizers are also a potential source of exposure for many people and may make it difficult to locate and repair ruptures or leaks. By placing the cylinders close to the sterilizer in a mechanical access room (as many hospitals do), the exposure and accident hazard can be contained and controlled. Although the mechanical access room is usually very warm and humid, these conditions can be controlled through adequate exhaust ventilation.

Hospitals with sterilizers that use 100% ethylene oxide cartridges should store only a few cartridges in the department. The rest should be kept in a

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cool, dry place. Exhaust systems for ethylene oxide should be designed to prevent re-entry of the vapors into other areas of the building. The health effects of ethylene oxide are discussed in Section 5.1.5.

3.2.1.2 Sharp Objects

Cuts, bruises, and puncture wounds from blades, needles, knives, and broken glass are among the most common accidents in central supply areas. Rules for gathering and disposing of sharp or other hazardous instruments should be reviewed regularly. Workers should handle items returned to central supply as if they contained sharp or hazardous instruments.

3.2.1.3 Material Handling

Strains, sprains, and back injuries are common in central supply areas. Workers should be provided with appropriate carts, dollies, and other material-handling aids, and they should be instructed in proper techniques for handling materials. Step stools and ladders should be available and checked frequently for serviceability. Chairs, boxes, and other makeshift devices should not be used for climbing because they are a frequent cause of falls.

3.2.1.4 Soaps, Detergents, and Cleaning Solutions

Workers may also develop dermatitis from soaps, detergents, and solutions used in central supply. When possible, agents that do not cause dermatitis should be substituted for those that do, or protective clothing should be provided.

3.2.2 Food Service

Injuries occur in food service areas while workers are (1) handling materials as they are received, processed, and distributed, (2) walking on wet and greasy floor areas, and (3) using faulty equipment. These hazards can be reduced by

- servicing electrical components and equipment adequately,
- training workers in correct material-handling techniques,
- properly guarding machinery and hot surfaces,
- maintaining dry and uncluttered walking and working surfaces, and
- maintaining good work and housekeeping practices.

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3.2.2.1 Walking and Working Surfaces

The floors in wet and greasy areas (around sinks, dishwashers, and stoves), should be made of nonskid material or covered with nonskid mats. Spilled foods, liquids, and broken dishes should be swept or cleaned up immediately, or the area should be clearly marked and roped off until cleanup. Where work surfaces are slippery, workers should wear shoes with slip-resistant soles. Damaged floor mats should be repaired or replaced promptly.

Workers should not stand on chairs, stools, and boxes. Step stools or ladders should be provided to help workers reach high storage areas. Carts, boxes, or trash should not obstruct aisles or block exits.

3.2.2.2 Electrical Equipment

Workers should follow the recommendations discussed in Subsection 3.1.5 (Electrical Equipment). Toasters, blenders, hand mixers, fans, refrigerators, and radios should be grounded or double insulated. If these items were designed for household use, they should be checked to ensure proper grounding for industrial application.

Workers should turn off switches and pull plugs before adjusting or cleaning power equipment such as slicers, grinders, and mixers. Equipment that is being serviced or cleaned should be tagged as "OUT OF SERVICE." Workers should never plug in electric equipment while their hands are wet or while they are standing in water.

When fixed-equipment (i.e., permanently wired equipment) must be serviced, the electrical power to the equipment should be disconnected. To prevent someone from inadvertently turning the power on while the unit is being serviced, a lock and a tag should be placed on each disconnecting means used to deenergize the equipment. Each worker should apply his own lock, and only the person who applies the lock should remove it.

3.2.2.3 Stove Hoods

Stove hoods should be cleaned and filters should be replaced on a regular schedule. The flange on a stove hood, which is a repository for condensed oil from cooking, should be cleaned regularly. The stove should not be used if hood filters are not in place. Because improperly installed and makeshift filters can be fire hazards, only the proper size and type of filters should be used as replacements.

3.2.2.4 Fire Extinguisher Systems

Kitchen workers should be taught how to use the fire extinguishers and hood extinguishing systems. They should also know when to stay in the area and

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use the fire extinguisher and when to leave and call the fire department. Fire extinguishers should be properly mounted, and the immediate area around their location should be kept clear.

Where automatic fire control systems are in place, the head or nozzle should be directed toward a potential fire area.

Inspections must be made in accordance with OSHA standards (29 CFR* 1910).

3.2.2.5 General Kitchen Equipment

Meat saws, slicers, and grinders should be properly guarded. Tamps or push sticks should be used to feed food grinders and choppers.

The wheels of food carts should be kept in good repair. Workers should be instructed to obtain help when moving a heavily loaded cart over a carpet or mat or from an elevator that has not leveled properly. Workers should also be instructed to push (not pull) food carts.

Carbon dioxide tanks should be secured or stored where they cannot be knocked over. All tank gauges should be kept in good working order.

All exposed drive belts, gears, chains, and sprockets on dishwashers, conveyors, and other equipment should be guarded.

Dumbwaiters should be securely closed when not in use.

Steam, gas, and water pipes should be clearly marked (e.g., color-coded) for identification, and personnel should learn the coding system and the location and operation of shut-off valves.

3.2.2.6 Knives

Workers should be instructed about the safe handling and use of knives. Cutlery should be kept sharpened and in good condition: dull knives tend to slip. A cutting board or other firm surface should always be used. The direction of the cut should always be away from the body.

Knives, saws, and cleavers should be kept in a designated storage area when not in use. The blades should not be stored with the cutting edge exposed. Knife holders should be installed on work tables to prevent worker injury. Knives and other sharp objects should not be put into sinks between periods of use.

*Code of Federal Regulations. See CFR in references.

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Newly purchased knives should be equipped with blade guards (knuckle guards) that protect the hand from slipping onto the blade.

3.2.2.7 Hot Utensils and Equipment

All stoves, pots, and pans should be treated as hot equipment. The handles of cooking utensils should be turned away from the front of the stove. Hand protection for grasping hot utensils should be readily available near stoves.

When uncovering a container of steaming material, the worker should hold the cover to deflect steam from the face.

Workers should take special care to stand to the side of the unit when lighting gas stoves and ovens.

3.2.2.8 Chemical and Physical Agents

Workers in food service areas can be exposed to agents that pose potential occupational safety and health problems. The most common are listed below:

3.2.2.8.1 Ammonia

Ammonia solution is frequently used as a cleaning agent, and ammonia gas is used as a refrigerant. Because concentrated solutions of ammonia can cause severe burns, workers should avoid skin contact with this substance by wearing protective clothing such as appropriate gloves (see Section 2.3.5). Respirators should be used as needed (see Section 2.3.5.6). If skin or eye contact occurs, the affected area should be washed promptly with water.

Workers who handle concentrated solutions of ammonia should wear rubber gloves and goggles or a face shield. Because ammonia gas is released from solution, good ventilation should be provided. For example, stove hoods should be operating when workers use ammonia to clean grease from stoves. Because ammonia can react with some deodorizing chemicals to produce harmful byproducts, these substances should not be stored or used together.

3.2.2.8.2 Chlorine

Chlorine solutions can be used as disinfectants in dishwashing. When chloride solutions are added to other compounds, a chemical reaction may occur, and chlorine gas may be released. Exposure to chlorine, even at low concentrations, can cause eye, nose, and throat irritation; high concentrations can produce pulmonary edema. Protective clothing and equipment should be used when personnel are working with chlorine. Selection of the appropriate protective equipment and clothing should be based on the type and extent of exposure anticipated (see Section 2.3.5).

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3.2.2.8.3 Drain cleaners

Drain cleaners can cause skin burns and damage to the eyes. Workers should wear rubber gloves and goggles or face shields when they use drain cleaners and when splashing is possible (see Section 2.3.5).

3.2.2.8.4 Ambient Heat

Ambient heat may be a problem in kitchen areas. High heat levels can cause heat-related illnesses, and workers should be aware of the symptoms of heat disorders and the need for frequent water consumption and rest periods.

3.2.2.8.5 Microwave Radiation

Microwave ovens are becoming standard appliances in hospitals. As these ovens wear out, hinges and catches may loosen, and microwave radiation may be released from the units. The units should be cleaned regularly because spilled food can prevent oven doors from closing properly. If the interlock system fails, the unit may not shut off when the door is opened. Trained personnel should check units periodically for leaks.

3.2.2.8.6 Oven cleaners

Oven cleaners may be sprayed or brushed onto oven walls. Workers using oven cleaners should wear protective gloves and goggles and avoid breathing the vapors. Most oven cleaners can cause skin irritation, such as rashes and dermatitis; inhaled vapors are also irritating to the respiratory tract (see Section 2.3.5).

3.2.2.8.7 Soaps and detergents

Soaps and detergents may cause dermatitis if precautions are not taken (for example, gloves should be worn and substitutes should be found for known sensitizers).

3.2.2.8.8 Strong caustic solutions

Strong caustic solutions are often used to clean reusable filters on stoves, grills, and broiler exhaust hoods. Strong caustics can burn the skin, harm the eyes, and cause skin rashes and dermatitis. Protective clothing and equipment should be used to prevent skin and eye contact.

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3.2.3 Housekeeping

Housekeeping workers serve in all patient and nonpatient areas and are thus potentially exposed to all of the health and safety hazards found in the hospital environment. They should receive periodic instruction to keep them aware of the specific hazards in each department, especially in those areas where X-rays, radioisotopes, oxygen and other gases, and specific chemicals are used.

3.2.3.1 Health and Safety Guidelines for Housekeeping Workers

The following specific guidelines should be included in a health and safety program for housekeeping workers:

- Workers should be trained in proper material-handling techniques.
- Workers should be instructed to wash their hands thoroughly before eating, drinking, and smoking, before and after using toilet facilities, after removing contaminated work gloves, and before going home.
- Workers should be aware that other persons may not have followed proper procedures for disposing of needles, knives, and glassware. All refuse should be handled as if hazardous items were present.
- Workers should seek help either from other persons or with mechanical devices when lifting or moving equipment or furniture that is heavy or awkward to handle.
- Workers may be injured as a result of improper use and poor maintenance of ladders, step stools, and elevated platforms. To reduce the frequency of falls,
 - workers should not stand on the top two steps of a ladder, and
 - workers should not substitute chairs, beds, boxes, or other items for a ladder.
- All electrical appliances, such as vacuums and polishers, should have grounded connections.
- Service carts should be equipped with large, wide wheels to make them easier to push.
- The slippery areas on floors that are being scrubbed or polished, should be identified with signs or roped-off areas.

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3.2.3.2 Chemical and Physical Agents

Some hazardous chemical and physical agents frequently encountered by housekeeping workers are listed below.

3.2.3.2.1 Soaps and detergents

Soaps and detergents may cause dermatitis or sensitization reactions. Workers should be trained to use these materials properly and should be provided with appropriate protective gloves (see Section 2.3.5). Effective cleaning solutions that do not cause dermatitis or sensitization should be substituted when possible. Sensitized workers should be transferred to other duties if necessary.

3.2.3.2.2 Solvents

Solvents, such as methyl ethyl ketone, acetone, and Stoddard solvent, are often used to clean grease from equipment and may have several cleaning applications throughout the hospital. Workers should be instructed in their proper use to prevent both fire hazards and exposures that could lead to illness. Many solvents remove the natural fats and oils from the skin and when absorbed through the skin, can cause respiratory effects. Appropriate personal protective equipment (see Section 2.3.5) should be worn by workers who come into contact with solvents.

3.2.3.2.3 Cleaners

Cleaners used throughout the hospital may contain acids or caustics that can cause burns. Workers who use these solutions should wear proper protective clothing such as rubber gloves, rubber or plastic aprons, and eye protection.

3.2.3.2.4 Disinfectants

Disinfectants (including quaternary ammonia compounds, phenols, and iodophors) are used in such hospital areas as nurseries and operating rooms. Because many disinfectants can produce skin rashes and dermatitis, personal protective equipment for the skin (see Section 2.3.5) and eyes is required.

3.2.3.3 Bacteria and Viruses

Housekeeping personnel are frequently exposed to viruses and bacteria. They should therefore (1) follow instructions issued by the infection control

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personnel for reporting infections, and (2) take appropriate measures to limit further contagion from patients by practicing universal precautions for handling blood and body fluids.

3.2.4 Laundry

The following points should be included in a health and safety program for hospital laundry workers:

- Floors should be kept as dry as possible, and wet floors should be labeled. Nonskid mats or flooring should be provided in wet areas, and workers should wear nonskid boots or shoes.
- Laundry should be handled as if hazards were present because puncture wounds and cuts can result from needles, knives, and blades that are folded in soiled linens.
- Soiled linens should be handled as little as possible and with minimum agitation to prevent contamination of the air. This is especially true for linens used by patients who have infectious microorganisms or radioactive implants or are taking cytotoxic drugs. All soiled linens should be bagged with impervious, color-coded bags at the site where they are used, and materials contaminated with potentially infective agents, cytotoxic drugs, or radionuclides should be clearly labeled and handled with special care. To protect workers from unnecessary contact, a barrier should separate soiled linen areas from the rest of the laundry area.
- Proper precautions should be taken when handling soaps and detergents (for example, gloves should be worn and substitutes should be used for known sensitizers).
- The high temperatures and excessive humidity in some laundry areas may be impossible to control with engineering devices alone, especially during the summer months. Administrative controls may be necessary (NIOSH 1986), and persons working in excessively hot environments can be rotated to other jobs or shifts.
- Workers should be aware of the symptoms of heat stress and the need for water consumption and more frequent breaks.
- Workers who sort and wash contaminated linens should wear proper protective clothing and respirators.
- Workers should be trained in the proper techniques for lifting and material handling.

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- Laundry personnel should be instructed to wash their hands thoroughly before eating, drinking, and smoking, before and after using toilet facilities, and before going home.
- Workers who handle and sort soiled linen in the laundry department should be included in the hospital immunization program.
- The wrapping on steam lines should be adequately maintained to protect workers from burns.

3.2.5 Maintenance Engineering

Maintenance shops in hospitals tend to be overlooked when safety and health are considered. Housekeeping is often very poor, with materials scattered in aisles and over floors, equipment and stock stored improperly, and machinery improperly guarded. Standards pertinent to maintenance areas may be found in 29 CFR 1910, NFPA (1983) codes, and State and local laws and regulations. Section 5 addresses in detail many of the hazards encountered in maintenance areas. The major hazards will be described briefly below.

3.2.5.1 General Rules for Maintenance Areas

The following general rules should be applied to maintenance areas:

- Drive belts must be guarded. Gears, shafting, and chains and sprockets must be properly enclosed (29 CFR 1910, Subpart O).
- Tool rests, adjustable tongue guards, and spindle guards on grinders must be installed and kept properly adjusted (29 CFR 1910, Subpart O).
- Blade guards must be installed on table saws, band saws, and radial arm saws. If saws are used for ripping, anti-kickback devices must be installed (29 CFR 1910, Subpart O).
- Electrical equipment must be properly grounded or double insulated (29 CFR 1910.3).
- Extension cords must be the three-wire type and have sufficient capacity to safely carry the current drawn by any devices operated from them. Extension cords may be used only in temporary situations and may not be substituted for fixed wiring (29 CFR 1910.3).

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- Electrical switches on circuit boards should be marked with danger tags and physically locked to prevent circuit activation when machinery is being repaired. Circuits should be deenergized before repair work begins.
- Metal ladders should never be used by workers to change light bulbs or work on electrical equipment or wiring.
- Broken ladders should be destroyed or tagged, removed from service, and repaired.
- Battery-charging areas should be adequately ventilated to prevent a buildup of hydrogen gas. These areas should be designated as "NO SMOKING" areas.
- Gasoline- and diesel-powered equipment should be properly maintained and operated only in areas that are well-ventilated or vented to the outside to prevent a buildup of carbon monoxide. Data obtained recently from animal studies indicate that diesel exhaust is a potential carcinogen.
- Workers should wear protective clothing and equipment when exposed to hazards requiring such protection (see Section 2.3.5). Protective clothing and equipment include:
 - Gloves for handling hot, wet, or sharp objects and chemicals
 - Eye and face protection to prevent injuries from chips, sparks, glare, and splashes
 - Hearing protection to prevent hearing loss from noise sources
 - Respirators to prevent exposure to dusts, fumes, and vapors, as appropriate
- Paints, solvents, and other flammable materials must be stored in cabinets or rooms that meet the requirements outlined in NFPA 30 (NFPA 1983, Volume 3).
- Hand tools should be maintained and stored properly.
- Fuel and cylinders of flammable gas must be stored separately from cylinders of oxidizing gas. Cylinders must be kept away from heat sources such as radiators, steam pipes, and direct sunlight (NFPA 1983, Volume 4).
- Cylinders must be stored and used in the upright position (NFPA 1983, Volume 4). Cylinders of compressed gas must be chained or secured to prevent them from falling.

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- Trash compactors should not be operated in the open position. They should have guarding devices, such as two-hand controls, electric eyes, and emergency shut-off bars.
- In laboratories that use sodium azide for the automatic counting of blood cells, the pipes should be flushed before plumbing repairs can be made because a buildup of sodium azide in the pipes can result in a violent explosion. A sodium-azide decontamination procedure is available from NIOSH (NIOSH 1976).
- The use of compressed air for cleaning surfaces should be avoided.

For additional requirements regarding electrical equipment and storing and handling compressed-gas cylinders, refer to Sections 3.1.5 and 3.1.3, respectively.

3.2.5.2 Chemical and Physical Agents

Some chemical and physical agents that pose common occupational health hazards in maintenance shops are discussed below.

3.2.5.2.1 Asbestos

Asbestos was commonly used in older buildings as an insulating material for steam pipes. When that insulation is torn off and replaced, asbestos fibers may be released into the air. Persons exposed to asbestos fibers may develop a fibrosis of the lungs (asbestosis) and possibly lung cancer or peritoneal mesothelioma. Smokers are more susceptible to asbestos-induced lung cancer than are nonsmokers.

To reduce asbestos exposure, workers should wear a NIOSH-approved, positive-pressure, air-supplied respirator (NIOSH-EPA 1986), and the insulation material should be dampened before it is cut or torn apart. Areas containing asbestos should be vacuumed rather than swept, and waste material should be discarded in sealed plastic bags. State health departments or other responsible jurisdictions should be contacted before asbestos removal operations begin; many states certify companies engaged in asbestos removal. Guidance for Controlling Asbestos-Containing Materials in Buildings (EPA 1985) contains procedures for removing asbestos. Specific federal requirements govern asbestos exposure; for more information on asbestos, see 29 CFR 1910.1001 and Section 5.1.2 of this document.

3.2.5.2.2 Ammonia

Ammonia is used as a liquid cleaning agent and as a refrigerant gas. Concentrated solutions of ammonia can cause severe burns. Workers

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should avoid skin contact with ammonia by wearing protective clothing (see Section 2.3.5). If skin or eye contact occurs, the affected area should be washed promptly. Workers who handle concentrated solutions of ammonia, should wear rubber gloves and goggles or face shields. Ammonia gas is released from a concentrated solution, and thus good ventilation should be provided. Ammonia and some deodorizing chemicals should not be stored or used together because they can react to produce harmful byproducts. The NIOSH REL for ammonia is 50 ppm (35 mg/m³) as a 5-min ceiling; the OSHA PEL for ammonia is 50 ppm as an 8-hr TWA; the ACGIH recommended TLV is 25 ppm (18 mg/m³) as an 8-hr TWA with a STEL of 35 ppm (27 mg/m³).

3.2.5.2.3 Carbon monoxide

Carbon monoxide exposures can occur when the gasoline-powered engines of forklifts, auxiliary power generators, etc., are run in poorly ventilated areas. Symptoms of carbon monoxide exposure begin with a slight headache followed by nausea, dizziness, and unconsciousness. Emergency care should be initiated for any worker exposed to excessive carbon monoxide. The NIOSH REL for carbon monoxide is 35 ppm as an 8-hr TWA with a ceiling of 200 ppm; the OSHA PEL is 50 ppm as an 8-hr TWA.

3.2.5.2.4 Drain-Cleaning Chemicals

Drain-cleaning chemicals can burn the skin and damage the eyes. Workers should wear rubber gloves and goggles or face shields when they use drain cleaners and splashing is possible. Product information sheets or material safety data sheets contain additional information.

3.2.5.2.5 Noise

Noise exposure at levels that exceed 90 decibels--measured on the A scale (dBA)--often occurs in boiler houses and power-supply locations. Adequate hearing protection should be provided and worn in noise areas when engineering or administrative controls cannot eliminate the exposure. When noise levels exceed 85 dBA, OSHA requires a hearing conservation plan. The OSHA standard for occupational noise exposure contains additional information (29 CFR 1910.95).

3.2.5.2.6 Paints and adhesives

Paints and adhesives contain a wide variety of solvents and should be used only in areas with adequate ventilation. If ventilation is inadequate, workers should wear respirators approved for use with organic vapors (see Section 2.3.5.6). Skin contact with epoxy paints

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and adhesives can be prevented by using gloves and other personal-protective clothing (see Section 2.3.5). If skin contact does occur, the skin should be washed immediately. Section 5 contains more information about the hazards associated with solvent exposure.

3.2.5.2.7 Pesticides

Pesticides are used throughout the hospital for fumigation and pest extermination. Workers who apply these substances should wear protective gloves and respirators (see Section 2.3.5) approved for use with pesticides (organic dusts and vapors). Workers should be familiar with emergency procedures for spills and splashes and federal regulations governing the application of pesticides.

3.2.5.2.8 Solvents

Solvents such as methyl ethyl ketone, acetone, and Stoddard solvent may be used to clean parts in maintenance shops. Recommended personal protective equipment should be worn by workers who come into contact with solvents (see Section 2.3.5). Many solvents remove the natural fats and oils from the skin and may be absorbed through the skin. Neurotoxicity is a principal effect of solvent exposure (NIOSH 1987). All organic solvents should be used with adequate ventilation. Because some solvents are also flammable, they should be stored in approved safety containers. Cleaning tanks should be kept closed when not in use (See Section 5).

3.2.5.2.9 Waste anesthetic gases and ethylene oxide

Maintenance workers may be exposed to waste anesthetic gases and ethylene oxide when repairing ventilation or exhaust systems that are used to remove these gases. Workers should be aware of the health effects of anesthetic gases and ethylene oxide as well as their physical properties. For example, ethylene oxide is a carcinogen and is extremely flammable. Appropriate personal protective equipment and clothing should therefore be provided and worn by workers when exposure to either anesthetic gases or ethylene oxide is possible (see Section 2.3.5). Control measures should be followed to minimize the levels of exposure. See Section 5.1.5 for more information about ethylene oxide. See Section 5.1.12 and the NIOSH criteria document (NIOSH 1977a) for more information about waste anesthetic gases.

3.2.5.2.10 Welding fumes

Welding fumes contain particulate matter and gases from the metals being joined, the filler material used, and coatings on the welding

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rods. Exposure to welding fumes frequently occurs when maintenance personnel weld in confined spaces. Local exhaust ventilation should be provided when extensive welding operations are performed. Workers who weld should be familiar with the potential adverse health effects of exposure to welding fumes. NIOSH has published a criteria document (NIOSH 1988) that contains recommendations for protecting the safety and health of welders.

3.2.6 Office Areas

Office areas are frequently overlooked during health and safety inspections in hospitals. The following guidelines should be included in health and safety programs for office workers:

- Desks and countertops should be free of sharp, square corners.
- Material should be evenly distributed in file cabinets so that the upper drawers do not unbalance the file and cause it to fall over. Only one drawer should be opened at a time, and each drawer should be closed immediately after use.
- Papers and other office materials should be properly stored and not stacked on top of filing cabinets.
- Aisles and passageways should be sufficiently wide for easy movement and should be kept clear at all times. Temporary electrical cords and telephone cables that cross aisles should be taped to the floor or covered with material designed to anchor them.
- Electrical equipment should be properly grounded, and the use of extension cords should be discouraged.
- Carpets that bulge or become bunched should be relaid or stretched to prevent tripping hazards.
- Heavy materials should not be stored on high shelves.

Video display terminals (VDTs) have been introduced on a large scale in hospital office areas during the past decade. Terminals should be selected that incorporate modern ergonomic advances in design. They should then be properly installed, and training in their use should be provided. Otherwise, they may be a source of musculoskeletal disorders (shoulder, neck, and arm) and eyestrain. The NIOSH report, Potential Health Effects of Video Display Terminals, contains recommendations for preventing these problems (NIOSH 1981a). (See also Section 5)

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3.2.7 Print Shops

The following guidelines should be followed in print shops:

- Material safety data sheets (MSDS's) should be requested from the manufacturers of all chemicals used in the print shop. The MSDS's must conform to requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200). Once the composition of chemicals is known, proper safety and health precautions should be implemented.
- Smoking should be prohibited because highly flammable inks and solvents are used in the print shop.
- Water-based inks should be used whenever possible.
- Safety cans should be used to store all flammable liquids. Ink-cleaning chemicals should be dispensed from plunger-type safety cans.
- All rags soaked with solvent and solvent-based ink should be disposed of in covered metal containers that are emptied at least daily.
- Ventilation should be provided as needed to control airborne concentrations of solvents and other toxic substances used in the print shop.
- The cutting edge of guillotine papercutters should be guarded. Two-hand controls are an effective method of reducing this hazard. All gears, belts, pulleys, and pinch points should be guarded.
- Because printing equipment produces a noisy environment, control measures should be implemented to reduce noise to the lowest possible level. Adequate hearing protection should be provided, and surveys of noise level should be conducted routinely.

3.2.8 Patient Care Areas (Nursing Service)

3.2.8.1 Physical Exertion

Strains and sprains account for approximately half of the compensable disorders among hospital workers (see Table 1-1 and Health Alert [1978]). Falling, lifting patients and heavy materials, moving beds and furniture, pushing heavy carts, and wearing improper footwear all contribute to the frequency of these injuries.

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The following control measures can help prevent strains and sprains:

- Make aisles and passageways adequate for the movement of personnel and materials. Passageways, aisles, and halls should not be used as storage areas.
- Treat floors with non-slip material.
- Clean up spills immediately.
- Teach workers to use proper lifting techniques to help prevent injuries.
- Place temporary electric cords for lights, radios, televisions, and patient-monitoring equipment in a way that prevents tripping hazards; either tape them to the floor or cover and anchor them with other material.
- Use only properly maintained, safe ladders to reach high objects. Do not use stools, chairs, or boxes as substitutes for ladders.

3.2.8.2 Needles and Sharp Instruments

Cuts, lacerations, and punctures are also common among hospital workers (see Table 1-1 and Health Alert [1978]). Needles and other sharp instruments should be discarded in designated puncture-resistant containers and not in trash cans or plastic bags. Hospitals should establish and enforce policies to prevent the recapping of needles.

Rules for safe disposal and collection of sharp instruments or other hazardous materials should be reviewed regularly. Workers should examine and handle soiled linens and similar items as if they contained hazardous items.

3.2.8.3 Obstacles and Broken Objects

Abrasions, contusions, and lacerations are also among the more frequently reported occupational injuries in patient care areas. Control measures to prevent such injuries include

- Arranging furniture to allow free movement about the room.
- Keeping doors and drawers closed when not in use.
- Turning bed-adjustment handles in or under the bed.

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- Allowing only smooth and rounded corners on desks and countertops at the nurses' stations.
- Sweeping up and disposing of broken glass immediately and properly. Workers should not pick up broken glass with their fingers.
- Grasping ampoules with protective gauze before scoring the tip with a metal file and snapping the top open.

3.2.8.4 Electrical Hazards

Workers should be instructed in the proper use of electrical equipment and should take the following precautions:

- Report defective equipment immediately, tag it, remove it from service, and repair or discard it.
- Prohibit patients, visitors, and workers from using ungrounded coffeepots, radios, cooling fans, portable heaters, or other appliances.
- Implement a program to check all electrical equipment and connections in nurses' stations and kitchenette areas regularly to find damaged cords and ungrounded electrical equipment.
- Implement a program to check regularly all electrical equipment (e.g., razors and hair dryers) brought into the hospital by patients.
- Ground beds that have electrical controls and place cords under the bed.
- Clean microwave ovens regularly and check periodically for proper door closure and seal. These ovens should be used only in designated areas.

3.2.8.5 Other Hazards

The following guidelines apply to miscellaneous hazards found in patient care areas:

- Label acids and other chemicals properly and store and handle safely.
- Label linens and wastes properly.
- Use personal protective equipment and protective measures as recommended (see Section 2.3.5).

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- Enforce the isolation techniques developed according to CDC recommendations when staff members (including physicians) provide care for patients with infectious diseases.
- Enforce exposure limits for ionizing radiation according to Federal or State regulations and standards.

3.2.9 Pharmacy

Pharmacy workers are also subject to slips and falls, back injuries, cuts from broken bottles and equipment, and exposure to chemicals (such as alcohols and solvents), dusts (such as talc and zinc oxide), and antineoplastic drugs. The following control measures should be considered:

- Provide stepladders to help personnel reach items stored on high shelves.
- Clean up spills promptly.
- Dispose of broken bottles and unusable pharmaceuticals according to established procedures.
- Guard mixers, packaging and bottling equipment, and labeling machinery properly. Adequate exhaust hoods should be provided where needed. If a laminar air-flow hood is used, it should be checked frequently to determine whether it is operating properly.
- Make pharmacy personnel aware of hazards associated with handling antineoplastic agents and make them familiar with safety guidelines. See Section 5 for a more in-depth discussion of antineoplastic agents.
- Instruct workers in safe practices for lifting and carrying to prevent injuries.
- Do not repair thermometers, manometers, and other instruments that contain mercury in the pharmacy. This equipment should either be repaired in an appropriate hospital shop or sent out for repair.
- Install opening devices on the inside of walk-in vaults and refrigerators to prevent workers from being accidentally locked inside.
- Identify through medical surveillance the adverse effects of exposure to any medications that are packaged or dispensed in the pharmacy.

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- Do not permit workers to smoke or eat in pharmacy preparation areas because drug aerosols may be inhaled or pharmaceuticals may be ingested.

3.2.10 Laboratories

3.2.10.1 Types of Laboratory Hazards

3.2.10.1.1 Equipment

Increased attention in the past decade has been focused on health hazards in the laboratory, such as infectious diseases and toxic chemicals, but laboratory safety is still a problem. Electric appliances that replaced the open flames of Bunsen burners have resulted in increased risk of electric shock.

Chemical Laboratory Safety Audit (Reich and Harris 1979) provides a general protocol to help identify potential safety problems.

3.2.10.1.2 Infection

Microorganisms in the laboratory can be inhaled, ingested, or inoculated through the skin. Pike (1976) reviewed published case reports of infections associated with medical laboratories and found 42% caused by bacteria and 27% associated with viruses. Many laboratory-acquired infections, especially common diseases, were not reported, and Pike concludes that laboratory-acquired tuberculosis and hepatitis are significantly under-reported. Nearly all sizable blood banks and serology laboratories had at least one case of hepatitis. Of the 3,921 cases reported, 65% involved trained workers, 59% were in research laboratories, and 17% were in diagnostic laboratories.

For 82% of the reported infections, no source was recognized. Of the 18% for which a source was recognized, one fourth involved needle punctures, leaking syringes, or contamination while separating needles from syringes. Other commonly recognized exposure incidents included spills and breakage resulting in sprays (aerosols) of infectious material, injuries with broken glass or other sharp instruments, and aspiration during mouth pipetting. Research laboratories were the most hazardous because they lack the standard and routine handling procedures found in large commercial laboratories.

For the 75% to 80% of all laboratory infections for which there is no recognized causal accident or event, the suspected source is usually an aerosol (Collins 1980). Aerosols are airborne droplets of infectious material that may be generated by

- Opening containers

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- Blowing out pipettes
- Mixing test-tube contents
- Opening lyophilized cultures
- Centrifuging suspensions
- Pouring liquids
- Using automatic pipetters
- Mixing fluid cultures by pipette
- Harvesting or dropping infected eggs
- Mixing with high-speed blenders
- Using poorly made, open, or large wire loops
- Spilling liquids

Small aerosol particles dry almost instantly and remain suspended in the air for long periods. When inhaled, they penetrate deep into the lung and may cause infections. Larger and heavier particles settle slowly on laboratory surfaces and workers' skin. They may enter the body through contaminated foods, contaminated skin, or objects that touch the eyes or mouth (Collins 1980).

Ways to reduce aerosols include

- Using smooth agar and a glass rod (or cool wire loop if necessary) for spreading
- Draining pipettes instead of blowing them out
- Mixing cultures in a tube mixer
- Using disinfectant gauze or Benchkote® on work surfaces during transfers of biogenic material
- Wrapping needles and bottle tops in alcohol-soaked pledgets when withdrawing needles from stoppered vaccine bottles
- Properly maintaining equipment such as high-speed blenders
- Using sealed centrifuge buckets
- Carefully packaging specimens during transport and storage

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3.2.10.1.3 Allergic sensitization

Allergic sensitization to laboratory materials is a related but less common hazard for some workers. Severe allergic reactions may require a job change to an allergen-free environment. Ascaris, brucella, formaldehyde, penicillin, tuberculin, and the dander of laboratory animals are common allergens and sensitizers.

3.2.10.1.4 General chemical hazards

Each laboratory should identify the chemicals used there and should establish appropriate training, precautions, personal protective equipment (see Section 2.3.5) and controls. Although laboratory workers usually recognize warnings for explosive gases and liquids, they should also be aware of several hazardous mixtures, such as mixtures of bleach, chromic acid, and certain organics; oxidants and flammable liquids; and chemicals like ethers and alkenes. The American Association of Anatomists has listed and reviewed the following chemicals ordinarily used in medical laboratories (Lavelle 1979):

Fixatives	acrolein, formaldehyde, glutaraldehyde, osmium tetroxide, phenol, picric acid, potassium dichromate
Solvents.	acetone, benzene, carbon tetrachloride, chloroform, dioxane, ether, ethoxyethanol, glycerol, methanol, propylene oxide, pyridine, tetrahydrofuran, toluene, trichloroethylene, xylene
Embedding media and reagents.	azodiisobutyronitrile, benzoyl peroxide, benzyl dimethylamine, dibutyl phthalate, dichlorobenzoyl peroxide, dimethylaminoethanol, dodeceny succinic anhydride, resins (acrylic, epoxy, nitrocellulose, and polyester), tridimethylaminomethyl phenol
Metals and metal compounds.	chromic acid, lead acetate, mercury, osmium tetroxide, potassium permanganate, silver nitrate, uranyl acetate, vanadium, vanadyl sulfate
Dyes.	acridine dyes, Auramine OH, Direct Black 38, Direct Blue 6

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Explosive agents.	ammonium persulfate, benzene, dioxane, azides, ether, glycerol, methanol, nitrocellulose, perchloric acid, picric acid, silver nitrate, tetrahydrofuran
Miscellaneous	acrylamide, diaminobenzidine, hydroxylamine

3.2.10.1.5 Carcinogens

Although only about two dozen chemicals have been established as human carcinogens (Olishifski 1979), several hundred have been found to cause cancer in test animals, and many more have not yet been tested. Laboratory workers may frequently be exposed to many potential carcinogens, including chromium trioxide, benzidine, carbon tetrachloride, 1,2-dichloroethane, ethylene oxide, benzene, 1,4-dioxane, and 2,2',2"-nitrilotriethanol. Because laboratory workers are potentially exposed to many suspected carcinogens, engineering controls and safe work practices should be used to reduce worker exposure as much as possible.

3.2.10.1.6 Mutagens and teratogens

Laboratory workers are potentially exposed to both mutagens (chemicals that may cause mutations or genetic changes) and teratogens (chemicals that may cause congenital malformations in the developing fetus of a pregnant worker). Although most reproductive hazards may affect both men and women, the fetus is particularly at risk from exposure to ionizing radiation, drugs, and biologic agents. An estimated 125,000 women work in laboratories in the United States (Hricko and Brunt 1976). Studies suggest a higher rate of adverse reproductive outcomes (major malformations, spontaneous abortions, and neonatal deaths) among female laboratory workers (Ericson and Kallen 1984, Axelsson and Jeansson 1980, and Meirik et al. 1979).

Known and suspected reproductive hazards include:

Ionizing radiation	alpha-, beta-, and gamma-emitting radionuclides and X-rays
Drugs.	actinomycin D, antineoplastics, mitomycin, quinine, and streptomycin

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Chemicals.	anesthetic gases, benzene, dibutyl phthalate, diethyl phthalate, diethylhexyl phthalate, ethylene oxide, ethylene diaminetetraacetic acid (EDTA), diazo dyes (Evans blue, Niagara blue, Congo red, Janus green B), lead, lead acetate, mercury, sodium arsenate, toluene, xylene,
Biologic agents.	cytomegalovirus, mumps, rubella (German measles), <u>Toxoplasma gondii</u> (Toxoplasmosis), varicella (herpes zoster), hepatitis viruses (hepatitis), human immunodeficiency virus (acquired immunodeficiency syndrome)

3.2.10.1.7 Physical stress

Forester and Lewy (1983) described a case of pipetter's shoulder (tendinitis resulting from the frequent repetitive movement of the shoulder joint during prolonged periods of pipetting) that developed after a worker had performed an unusually large number of assay procedures. Minuk et al. (1982) reported a case of osteoarthritis that developed in the right thumb of a pipetter. The frequency of these problems among laboratory workers has not been determined.

3.2.10.1.8 Laboratory animals

Animals can carry and transmit serious diseases. A university hospital reported 15 cases of lymphocytic choriomeningitis (LCM) among laboratory workers, and another hospital reported 46 cases of LCM where staff worked in close contact with a hamster colony (Hotchin et al. 1974). Q fever has been a recurrent source of infection, serious disease, and occasional fatality for laboratory and research workers, and CDC has developed a set of guidelines for managing this risk at medical research centers that use sheep (CDC 1979).

3.2.10.1.9 Emotional stress

Laboratory workers commonly report stress as a job hazard. A NIOSH study ranked clinical laboratory work seventh among stressful occupations based on frequency of admission to community mental health centers (Colligan et al. 1977). Griffin and Klun (1980) listed the primary source of stress for hospital-employed medical technologists as physician attitudes, followed by emergency-response procedures, the need for accuracy, lack of communication (between shifts, between laboratory workers and doctors, and among

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laboratory staff), fear of making an error (especially if it might result in a patient's death), overwork, deadlines, lack of support from pathologists or supervisors, and lack of appreciation by other hospital staff members.

3.2.10.2 Standards and Recommendations

No uniform national safety standards exist for all laboratories. In August 1986, OSHA proposed a standard to protect laboratory workers; but until that standard is promulgated, only laboratories involved in interstate commerce are regulated by the Clinical Laboratory Improvement Act of 1967.

Accreditation by the College of American Pathologists (CAP) requires that laboratories comply with Standards for Accreditation of Medical Laboratories (CAP 1982). Some federal funding and insurance legislation also includes general requirements for safe practices and conditions in laboratories.

The CRC Handbook of Laboratory Safety (Steere 1971) contains extensive additional information on laboratory safety. Biosafety Guidelines for Microbiological and Biomedical Laboratories (CDC-NIH 1984), developed jointly by CDC and the National Institutes of Health (NIH), offer a recommended code of practice for laboratories involved with infectious microbial agents.

3.2.10.3 Methods for Controlling Exposure

Both Engineering a Safe Hospital Environment (Stoner et al. 1982) and Industrial Ventilation (ACGIH 1986) contain information on exhaust ventilation hoods, biological safety cabinets, and other forms of hazard control for laboratory safety.

3.2.10.3.1 Storage and disposal of laboratory waste

The correct storage and disposal of laboratory waste, including infectious materials and chemicals, are complex and important issues. The hazards of improper disposal include

- Mercury trapped in porous sinks that continues to vaporize
- Improper use of perchloric acid that can result in an explosion
- Azides that combine with the metals (copper, ammonium, or lead) in plumbing systems and may form explosive combinations when dry
- Organic solvents that continue to vaporize and contaminate laboratory air even after vigorous flushing

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- Aerosols of infectious material that are accidentally sprayed throughout the laboratory environment

Storage of hazardous waste is discussed throughout this section; disposal is covered in Section 6. Stations should be installed to receive, handle, and dispense volatile or corrosive chemicals. Appropriate protective equipment, eye washes, and emergency showers should be provided. Laboratory workers should be trained in emergency procedures and routine safe work practices.

3.2.10.3.2 Protective equipment

Because no universally protective material exists, protective equipment such as gloves and respirators should be selected specifically for agents to which the worker may be exposed (see Section 2.3.5). The manufacturers of chemical protective clothing and equipment can provide specific information.

3.2.10.3.3 Work practices

Safe work practices are very important in protecting laboratory workers. The following precautions should be taken to avoid accidental poisonings with laboratory chemicals:

- Do not eat, drink, or smoke in a laboratory. Food and beverages should not be stored in refrigerators or elsewhere in laboratories.
- Do not wear contact lenses when working with chemicals.
- Never pipette by mouth.
- Wear a laboratory coat or apron while in the laboratory and remove it when leaving.
- Wear chemical worker's goggles or a face shield when accidental splashes to the face or eyes are possible.

Ventilation hoods can be effective for capturing and containing contaminants. Design specifications for laboratory fume hoods may be found in Industrial Ventilation: A Manual of Recommended Practice (ACGIH 1986).

Ventilation rates should be measured and recorded for all hoods, and the measurements should be kept near the hoods for future reference. The entire ventilation system should be monitored monthly to check its efficiency. In addition, chemical fume hoods must at least meet the requirements of NFPA 45, Laboratory Ventilating Systems and Hood Requirements (NFPA 1983, Volume 3).

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3.2.10.3.4 Labeling

All chemicals used in a laboratory should be clearly labeled with the generic chemical name, date of arrival, probable shelf life, hazardous character, and special storage requirements. The laboratory safety officer should maintain a complete list of all chemicals in the laboratory and review it with the hospital health and safety committee and the personnel health service. The hospital health and safety committee or officer should consult the OSHA hazard communication standard (29 CFR 1910.1200).

3.2.10.3.5 Laboratory equipment

All electrical equipment should be grounded. The disconnects for all equipment should be properly marked, and the areas around the breaker boxes should be kept clear. Wiring and connections on all electrical equipment should be checked regularly; equipment that rotates, moves, and vibrates may wear through the insulation or put tension on the terminal screws.

Cylinders of compressed gas should be secured and kept upright, and the valve-protection caps should be fastened when not in use. Hoses, fittings, and gauges for compressed gas should be kept in good condition and checked periodically for leaks.

Laboratory equipment and work surfaces that have been contaminated with infectious material should be cleaned with an effective disinfectant.

3.2.10.3.6 Chemical, physical, and biologic agents

Laboratory work requires the use of many chemical, physical, and biologic agents that are not discussed in this manual. The following recommendations will help control common laboratory hazards:

- Compile a list of the common agents used in each laboratory, including
 - organic compounds such as acetone, formaldehyde, xylene, and other solvents,
 - inorganic compounds,
 - physical hazards such as ultraviolet radiation and ultrasonic devices,
 - biologic hazards such as viruses (hepatitis) and bacteria (tuberculosis), and
 - radioactive isotopes such as those of iodine and cesium.

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- Inform workers potentially exposed to hazardous substances about the hazards, symptoms of exposure, and effects of over-exposure.
- Monitor worker exposures to ensure that airborne concentrations of specific contaminants are at least below the allowable limits. The local OSHA office, NIOSH (see the listing in Section 7), or a State or local industrial hygiene office can supply information on air sampling techniques.
- Collect biologic samples to monitor worker exposures to toxic substances (e.g., mercury in the blood, hippuric acid in the urine [toluene exposure], and enzyme activity levels [liver damage]).
- Establish a procedure for the proper storage, handling, and disposal of all chemicals.
- Establish a procedure to ensure that biologic safety cabinets are decontaminated routinely and certified annually.
- Establish a detailed procedure for dealing with chemical spills.
- Check floors and benches for accumulations of spilled mercury.
- Post names and telephone numbers of persons to be notified in emergency situations. This is particularly important for large research laboratories involved in experimental work.

3.2.11 Surgical Services

Hazardous materials found in operating rooms include anesthetic gases, their vapors, and the vapors of various solvents.

3.2.11.1 Anesthetic Gases

Because anesthetic gases can pose both safety and health hazards, testing for leaks should be performed on a continuing basis. The volume of anesthetic gases used should be recorded, and the records should be analyzed routinely as a check for leakage.

Nitrous oxide is the most commonly used anesthetic gas. The vapors of diethyl ether, cyclopropane, enflurane, halothane, and isoflurane are also used frequently and will be considered as gases in this document. The principal source of waste anesthetic gases in operating rooms is leakage from equipment, particularly when anesthetic is administered by face mask.

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The NIOSH criteria document on waste anesthetic gases (NIOSH 1977a) provides a description of work practices for areas where anesthetic gases are used. More recent sources are Eger (1985), Saidman and Smith (1984), and Whitcher (1987).

3.2.11.2 Flammable Anesthetics

Although many hospitals have discontinued the use of flammable anesthetics, they may still be used in some cases. The following measures should be implemented in operating rooms where flammable anesthetics are used:

- Only electrical equipment approved by the hospital engineering department should be used in operating rooms. The equipment should be checked regularly to ensure that it is operating properly.
- Flammable anesthetics should have a separate, fire-resistant storage space that is vented to the outside.
- The floors of operating-rooms should be covered with an approved conductive material; it should be tested regularly for conductivity, and records of the testing should be kept.
- Conductive clothing should be worn where required. Conductive footwear should be required and tested daily for conductivity.

The NFPA standard for inhalation anesthetics (NFPA 1983, Volume 4) and the National Electrical Code (NFPA 1983, Volume 6) contain further information.

3.2.11.3 Compressed Gases

Compressed gases used for anesthesia or other purposes in surgical suites include oxygen, nitrous oxide, ethylene oxide, and air. These gases may be piped in from a central storage area or used directly from cylinders in the surgical suite. Hospital administrative personnel must ensure that cylinders of compressed gas are stored and used safely. The NFPA has made recommendations for the storage and labeling of compressed-gas cylinders and the use of regulators, valves, and connections (NFPA 1983, Volume 4, 56A). The principal recommendations are to conduct proper inspections to ensure that the gas delivered is the same as that shown on the outlet label and to provide appropriate storage rooms for oxidizing gases such as oxygen and nitrous oxide. The National Fire Codes (NFPA 1983, Volume 4, 56A) give a more detailed explanation of the NFPA recommendations.

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3.2.11.4 Scavenging

Scavenging is the process of collecting and disposing of waste anesthetic gases and vapors from breathing systems at the site of overflow. It is carried out to protect operating-room personnel by preventing the dispersal of anesthetic gases into the room air. A scavenging system has two major parts: a collecting device or scavenging adapter to collect waste gases, and a disposal route to carry gases from the room.

The NIOSH publication, Development and Evaluation of Methods for the Elimination of Waste Anesthetic Gases and Vapors in Hospitals (NIOSH 1977), contains information about control methods to establish and maintain low concentrations of waste anesthetic gas in operating rooms. The document includes techniques for scavenging, maintaining equipment, monitoring air, and minimizing leakage while administering anesthesia. It also illustrates various scavenging systems, details procedures for initiating a scavenging program, and presents the results of gas distribution and air monitoring studies. See also Eger (1985), Saidman and Smith (1984), and Whitcher (1987).

3.2.11.5 General Guidelines

Persons responsible for health and safety in the hospital surgical department should be aware of the availability of new products and new information on familiar products. For example, methyl methacrylate, which is used in bone surgery, has been recently investigated as a potentially hazardous substance.

The following guidelines will help protect workers in the surgical service:

- Use separate collection containers for glass, empty ether cans, aerosol cans, disposables, etc., that are not to be incinerated.
- Dispose of sharp instruments, blades, and needles in designated, puncture-resistant containers. All supplies and instruments used should be accounted for to prevent their disposal in linens and other materials that will be handled by hospital workers.
- Keep towel clips and scissors closed when not in use.
- Install suction lines and electrical cords to minimize tripping hazards. Lines and cords should be suspended from the ceiling or placed under the floor whenever possible.
- Instruct personnel to report defective equipment.
- Post warning signs where necessary and enforce proper work practices.

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- Instruct workers in proper lifting practices.
- Discuss safe work practices and health hazards with each new worker as part of orientation. Review this training periodically.

3.2.12 Temporary Personnel (Floaters)

Nursing students, medical students, and medical house staff who rotate through many different training situations have potential exposure to a wider variety of hazards than do most workers who are stationary. Temporary workers are usually unfamiliar with the hazards of each new department and the proper work practices and other means of preventing injury or illness to themselves and others.

Sleep deprivation is a problem for medical students and house staff (who often work 80 hr/week or more) and for some nursing students (who may support themselves with a second job while completing training). A study of sleep deprivation in a group of medical interns (Friedman et al. 1973) showed difficulty in thinking, depression, irritability, depersonalized treatment of patients, inappropriate attitudes or behavior, and short-term memory loss. Medical students have also exhibited high rates of psychotic depression, withdrawal from medical school, and suicidal thoughts and actions. When students and house staff are deprived of sleep, both patient care and inter-staff relations suffer.

Chemical hazards for laboratory and other technicians may be greater during training periods when they have not received health and safety instructions or learned to carry out procedures smoothly and quickly.

For example, nursing students who do not know how to protect themselves may change dressings, apply topical medications, and perform other duties in close contact with patients who have infectious diseases. Medical students spend many hours their first year dissecting cadavers preserved in formaldehyde (a suspected carcinogen) without knowing the danger or how to avoid the risks. The student or trainee usually feels pressured to carry out the assigned task and hesitates to question the wisdom or manner of carrying it out. Volunteers (e.g., premedical or other pre-health-care career students), who are even less well-trained to recognize or prevent health hazards in the transmission of infectious diseases, often go from patient to patient distributing reading materials and doing other errands.

To solve these problems, transient workers should have (1) prompt and adequate training in hospital health and safety, (2) training specific to the departments in which they will spend time, (3) adequate time to perform tasks in a careful and safe manner, (4) adequate supervision to monitor their performance and answer their questions, and (5) sufficient rest to perform their duties safely.

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4. RECOMMENDED GUIDELINES FOR CONTROLLING INFECTIOUS DISEASE HAZARDS IN HOSPITALS

CDC, through its Center for Infectious Diseases and NIOSH, is developing new recommended guidelines for protecting health care workers from infectious diseases. For the present, the reader is referred to guidelines that CDC has already published on this topic. This information is reprinted in Appendices 5, 6, and 8.

Appendix 5 contains the Joint Advisory Notice from the Department of Labor and the Department of Health and Human Services entitled Protection Against Occupational Exposure to Hepatitis B Virus (HBV) and Human Immunodeficiency Virus (HIV), published October 19, 1987.

Appendix 6 contains nine articles from the Morbidity and Mortality Weekly Report with recommended guidelines for protecting health care workers against AIDS and hepatitis, published between 1983 and 1988.

Appendix 8 contains three Guidelines in a series of CDC recommendations for preventing and controlling nosocomial infections: infection control in hospital personnel (1983), isolation precautions in hospitals (1983), and guidelines for handwashing and hospital environmental control (1985).



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5. RECOMMENDED GUIDELINES FOR CONTROLLING NONINFECTIOUS HEALTH HAZARDS IN HOSPITALS

Workers encounter many noninfectious health hazards in hospitals, including chemical hazards, physical hazards, mutagens and teratogens, dermatologic hazards, and stress. The following subsections describe these hazards in terms of their location in the hospital, potential health effects, existing standards and recommendations for safe use, recommended environmental monitoring, existing exposure control methods, and recommended medical surveillance.

5.1 CHEMICAL HAZARDS

5.1.1 Introduction

Chemicals may exert either acute or chronic effects on workers. The effects depend on (1) extent (concentration and duration) of exposure, (2) the route of exposure, and (3) the physical and chemical properties of the substance. The effects exerted by a substance may also be influenced by the presence of other chemicals and physical agents or by an individual's use of tobacco, alcohol, or drugs. Basic principles of toxicology are reviewed in Doull et al. (1980).

5.1.1.1 Extent of Exposure

The exposure concentration of a substance is the mass per unit volume of air to which a worker is exposed. In the workplace, airborne concentrations are usually expressed in terms of milligrams of substance per cubic meter of air (mg/m^3) or parts of substance per million parts of air (ppm). In the case of asbestos, concentration is expressed as fibers per cubic centimeter (f/cc) or fibers per cubic meter (f/m^3) of air. The exposure dose is the amount of a substance that actually enters the body during the period of exposure. The substance continues to be present in the body until it is metabolized or eliminated. Although some chemicals are rapidly metabolized, others are not and may be excreted unchanged or stored in the fatty tissues (solvents), lungs (dusts and fibers), bone (lead and radium), or blood (soluble gases).

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5.1.1.2 Route of Entry into the Body

Toxic substances can enter the body through several routes, including the intact skin, the respiratory system (inhalation), the mouth (inhalation and ingestion), the eyes, and by accidental needle punctures. Some substances can also damage the skin or eyes directly without being absorbed. Not all substances can enter the body through all routes. Inorganic lead, for example, can be inhaled or swallowed, but it does not penetrate the skin. (It should be noted that tetraethyl lead, a component of automotive gasolines, can be absorbed through the skin and therefore can contribute to the total absorbed dose.) Sometimes a chemical substance can enter through more than one route. Asbestos, for example, can be swallowed or inhaled, but the latter route appears to be more hazardous.

5.1.1.3 Physical and Chemical Properties

The physical properties of a chemical or physical agent include such characteristics as vapor pressure, solubility in water and organic solvents, boiling point, melting point, molecular weight, specific gravity, and morphology. Chemical properties describe the reactivity of a substance with other chemicals.

5.1.1.4 Warning Properties

Some chemicals have characteristics that can be perceived by workers and can serve as a warning of the chemical's presence. The most commonly discussed warning property is odor. Depending on a person's ability to detect the odor of a substance, a chemical is considered to provide either good or poor warning of its presence. The lowest concentration at which the odor of a chemical can be detected is called the odor threshold. Some substances, such as asbestos, have no odor and therefore provide no warning of their presence. In many cases, the concentration of a chemical that can be detected by odor and the concentration that is capable of causing adverse effects are similar. For example, the odor threshold of ethylene oxide is about 700 ppm (Jay et al. 1982), a concentration that has been demonstrated to cause a variety of severe effects among exposed workers. In other cases, exposure to a chemical can cause olfactory fatigue that prevents a worker from continuing to smell the chemical. People cannot detect odors equally well. Thus some may be able to detect the odor of chlorine at a concentration of 0.02 ppm, and others cannot detect its presence until the concentration reaches 0.2 ppm (NIOSH 1976b). For these reasons, workers should not rely on their sense of smell to warn them of the presence of hazardous substances. Nevertheless, available information on odor thresholds has been included for the substances discussed here. A more complete discussion of odor as a warning property can be found in, Odor as an Aid to Chemical Safety: Odor Thresholds Compared with Threshold Limit

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Values and Volatilities for 214 Industrial Chemicals in Air and Water Dilution (Amoore and Hautala 1983) and Odor Threshold Determinations of 53 Odorant Chemicals (Leonardos et al. 1969).

5.1.1.5 Synergistic Effects of Various Hazards

Possible interactions may occur as a result of the multiple exposures that exist in a hospital environment. These interactions may involve (1) exposures to chemical and/or physical agents, (2) an individual's use of tobacco, alcohol, or drugs, or (3) the physiological or psychological state of the worker. Limited data are available on interactions of physical and chemical agents; however two studies of other occupations have shown increased toxicity resulting from the synergistic effects of solvent mixtures (Murphy 1984; Struwe and Wennberg 1983). Information is also available on the interactions of chemical and physical agents and the consumption of tobacco, alcohol, or drugs (Bos et al. 1982; Robbin 1979; Hills and Venable 1982). NIOSH Current Intelligence Bulletin 31 (NIOSH 1979b) includes a discussion of the adverse health effects of smoking in the work environment. To determine an exposure, it is imperative to consider other possible exposures or factors that might influence the results.

5.1.2 Asbestos

Asbestos refers to a group of impure magnesium silicate minerals that occur in fibrous form. Asbestos is defined to be chrysotile, crocidolite, and fibrous cummingtonite-grunerite including amosite, fibrous tremolite, fibrous actinolite, and fibrous anthophyllite (NIOSH 1980b). Because of the limitations of the analytical method, only fibers that are 5 micrometers or more in length and have a length-to-diameter ratio of 3:1 or greater are considered when determining a worker's asbestos exposure (29 CFR* 1910.1001).

Because asbestos is an extremely hazardous material and compliance with all relevant aspects of the OSHA asbestos regulations must be assured, hospitals should develop a policy for working with asbestos. All workers who may have reason to work with this substance should receive training.

A hospital asbestos policy must outline specific OSHA requirements (29 CFR 1910.1001) for the following:

- Reports of each asbestos use or exposure (a log of all jobs in which personnel are exposed)

*Code of Federal Regulations. See CFR in references.

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- Work practices for handling asbestos, such as wet handling, development of cleanup protocols, use of plastic sheeting to seal off work areas, and bagging of removed insulation during routine operations, maintenance, and repair
- Asbestos waste collection, labeling, and disposal
- Respiratory protective equipment (types of respirators, maintenance, training programs, use, and recordkeeping)
- Dressing rooms and special clothing
- Air monitoring
- Recordkeeping and maintenance of records (30 years)
- Medical surveillance (requirements are set by OSHA according to the level of asbestos exposure)
- Training

Asbestos removal must only be conducted by fully trained personnel as specified by OSHA (29 CFR 1910.1001).

5.1.2.1 Hazard Location

Hospitals use asbestos for many purposes, including the noncombustible, nonconducting, or chemically resistant materials required for fireproof clothing, curtains, and roofing. Before the early 1970's, asbestos was used as insulation throughout most buildings (including hospitals). Significant asbestos exposures can occur when insulation in old buildings is removed during renovation. Maintenance personnel in most hospitals do not know and often are not trained in the proper methods of performing repairs on systems that contain asbestos. They frequently perform spot repairs without protecting themselves, patients, or staff from exposure. Asbestos is also used to make heat-resistant protective gloves for central supply and laboratories. With time, these gloves may become worn and disintegrate, releasing fibers into the air.

5.1.2.2 Potential Health Effects

Asbestos causes asbestosis (a fibrosis or scarring of the lung tissue) and cancer. These diseases may develop 15 to 30 years after the first exposure.

Asbestosis belongs to the group of pulmonary diseases called pneumoconioses; these include coal workers' pneumoconiosis (often called black lung disease) among coal workers and silicosis among workers with prolonged exposure to sand blasting or other operations in which silica-containing rock is

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crushed, drilled, or used. Pneumoconiosis is characterized by restriction of lung function, which eventually increases the load on the circulatory system so that the fully developed disease usually involves heart failure as well. The only hospital workers most likely to encounter enough asbestos to produce asbestosis are engineers who work in furnace rooms where boilers are lined with asbestos, and maintenance workers who frequently repair old piping or do minor renovation. These workers must take special care to protect themselves and to ensure that asbestos is not spread throughout the facility when they perform tasks involving this substance.

Inhaling asbestos, even in small amounts, may result in lung cancer, gastrointestinal cancer, or mesothelioma (a cancer of the lung and abdomen lining). An association has also been suggested between the ingestion of asbestos and the development of gastrointestinal cancer, but no studies have yet confirmed this. Persons with less than a month of exposure have been known to develop mesotheliomas 20 or 30 years later. Because there is no known safe level of asbestos exposure, any hospital worker who is exposed to moderate or high concentrations of asbestos for even a relatively short time may be at increased risk of developing asbestos-related diseases.

All asbestos-exposed workers have a higher risk of lung cancer than nonexposed workers, but exposed workers who smoke cigarettes have a markedly greater risk of lung cancer than nonsmoking exposed workers (29 CFR 1910.1001). Thus smoking cessation and counseling should be targeted especially to workers who have already been exposed to asbestos. Such programs do not rule out the need to comply with the OSHA asbestos standard (29 CFR 1910.1001).

5.1.2.3 Standards and Recommendations

The current OSHA PEL for asbestos is an 8-hour TWA concentration of 0.2 f/cc (200,000 f/m³) for fibers that are 5 micrometers or longer and that have a length-to-diameter ratio of 3:1 (29 CFR 1910.1001). The asbestos standard is very detailed and has specific requirements for training, labeling, protective equipment, medical surveillance, and environmental monitoring. Questions regarding the implementation of the standard should be referred to the State or Federal OSHA program, which has a consultation service. The NIOSH REL for asbestos (fibers longer than 5 micrometers with a length-to-diameter ratio of 3:1 or greater) is an 8-hr TWA concentration of 100,000 f/m³ (0.1 f/cc) (NIOSH 1984b).

5.1.2.4 Environmental Monitoring

Sampling should be conducted in a manner and on a schedule that will provide an accurate depiction of job-specific asbestos exposures. All analyses should be done by laboratories accredited by the American Industrial Hygiene Association (AIHA). The minimum schedule for monitoring is established by OSHA regulation (29 CFR 1910.1001).

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5.1.2.5 Exposure Control Methods

5.1.2.5.1 Removal and encapsulation

Whenever asbestos fibers are exposed, they present a hazard that can be eliminated by removing or encapsulating (covering) them so that they will not be released. Asbestos must only be removed by fully trained personnel using methods and protective equipment mandated by OSHA (29 CFR 1910.1001).

5.1.2.5.2 Protective equipment

Complete physical covering and a NIOSH/MSHA-certified, positive-pressure, air-supplied respirator are required for any worker exposed to asbestos. The OSHA asbestos standard should be consulted along with the NIOSH/EPA document entitled A Guide to Respiratory Protection for the Asbestos Abatement Industry (NIOSH/EPA 1986).

5.1.2.5.3 Work practices

Only workers fully trained in asbestos handling should be allowed in areas where asbestos is exposed. The work practices appropriate for handling asbestos are set out in detail in the OSHA regulation (29 CFR 1910.1001).

5.1.3 Chemical Disinfectants

Because of the variety of needs for disinfectants within the hospital, a number of different substances are used. The most important are:

- Isopropyl alcohol
- Sodium hypochlorite (chlorine)
- Iodine
- Phenolics
- Quaternary ammonium compounds
- Glutaraldehydes
- Formaldehyde

Many of the following descriptions of disinfectants refer to the lowest concentration at which the odor of these substances can be detected; however, workers should not rely on odor as a warning of exposure because many persons are unable to detect odors.

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5.1.3.1 Isopropyl Alcohol

5.1.3.1.1 Hazard location

Isopropyl alcohol is a widely used antiseptic and disinfectant; it is used mostly to disinfect thermometers, needles, anesthesia equipment, and various other instruments.

5.1.3.1.2 Potential health effects

The odor of isopropyl alcohol may be detected at concentrations of 40 to 200 ppm [NIOSH 1976a]. Exposure to isopropyl alcohol can cause irritation of the eyes and mucous membranes. Contact with the liquid may also cause skin rashes.

5.1.3.1.3 Standards and recommendations

The OSHA PEL for isopropyl alcohol is 400 ppm (980 mg/m³) as an 8-hr TWA (29 CFR 1910.1000, Table Z-1). The NIOSH REL for isopropyl alcohol is 400 ppm (984 mg/m³) for up to a 10-hr TWA with a ceiling of 800 ppm (1,968 mg/m³) for 15 min (NIOSH 1976a).

5.1.3.1.4 Exposure control methods

Workers should be provided with and required to use appropriate protective clothing (see Section 2.3.5) such as gloves and face shields to prevent repeated or prolonged skin contact with isopropyl alcohol. Splash-proof safety goggles should also be provided and required for use where isopropyl alcohol may contact the eyes.

Any clothing that becomes wet with isopropyl alcohol should be removed immediately and reworn only after the compound has been removed. Clothing wet with isopropyl alcohol should be stored in closed containers until it can be discarded or cleaned. The worker who is laundering or cleaning such clothes should be informed of isopropyl alcohol's hazardous properties.

Skin that becomes wet with liquid isopropyl alcohol should be promptly washed or showered.

Adequate exhaust ventilation must be supplied in the hospital to remove isopropyl alcohol vapor in the work area.

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5.1.3.2 Sodium Hypochlorite (Chlorine)

Chlorine can be generated from solutions of sodium hypochlorite. Chlorine is effective against bacteria and viruses, and it can destroy some spores, depending on the concentration.

5.1.3.2.1 Hazard location

Chlorine is used for disinfecting water tanks, bathtubs, toilets, and bathrooms; it is also used as a bleach for laundries, a sanitizer for dishwashing, and a disinfectant for floors. Chlorine-containing cleaning materials should never be mixed with ammonia or ammonia-containing materials because the reaction may produce a toxic gas.

5.1.3.2.2 Potential health effects

Chlorine is released slowly from cleaning and bleaching solutions as they are used. Repeated exposure to chlorine may cause a runny nose, coughing, wheezing, and other respiratory problems (NIOSH 1976b). Mild irritation of the mucous membranes can occur at exposure concentrations of 0.5 ppm (ACGIH 1986).

5.1.3.2.3 Standards and recommendations

The OSHA PEL for chlorine is a ceiling of 1 ppm (3 mg/m^3) (29 CFR 1910.1000, Table Z-1). The NIOSH REL is a ceiling of 0.5 ppm for 15 min (NIOSH 1976b). Chlorine has an odor threshold between 0.02 and 0.2 ppm, but since the sense of smell is dulled by continued chlorine exposure, odor does not provide adequate warning (NIOSH 1976b).

The ACGIH recommends a TLV of 1 ppm (3.0 mg/m^3) as an 8-hr TWA and a short-term exposure limit (STEL) of 3 ppm (9 mg/m^3) but has published a notice of intended change to a TLV of 0.5 ppm (1.5 mg/m^3) as an 8-hr TWA and a STEL of 1 ppm (3 mg/m^3) (ACGIH 1987).

5.1.3.2.4 Exposure control methods

Workers should be provided with and required to use splash-proof safety goggles where there is any possibility that chlorine-containing solutions may contact the eyes. To prevent any possibility of skin contact with chlorine-containing liquids, workers should be provided with and required to use appropriate personal protective equipment (see Section 2.3.5), such as gloves, face shields, and respirators (see Section 2.3.5.6) as necessary. Nonimpervious clothing that becomes contaminated with chlorine-containing solutions should be removed immediately and reworn only after the chlorine-containing solution is removed from the clothing.

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Skin that becomes contaminated with chlorine should be immediately washed to remove any chlorine. Additional control measures for chlorine include process enclosure and good exhaust ventilation.

5.1.3.3 Iodine

Iodine is a general disinfectant; it can be mixed with alcohol for use as a skin antiseptic or with other substances for general disinfecting purposes.

5.1.3.3.1 Hazard location

Iodine can be found throughout the hospital.

5.1.3.3.2 Potential health effects

Symptoms of iodine exposure include irritation of the eyes and mucous membranes, headaches, and breathing difficulties (ACGIH 1986). Crystalline iodine or strong solutions of iodine may cause severe skin irritation: it is not easily removed from the skin and may cause burns.

5.1.3.3.3 Standards and recommendations

The OSHA PEL for iodine is a ceiling of 0.1 ppm (1.0 mg/m³) (29 CFR 1910.1001, Table Z-1). The ACGIH recommends a TLV of 0.1 ppm (1.0 mg/m³) as a ceiling (ACGIH 1987). NIOSH has no REL for iodine.

5.1.3.3.4 Exposure control methods

To prevent skin contact with solids or liquids containing iodine, workers should be provided with and required to use personal protective equipment such as gloves, face shields, and any other appropriate protective clothing deemed necessary (see Section 2.3.5).

If there is any possibility that clothing has been contaminated with solid iodine or liquids containing iodine, a worker should change into uncontaminated clothing before leaving the work area. Clothing contaminated with iodine should be stored in closed containers until provision is made to remove the iodine. The person laundering or cleaning such clothes should be informed of iodine's hazardous properties.

Skin that becomes contaminated with solids or liquids containing iodine should be immediately washed with soap or mild detergent and rinsed with water. Workers who handle solid iodine or liquids containing iodine should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

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5.1.3.4 Phenolics

Phenolics were among the first disinfectants used in hospitals. Certain detergent disinfectants belong to the phenol group, including phenol, para-tertiary butylphenol (ptBP), and para-tertiary amyphenol (ptAP). They are generally used for a wide range of bacteria, but they are not effective against spores.

5.1.3.4.1 Hazard location

Phenolics are widely used on floors, walls, furnishings, glassware, and instruments.

5.1.3.4.2 Potential health effects

Phenol may be detected by odor at a concentration of about 0.05 ppm. Serious health effects may follow exposure to phenol through skin adsorption, inhalation, or ingestion. These effects may include local tissue irritation and necrosis, severe burns of the eyes and skin, irregular pulse, stertorous breathing (harsh snoring or gasping sound), darkened urine, convulsions, coma, collapse, and death (NIOSH 1976d). Both ptBP and ptAP have caused hospital workers to experience loss of skin pigment that was not reversed one year after use of the compounds was discontinued (Kahn 1970).

5.1.3.4.3 Standards and recommendations

The OSHA PEL for phenol is 5 ppm (19 mg/m³) as an 8-hr TWA (Skin) (29 CFR 1910.1000, Table Z-1). The NIOSH REL for phenol is 20 mg/m³ (5.2 ppm) for up to a 10-hr TWA with a 15-min ceiling of 60 mg/m³ (15.6 ppm) (NIOSH 1976d). Neither OSHA nor NIOSH has established exposure limits for ptBP or ptAP.

5.1.3.4.4 Exposure control methods

When working with phenol, workers should be provided with and required to use protective clothing (see Section 2.3.5), gloves, face shields, splash-proof safety goggles, and other appropriate protective clothing necessary to prevent any possibility of skin or eye contact with solid or liquid phenol or liquids containing phenol.

If there is any possibility that the clothing has been contaminated with phenol, a worker should change into uncontaminated clothing before leaving the work area and the suspect clothing should be stored in closed containers

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until it can be discarded or until provision is made for removal of the phenol. The worker laundering or cleaning such clothes should be informed of phenol's hazardous properties.

Skin that becomes contaminated with phenol should be immediately washed with soap or mild detergent and rinsed with water. Eating and smoking should not be permitted in areas where solid or liquid phenol or liquids containing phenol are handled, processed, or stored. Workers who handle solid or liquid phenol or liquids containing phenol should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

Additional measures to control phenol exposure include process enclosure, local exhaust ventilation, and personal protective equipment.

5.1.3.5 Quaternary Ammonium Compounds

5.1.3.5.1 Hazard location

Quaternary ammonium compounds are widely used as disinfectants in hospitals, and they have the major disadvantage of being ineffective against tuberculosis and gram-negative bacteria. Quaternary ammonium compounds are most likely to be encountered by workers in central supply, housekeeping, patient, and surgical services areas. The detergent benzalkonium chloride is the most widely used quaternary ammonium compound and is found in the following commercial products (Cohen 1987):

- Zephiran chloride
- Zephirol
- BTC
- Roccal
- Benirol
- Enuclen
- Germitol
- Drapolene
- Drapolex
- Cequartyl
- Paralkan
- Germinol
- Rodalon
- Osvan

5.1.3.5.2 Potential health effects

Quaternary ammonium compounds can cause contact dermatitis, but they tend to be less irritating to hands than other substances. They can also cause nasal irritation.

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5.1.3.5.3 Standards and recommendations

No OSHA PEL, NIOSH REL, or ACGIH TLV exists for quaternary ammonium compounds.

5.1.3.6 Glutaraldehyde

Although glutaraldehyde is available in 50%, 25%, 10%, and 2% solutions, most hospitals use 2% glutaraldehyde solutions buffered to pH 7.5 to 8.5 before use. Glutaraldehyde solutions also contain surfactants to promote wetting and rinsing of surfaces, sodium nitrite to inhibit corrosion, peppermint oil as an odorant, and FD&C yellow and blue dyes to indicate activation of the solution (NIOSH 1983b). One disadvantage of buffered glutaraldehyde solutions is that they are stable for less than 2 weeks, so solutions must be dated and made as needed (Gorman et al. 1980). Another disadvantage is that at 20°C (68°F), a 50% solution of glutaraldehyde has a vapor pressure of 0.015 mmHg (ACGIH 1986) and thus can generate an atmosphere that contains as much as 20 ppm of glutaraldehyde. This concentration is well above that shown to cause adverse health effects in animals and humans.

5.1.3.6.1 Hazard location

Glutaraldehyde is a newer disinfectant that is especially effective for cold sterilization of instruments; it has recently been used as a substitute for formaldehyde during embalming. Glutaraldehyde has been used in pulmonary physiology units, at nurses' stations, and in research laboratories. As a disinfectant, glutaraldehyde has been used to clean sputum mouthpieces, suction bottles and tubing, and equipment used for ear, nose, and throat treatment (NIOSH 1983b).

5.1.3.6.2 Potential health effects

Glutaraldehyde may be absorbed into the body by inhalation, ingestion, and skin contact. Extensive skin contact may cause allergic eczema and may also affect the nervous system. Glutaraldehyde has an odor threshold of about 0.04 ppm, is highly toxic, and is irritating to the skin and mucous membranes at concentrations of about 0.3 ppm (1.05 mg/m³) (ACGIH 1986). In a study of 541 members of a hospital cleaning department, 39.1% of the workers had skin disease during their employment. In 21% of the workers, contact dermatitis was attributed to the use of glutaraldehyde, formaldehyde, and chloramine (Hansen, 1983).

A NIOSH investigation (NIOSH 1983b) determined that airborne glutaraldehyde concentrations of 0.4 ppm (1.5 mg/m³) were responsible for symptoms of irritation in 9 of 11 (82%) exposed workers. Eye, throat, and lung

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irritation were reported among 45% of the workers. Other symptoms, including cough, chest tightness, headache, skin irritation, and asthma-like symptoms, were also reported.

Glutaraldehyde exposure has been associated with fetotoxicity in mice, DNA damage in chickens and hamsters, and mutagenicity in microorganisms (NIOSH 1985).

5.1.3.6.3 Standards and recommendations

The ACGIH recommended ceiling limit for glutaraldehyde is 0.2 ppm (0.8 mg/m³) (ACGIH 1986). OSHA does not have a PEL for glutaraldehyde, and NIOSH has no REL.

5.1.3.6.4 Exposure control methods

Workers should avoid breathing glutaraldehyde vapors. They should also be provided with and required to use splash-proof safety goggles where there is any possibility of contaminating the eyes with glutaraldehyde. To prevent any possibility of skin contact, workers should be provided with and required to use protective clothing (see Section 2.3.5). If clothing becomes contaminated with glutaraldehyde, it should be promptly removed and not re worn until the glutaraldehyde has been removed. The worker who is laundering or cleaning such clothes should be informed of glutaraldehyde's hazardous properties. Skin that becomes contaminated with glutaraldehyde should be washed immediately or showered.

5.1.3.7 Formaldehyde

Formaldehyde is used for cold sterilization of various instruments and as an embalming agent. This compound is fully discussed later in this Section (5.1.6).

5.1.4 Antineoplastic Drugs

Nurses and pharmacists face a variety of potential hazards from contact with pharmaceuticals. The drugs of greatest concern are those associated with cytotoxicity and fetotoxicity (e.g., folate antagonists, 6-mercaptopurine, and some alkylating agents), and teratogenicity (e.g., actinomycin-D, mitomycin-C, nitrogen mustard, prednisone, procarbazine, streptomycin, and vincristine). Many chemotherapeutic agents have been reported to cause cancer in animals and thus can be considered to be potential human carcinogens (e.g., cyclophosphamide and chlorambucil) (Sorsa et al. 1985).

Antineoplastic drugs derive their name from the fact that they interfere with or prevent the growth and development of malignant cells and

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neoplasms. They may also be called cytotoxic or cytostatic because they have the ability to prevent the growth and proliferation of cells. Approximately 30 antineoplastic drugs are currently available commercially. Each year some 200,000 to 400,000 cancer patients are treated with antineoplastic drugs (Sorsa et al. 1985; Devita 1982).

5.1.4.1 Effects of antineoplastic drugs

Many antineoplastic drugs are reported to cause mutations in test systems and are carcinogenic and teratogenic in experimental animals (see Table 5-1). Evidence indicates that cyclophosphamide, chlorambucil, 1,4-butanediol dimethylsulfonate, and melphalan are human carcinogens (Sorsa et al. 1985). When given to patients in therapeutic doses, many antineoplastic drugs (e.g., cyclophosphamide) have been associated with an increased incidence of malignant tumors that develop at a later date (IARC 1981). Available human evidence suggests that cyclophosphamide is also a teratogen.

Toxic effects have been observed in patients treated with antineoplastic drugs. These effects include lack of sperm production, reduced sperm counts, amenorrhea, and adverse effects on the bone marrow, heart, central nervous system, liver, skin, ears, pancreas, lungs, kidneys, and endocrine glands (Stellman and Zoloth 1986). Treatment with antineoplastic drugs has also resulted in depression of the hematopoietic system (LaFond 1978; Caro 1980).

The acute effects of accidental exposure to these drugs can be severe. For example, an accidental needle prick of a patient's finger with mitomycin-C has been reported to cause the eventual loss of function of that hand (Duvall and Baumann 1980). Some antineoplastic drugs (e.g., mustine hydrochloride and doxorubicin) are strong vesicants that can cause varying degrees of local tissue necrosis upon direct contact (Knowles and Virden 1980).

Little is known about the potential health hazards of chronic exposure to antineoplastic drugs, but Selevan et al. (1985) observed a statistically significant association between fetal loss and the occupational exposure of nurses to these drugs. Sotaniemi et al. (1983) documented liver damage in three oncology nurses who had handled antineoplastic drugs for a number of years. Light-headedness, dizziness, nausea, headache, skin and mucous membrane reactions, hair loss, cough, and possible allergic reactions have been reported by nurses handling antineoplastic drugs (Crudi 1980). These side effects observed in nurses are the same as those noted by patients receiving antineoplastic drugs (Croke and Prestayko 1981).

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Table 5-1. Carcinogenicity, teratogenicity, and embryo toxicity of anticancer agents*

Compound used in chemotherapy	Degree of evidence for carcinogenicity in		Teratogenicity and embryotoxicity†
	Humans	Animals	
Actinomycin-D	Inadequate	Limited	T,E†
Adriamycin	Inadequate	Sufficient	....
BCNU	Inadequate	Sufficient	T,E
Bleomycin	Inadequate	Inadequate	....
1,4-Butanediol dimethylsulfonate (Myleran, Busulfan)	Sufficient	Limited	T
Chlorambucil	Sufficient	Sufficient	T,E
CCNU	Inadequate	Sufficient	T,E
Cisplatin	Inadequate	Limited	E
Cyclophosphamide	Sufficient	Sufficient	T,E
Dacarbazine	Inadequate	Sufficient	T,E
5-Fluorouracil	Inadequate	Inadequate	T,E
Melphalan	Sufficient	Sufficient	T
6-Mercaptopurine	Inadequate	Inadequate	T,E
Methotrexate	Inadequate	Inadequate	T,E
Nitrogen mustard	Inadequate	Sufficient	T,E
Procarbazine	Inadequate	Sufficient	T,E
Thiotepa	Inadequate	Sufficient	T
Uracil mustard	Inadequate	Sufficient	T
Vinblastine	Inadequate	Inadequate	T,E
Vincristine	Inadequate	Inadequate	T,E

*Adapted from Sorsa et al. (1985).

†Teratogenicity (T) and embryotoxicity (E) in experimental animals as summarized by IARC (1975, 1976, 1981).

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Several other antineoplastic drugs (e.g., methotrexate and vincristine) are skin and mucous membrane irritants (Knowles and Virden 1980). Bleomycin and cisplatin may cause allergic reactions following skin contact (Knowles and Virden 1980).

5.1.4.2 Methods for estimating exposure to antineoplastic drugs

At present, few economically feasible tests are available for monitoring the exposures of nurses and pharmacy technicians who work with a variety of antineoplastic drugs. Primary routes of worker exposure to antineoplastic drugs are inhalation and dermal absorption.

Exposures by inhalation can occur during drug preparation or administration. Aerosols can be generated when inserting needles into or withdrawing them from vials, and when expelling air from syringes before injection (Hirst et al. 1984; Stellman et al. 1984). In one study, for example, low levels of the antineoplastic drugs cyclophosphamide and fluorouracil were measured in workroom air (deWerk et al. 1983).

Skin absorption may occur when antineoplastic drugs are spilled during their preparation or administration (Jardine et al. 1978). Skin exposure may also occur as a result of contact with the urine of patients being treated with antineoplastic drugs (Hirst et al. 1984). Because of the relatively large number of antineoplastic drugs in use and the variety of metabolites formed, it is not economically feasible for the hospital laboratory to conduct biological monitoring for each drug in use. However, methods have been developed for detecting platinum (from cisplatin exposure) and cyclophosphamide in the urine of exposed workers (Venitt et al. 1984).

Mutagenicity assays using urine can detect excreted mutagenic parent compounds or their mutagenic metabolites. Several studies have analyzed mutagenic constituents in the urine as a measure of exposure to antineoplastic drugs. Five studies reported that nurses or pharmacy technicians handling antineoplastic drugs have increased urine mutagenicity compared with a control population (Nguyen et al. 1982; Falck et al. 1979; Kolmodin-Hedman 1983; Bos et al. 1982; Anderson et al. 1982). However, negative results were reported in five other studies of similar groups of nurses or pharmacy technicians (Venitt et al. 1984; Staiano et al. 1981; Rorth et al. 1983; Ratcliffe 1983; Gibson et al. 1984). Evidence is still insufficient to recommend routine urine mutagenicity testing for estimating exposure to antineoplastic drugs.

Sister chromatid exchange (SCE) analysis using human peripheral blood lymphocytes is thought to provide an estimate of DNA damage produced by mutagens and carcinogens. Increased frequencies of SCE and chromosome aberrations were found in hospital personnel handling antineoplastic drugs (Norppa et al. 1980; Waksvik et al. 1981; Nikula et al. 1984). However,

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these observations were not confirmed by other investigators (Barale et al. 1985; Kolmodin-Hedman et al. 1983). Thus evidence is still insufficient to recommend routine SCE analysis for estimating exposure to antineoplastic drugs.

5.1.4.3 Methods for preventing exposure to antineoplastic drugs

Methods for preventing exposure to antineoplastic drugs are detailed in the OSHA work practice guidelines attached to this document as Appendix 7 (OSHA 1986). These guidelines address drug preparation, drug administration, waste disposal, spills, medical surveillance, storage and transport, training, and information dissemination. Recommendations have also been issued by the National Institutes of Health (NIH), the Society of Hospital Pharmacists, the American Society of Hospital Pharmacists, the National Study Commission on Cytotoxic Exposure, and individual directors of hospital pharmacies (Knowles and Virden 1980, Waksvik et al. 1981; Crudi 1980; Crooke and Prestayko 1981; Caro 1980; Vaughn and Christensen 1985).

5.1.4.4 Medical monitoring

Workers exposed to antineoplastic drugs should receive preplacement and periodic medical evaluations that include at least the following:

- A complete work history and medical history
- An examination that emphasizes the skin, the liver, and the hematopoietic, reproductive, and nervous systems

Other tests may be performed at the discretion of the examining physician, who should be particularly alert for symptoms of liver disease, skin and mucous membrane irritation, central nervous system depression, teratogenic effects, and cancer.

5.1.5 Ethylene Oxide

Ethylene oxide, which is a colorless gas with a distinctive sweet, ether-like odor (NIOSH 1981j), is used to sterilize medical instruments, particularly those made of heat-labile materials (Gross et al. 1979). This compound is regulated by OSHA as a carcinogen (29 CFR 1910.1047). Ethylene oxide is typically supplied to U.S. hospitals in compressed gas cylinders that contain 88% Freon® (see Section 5.1.7) and 12% ethylene oxide, or in single-dose cartridges of 100% ethylene oxide (NIOSH 1977d).

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5.1.5.1 Hazard Location

Workers in central supply, dental operatories, and surgical suites who use ethylene oxide are at risk of potential exposure. In 1983, OSHA estimated that approximately 62,370 workers were directly exposed to ethylene oxide and that 25,000 others may have been incidentally exposed in U.S. hospitals (Federal Register 1983). An estimated 7,700 ethylene oxide sterilizers are in operation in 6,300 hospitals in the United States (Federal Register 1983).

The typical source of ethylene oxide exposure in the hospital environment is through the operation of sterilizing equipment. Unless good engineering controls and good work practices are used, workers may encounter relatively high concentrations of ethylene oxide over relatively brief periods. A study by Yager et al. (1983) highlights the need to control short-term peak exposures to ethylene oxide.

5.1.5.2 Potential Health Effects

Exposure to ethylene oxide occurs primarily through inhalation, but exposure of moist skin to the vapors can also cause irritation.

5.1.5.2.1 Acute effects

Although ethylene oxide has an odor threshold of about 700 ppm (Jay et al. 1982), exposure at 200 ppm may cause irritation of the eyes and upper respiratory system. High concentrations can cause severe skin burns, rashes, sores, headache, nausea, and hemolysis (the destruction of red blood cells). Very high exposures may cause vomiting, shortness of breath, weakness, drowsiness, lack of coordination, cyanosis, bluish skin color resulting from oxygen insufficiency, and pulmonary edema (NIOSH 1977d).

Contact with ethylene-oxide-sterilized equipment or wrappings that have not been adequately aerated to remove residual ethylene oxide may cause severe skin burns with large blisters and peeling skin. Healing may leave hyperpigmentation (brown discoloration of skin).

Ethylene oxide may also pose a fire hazard, depending on how it is stored and used (see Section 3).

5.1.5.2.2 Chronic effects

Ethylene oxide is a mutagen in many assay systems and causes reproductive damage in both male and female experimental animals. Some data also suggest that ethylene oxide may adversely affect human reproduction (Hemminki et al. 1982). Thiess et al. (1981) found chromosomal abnormalities in workers

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exposed to alkylene oxides (including ethylene oxide), and Garry et al. (1979) found a dose-response relationship between ethylene oxide concentrations and chromosomal abnormalities. The significance of these chromosomal abnormalities is not known, but concern exists over a possible link between them and the ability to cause cancer and adverse reproductive effects (Hogstedt et al. 1979b). An increased incidence of spontaneous abortion has also been associated with ethylene oxide exposure (Hemminki et al. 1982).

In 1981, NIOSH published a Current Intelligence Bulletin stating that ethylene oxide should be considered a potential occupational carcinogen (NIOSH 1981j). An increased rate of leukemia has been found in workers exposed to levels below the former OSHA PEL of 50 ppm as an 8-hr TWA, but this result has not been confirmed by other studies (Hogstedt et al. 1979a).

The neurotoxicity of ethylene oxide has been documented in four exposed workers (Gross et al. 1979). Findings included acute encephalopathy and peripheral neuropathy. Nerve conduction velocity was abnormal in most patients. Decreasing the amount of exposure relieved symptoms, but only total removal from exposure caused nerve conduction velocities to return to normal.

Chronic exposure to ethylene oxide increases the risk of sensitization and cataract development (Jay et al. 1982).

5.1.5.3 Standards and Recommendations

The OSHA PEL for ethylene oxide is an 8-hr TWA of 1 ppm with an excursion limit of 5 ppm for any 15-min period (29 CFR 1910.1047). The NIOSH REL for ethylene oxide is a ceiling of 5 ppm for no more than 10 min in any working day, and an 8-hr TWA less than 0.1 ppm (NIOSH 1983e).

5.1.5.4 Environmental Monitoring

A comprehensive monitoring program is an important part of the overall ethylene oxide control strategy. A detailed discussion of hospital sampling procedures and methods appears in the Technical Industrial Processes Sourcebook (Wood 1984).

Three types of monitoring are generally used for ethylene oxide: direct-reading instruments (e.g., infrared analyzers), samples collected on activated charcoal for subsequent analysis, and passive dosimeters. Portable infrared analyzers are direct-reading instruments that may be used for area monitoring of ethylene oxide concentrations. Note, however, that these instruments may not be accurate at ethylene oxide concentrations below 1 ppm (1.8 mg/m³) because they are sensitive to high humidity and may produce false readings. Activated charcoal tubes are used to determine

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exposure for the entire sampling period (an 8-hr day, for example). Passive dosimeters are generally worn on a worker's lapel; after chemical analyses, they can provide a semi-quantitative indication of exposure.

5.1.5.5 Exposure Control Methods

A NIOSH study of hospitals with good engineering controls has shown that ethylene oxide exposures can be kept below 0.1 ppm (0.18 mg/m³) for an 8-hr TWA and below 5 ppm (9 mg/m³) for short-term exposures of less than 2 min (Kercher and Mortimer 1987).

5.1.5.5.1 Substitution

In most cases, no acceptable substitute exists for ethylene oxide in the sterilization of heat-sensitive equipment.

5.1.5.5.2 Engineering controls

The following engineering controls are recommended:

- The sterilizer should be enclosed either in a mechanical access room or a cabinet, and the enclosure should be exhausted to a dedicated ventilation system.*
- Sterilizing operations should be centralized and access to sterilizer rooms should be restricted.
- The sterilizer should be checked with the infrared analyzer at least once every 3 months.
- Floor drains should have a cover with an anti-siphon air gap. The air gap, at the junction of the vacuum pump discharge line with the floor drain, should be enclosed. Dedicated exhaust ventilation should be provided for the enclosure.
- Local exhaust ventilation sufficient to effectively remove ethylene oxide should be as close as possible to the top of the sterilizer door.

* A dedicated exhaust system is one that serves the sterilizer area only and routes ethylene oxide directly to the outside of the building at a location where prevailing winds will not carry the exhaust into populated areas or into the air intakes of other buildings.

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- The number of exhaust cycles recommended by the sterilizer manufacturer should be completed before the door is opened; the door should remain only slightly open for at least 15 min.
- Supply cylinders should be located in a ventilated enclosure (either a ventilated cabinet or a hood that covers the point where the cylinder is connected to the sterilizer supply line).
- Aerators and the overpressure relief valves (if present) should be vented to a dedicated exhaust system.
- Sensors should be provided to identify a ventilation failure and to detect ethylene oxide. Both audible and visual alarms should be activated by the sensors.
- Ventilation air from the sterilizing room should not be recirculated.
- Exhaust gases should preferably be vented directly to the outside of the building (away from intake vents); this procedure is strongly recommended for all sterilizers.
- Sterilized material and its packaging should be aerated in aeration cabinets, since approximately 5% of the ethylene oxide in the sterilizer remains in these items. Aeration times depend on the composition, form, and weight of the material. Refer to the recommendations from the Association for the Advancement of Medical Instrumentation (AAMI 1982), and follow the manufacturer's recommendations for each type of equipment sterilized. Materials that do not absorb ethylene oxide (metal and glass) need no aeration unless they are wrapped.
- Sterilizers that use glass ampules in a plastic bag (flash bag) have a high potential for worker exposure to ethylene oxide. If they are used, all sterilization procedures should be conducted in a ventilated enclosure.

5.1.5.5.3 Protective equipment

A worker should use protective gloves (see Section 2.3.5) and splash-proof goggles and/or a face shield when changing ethylene oxide supply cylinders. If good engineering controls are used (i.e., if the cylinder is located in a ventilated hood), a respirator should not be necessary. If a respirator is necessary or desired, the worker should use a chemical cartridge respirator with an end-of-service-life indicator that has been approved by NIOSH/MSHA. The end-of-service-life indicator is needed because the odor threshold for ethylene oxide is about 700 ppm (Jay et al. 1982), and failure of the adsorbent material will not be detected by the user.

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Protective gloves and long-sleeved garments should be worn when removing items from the sterilizer or transferring them to the aerator.

When cleaning up liquid spills that contain ethylene oxide, workers should wear protective outer clothing and dispose of or launder it immediately afterward. If leather shoes become contaminated with ethylene oxide, they should be discarded.

A positive-pressure, self-contained breathing apparatus should be available for emergency situations and should be stored in an area away from the sterilizer and the ethylene oxide supply location.

5.1.5.5.4 Work practices

Sterilizers should be operated only by personnel trained in sterilization procedures and in the health and safety hazards of ethylene oxide. If local exhaust ventilation has been provided above the sterilizer door, a worker should open the door slightly and step away for an established time period. The time period should be determined by monitoring and should be at least 15 min. The door opening should be smaller than the capture distance of the hood.

To clean the sterilizer (especially the back surfaces), a worker must often reach inside the chamber with the whole upper body. Ethylene oxide exposure during this cleaning can be controlled by (1) scheduling the cleaning activity as long as possible after processing a load, (2) leaving the sterilizer door fully open for at least 30 min before cleaning, and (3) wearing a respirator.

5.1.5.6 Medical Monitoring

Employers should obtain pre-employment baseline data on workers who will be handling ethylene oxide. This information should include data on the eyes, skin, blood, and respiratory tract. Periodic examinations thereafter should include the following organs and systems:

<u>Organ or system</u>	<u>Suspicious symptoms</u>
Skin . . . . .	.Rashes, cracking, burns, blisters
Eyes . . . . .	.Swelling or irritation
Respiratory systemBreathing difficulty, nose or throat irritation, prolonged or dry cough, chest pains, wheezing

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Neurological system.Drowsiness, numbness or tingling of hands or feet, weakness or lack of coordination, headaches

Reproductive system.Spontaneous abortions, birth defects

5.1.6 Formaldehyde

NIOSH regards formaldehyde as a potential occupational carcinogen (NIOSH 1981; NIOSH 1986c). Formaldehyde is used for cold sterilization of some instruments, but it is not used as a general disinfectant because it is very caustic.

5.1.6.1 Hazard location

Formaldehyde may be encountered in the laboratory as a tissue preservative, in central supply as a sterilant, and in the dialysis unit as a sterilant. Formaldehyde is often combined with methanol and water to make formalin.

5.1.6.2 Potential Health Effects

5.1.6.2.1 Acute effects

The odor of formaldehyde can be detected in air at about 0.8 ppm (Amoore and Hautala 1983). Formalin solutions splashed in the eyes may cause severe injury and corneal damage. Low ambient concentrations of formaldehyde (0.1 to 5 ppm) may cause burning and tearing of the eyes and irritation of the upper respiratory tract. Higher concentrations (10 to 20 ppm) may cause coughing, chest tightness, increased heart rate, and a sensation of pressure in the head. Exposures of 50 to 100 ppm may cause pulmonary edema, pneumonitis, and death (NIOSH 1981i).

5.1.6.2.2 Chronic effects

Repeated exposure to formaldehyde may cause some persons to become sensitized. Sensitization may occur days, weeks, or months after the first exposure. Sensitized individuals will experience eye or upper respiratory irritation or an asthmatic reaction at levels of exposure that are too low to cause symptoms in most people. Reactions may be quite severe with swelling, itching, wheezing, and chest tightness (NIOSH 1976f).

One study (Hendrick et al. 1982) reported that two nurses working in a renal dialysis unit developed asthmatic symptoms associated with their work with formaldehyde. The symptoms completely resolved for the nurse who spent 5 to 7 years without further exposure to formaldehyde, but the other nurse, who continued the exposure, continued to have symptoms.

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Dermatitis (including red, sore, cracking, and blistered skin) is also a common problem with formaldehyde exposure. Repeated exposure may make the fingernails soft and brown (NIOSH 1976f). A NIOSH health hazard evaluation of a hospital hemodialysis unit (NIOSH 1983a) indicated that respiratory irritation, eye irritation, and dermatological problems were the primary health problems associated with formaldehyde exposure.

Formaldehyde is a mutagen in many assay systems and has caused nasal and other cancers in experimental animals. In 1981, NIOSH published the Current Intelligence Bulletin 34 (NIOSH 1981i), which recommended that formaldehyde be handled as a suspect carcinogen in the workplace.

5.1.6.3 Standards and Recommendations

The OSHA standard for formaldehyde is 1 ppm as an 8-hr TWA with a ceiling concentration of 2 ppm as a 15-min short-term exposure limit (29 CFR 1910.1048).

The NIOSH REL for formaldehyde is 0.1 ppm as determined in any 15-min air sample and 0.016 ppm as an 8-hr TWA (NIOSH 1986d). In the Current Intelligence Bulletin 34, NIOSH recommended that engineering controls and stringent work practices be used to reduce occupational exposure to the lowest feasible limit (NIOSH 1981i).

The ACGIH has designated formaldehyde a suspected human carcinogen and has recommended a TLV of 1 ppm (1.5 mg/m^3) as an 8-hour TWA with a short term exposure limit (STEL) of 2 ppm (3 mg/m^3) (ACGIH 1987).

The odor of formaldehyde can be detected at about 0.8 ppm (Amoore and Hautala 1983), but even a short period of exposure will decrease the worker's ability to smell it. Thus odor is not a reliable warning for the presence of formaldehyde (NIOSH 1976f).

5.1.6.4 Environmental Monitoring

NIOSH industrial hygiene surveys have found formaldehyde concentrations ranging from 2.2 to 7.9 ppm in hospital autopsy rooms (NIOSH 1981i). Passive dosimeters, direct-reading colorimetric detector tubes, and the personal sampling pump may be used to monitor exposures. Although some colorimetric detector tubes can detect as little as 0.05 ppm formaldehyde, personal sampling pumps and charcoal tubes are preferred for measuring low-level exposures. For a more detailed description of sampling procedures for formaldehyde, refer to the Technical Industrial Processes Sourcebook (Wood 1984), or Air Sampling Instruments for Evaluation of Atmospheric Contaminants (ACGIH 1983).

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5.1.6.5 Exposure Control Methods

Phenols may be substituted for formaldehyde in some cases, and dilute bleach solutions can be used to disinfect the exteriors of dialyzers. Other cold sterilants such as glutaraldehyde are also available. These substitutes should be used with caution (see Sections 5.1.3.4 and 5.1.3.6).

5.1.6.5.1 Engineering controls

The following engineering controls are recommended to minimize formaldehyde exposure:

- Local exhaust ventilation should be installed over work stations using formalin or specimens preserved in formalin.
- Small quantities of formaldehyde should be purchased in plastic containers for ease of handling and safety.
- Traps should be placed in floor drains.
- Spill-absorbent bags should be available for emergencies.
- Engineering controls in hemodialysis units should include (1) isolating the main system from personnel and patients in case of inadvertent spills or (2) disconnecting the dialyzers before the sterilization process is completed. Also, formaldehyde vapors should be prevented from entering the room from the drains serving the main system and the dialysis consoles. The air should be regularly monitored for formaldehyde, and in-service education should be conducted periodically on the effects of formaldehyde.

5.1.6.5.2 Protective equipment

Skin and eye contact with formaldehyde should be avoided. Goggles, face shields, aprons, NIOSH certified positive-pressure air-supplied respirators (see Section 2.3.4.6), and boots should be used in situations where formaldehyde spills and splashes are likely. Appropriate protective gloves (see Section 2.3.4) should be used whenever hand contact is possible; latex examination gloves are too fragile.

5.1.6.6 Medical Monitoring

Pre-employment baseline data should be recorded for the respiratory tract, liver, and skin condition of any worker who will be exposed to formaldehyde. Thereafter, periodic monitoring should be conducted to detect symptoms of pulmonary or skin sensitization or effects on the liver.

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5.1.7 Freon®

Freon® includes a number of gaseous, colorless chlorofluorocarbons. Those most commonly used in hospitals are Freon 12 (dichlorodifluoromethane), Freon 11 (fluorotrichloromethane), and Freon 22 (chlorodifluoromethane).

5.1.7.1 Hazard Location

Workers may encounter Freon hazards in the pathology laboratory (where it is used to prepare frozen tissue sections), in aerosol cans (where it is used as a propellant), in central supply departments (where it is used in combination with ethylene oxide for sterilization), and in refrigerant gas. Freon can freeze the skin and also cause defatting.

5.1.7.2 Potential Health Effects

Exposure to Freon may cause eye and skin irritation or sensitization. High concentrations of Freon cause severe depression of the central nervous system, weakness, dizziness, convulsions, and cardiac arrhythmia (irregular heart beat) (ACGIH 1986). In one study of pathology residents in a Boston hospital, all residents in their second and third years experienced palpitations that appeared to be associated with the addition of the surgical pathology rotation to their schedules. On this rotation, the only procedure that could have possibly caused palpitations was the preparation of frozen sections in which a Freon-22-based aerosol was used to decrease work time. Freon exposures of 300 ppm were measured over a 2-min period for workers engaged in tissue preparation. Four residents experienced palpitations severe enough to prompt electrocardiograms (Speizer et al. 1975). A number of deaths (7 in 1967, 31 in 1968, and 27 in 1969) have been reported among persons "sniffing" Freons intentionally (Reinhardt et al. 1971).

5.1.7.3 Standards and Recommendations

The OSHA PEL for Freon 11 (fluorotrichloromethane) is 1,000 ppm (5600 mg/m³) as an 8-hr TWA; the OSHA PEL for Freon 12 (dichlorodifluoromethane) is 1,000 ppm (4,950 mg/m³) as an 8-hr TWA (29 CFR 1910.1000, Table Z-1). The ACGIH TLV's for Freon 11 and Freon 12 are identical to the respective OSHA PEL's (ACGIH 1987). There is no OSHA PEL for Freon 22, but the ACGIH TLV for Freon 22 (chlorodifluoromethane) is 1,000 ppm (3,500 ppm) as an 8-hr TWA (ACGIH 1987). There are no NIOSH REL's for the Freon compounds.

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5.1.7.4 Environmental Monitoring

Freon concentrations can be estimated using direct-reading colorimetric detector tubes or determined by charcoal-tube adsorption and gas chromatography analysis.

5.1.7.5 Exposure Control Methods

5.1.7.5.1 Engineering controls

Local exhaust ventilation hoods should be installed to carry Freon vapors away from laboratory workers. Ventilation controls that protect workers adequately from ethylene oxide during sterilizing procedures will also protect them from Freon.

5.1.7.5.2 Protective equipment

Goggles, aprons, and protective gloves (see Section 2.3.5) should be provided to workers exposed to large amounts of Freon such as those encountered in the repair of refrigerant systems. Because Freon does not have adequate warning properties, only approved atmosphere-supplying respirators should be used.

5.1.7.5.3 Work practices

Hand contact should be minimized because of the possibility of sensitization. Workers should be warned against touching their eyes with contaminated hands or gloves for the same reason.

5.1.7.6 Medical Monitoring

A cardiovascular history should be obtained from each worker exposed to Freon because exposure may pose a greater risk to those with cardiovascular problems. Eyes, skin, cardiac symptoms, and electrocardiograms should be monitored periodically for exposed workers.

5.1.8 Mercury

Elemental mercury is a metallic element that is liquid at room temperature.

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5.1.8.1 Hazard Location

Mercury is used in many types of hospital equipment and can be found in thermometers, Coulter counters, Van Slyke apparatus, Miller-Abbot and Cantor tubes, and sphygmomanometers (Notani-Sharma 1980). Mercury is also used in dental amalgams. Exposure to mercury in the hospital is usually the result of an accidental spill. The two procedures during which such exposures usually occur are (1) repair of broken sphygmomanometers in central supply or maintenance, and (2) sterilization and centrifugation of thermometers in central supply (Notani-Sharma 1980).

5.1.8.2 Potential Health Effects

Although inhalation is the major route of entry for mercury, the element can also be absorbed through the skin.

Exposure to short-term high levels of mercury can produce severe respiratory irritation, digestive disturbances, and marked renal damage (NIOSH 1973a).

Long-term exposure to low levels of mercury results in the classic mad hatter syndrome (named for the makers of felt hats who used mercury in processing). This syndrome is characterized by emotional instability and irritability, tremors, inflammation of the gums (gingivitis), excessive salivation, anorexia, and weight loss. Mercury has also been reported as a cause of sensitization dermatitis (NIOSH 1973a).

5.1.8.3 Standards and Recommendations

The current OSHA PEL for mercury is 0.1 mg/m^3 as a ceiling value (29 CFR 1910.1000, Table Z-2). The NIOSH REL is 0.05 mg/m^3 as an 8-hr TWA (NIOSH 1973a).

5.1.8.4 Environmental Monitoring

Mercury vapors can be measured with a direct-reading colorimetric dosimeter, diffusion tubes, or mercury vapor analyzer (mercury "sniffer") or with charcoal tubes impregnated with iodine. Particulate contamination can be collected on a filter for subsequent analysis.

If mercury spills are not promptly cleaned up, mercury may accumulate in the carpeting, on floors, and on other surfaces such as porous laboratory sinks and counters. In most cases, workers in these situations were unaware that mercury vaporizes easily at room temperatures.

In one investigation (Harrington 1974), several workers in a quality-control laboratory noticed their jewelry becoming "silvered" with no apparent cause. A source of mercury vapor was found when droplets of mercury were

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observed in the sink, on a bench, on the floor, and in the clothing of the lab assistants. The floor was removed, and pools of mercury were discovered. In another laboratory, nearly 7 lb of mercury was discovered beneath the floor (Harrington 1974). A study of 298 dentists reported that 30% of those with urine mercury levels above 20 micrograms/g had polyneuropathies (nervous system symptoms) (Shapiro et al. 1982). Other surveys have found high background levels of mercury in the air of about 10% of the dental offices and elevated mercury levels in the urine and hair of workers in these offices (Shapiro et al. 1982).

5.1.8.5 Exposure Control Methods

5.1.8.5.1 Engineering controls

Emergency engineering procedures for handling mercury contamination should include procedures for cleanup as well as for respirator selection. Exhaust systems should be designed and maintained to prevent the accumulation or recirculation of mercury vapor into the workroom.

5.1.8.5.2 Protective equipment

Disposable protective equipment such as shoe covers, protective gloves (see Section 2.3.5), special mercury vapor respirators (see Section 2.3.5.6), and gowns and hoods should be used while cleaning up mercury spills.

5.1.8.5.3 Work practices

Spills should be cleaned up promptly with special mercury vacuum cleaners, disposable protective equipment, and a water-soluble mercury decontaminant. Mercury wastes must be disposed of according to U.S. Environmental Protection Agency regulations (40 CFR 261.24).

All spill areas should be clearly posted until adequate cleanup has been accomplished. If the spill is extensive, patients and personnel other than the cleanup crew should be removed from the area.

5.1.8.6 Medical Monitoring

Pre-exposure data should be recorded for the respiratory tract, nervous system, kidneys, and skin of any worker who may be exposed to mercury. Urine mercury levels should be monitored periodically in workers who are routinely or accidentally exposed to this element. Although there is no critical level of mercury in urine that indicates mercury poisoning, observers have suggested that 0.1 to 0.5 mg of mercury/liter of urine has clinical significance (NIOSH 1973a).

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5.1.9 Methyl Methacrylate

5.1.9.1 Hazard Location

Methyl methacrylate is an acrylic cement-like substance commonly used in operating rooms to secure surgical prostheses to bone (e.g., in total hip replacements). This compound is also used in dental prostheses (NIOSH 1977e). The two components, a liquid and a powder, are mixed immediately before use.

In a study of operating room exposures, concentrations of methyl methacrylate reached 280 ppm immediately after the components were mixed, but fell below 50 ppm within 2 min and to 2 ppm after 6 min (ACGIH 1986). The mixing process usually takes no more than 2 min.

5.1.9.2 Potential Health Effects

5.1.9.2.1 Acute effects

Methyl methacrylate has been reported to have an odor threshold of about 0.08 ppm (Amoore and Hautala 1983). At concentrations in excess of 400 ppm, methyl methacrylate affects the central nervous system (ACGIH 1986). Methyl methacrylate is an eye, skin, and mucous membrane irritant in concentrations at or above 170 to 250 ppm. Patients exposed to this compound have suffered acute episodes of hypotension (low blood pressure) and cardiac arrest (Hyderally and Miller 1976).

5.1.9.2.2 Chronic effects

Methyl methacrylate has been reported to produce degenerative liver changes in experimental animals (NIOSH 1977e). This chemical has also been reported to be mutagenic, but has not been found to be carcinogenic in rats or mice (NTP 1986). Methyl methacrylate has also been reported to be teratogenic (Singh et al. 1972).

5.1.9.3 Standards and Recommendations

The OSHA PEL, as well as the ACGIH TLV, for methyl methacrylate is 100 ppm (410 mg/m³) as an 8-hr TWA (29 CFR 1910.1000, Table Z-1; ACGIH 1987). NIOSH has not recommended a standard for methyl methacrylate.

5.1.9.4 Environmental Monitoring

Methyl methacrylate is monitored in the environment by sampling with an adsorption tube and analyzing with gas chromatography (NIOSH 1980a).

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5.1.9.5 Exposure Control Methods

5.1.9.5.1 Engineering controls

A local exhaust hood should be used to conduct exhaust fumes from the area in which methyl methacrylate is mixed. A tent hood may be used unless mixing can be done in a separately ventilated area. Portable hoods are available for operating room use.

5.1.9.5.2 Protective equipment

Workers who handle methyl methacrylate should wear personal protective equipment and clothing (see Section 2.3.5). This may include gloves, goggles, face shields, and respirators, as appropriate. Portable hoods are available for operating room use.

5.1.9.5.3 Work practices

Workers should be instructed to avoid touching contaminated hands or gloves to their eyes or mouths.

5.1.9.6 Medical Monitoring

Pre-exposure data should be recorded for the skin and respiratory systems of workers who may be exposed to methyl methacrylate. Periodic monitoring thereafter should emphasize the skin and respiratory systems.

5.1.10 Peracetic Acid (PAA)

5.1.10.1 Hazard Location

Peracetic acid (peroxyacetic acid) is used in hospitals to sterilize the surfaces of medical instruments and may be found in laboratories, central supply, and patient care units.

5.1.10.2 Potential Health Effects

Peracetic acid (peroxyacetic acid) is a strong skin, eye, and mucous membrane irritant in both humans and animals. Continued skin exposure may cause liver, kidney, and heart problems. Peracetic acid has been observed to promote wart-like tumors (skin papillomas) in rats (NIOSH 1985). As a result, direct skin contact and exposure to vapors should be restricted.

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5.1.10.3 Standards and Recommendations

Currently no standards exist for regulating exposures to peracetic acid, and no recommendations have been made by others such as NIOSH, ACGIH, or ANSI.

5.1.10.4 Exposure Control Methods

Use of an isolation chamber should eliminate major exposure to peracetic acid vapors in hospitals. This chamber should be checked frequently for defects. Peracetic acid should never be used outside this chamber.

5.1.11 Solvents

5.1.11.1 Hazard Location

The generic term "solvent" refers to a large number of chemicals used in medical laboratories. Some are used widely as cleaning agents in housekeeping and maintenance, and some are present in inks and in cleaning agents in print shops.

5.1.11.2 Potential Health Effects

Most solvents can be absorbed through the skin or by inhalation and ingestion.

5.1.11.2.1 Acute effects

Many solvents act as central nervous system depressants, causing headaches, dizziness, weakness, nausea, and other symptoms (NIOSH 1986c). Solvents may also irritate eyes, skin, and the upper respiratory tract. Prolonged contact may result in defatting and dehydration of the skin.

5.1.11.2.2 Chronic effects

Long-term exposure to some solvents has been associated with cancer, adverse reproductive effects, cardiovascular problems, and damage to the liver, kidneys, central nervous system, and hematopoietic system (see Table 5-2) (NIOSH 1974, 1975a, 1977a).

5.1.11.3 Standards and Recommendations

The hospital safety officer should develop an inventory of solvents in use and consult 29 CFR 1910.1000 for the pertinent OSHA PEL. The safety officer

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Table 5-2. Health effects and exposure limits for certain solvents

Solvent	Specific effect	OSHA PEL*	NIOSH REL†
Dioxane	Suspected carcinogenic effects, liver and kidney effects	100 ppm (360 mg/m ³) as 8-hr TWA (Skin)	1-ppm (3.6 mg/m ³) ceiling for 30 min
Xylene	Cardiovascular and reproductive effects, central nervous system depressant	100 ppm (435 mg/m ³) as 8-hr TWA	100 ppm (434 mg/m ³) for up to a 10-hr TWA; 200-ppm (868 mg/m ³) ceiling for 10 min
Benzene	Cancer (leukemia) and blood changes, including aplastic anemia	1 ppm as 8-hr TWA; 5-ppm short-term exposure limit (15 min)	0.1 ppm (0.32 mg/m ³) as 8-hr TWA; 1-ppm (3.2 mg/m ³) ceiling for 15 min

*29 CFR 1910.1000, Tables Z-1 and Z-2.

†CDC (1986).

should also consult the NIOSH criteria documents, Current Intelligence Bulletins, and other documents on solvents, which are listed by compound in NIOSH Recommendations for Occupational Safety and Health Standards (CDC 1986).

5.1.11.4 Environmental Monitoring

NIOSH investigations have found high concentrations of solvents, either as TWA's or as peaks during certain processes in medical laboratories (NIOSH 1981f). The effects reported by workers are frequently those of a combination of solvents, each one of which is present at a concentration below the established standard. No regulation exists to cover the additive or synergistic effects of similar chemicals.

Solvents can be collected on adsorbent charcoal for later analysis, or they can be directly measured with colorimetric detector tubes or passive dosimeters. For a more detailed description of sampling procedures for solvents, refer to the Technical Industrial Processes Sourcebook (Wood 1984) and Air Sampling Instruments for Evaluation of Atmospheric Contaminants (ACGIH 1983).

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5.1.11.5 Exposure Control Methods

5.1.11.5.1 Substitution

A less hazardous solvent can frequently be substituted for one of those discussed.

5.1.11.5.2 Engineering controls

Local exhaust ventilation and enclosure of solvent vapor sources are the preferred methods for controlling exposures to solvents in laboratories. When selecting engineering and other controls, consideration must be given to not only the toxicity of the solvent, but to its flammability and explosion potential as well.

5.1.11.5.3 Protective equipment

Protective gloves (see Section 2.3.4) help prevent absorption of solvents through the skin. Respirators (see Section 2.3.4.6), rubber aprons, goggles, and boots may be required during certain procedures or during cleanup of spills.

5.1.11.5.4 Work practices

Workers should be thoroughly trained to recognize the symptoms of solvent exposure, to avoid eating in potentially contaminated areas, to work only under exhaust hoods when handling solvents and to follow those work practices recommended for specific solvents.

5.1.11.6 Medical Monitoring

Pre-exposure information should be recorded for workers who will be exposed to solvents and should include baseline and current data on the skin, kidney, liver, and nervous and hematopoietic systems (NIOSH 1986b). Kidney and liver function tests and a complete blood count should be performed.

5.1.12 Waste Anesthetic Gases

The principal source of waste anesthetic gas in the hospital is leakage from anesthetic equipment. Nitrous oxide, enflurane, halothane, and isoflurane are currently the most widely used inhalation anesthetic agents in the United States (NIOSH 1977c, Whitcher 1987b). Methoxyflurane, once in general use, is now used primarily in veterinary procedures (Whitcher 1987b).

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5.1.12.1 Hazard Location

In 1977, NIOSH estimated that some 50,000 operating-room personnel (excluding surgeons) were exposed each year to waste anesthetic gases (NIOSH 1977c). Exposures occur in operating rooms; labor, delivery, and recovery rooms; dental operatories; emergency rooms; outpatient clinics; and miscellaneous locations.

Leakage from anesthetic equipment is in most cases associated with the work practices and habits of the anesthesiologists and nurse anesthetists. Incorrect installation and maintenance of scavenging systems is also a major factor.

Exposures may occur in the following ways:

- Gas may escape during hook-up and check-out of the system.
- Excess gas may seep over the lip of the patient's mask.
- The patient may exhale gas into the room.
- Leaks may occur in the anesthetic breathing system.
- Scavenging systems may be misused or not used at all.

The degree of exposure in the operating room depends on the amount of leakage, the adequacy of the ventilation system, and the type of operation being done. Gas leakage occurs primarily when face masks are used for short procedures and a problem exists with the anesthetist's technique or with the patient's facial anatomy (e.g., when the patient has no teeth).

A related problem is the exposure of recovery room personnel to waste gases in the exhaled breath of post-operative patients. Nitrous oxide, halothane, and methoxyflurane have all been found in the exhaled breath of both patients and operating room staff for periods ranging from hours to several days after the administration of the anesthetic (NIOSH 1977c). This phenomenon may pose a significant health hazard to staff in crowded recovery rooms with a high patient turnover rate.

5.1.12.2 Potential Health Effects

5.1.12.2.1 Acute effects

Workers exposed to excessive amounts of anesthetic gases begin to feel like anesthetized patients, experiencing drowsiness, irritability, depression, headache, nausea, fatigue, and problems of judgment and coordination (NIOSH 1977c). These behavioral effects are of particular concern because both the success of the surgery and health of the operating room staff may be compromised.

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5.1.12.2.2 Chronic effects

Epidemiologic studies have found increased incidences of embryo toxicity, liver and kidney disease, and cancer among groups of female personnel working in the operating room (Cohen et al. 1975). Some observers have suggested a relationship between exposure to waste anesthetic gases and reports of increased cancer rates and adverse effects on reproduction among exposed workers (NIOSH 1977c).

5.1.12.2.3 Reproductive effects

A 1975 survey (Cohen et al. 1975) indicated an increased risk of spontaneous abortion among female anesthesiologists, nurse-anesthetists, and other staff personnel who worked in operating rooms during their first trimester of pregnancy and the year preceding. An increased risk of congenital abnormalities also existed among the live-born babies of exposed female participants in the survey. Studies have also shown a higher incidence of miscarriage in the wives of male operating-room personnel (Cohen et al. 1975).

5.1.12.3 Standards and Recommendations

NIOSH has recommended exposure limits for the following anesthetic gases (NIOSH 1977c):

Chloroform . . . . .	.2 ppm (9.76 mg/m ³) ceiling (1 hr)
Trichloroethylene* . . . . .	.2 ppm (10.75 mg/m ³) ceiling (1 hr)
Halothane. . . . .	.2 ppm (16.15 mg/m ³) ceiling (1 hr)
Methoxyflurane . . . . .	.2 ppm (13.5 mg/m ³) ceiling (1 hr)
Enflurane. . . . .	.2 ppm (15.1 mg/m ³) ceiling (1 hr)
Fluroxene. . . . .	.2 ppm (10.31 mg/m ³) ceiling (1 hr)
Nitrous oxide.	25 ppm (30 mg/m ³) as a TWA over period of use

*NIOSH recommends that trichloroethylene be regarded as a potential occupational carcinogen (NIOSH 1978b).

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When nitrous oxide is used in combination with the halogenated agents described above, control of nitrous oxide to 25 ppm during the administration period will result in concentrations of the halogenated agents of about 0.5 ppm.

5.1.12.4 Environmental Monitoring

The vapors of anesthetic agents such as enflurane, halothane and isoflurane can be monitored with charcoal tubes. Nitrous oxide can be monitored with a direct-reading infrared analyzer or by passive dosimeters.

Records of all collected air samples should be kept, and results should be noted in the medical records of the corresponding workers. Detailed descriptions of sampling procedures for nitrous oxide are available from several sources (Eger 1985; Saidman and Smith 1984; Wood 1984; Whitcher 1987a).

5.1.12.5 Exposure Control Methods

The following documents detail the components of a control program for waste anesthetic gases: Development and Evaluation of Methods for the Elimination of Waste Anesthetic Gases and Vapors in Hospitals (NIOSH 1975b), Criteria for a Recommended Standard: Occupational Exposure to Waste Anesthetic Gases and Vapors (NIOSH 1977c), Controlling Waste Anesthetic Gases (AHA 1980), ANSI Standard for Anesthetic Equipment: Scavenging Systems for Excess Anesthetic Gases (ANSI 1982), Nitrous Oxide, N₂O (Eger 1985), Occupational Exposure to Inhalation Anesthetics: An Update (Whitcher 1987a), and Monitoring Exposure to Inhalation Anesthetics (Saidman and Smith 1984).

5.1.12.5.1 Engineering controls

A scavenging system is the basic engineering control for waste anesthetic gases. Such systems collect waste gas and ventilate it from the operating room. Although some scavenging systems are elaborate and costly, adequate systems can be inexpensive and can dramatically reduce contamination of the operating room environment. A scavenging system should be selected, installed, used, and maintained according to the references listed above in 5.1.12.5.

The equipment must be regularly monitored for leakage, improper design, or tubing defects. In some cases, poor wall connections and compression fittings or other defective equipment may be the sources of leakage.

The 1977 NIOSH document entitled Criteria for a Recommended Standard: Occupational Exposure to Waste Anesthetic Gases and Vapors (NIOSH 1977c) contains information on control procedures and work practices that have been demonstrated to reduce anesthetic gas concentrations to the NIOSH recommended exposure limits. A more thorough discussion of ventilation

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systems for anesthetic gases and their disposal can be found in the NFPA Health Care Facilities Handbook (NFPA 1984), which contains the complete text of NFPA 99 (Standard for Health Care Facilities). Stoner et al. (1982) provide a general description of the control of anesthetic gases, including discussions of physiological effects, anesthetic methods, and monitoring techniques.

The International Labour Office proposes three steps to control exposure to waste anesthetic gases (Parmeggiani 1983): (1) installing a proper nonrecirculating air conditioning system with a minimum of 20 room air exchanges per hour; (2) installing a scavenging system for collecting waste gases at the the anesthetic breathing level, and (3) using low-flow rates of anesthetic gases.

5.1.12.5.2 Personal protective equipment

Personal protective equipment is not needed or recommended if an adequate control program is in place. However, monitoring should be done, and personal protective equipment should be available for use in case of an emergency.

5.1.12.5.3 Work practices

Operating-room workers can protect themselves from excess exposure by properly connecting the scavenging equipment, turning the gas off when the breathing system is disconnected from the patient, and ensuring that all patients have properly fitting masks.

5.1.12.5.4 Training programs

Workers involved with waste anesthetic gases should be trained to recognize, understand, monitor, and reduce the health and safety risks of exposure to these substances.

5.1.12.6 Medical Monitoring

Workers exposed to anesthetic gases should have complete medical histories on file. These should include family, genetic, and occupational histories and the outcomes of all pregnancies of female workers or of the wives of male workers. Baseline data should be obtained on the hepatic, renal, and hematopoietic systems. Exposed workers should be monitored periodically for liver and kidney function.

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5.2 PHYSICAL HAZARDS

5.2.1 Heat

5.2.1.1 Hazard Location

The laundry, boiler room, and kitchen are known as hot environments. Other departments of the hospital may also be hot during the summer months, especially in older facilities that have inadequate ventilation and cooling systems.

5.2.1.2 Potential Health Effects

Heat-related health effects include heat stroke, heat exhaustion, heat cramps, fainting, and heat rash (NIOSH 1986b).

5.2.1.2.1 Heat stroke

Heat stroke is the most serious heat-related health effect; it results from a failure of the body's temperature regulating mechanism. The victim's condition may be characterized by hot, dry skin, dizziness, headache, thirst, nausea, muscular cramps, mental confusion, delirium, convulsions, or unconsciousness. Body temperature may exceed 105°F (41°C). Unless quick and proper treatment is rendered, death may occur.

Workers with any of these symptoms should be immediately removed to a cool area and attempts should be made to reduce body temperature by soaking the clothing thoroughly with water and fanning vigorously. A physician should be called immediately.

5.2.1.2.2 Heat exhaustion

Heat exhaustion is caused by the loss of large amounts of fluid and sometimes by the excessive loss of salt through sweating. The symptoms of heat exhaustion resemble those of heat stroke, but unlike the latter, the symptoms are milder and victims sweat and have a body temperature that is normal or only slightly elevated.

Victims of heat exhaustion should be removed to a cool place and given large amounts of liquids to drink. In mild cases, recovery is usually spontaneous with this treatment. Severe cases require the attention of a physician and may take several days to resolve.

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5.2.1.2.3 Heat cramps

Heat cramps are painful muscle spasms that occur from salt loss through sweating and from the dilution of body fluids through drinking large quantities of liquids. The cramps usually occur in those muscles that are being used for work. Cramps may occur during or after work and may be relieved by drinking salty liquids. Workers on low sodium diets should consult a physician before beginning work in a hot environment.

5.2.1.2.4 Fainting

One mechanism for dissipating body heat is dilatation of blood vessels, which may cause fainting when blood pools in the legs and reduces circulation to the brain. This problem may affect unacclimatized workers who spend much of their time standing with little movement. Recovery may be hastened by placing the victim on his back with the legs elevated. Workers who must stand for long periods can prevent fainting by moving around.

5.2.1.2.5 Heat rash

Heat rash (prickly heat) results when the skin remains wet with sweat for prolonged periods and evaporation is reduced or absent. These conditions cause the sweat glands to become plugged and irritated, leading to development of a rash. Although it is not a health threatening condition, heat rash may be sufficiently irritating to impair the worker's performance. Heat rash can be prevented by keeping the skin dry and clean.

5.2.1.3 Standards and Recommendations

NIOSH has recommended an occupational standard for workers exposed to hot environments (Figures 5-1 and 5-2) (NIOSH 1986a). The standard includes recommendations for exposure limits, medical surveillance, posting of hazardous areas, protective clothing and equipment, worker information and training, methods for controlling heat stress, and recordkeeping. The recommendations consider both acclimatized and unacclimatized workers and the effects of clothing. The recommended exposure limits are based on the combined effects of metabolic and environmental heat (NIOSH 1986a). Table 5-3 provides data for estimating metabolic heat.

The values in Table 5-3 can be used to calculate the approximate total metabolic heat (H_t) consumed by a worker performing various tasks.

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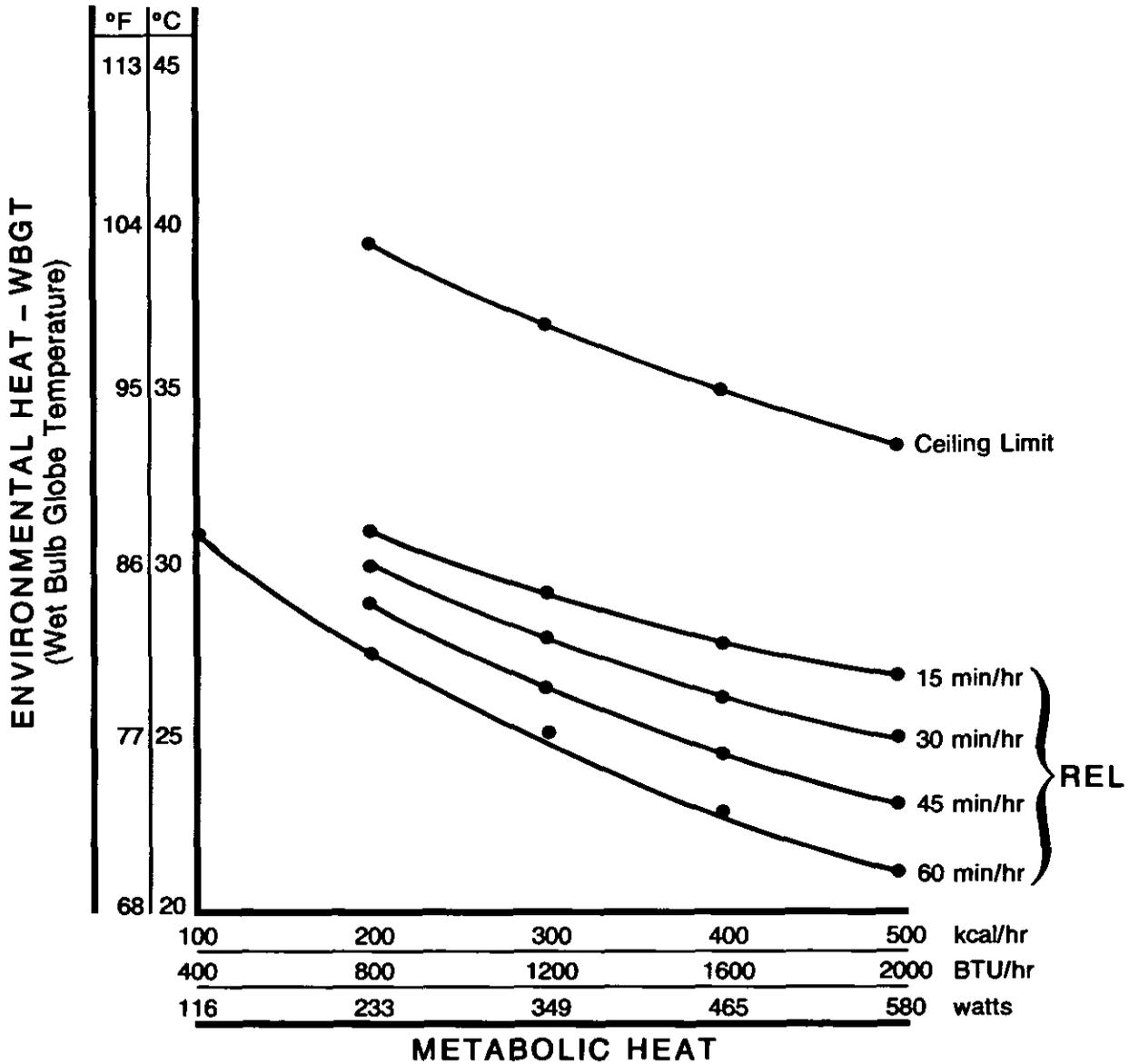


Figure 5-1. Recommended exposure limits (REL) for unacclimatized workers. Data assume a standard worker having a body weight of 154 lb (70 kg) and a surface area of 19.4 ft² (1.8 m²). Adapted from NIOSH 1986a.

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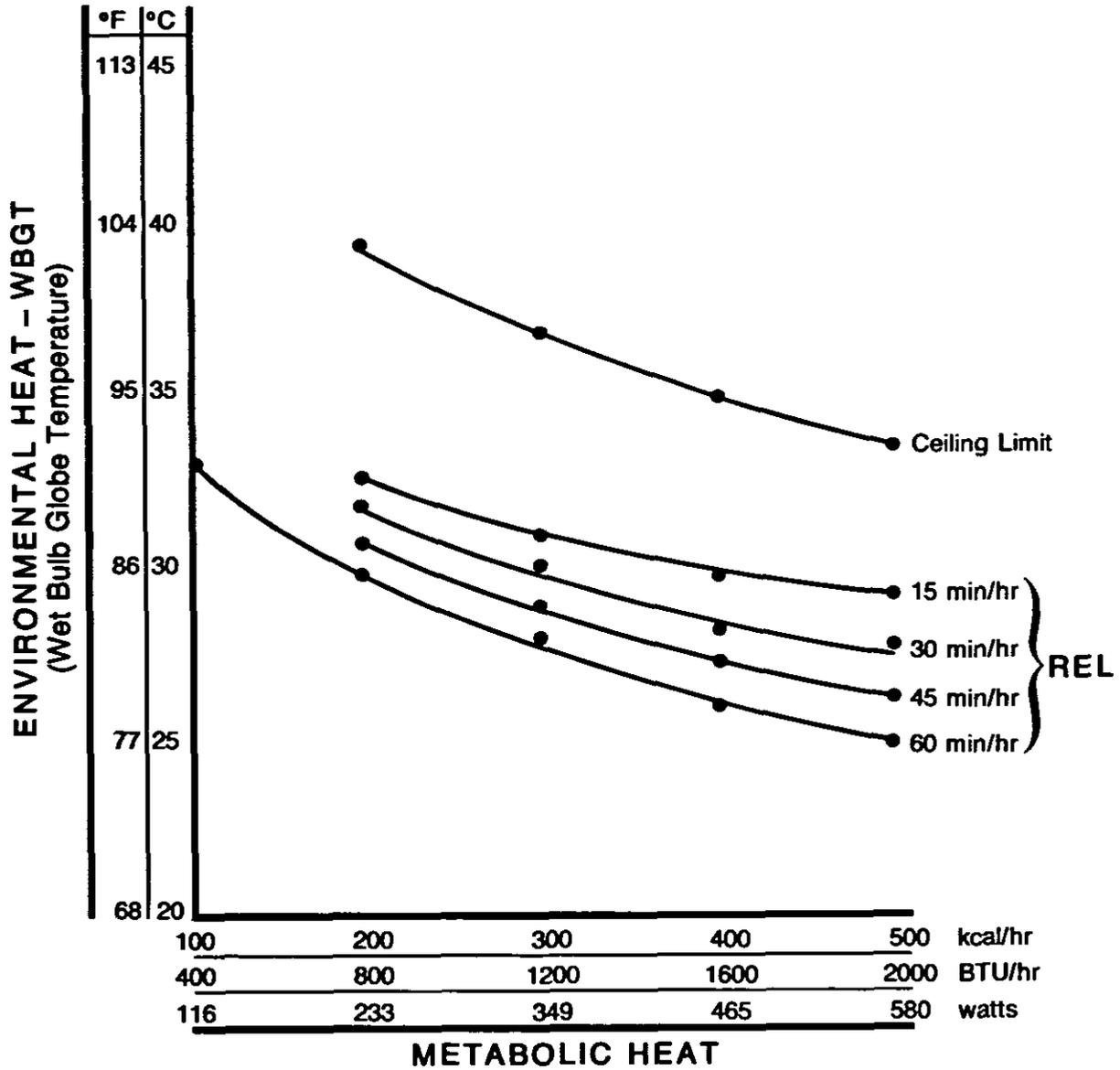


Figure 5-2. Recommended exposure limits (REL) for acclimatized workers. Data assume a standard worker having a body weight of 154 lb (70 kg) and a surface area of 19.4 ft² (1.8 m²). Adapted from NIOSH 1986a.

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Table 5-3. Approximate energy consumption of a standard* worker during various work tasks†

Activity or work task	Average kcal/hr
Body position and movement:	
Sitting	18
Standing	36
Walking on a level surface	150
Walking uphill	To 150, add 48 for every meter of rise
Type of work:	
Hand work:	
Light	24
Heavy	54
One-arm work:	
Light	60
Heavy	108
Two-arm work:	
Light	90
Heavy	150
Whole-body work:	
Light	210
Moderate	300
Heavy	420
Very heavy	540
Basal metabolism	60

*A standard worker is assumed to have a body weight of 154 lb (70 kg) and a surface area of 19.4 ft² (1.8 m²).

†Adapted from NIOSH 1986a.

Total metabolic heat is calculated using the following formula:

$$H_t = H_m + H_w + M_b$$

where H_t = total metabolic heat (kcal/hr)
 H_m = heat of movement (kcal/hr)
 H_w = heat of work (kcal/hr)
 M_b = basal metabolism (1 kcal/hr)

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For example, a worker who is standing and using both arms to perform a task would be producing metabolic heat as follows:

$$\begin{aligned}H_m \text{ standing} &= 36 \text{ kcal/hr} \\H_w \text{ for two arms} &= 150 \text{ kcal/hr} \\M_b &= 60 \text{ kcal/hr}\end{aligned}$$

Thus

$$H_t = 36 \text{ kcal/hr} + 150 \text{ kcal/hr} + 60 \text{ kcal/hr} = 246 \text{ kcal/hr}$$

The metabolic heat is used with the wet bulb globe temperature to determine exposure limits for work (Figures 5-1 and 5-2).

5.2.1.4 Environmental Monitoring

The most common and direct way of measuring heat exposure is with wet bulb and globe thermometers and the wet bulb globe temperature (WBGT) index. The WBGT index combines the effects of radiant heat and humidity with the dry bulb temperature. This method is inexpensive and simple (NIOSH 1986a).

5.2.1.5 Exposure Control Methods

A good source of general information on the health effects and control of occupational heat exposures is Criteria for a Recommended Standard: Occupational Exposure to Hot Environments (NIOSH 1986a). Listed below are some specific steps for reducing heat stress in hospital workers exposed to hot work areas (NIOSH 1986a; NIOSH 1986b):

- Schedule heavy work for the coolest part of the day and allow frequent rest breaks in cool areas.
- Isolate, enclose, and/or insulate hot equipment.
- Install exhaust ventilation to draw heat or steam away from the work area.
- Install reflective shielding where appropriate.
- Provide fans to increase sweat evaporation.
- Make cool water available.
- Provide cool areas for rest breaks and lunches.
- Train workers to recognize symptoms of heat stress.

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- Permit workers who are new or returning from vacation or illness to become acclimatized to the hot environment. Heat acclimatization can usually be accomplished in 5 to 7 days while working in a hot job (NIOSH 1986a).

5.2.2 Noise

Noise is any unwanted sound; it is created by sound waves, which are rapid vibrations in the air. Sound has three characteristics: frequency (pitch), amplitude (intensity), and perceived loudness. Frequency is measured in cycles per second, or Hertz (Hz), and sound intensity is measured in decibels (dB). The decibel scale is a logarithmic measure of intensity. When a sound increases by 10 dB, it is 10 times as intense and is perceived as being twice as loud. Loudness, unlike intensity, is a subjective perception of sound and cannot be measured by instrument.

5.2.2.1 Hazard Location

Exposure to high levels of noise in the workplace is one of the most common job hazards, and despite the popular image of hospitals as quiet zones, they can be noisy places. In a 1979 survey of noise levels in 26 hospitals, five work areas were identified as noisy enough to reduce productivity (Seidletz 1981): the food department, laboratory, engineering department, business office or medical records department, and nursing units.

5.2.2.2 Potential Health Effects

The ear changes air pressure waves into nerve impulses that the brain interprets as sound. Hair cells in the inner ear stimulate nerves that carry the message to the brain. Loud noise damages these nerves and decreases hearing acuity. This decrease is called a temporary threshold shift. Such shifts can be reversed if there is enough rest from high noise levels, but exposure to loud noise for many years leads to irreversible hearing loss. Very loud noises of short duration, such as gunfire, can cause a permanent hearing decrement.

Noise may also trigger changes in cardiovascular, endocrine, neurologic, and other physiologic functions, all of which suggest a general stress reaction. These physiologic changes are typically produced by intense sounds of sudden onset, but they can also occur under sustained high-level or even moderately strong noise conditions. Whether repeated noise-induced reactions of this type can ultimately degrade one's physical and mental health is still uncertain. There are some reports that show that prolonged exposure to high-level noise may lead to physiologic disorders in animals (NIOSH 1972).

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In addition to adverse health effects, work in high-noise areas makes it difficult for workers to communicate among themselves, either to relate socially or to warn others of impending danger (e.g., falling equipment or a slippery floor) or to concentrate on critical job functions.

5.2.2.3 Standards and Recommendations

The OSHA occupational exposure limit for noise is 90 dB measured on the A-weighted scale* (90 dBA) as an 8-hr TWA (29 CFR 1910.95). Because the noise exposure limit is time-weighted, the amount of time workers are permitted to spend in a noise exposure area varies according to the noise level, as follows:

<u>Hours of exposure per workday</u>	<u>Permissible noise level (dBA)</u>
8	90
6	92
4	95
3	97
2	100
1	105
0.5	110
0.25	115

For more detailed information on determining and complying with the OSHA noise standard, refer to 29 CFR 1910.95. This standard was amended in 1983 to require that employers document any worker exposures to noise levels equal to or greater than an 8-hr TWA of 85 dBA. If workers are exposed to higher noise levels, employers must administer a continuing hearing conservation program as cited in the OSHA standard. An important part of this program is the requirement for an audiometric testing program.

5.2.2.4 Environmental Monitoring

The OSHA publication Noise Control: A Guide for Workers and Employers (OSHA 1983) is a helpful guide for establishing a noise monitoring and control program. The standard sound level meter is the basic noise-measuring instrument; however, there are noise dosimeters that can measure the integrated (daily) noise exposure.

*The A-weighted scale approximates the frequency response of the human ear.

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5.2.2.5 Exposure Control Methods

5.2.2.5.1 Noise abatement programs

A noise survey should be made by trained personnel. If a worker's noise exposure exceeds the standard, a noise abatement program is required. Such a program should include periodic noise measurement, engineering and administrative controls, hearing protection for use while controls are being implemented, and annual audiometric testing.

5.2.2.5.2 Engineering controls

The goal of the hearing conservation program should be to develop engineering controls to reduce noise exposure. Engineering controls could include enclosure of noisy equipment, acoustical treatment of walls to reduce noise reflection, vibration damping of noisy machines, and replacement of metal-to-metal contact with synthetic material-to-metal contact. Administrative controls can also be used to limit a worker's exposure time to excessive noise.

5.2.2.5.3 Hearing protection devices

If engineering or administrative controls are not feasible, or if they are in the process of being implemented, hearing protection is required. Many forms of hearing protection are available, including ear muffs and ear plugs. Some are more effective than others depending on the noise level, frequency, and individual fit of the devices. Protection must be effective but reasonably comfortable.

5.2.2.5.4 Methods for reducing noise levels in various departments

5.2.2.5.4.1 Food department

The following methods can significantly reduce noise within the food department and still allow sanitary requirements to be met (Seidletz 1981):

- Mount table-top equipment on rubber feet or pads.
- Install sound-absorbent floor tiles.
- Isolate dishwashing areas when dishwasher noise cannot be reduced.
- Use acoustical ceiling tiles, wall hangings, and carpets to reduce cafeteria noise.

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- Place rubber matting on landing tables (for scraping dishes) and in the steam table area.
- Install sealing around doors.

5.2.2.5.4.2 Office areas

Noise levels in office areas generally average 68 to 75 dBA. The use of padding under typewriters and sound-absorbing wall hangings reduced noise levels by 13 to 18 dB (Seidletz 1981).

5.2.2.5.4.3 Engineering department

In engineering departments, noise levels range from 78 to 85 dBA, with short bursts as high as 100 dBA. Noise levels around hospital generators may reach 110 dBA. Significant noise reduction can be achieved by isolating the generator area and installing mufflers and using sound-absorbing materials wherever possible (Seidletz 1981).

5.2.2.5.4.4 Nursing units and laboratories

Noise in nursing units and laboratories results from sources such as the ventilation system, intercom system, door closings, telephones, food service carts, radios, televisions, and conversations among staff, patients, and visitors. The results of a hospital noise survey showed that noise levels interfered with speech during the day and with sleep at night (Turner et al. 1975).

Most noise in nursing areas and laboratories can be simply and economically eliminated by the following methods (Turner et al. 1975):

- Decrease the volume of intercom speakers, televisions, and radios.
- Lubricate wheels, hinges, and latches.
- Adjust closers on doors to prevent slamming.
- Use sound-absorbent materials wherever possible.
- Make the staff aware of noise problems and secure their cooperation.

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5.2.2.6 Medical Monitoring

As mentioned earlier, the OSHA noise standard (29 CFR 1910.95) requires audiometric testing (at least once a year) for all workers exposed to noise levels equal to or greater than an 8-hr TWA of 85 dBA.

5.2.3 Ionizing Radiation

5.2.3.1 Types of Ionizing Radiation

Ionizing radiation is part of the natural environment, and since the discovery of X-rays and radioactivity, it has become part of the work environment as well (NIOSH 1977d). Radiation is measured and defined as follows (SI units are given in the definitions):

- Curie. A measure of a substance's radioactivity.
1 curie (ci) = 3.7×10^{10}
disintegrations per second.
- Absorbed Dose. The amount of radiation that the body
absorbs.
- Exposure The amount of radiation to which the body
is exposed.
- Radioactive half-life. . The time required for the radioactivity of
an isotope to decrease by 50%.
- Rem (rem). Acronym for roentgen equivalent man--the
dosage of any ionizing radiation that will
cause biological injury to human tissue
equal to the injury caused by 1 roentgen
of X-ray or gamma-ray dosage. 1 rem =
0.01 sievert (SV).
- Millirem (mrem). 10^{-3} rem. 1 mrem = 0.01 mSV.
- Rad. Acronym for radiation absorbed dose--a
unit that measures the absorbed dose of
ionizing radiation. 1 Rad = 100 ergs/gm =
0.01 Gray (Gy).
- Roentgen Unit of measure for quantity of ionization
produced by X-radiation or gamma
radiation. 1 Roentgen (R) = 2.58×10^{-4}
coulomb/kg.

The different types of ionizing radiation vary in their penetrative powers as well as in the number of ions they produce while traversing matter.

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Ionizing radiation is produced naturally by the decay of radioactive elements or artificially by such devices as X-ray machines. A radioactive element is one that spontaneously changes to a lower-energy state, emitting particles and gamma rays from the nucleus in the process. The particles commonly emitted are alpha or beta particles. X-rays are produced when high-energy electrons strike the nuclei of a suitable target, such as tungsten. When these fast-moving electrons approach the electrical field around the nuclei of the target material, the electrons are deflected from their path and release energy in the form of high-energy electromagnetic radiation (X-rays).

Alpha particles usually have energies of 4 to 8 million electron volts (MeV). They travel a few centimeters in air and up to 60 microns into tissue. The high energy and short path result in a dense track of ionization along the tissues with which the particles interact. Alpha particles will not penetrate the stratum corneum of the skin, and thus they are not an external hazard. However, if alpha-emitting elements are taken into the body by inhalation or ingestion, serious problems such as cancer may develop. Radium implants (radium-226 and radium-222) are examples of alpha particle emitters that may be used in hospitals.

Beta particles interact much less readily with matter than do alpha particles and will travel up to a few centimeters into tissue or many meters through air. Exposure to external sources of beta particles is potentially hazardous, but internal exposure is more hazardous. Examples of beta-particle emitters are the isotopes carbon-14, gold-198, iodine-131, radium-226, cobalt-60, selenium-75, and chromium-51.

Protons with energies of a few MeV are produced by high-energy accelerators and are quite effective in producing tissue ionization. The path length of a proton is somewhat longer than that of an alpha particle of equivalent energy.

X-rays generally have longer wavelengths, lower frequencies, and thus lower energies than gamma rays. The biologic effects of X-rays and gamma rays are better known than those of any of the other ionizing radiation. X-rays may be encountered during the use of electronic tubes and microscopes. Examples of gamma emitters are cobalt-60, cesium-137, iridium-192, and radium-226.

5.2.3.2 Sources of Radiation Exposure

In the United States, natural radiation results in an estimated average dose of about 125 mrem each year (Hamilton and Hardy 1974). In 1973, NIOSH estimated that medical and dental irradiation of patients in diagnostic and therapeutic procedures produced an average dose of 50 to 70 mrem per person per year in addition to natural radiation (NIOSH 1973c).

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5.2.3.3 Hazard Location

Radiation exposure usually results from (1) the scatter of X-ray beams caused by deflection or reflection from the main beam, or (2) the emission of gamma rays by patients who are being treated with radionuclides or have therapeutic implants that emit gamma and beta radiation.

Ionizing radiation is used in the hospital for (1) diagnostic radiology, including diagnostic X-ray, fluoroscopy and angiography, dental radiography, and computerized axial tomography scanners (CAT scanners), (2) therapeutic radiology, (3) dermatology, (4) nuclear medicine in diagnostic and therapeutic procedures, and (5) radiopharmaceutical laboratories. A radiation hazard may also exist in areas where radioactive materials are stored or discarded. Radiation safety is usually well managed in diagnostic and therapeutic radiology units by the radiation protection officer. Staff in departments where portable X-rays are taken (operating rooms, emergency rooms, and intensive care units) are often inadvertently exposed and inadequately monitored for the effects of radiation exposure.

5.2.3.4 Types and Amounts of Radiation Exposure

The conditions presented by external radiation sources are entirely different from those presented by internal sources. Radiation can be deposited in the body as a result of accidental skin puncture or laceration and subsequent contact with radioactive material. Once inside the body, radionuclides can be absorbed, metabolized, and distributed throughout the tissues and organs. The extent of the effects of radiation on organs and tissues depends on the energy and type of radiation and its residence time in the body (biological half-life) and the radioactive half-life of the radioisotope. But the principal hazard presented by internal radiation sources is the continuous irradiation of cells.

The amount of external radiation received depends on the amount of radiation present, the duration of the exposure, the distance from the source to the worker, and the types of barriers between the source and the worker. The effects of radiation from external sources depend on the energy. Unless alpha and beta particles are inhaled or ingested, they are of little concern since they are low energy sources that do not penetrate the outer tissues. Gamma radiation is also rapidly attenuated.

Radiation workers in hospitals receive an annual average dose of radiation that ranges from 260 to 540 mrem. Twelve percent of dental personnel had an average annual exposure of 41 mrem, and 98% had exposures of less than 500 mrem (0.5 rem) (National Research Council 1980).

Nuclear medicine technicians who assist in many procedures during a single day may have higher exposures than others who handle radioactive materials. For example, technicians involved in nuclear cardiovascular studies can

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receive exposures of 2.5 mrem/hr (Syed et al. 1982). Radio-pharmaceuticals have been found contaminating the hands, wrists, lab coats, and urine of technicians and laboratory workers studied (Nishiyama et al. 1980).

Angiography is an activity of particular concern. Exposures during these procedures have ranged from 1 to 10 mrem inside the lead apron, and eye exposures have ranged up to 57 mrem (Santen et al. 1975; Kan et al. 1976; Rueter 1978).

5.2.3.5 Potential Health Effects

Radiation produces acute effects as well as delayed injuries. The degree of radiation damage depends on which organs and tissues are radiated. In general, the effects of radiation exposure are cumulative.

5.2.3.5.1 Acute effects

Occupational exposure to ionizing radiation is usually localized and can lead to erythema or radiodermatitis. An acute radiation syndrome episode occurs very rarely. Such an episode involves whole-body exposure exceeding 100 roentgens during a very short period. Persons with this syndrome usually suffer from nausea, vomiting, diarrhea, weakness, and shock. Following a latent period of 2 to 14 days, symptoms of fever and malaise occur and hemorrhagic lesions of the skin often appear. By the third week, epilation occurs. Internal and external ulceration may appear over the entire body, and bloody diarrhea may occur. Death may result from severe bone marrow depression if the radiation exposure level is high. If the person survives the toxic stage, recovery usually begins by the fifth or sixth week and is essentially complete after a long period (NIOSH 1977d).

A very high dose of radiation can produce symptoms of cerebral edema within minutes and death within 24 hr.

5.2.3.5.2 Chronic effects

Evidence continues to accumulate that low levels of radiation can cause biological damage. Researchers differ over the amount of radiation that is hazardous, but any amount of radiation is assumed to involve some risk. Workers should therefore avoid any radiation exposure. Variables such as age, sex, cigarette smoking, genetic makeup, state of health, diet, and endocrine status may modify the effects of ionizing radiation.

Ionizing radiation can cause gene mutation and chromosomal alteration; it can also delay or impair cell division and interfere with metabolic processes. Cells that normally divide rapidly (e.g., the blood-forming

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tissues, skin, gonads, and eye lenses) are usually more severely affected than the slower-dividing cells (e.g., the bones, endocrine glands, and nervous system).

Other somatic effects that result from irradiation include several types of cancers (myelogenous leukemia, bone, skin, and thyroid in children), lung and kidney fibrosis, lens opacities (cataracts), aplastic anemia, sterility, radiodermatitis, and shortened life span resulting from accelerated aging.

Prenatal radiation exposure may result in prenatal death from leukemia and morphological abnormalities in the developing nervous system or other organ systems. Sex-ratio changes have been noted. Doses of 10 to 19 rem received by human fetuses have been shown to produce small head size; doses above 150 rem have been associated with mental retardation (Beebe 1981; Meyer and Tonascia 1981).

5.2.3.6 Standards and Recommendations

OSHA has a standard for ionizing radiation (29 CFR 1910.96) that is intended to protect those workers not covered by the Nuclear Regulatory Commission (NRC) in 10 CFR 20. Several other agencies also have the authority to set and enforce standards and other measures to protect workers from radiation exposure (see Table 5-4). The National Council on Radiation Protection and Measurements (NCRP) was created by Congress in part to collect, analyze, develop, and disseminate information and recommendations about radiation measurements, quantities, and units. In 1971, the NCRP recommended maximum permissible dose equivalents of ionizing radiation during occupational exposure (NCRP 1975). The annual permissible dose for total body exposure is 5 rem per year, with 3 rem permitted within a 13-week period. The basic goals of the NCRP radiation dose limits are to prevent injuries such as cataracts and erythema and to reduce the probability of cancer. An exposure equivalent to 5 rem per year for the whole body or for certain organ systems is believed to permit a lifetime occupational exposure without reaching an injurious level. Specific limitations exist for dosages to various parts of the body such as the head, arms, hands, and trunk. In addition, the dose limit for the fetus of an occupationally exposed woman is 0.5 rem for the entire gestation period (NCRP 1977).

Under the Federal Food, Drug, and Cosmetic Act and other laws, the U.S. Food and Drug Administration (FDA) has the authority to regulate the manufacture and distribution of radiopharmaceuticals and medical devices containing radioactive materials. FDA shares this authority with the Nuclear Regulatory Commission (NRC), which has similar powers when the drugs or devices contain materials governed by the Atomic Energy Act. The two agencies have worked together in the development of regulations. The FDA's National Center for Devices and Radiological Health sets basic performance standards for X-ray machines and other radiation-emitting electronic products manufactured after 1974. The standards ensure that the products emit the smallest amount of radiation consonant with effective operation.

Table 5-4.--Standards for exposure to ionizing radiation*

Type of standard	Federal Radiation Council	National Council on Radiation Protection and Measurements (NCRP #39)	Nuclear Regulatory Commission (10 CFR 20)	OSHA (29 CFR 1910.96)
Radiation worker:† Whole body	5 rem/year, 3 rem/quarter, not to exceed the cumulative lifetime limit	5 rem/year, 3 rem/quarter, not to exceed the cumulative lifetime limit	5 rem/year, 3 rem/quarter, not to exceed the cumulative lifetime limit	3 rem/quarter
Cumulative life-time limit	5(N-18) rem§	5(N-18) rem	5(N-18) rem	5(N-18) rem
General population, individual, whole body	0.5 rem/year	0.5 rem/year	0.5 rem/year	---

*Adapted from ACGIH (1986), Documentation of the threshold limit values. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
 †Workers in the radiation department or other job categories potentially exposed to ionizing radiation.
 §N-18 = age of worker minus 18 years.

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FDA also issues recommendations for the use of X-ray machines and other radiation emitters, conducts education programs, and assists the States with their activities. Title 10 of the Code of Federal Regulations contains the NRC rules on isotope sources (10 CFR Parts 20 and 34) and Title 21 for the FDA regulations on X-ray machines (21 CFR Parts 1,000 and 1,050). Many States have executed agreements with the Federal Government to assume responsibility for regulation of radiation sources in their States.

The JCAHO requires that a professional health physicist be available on the staff or as a consultant in any hospital with radiology equipment (JCAH 1979).

5.2.3.7 Exposure Control Methods

The amount of protection needed for a particular source of X-rays or gamma rays depends on the energy of the radiation and the length of time it will be in use (Parmeggiani 1983). The chief methods for reducing doses from external X-rays and gamma rays are to limit the time of exposure, increase the distance from the source of exposure, shield the source with protective material, and avoid unnecessary exposures. Improved equipment, knowledge, and reduced exposures have greatly reduced the risk for radiation workers.

5.2.3.7.1 Radiation protection officer

Reducing radiation exposure to personnel requires an integrated program directed by a radiation protection officer. This officer is responsible for all aspects of radiation safety in the hospital and should be available or on call at all times. The telephone number should be posted wherever radiation or radioactive materials are used. One of the functions of the radiation protection officer is to monitor workers and patients to ensure that applicable radiation exposure limits are not being exceeded. The officer must therefore devise a radiation monitoring program for both workers and patients to ensure that appropriate controls are implemented (NCRP 1976). The officer must also maintain an inventory and monitor the flow of radioactive materials entering and leaving the hospital. Training in the handling of radioactive materials is also the function of the radiation protection officer. This activity should begin with an intensive education program and should include information on equipment maintenance, personnel monitoring, and documentation. A successful program can reduce most personnel exposures to well below 0.5 rem per year (Laughlin 1981).

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5.2.3.7.2 Recordkeeping

The following records should be kept:

- Personal radiation exposures
- Radioisotope inventory
- Receipt and disposition log
- Radiation survey reports

Recordkeeping requirements of the Nuclear Regulatory Commission are published in 10 CFR 20.401.

5.2.3.7.3 Protective equipment

No part of the body should be directly exposed to radiation. If there is a danger of exposing a body part, appropriate protection must be used. Lead aprons, gloves, and goggles should be worn by workers located in the direct field or in areas where radiation levels from scattering are high. All protective equipment should be checked annually for cracks in the lead and other signs of deterioration. For consistently elevated exposure (such as that occurring during angioplasty), a thyroid shield and leaded glasses are recommended.

5.2.3.7.4 General control measures for radiation exposure

The following measures should be taken to reduce occupational radiation exposure in hospitals:

- Properly mark any rooms housing radiation sources; allow only authorized personnel in the area.
- Enclose all radioactive materials.
- Maintain effective contamination control boundaries around all sources.
- Locate X-ray controls to prevent the unintentional energizing of the unit.
- Check all X-ray machines before each use to ensure that the secondary radiation cones and filters are in place.
- Keep X-ray room doors closed when equipment is in use.
- Equip treatment rooms with radiation monitors, door interlocks, and visual alarm systems.

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- In therapeutic radiology settings, check system calibration periodically with lithium fluoride solid state dosimeters.
- Permit only the patient and trained personnel in the room where portable X-ray units and radioisotopes are used. Provide adequate warning to nearby workers when portable X-rays are about to be taken.
- Clearly identify patients who have received radioactive implants or other therapeutic radiology procedures.
- Follow correct decontamination procedures when control methods fail.
- Lead aprons, gloves, and goggles should be worn by workers located in the direct field or in areas where scatter radiation levels are high.
- Check all protective equipment annually for cracks in the lead.
- Use a thyroid shield and leaded glasses for consistently elevated exposure (such as that occurring during angioplasty).
- Prevent radiation exposure of pregnant workers.

5.2.3.7.5 Control measures for radioactive materials

Unlike X-rays, radioactive materials may be widely used throughout the hospital. They may be present in laboratories or in any place where patients are examined or cared for. Various precautions are needed when using radioactive materials--not only to avoid undue exposure to the radiation, but also to prevent these materials from contacting the skin or entering the body through cuts or injuries. To protect workers from radionuclides, attention must be paid to methods of handling them and to the laboratories where they are used. This section contains information to help minimize radiation exposure during diagnostic, therapeutic, and laboratory procedures.

5.2.3.7.5.1 Diagnostic procedures

The purpose of diagnostic procedures is to determine an organ's shape and how it is functioning. Most diagnostic procedures use small amounts of radioactive materials with short half-lives. Thus patients who are receiving such materials pose little risk of exposing others. Workers who must handle patients receiving diagnostic radioactive materials should observe the following precautions:

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- The radiation protection officer should monitor all diagnostic procedures to ensure that radioactive materials (including radioactive urine or fecal material) are handled properly (NCRP 1976).
- Waterproof gloves should be worn during the collection or transfer of radioactive urine or fecal material and during the cleaning of bedpans, urinals, or other contaminated items (NCRP 1976).
- Urine and feces of these patients may be discarded through the sanitary sewer (Stoner et al. 1982).
- Materials that contact radioactive liquids (e.g., syringes) should be regarded as radioactive and disposed of accordingly (see Section 6) (Stoner et al. 1982).
- When small quantities of radioactive gases are administered to patients, the expired gases should be exhausted through a shielded duct system that is vented at the top of the building at a safe distance from the building's air intake (Stoner et al. 1982).

5.2.3.7.5.2 Therapeutic procedures

The proper control of radioactivity during therapeutic procedures depends on the class of radioactive procedure being used (NCRP 1976):

- Class A -- Procedures in which radioactive materials are administered by mouth.
- Class B -- Procedures in which radioactive materials are injected into body cavities.
- Class C -- Procedures in which radioactive materials are injected into tumors and left there permanently.
- Class D -- Procedures used to deliver radiation at distances of up to a few centimeters (brachytherapy).

Workers involved in the care of patients who have undergone any of these therapeutic procedures should receive a sheet of specific instructions on proper patient care (see NCRP 1970 for details). Workers should adhere to the following guidelines when caring for patients who have been treated therapeutically with radioactive material (NCRP 1976):

- The radiation protection officer should establish limits for the time that any individual should spend with the patient.

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- A "radioactivity precautions" tag should be attached to the patient, the chart, and the bed.
- Workers should enter the patient's room to perform normal hospital duties, but they should not spend time visiting or performing nonvital personal services without authorization.
- Patients should be asked to care for themselves insofar as possible.
- Visitors may call, but they should stand at least 6 ft from the patient. Visits should be limited to 1 hr and should not include pregnant women or children.
- Pregnant workers should not be assigned to the routine care of radioactive patients.
- The radiation protection officer and the physician in charge should address all questions about the handling or disposal of contaminated clothing or instruments.

Patients who have undergone Class A procedures (radioactive material administered by mouth) may contaminate items such as linen, clothing, food utensils, and skin. In such an event, the radiation protection officer should be notified immediately. Patient care orders should provide special instructions for dealing with spilled urine, vomitus, excretion, or other body fluids. After a Class A procedure, the urine of patients may be collected during the first 24 to 48 hr for determination of radioactivity. If urine is not collected, the patient may use the regular toilet facilities (NCRP 1976).

Patients who have undergone Class B procedures (radioactive material injected into body cavities) may emit high energy gamma radiation or may be the source of contaminated surgical dressings or bandages. The latter should be changed only as directed by the physician in charge, and surgical gloves should be used to handle such materials. If the dressings are stained or bloody, they should be handled with forceps or tongs, and the physician in charge and the radiation protection officer should be notified immediately (NCRP 1976).

Patients who have undergone Class C procedures (radioactive material injected into tumors) may emit appreciable amounts of radiation for some time (NCRP 1976). The NCRP guidelines listed above in this subsection should be followed for such patients.

Patients who have undergone Class D procedures (brachytherapy) contain removable radioactive tubes or needles and present the greatest potential hazards. The exposure rate is likely to be considerable a few feet from the

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patient, and lead-impregnated aprons and gloves offer virtually no protection against high-energy gamma radiation. The NCRP has developed guidelines that should be followed for such patients (NCRP 1976):

- Nurses frequently assisting the physicians who implant radioactive tubes or needles should be designated as radiation workers. They should wear radiation monitors if the possibility exists for receiving one fourth of the permissible dose for radiation workers.
- Radioactive sources must be delivered to the operating room in lead-shielded containers by a worker responsible for proper handling and disposition of the material.
- No person should stand closer than necessary to the radioactive material either before or after its introduction into the patient.
- Any worker attending the patient after the operative procedure should stay as far as possible from the patient. Workers who attend such patients frequently may need to be classified as radiation workers.
- Nonhospital personnel should not be permitted to ride in elevators with such patients.
- X-rays of such patients should be completed as quickly as possible to avoid exposures of others in the area and to prevent fogging of X-ray film.
- These patients should remain in their own rooms unless other orders are issued.
- Linens, clothing, and bed pans should be checked regularly for radioactive tubes or needles that may have fallen out of the patient.
- If the patient's packing or dressing seems disturbed, the physician in charge should be notified, and the room should be checked for the presence of a tube, needle, or application device.
- If a radioactive capsule, needle, or other application device is loose or falls out, it should be picked up gently with forceps and placed in a container in the patient's room. Both the radiation protection officer and the physician in charge should be contacted immediately.

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- Workers should limit the time they spend with these patients to that necessary for proper nursing care. The radiation protection officer should determine a work schedule and nursing assignments to minimize exposure.
- Bed baths should be omitted as long as the radioactive material is in place, and perineal care should not be given to gynecological patients.
- Only the attending physicians or their delegates should change dressings or bandages covering an area of insertion. Dressings should be safely stored while awaiting disposal.
- No special precautions are needed for vomitus, sputum, urine, feces, or eating utensils.
- When a radioactive source is removed from the patient, it should be returned to the worker who has been assigned the responsibility for its disposition.

5.2.3.7.6 Control measures for radiological procedures

5.2.3.7.6.1 Diagnostic procedures

Before X-ray equipment is used, the radiation protection officer should take the following steps (NCRP 1976):

- Conduct a complete radiation survey to ensure that walls and other barriers are sufficiently protective.
- Ensure that all equipment complies with applicable regulations and is in proper working order.
- Survey all adjacent floors and rooms.
- Designate certain areas as radiation areas with restricted occupancy.

Guidelines for general radiographic procedures (including mammography and dental radiology) are as follows (NCRP 1976):

- Only patients are allowed in unshielded areas when X-rays are generated.
- All X-ray technicians must be inside a shielded booth or behind a protective screen.

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- Avoid using any person to hold or restrain a patient undergoing diagnostic radiology. If such restraint is necessary, efforts should be made to limit the number of times any worker performs this duty. A family member should be used if possible. Any such assistant should be provided with a protective apron and gloves and positioned to minimize direct exposure to the X-ray beam.
- When portable X-ray machines are used, the operator should be located at least 6 ft from the patient. Anyone assisting in the procedure should wear protective equipment.

Fluoroscopy and angiography require the presence of a number of personnel, all of whom should be aware of the basic principles of radiation protection and should take the following precautions (NCRP 1976):

- Protective devices supplied with the equipment (e.g., lead drapes, protective pull-up panels, etc.) should be used whenever possible.
- Special shielding devices should be devised when a number of patients are to be examined with the same physical set-up.
- Persons not required to attend the patient should stand back as far as possible or behind a protective shield.

All recommendations for control of radiological procedures should also be followed by radiation workers in animal laboratories.

5.2.3.7.6.2 Therapeutic procedures

No radiation is emitted from X-ray machines, linear accelerators, or betatrons until they are turned on. Workers may therefore enter treatment rooms without fear of exposure, but they must leave before the equipment is switched on. When radioactive cobalt or cesium is used for therapy, a low level of radiation is present at all times. When therapeutic procedures are performed, the following precautions should be implemented:

- The radiation protection officer must ensure that all workers are aware of the potential hazard and methods for minimizing exposures.
- Equipment used in radiation therapy should be checked for leaks at least once every 6 months and records should be maintained on the equipment's use, maintenance, and any malfunctions.
- Treatment rooms should be equipped with radiation monitors and an alarm system to indicate high levels of radiation and to prevent the door from being opened during treatment.

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5.2.3.7.7 Control measures for laboratories

The following measures should be taken to control radiation exposures in laboratories (NCRP 1976):

- Accurate records must be maintained for radioactive materials used in the laboratories.
- All laboratory personnel must be trained in proper handling, use, and disposal of radioactive materials.
- Laboratory workers should not eat, drink, smoke, or apply cosmetics in the laboratory.
- Workers should remove any protective clothing, including laboratory coats, before leaving the laboratory.
- The radiation protection officer should conduct periodic surveys of the laboratory and keep records of the results.
- In addition to the surveys by the radiation protection officer, the laboratory worker should check counters, floors, and other work areas for contamination.
- The radiation protection officer should be called in the event of a spill of radioactive material.
- When radioactive materials are used in research with animals, any fluids or wastes should be handled and disposed of as radioactive materials.

5.2.3.7.8 Procedures following the death of a patient containing therapeutic amounts of radioactive material

The NCRP offers detailed procedures for handling the bodies of patients containing radioactive materials (NCRP 1970). General procedures are as follows (NCRP 1976):

- The radiation protection officer must be notified immediately when such a patient dies.
- The attending physician is responsible for the removal of brachytherapy sources and applicators.
- A report describing the nature and extent of the radioactive material used should accompany the body.

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- The radiation protection officer should be contacted before an autopsy is performed on any body containing radioactive material.
- All personnel involved in such an autopsy should wear protective clothing.
- Tissues and fluids from such an autopsy should be disposed of as radioactive materials.

5.2.3.8 Environmental Monitoring

Dosimeters should be worn by all personnel exposed to sources of ionizing radiation. Two types of dosimeters are used to monitor ionizing radiation exposure--film and thermoluminescent dosimeters. Both are acceptable, but the thermoluminescent dosimeter is becoming more widely used because of the relative ease of processing. Wearing one film badge under the apron and one over the apron at the collar level will allow evaluation of both whole-body exposure and head and neck exposure. The pocket ionization chambers that can be worn and read daily are not acceptable for compliance purposes.

A dosimetry program should include:

- Regular analysis and recording of the results
- A program for informing workers of their measured exposure
- Laboratories that have a good quality control program

5.2.3.9 Medical Monitoring

All radiation workers should have preplacement and periodic examinations. These should include a complete blood count and differential white blood count, an eye examination, a history of previous radiation exposure, and a reproductive history.

The NRC regulatory guide entitled Instruction Concerning Prenatal Radiation Exposure may be helpful in assessing potential risks to women considering pregnancy (NRC 1975).

5.2.4 Nonionizing Radiation

Nonionizing radiation does not have enough energy to ionize atoms, but it vibrates and rotates molecules, causing heating. Nonionizing

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radiation is classified by frequency, which is stated in units of hertz (Hz). The following types of nonionizing radiation may be present in the hospital environment: ultraviolet (UV), visible (including lasers), infrared (IR), radiofrequency (RF)/microwave, and ultrasound.

5.2.4.1 UV Radiation

5.2.4.1.1 Hazard location

UV radiation may be emitted from germicidal lamps, some dermatology treatments, nursery incubators, and some air filters in hospitals.

5.2.4.1.2 Potential health effects

Over-exposure may result in the burning of exposed skin and serious eye effects. Eye exposure is especially dangerous because the results of over-exposure are not immediately evident. Damage is apparent only 6 to 8 hr after exposure. Although resulting conjunctivitis can be extremely painful, it is usually temporary. Long-term unprotected exposure can lead to partial loss of vision, accelerated skin aging, and increased risk of skin cancer (NIOSH 1977b).

5.2.4.1.3 Standards and recommendations

No OSHA standard exists for UV radiation exposure, but NIOSH has made recommendations for UV light in the spectral region of 200 to 400 nanometers (nm). For the spectral region of 315-400 nm, NIOSH recommends that the total amount of UV radiation allowed to strike unprotected skin or eyes (based either on measurement data or on output data) be no greater than 1.0 milliwatt (mW)/cm² for periods greater than 1,000 sec; for exposure times of 1,000 sec or less, the total radiant energy must not exceed 1,000 mW·sec/cm² (1.0 joule/cm²) (NIOSH 1973b). For the UV spectral region of 200 to 315 nm, the total amount of UV radiation allowed to strike unprotected skin or eyes should not exceed the levels described in the NIOSH criteria document for UV radiation (NIOSH 1973b).

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The following recommendations were developed by ACGIH (1987):

<u>Duration of exposure per day</u>	<u>Effective irradiance, ($\mu\text{W}/\text{cm}^2$)</u>
8 hr	0.1
4 hr	0.2
2 hr	0.4
1 hr	0.8
30 min.	1.7
15 min.	3.3
10 min.	5
5 min.	10
1 min.	50
30 sec.	100
10 sec.	300
1 sec.	3,000
0.5 sec.	6,000
0.1 sec.	30,000

5.2.4.1.4 Exposure control methods

The best preventive approach to UV exposure in hospital settings including newborn and intensive care nurseries is to provide a strong educational program and to issue protective glasses for potentially exposed workers. The use of shaded glass is usually sufficient to prevent damage to the eyes. Enclosures and shielding may also be used.

5.2.4.2 Visible Radiation

Sources of visible radiation in the hospital include incandescent and fluorescent lighting and lasers.

5.2.4.2.1 Incandescent and fluorescent lighting

5.2.4.2.1.1 Potential health effects

Constant exposure to glare from hospital lighting may result in visual fatigue and headaches. These effects are temporary and produce no known lasting physiological changes.

5.2.4.2.1.2 Standards and recommendations

No OSHA standard or NIOSH recommendation exists for exposure to visible radiation.

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5.2.4.2.1.3 Exposure control methods

Glare from visible radiation sources can be reduced by properly positioning equipment, filters, or shields; routine rest periods are also helpful.

5.2.4.2.2 Lasers

Lasers (light amplification by stimulated emission of radiation) emit electromagnetic radiation in either the UV, IR, or visible spectrum. The wavelength and frequency of the emitted light depend on which spectrum is used. In the biomedical field, the laser has been used for microsurgery and for measuring immunoglobulins and other elements in the blood. Lasers are becoming increasingly popular in surgery.

5.2.4.2.2.1 Hazard location

The most typical locations for lasers in the hospital are in radiology departments where they are used to help align patients for radiographic treatment and surgical areas where they have a wide variety of applications.

5.2.4.2.2.2 Potential health effects and safety hazards

Lasers cause damage because they focus large amounts of light energy on a small surface area. The eyes and skin are the organs most susceptible to damage by lasers (NIOSH 1977b).

The cornea and lens of the eye can focus the light from a laser of visible wavelength so that the light energy may cause lesions because it is more concentrated when it strikes the retina. In some cases, the damage to the retina is not reversible. The light from UV lasers may also cause damage by heating the surfaces of tissues and denaturing proteins.

When lasers strike the skin, the effects may range from erythema to blistering and charring. The extent of the damage depends on the wavelength, power, and duration of exposure. Because lasers use voltages as high as 15,000 V, they present a potential electrocution hazard.

5.2.4.2.2.3 Standards and recommendations

No OSHA standards exist for exposure to lasers, but their performance is regulated by the U.S. Food and Drug Administration (FDA) Bureau of Radiological Health under 21 CFR 1040. This regulation should be consulted when lasers are used. In the regulation, FDA has identified the following four classes of lasers that have been summarized by Stoner et al. (1982) as follows:

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Class 1: Lasers that are incapable of producing a damaging radiation level. (These are exempt from control measures.)

Class 2: Lasers that may be viewed directly under carefully controlled exposure conditions. (These must bear a precautionary label.)

Class 3: Lasers that require control measures to prevent direct viewing and subsequent eye damage.

Class 4: Lasers that must be controlled to prevent eye and skin damage.

ANSI also provides guidelines for the safe use of lasers (ANSI 1973), and ACGIH has published recommendations for occupational exposure to laser radiation (ACGIH 1986).

5.2.4.2.2.4 Exposure control methods

The primary means of worker protection is the use of effective eye protection and shielding of high-energy beams. When selecting eye protection, care must be taken to ensure that the filtering characteristics of the glass are appropriate for the laser being used. Protective glasses should be mounted in goggle-type frames to ensure that the eyes are protected from the side as well as the front. Each pair of goggles should be clearly marked to show the type of laser they are to be used for. Protective glasses should be checked regularly for cracks in the glass or deterioration of the frame. Hand protection should also be worn when working in or near the target area. Extreme care should be taken to ensure that the laser beam is not focused on any reflective surfaces. Special care should be taken with carbon dioxide lasers because of their invisible beams. In all cases, dry cloth, paper, or other flammable materials should not be located near the beam.

NIOSH recommends that a laser safety officer be appointed in facilities where lasers are used extensively. The laser safety officer should be responsible for developing the laser safety program and ensuring the proper maintenance of equipment.

5.2.4.2.2.5 Medical surveillance

Workers who are exposed to lasers should receive a periodic examination of the eyes and skin.

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5.2.4.3 IR Radiation

5.2.4.3.1 Hazard location

All objects with temperatures above absolute zero (-273°C, or -459.67°F) emit IR radiation, which increases as a function of the object's temperature. In humans and animals, the major IR insult occurs as a result of a temperature rise in the absorbing tissue (NIOSH 1977b). Exposure to IR radiation in hospitals may occur during the use of heating or warming equipment in the kitchen and during procedures involving lasers or thermography.

5.2.4.3.2 Potential health effects

The hazards associated with exposure to IR radiation are acute skin burns, increased vasodilation of the capillary beds, and an increased pigmentation that may continue for some time. Continued exposure may result in eye damage. Where highly intense and compact sources of radiation are used, an injury may occur fractions of a second before the pain is evident.

5.2.4.3.3 Standards and recommendations

No OSHA standard or NIOSH recommendation exists for occupational exposure to IR radiation.

5.2.4.3.4 Exposure control methods

Eye protection with proper filters should be provided to workers for use in areas with IR radiation. Shielding and enclosures may also be used to control exposures.

5.2.4.4 RF/Microwave Radiation

5.2.4.4.1 Hazard location

Numerous applications exist in the hospital environment for RF/microwave radiation. These applications include heating in diathermy, cancer therapy, thawing of frozen organs for transplantations, sterilization of ampuls, and enzyme inactivation in tissues of experimental animals. Microwave ovens are also used to heat food.

5.2.4.4.2 Potential health effects

RF/microwave radiation may produce some adverse biological effects from the heating of deep body tissues (NIOSH 1979c). As a result of this heating,

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potentially damaging alterations may be produced in cells. Some concern also exists for nonthermal effects. Effects associated with RF/microwave radiation include neurological, behavioral, and immunological changes.

RF/microwave radiation effects that are due to heating have been well documented in animals, but evidence is incomplete and in dispute for those effects occurring without an increase in tissue temperature. Thermal effects are in direct proportion to the field strength or power density. When the amount of heat generated from the absorbed energy is too great to be released into the surrounding environment, the temperature of the body gradually increases and can lead to heat stress.

A large body of literature addresses the various aspects of animal and human exposures to RF/microwaves. Most of the animal studies have investigated the thermal effects of RF/microwave radiation. The reports of human effects consist of a series of clinical and epidemiologic investigations into the association between RF radiation and damage to the eyes, central nervous system, and reproductive capability. Firm associations between RF radiation and these effects have not been demonstrated. A complete discussion of this literature is beyond the scope of this document.

5.2.4.4.3 Standards and recommendations

The OSHA standard for exposure to microwaves is 10 mW/cm². Both ANSI and ACGIH have published guidelines for occupational exposure to RF/microwave radiation (ANSI 1981; ACGIH 1986). FDA's Bureau of Radiological Health has set a limit of 5 mW/cm² for leakage from microwave ovens during normal use (21 CFR 1030.10).

5.2.4.4.4 Environmental monitoring

Leakage from diathermy equipment should be monitored in the proximity of the applicator before each treatment. Microwave ovens should be checked at least every 3 months; leakage can be checked easily with a small, hand-held instrument.

5.2.4.4.5 Exposure control methods

Any area where RF/microwave radiation exposure exceeds permissible levels should be considered potentially hazardous. The area should be clearly identified, and warning signs should be posted. Interlocks may be used to prevent unauthorized entry. Basic protective measures include the provision of shields or absorbing enclosures for equipment. Personal protective equipment may be used (e.g., gonad shields, protective suits, and wire-netting helmets). Although special protective goggles have been developed, they may not provide sufficient protection.

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5.2.4.5 Ultrasound

5.2.4.5.1 Hazard location

Ultrasound is the mechanical vibration of an elastic medium that is produced in the form of alternating compressions and expansions. The vibration may be produced by continuous or impulse sound in the form of a sequel of interrupted vibrations. The medical uses of ultrasound include therapeutic, surgical, and diagnostic procedures.

5.2.4.5.2 Potential health effects

Although exposure to ultrasound does not appear to pose a human health risk, exposure to audible high-frequency radiation above 10 kHz can result in a syndrome involving nausea, headaches, tinnitus, pain, dizziness, and fatigue. Temporary hearing loss and threshold shifts are also possible from high-frequency ultrasound radiation.

Low-frequency ultrasound radiation may produce local effects when a person touches parts of materials being processed by ultrasound. The hands are often involved in the area where ultrasound acts most strongly. Exposure to powerful sources of ultrasound may result in damage to peripheral nervous and vascular structures at the points of contact. Airborne ultrasound vibration may produce effects on the central nervous system and on other systems and organs through the ear and through extra-auditory routes.

5.2.4.5.3 Standards and recommendations

No OSHA standard or NIOSH recommendation exists for ultrasound. ACGIH has proposed the following TLVs for permissible exposure to airborne upper sonic and ultrasonic acoustic radiation (ACGIH 1987):

<u>Mid-frequency of third-octave band (kHz)</u>	<u>One-third octave-band level in dB re 20 μPa</u>
10	80
12.5	80
16	80
20	105
25	110
31.5	115
40	115
50	115

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5.2.4.5.4 Exposure control methods

Exposure to ultrasonic vibration can be reduced by the use of enclosures and shields. Sound-isolating panels on ultrasonic equipment should be free of any openings and should be isolated from the floor by rubber seals. Workers operating or repairing ultrasonic equipment should be provided with appropriate protective equipment that is selected based on the task being performed and the likelihood of exposure to radiation above 10 kHz or to contact with low-frequency sources.

5.2.4.6 Video Display Terminals

5.2.4.6.1 Hazard location

Video display terminals (VDT's) have rapidly replaced other word processing and data management systems in many hospital departments.

5.2.4.6.2 Potential health effects

VDT's are a frequent source of worker complaints. Eyestrain, back, neck, and arm discomfort, and symptoms of stress have all been associated with VDT work. These problems may be controlled or improved with ergonomic measures such as adjusting the position of the screen and keyboard, the chair, the lighting and glare, the color contrast, and the frequency of rest periods. Whether long-term VDT use causes significant visual dysfunction or degeneration is unknown. Extensive radiation measurements and health data have indicated that VDT's do not appear to present a radiation hazard to the operators (Pomroy and Noel 1984) or to the developing fetuses of pregnant operators (NIOSH 1984a). However, clusters of miscarriages and birth defects have been reported among VDT operators and warrant further investigation (NIOSH 1984a).

5.2.4.6.3 Recommendations

NIOSH studies have resulted in a report entitled Potential Health Effects of Video Display Terminals (NIOSH 1981h), which contains specific recommendations for the installation, maintenance, and use of VDT's. NIOSH recommends the following general guidelines for VDT work (NIOSH 1984a):

- Workstation design: VDT units, supporting tables, and operator chairs should be designed with maximum flexibility. VDT's should have detachable keyboards, and work tables should be adjustable for height. Chairs should be adjustable for height and should provide proper back support.

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- **Illumination:** Sources of glare should be controlled through VDT placement (i.e., parallel to windows, and parallel to and between lights), proper lighting, and the use of glare-control devices on the VDT screen surface. For VDT tasks requiring screen-intensive work, illumination levels should be lower than those needed when working with hard copy, which may require local lighting in addition to normal office lighting.
- **Work regimens:** Continuous work with VDT's should be interrupted periodically by rest breaks or other work activities that do not produce visual fatigue or muscular tension. As a minimum, a break should be taken after 2 hr of continuous VDT work. Breaks should be more frequent as visual, mental, and muscular burdens increase.
- **Vision testing:** VDT workers should have visual testing before beginning VDT work and periodically thereafter to ensure that they have adequately corrected vision to handle such work.

5.3 MUTAGENS AND TERATOGENS

5.3.1 Introduction

Measures for locating mutagens and teratogens, controlling worker exposures, and conducting medical surveillance of exposed workers are also discussed by specific agent in Section 4 and in the other subsections of Section 5.

Health care workers may be exposed to a number of agents that are considered to be mutagenic or teratogenic. These agents include the following (Yager 1973):

- **Biological agents**
 - Rubella virus
 - Cytomegalovirus
 - Hepatitis B virus
- **Chemicals**
 - Ethylene oxide
 - Organic solvents
- **Pharmaceuticals**
 - Anesthetic gases
 - Antibiotics
 - Cytotoxic drugs
- **Physical agents**
 - Ionizing radiation

5.3.2 Effects of Exposure

Estimates indicate that up to 4 million women employed in hospitals may be exposed to reproductive hazards (Kooker 1987). Lists of teratogenic agents present in the hospital environment have been compiled by Beckman and Brent (1986) and Schardein (1985). Despite the presence of known human teratogens in the hospital, there is no clear evidence that exposure conditions in hospitals have resulted in an excess rate of birth defects among the offspring of hospital workers. For example, cytomegalovirus is recognized as a human teratogen, but exposed nursery and pediatric care personnel do not appear to be at increased risk of cytomegalovirus-induced birth defects (U.S. Congress 1985).

A number of studies have supported more general associations between employment in hospitals (or laboratories in general) and an increased risk of adverse reproductive effects, primarily spontaneous abortion. For example, spontaneous abortions and birth defects have been associated with exposure of female operating room personnel to waste anesthetic gases; a similar relationship was also suggested for the wives of exposed men (NIOSH 1977a). Exposure to sterilizing agents (primarily ethylene oxide) has also been associated with increased frequencies of spontaneous abortions (Hemminki et al. 1982) and with chromosomal abnormalities in circulating lymphocytes (Hogstedt et al. 1983; Laurent et al. 1984).

5.4 DERMATOLOGICAL HAZARDS

5.4.1 Introduction

Skin injuries and diseases account for a large proportion of all occupational injuries and diseases (ASPH/NIOSH 1988). Skin injuries in the hospital environment include cuts, lacerations, punctures, abrasions, and burns. Skin diseases and conditions of hospital workers include dermatitis, allergic sensitization, infections such as herpes, and skin cancer. In 1984, dermatologic diseases accounted for more than 34% of all chronic occupational illnesses in the United States. Of workers who develop a dermatologic disease, 20% to 25% lose an average of 11 working days each year. In the service industries (which include the health service industry), nearly 8,000 cases of dermatologic diseases were reported to the Bureau of Labor Statistics in 1984—an incidence of 5 cases per 10,000 fulltime workers (ASPH/NIOSH 1988).

5.4.2 Hazard Location

Skin problems among hospital workers have been associated with work in every part of the hospital, but they are especially common among housekeeping personnel, maintenance workers, orderlies, and aides. In one hospital, 60% of the workers with occupational dermatitis of the hands were aides and

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housekeepers, even though these two categories made up only 17% of the total workers in the hospital (Dahlquist and Fregart 1970). Half of the workers with dermatitis had suffered with the skin problem for 6 months or more.

The NIOSH publication Occupational Diseases: A Guide to Their Recognition (NIOSH 1977d) contains an extensive list of occupational irritants and causes of dermatologic allergy. Listed below are some of the common causes of skin problems for some categories of hospital workers:

<u>Category of worker</u>	<u>Common cause of skin irritation</u>
Food service workers.	Heat, moisture, <u>Candida</u> (yeast), bacteria, grease, synthetic detergents, water softeners, soaps, fruit, acids, spices, sugars, and vegetable juices
Housekeepers.	Bacteria, synthetic detergents, disinfectants, houseplants, polishes, waxes, soaps, solvents, rubber gloves, and bactericides
Laundry workers	Alkalis, bactericides, bleaches, synthetic detergents, enzymes, fiber glass, fungicides, heat, moisture, optical brighteners, and soaps
Nurses.	Local anesthetics, antibiotics, antiseptics, bacteria, synthetic detergents, disinfectants, ethylene oxide, rubber gloves, soaps, drugs, fungi, and moisture

5.4.3 Potential Health Effects

Chemicals can directly irritate the skin or cause an allergic sensitization. Physical agents can also damage the skin, and skin that has been chemically or physically damaged is vulnerable to infection.

5.4.3.1. Effects of Chemical Agents

Skin reactions (dermatitis) are the most common and often the most easily preventable of all job-related health problems. The skin is the natural defense system of the body: it has a rough, waxy coating, a layer of protein (keratin), and an outer layer of dead cells to help prevent chemicals from penetrating the tissues and being absorbed into the blood.

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5.4.3.1.1 Direct irritation

Many chemicals cause irritation on contact with the skin (irritant contact dermatitis) by dissolving the protective fats or keratin (protein) layer, dehydrating the skin, or killing skin cells. Symptoms of this kind of irritation are red, itchy, peeling, dry, or cracking skin. Some chemicals are not irritants under normal conditions, but they will irritate skin that has already been damaged by sunburn, scratching, prolonged soaking, or other means. Tars, oils, and solvents can plug the skin pores and hair follicles, causing blackheads, pimples, and folliculitis.

Irritant contact dermatitis is diagnosed by a history of contact with a chemical and by the improvement or disappearance of symptoms when contact is discontinued.

Data from California (ASPH/NIOSH 1988) suggest that the following five types of agents are responsible for the greatest number of workers' compensation claims:

- Soaps, detergents, cleaning agents
- Solvents
- Hard, particulate dusts
- Food products
- Plastics and resins

5.4.3.1.2 Allergic contact dermatitis

Some persons become sensitized to chemicals days, months, or even years after their first exposure. This allergic reaction does not occur in every worker who contacts the chemical. Symptoms are red, itchy, and blistering skin (like a poison oak or ivy reaction) and may be much more severe than the direct irritation described in the previous subsection.

Sensitization is usually diagnosed by a history of contact and by patch testing, in which a physician applies a small amount of the suspect chemical to the skin under a patch to observe the reaction over 48 hr. Workers who are sensitized to a chemical will usually continue to have severe reactions unless all contact is prevented by substituting another chemical or transferring to another job. Common contact allergens include (ASPH/NIOSH 1988) the following:

- Metallic salts (i.e., salts of nickel, chrome, cobalt, gold, mercury)

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- Rubber accelerators and antioxidants (these may leach from rubber gloves) such as thiurans, dithiocarbamates, mercapto compounds, and paraphenylenediamine derivatives
- Plastic resins such as epoxies, phenolics, and acrylics
- Organic dyes such as those in photographic color-developing solutions
- First aid cabinet preparations such as neomycin, themerosal, and benzocaine
- Common laboratory chemicals such as phenol and formaldehyde.

5.4.3.2 Effects of Physical Agents

The skin can be damaged in a variety of ways including:

- Mechanical trauma (i.e., cuts, lacerations, abrasions, punctures)
- Burns from physical agents (electricity, heat, or UV radiation)
- Chemical burns

Although there are no data describing skin injuries among hospital workers specifically, data from the Bureau of Labor Statistics for 1983 indicate that almost 10% of the workers' compensation claims for skin injuries from 30 reporting states occurred among cooks and food service workers (ASPH/NIOSH 1988).

5.4.3.3 Skin cancer

The association between basal and squamous cell carcinomas and ultraviolet radiation has been well established. The association between skin cancer and exposure to other agents is less well documented, but ionizing radiation and anti-neoplastic drugs have been implicated. Other evidence indicates that malignant transformation of cells damaged by chronic allergic contact dermatitis may occur (ASPH/NIOSH 1988).

5.4.3.4 Effects of Biologic Agents

The skin can be damaged by a variety of microorganisms, including bacteria, fungi, viruses, and parasites. Herpes simplex is the most common dermatologic infection among dentists, physicians, and nurses. About 5% of all workers' compensation claims for skin diseases in 1985 were the result of primary skin infections. Biologic agents can also cause secondary skin

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infections when skin has been damaged chemically or physically. Secondary infections are particularly likely if good personal hygiene is not practiced (NIOSH 1987a).

5.4.4 Standards and Recommendations

There are no OSHA standards or NIOSH recommendations that specifically address dermatitis.

5.4.5 Exposure Control Methods

Relatively simple precautions can considerably reduce skin hazards. Effective measures include work practices and engineering controls that limit solvent exposure, the use of personal protective equipment, substitution of less irritating chemicals, and the institution of a good hygiene program. A more complete discussion of methods for controlling dermatologic hazards is contained in A Proposed National Strategy for the Prevention of Occupational Dermatologic Conditions (ASPH/NIOSH 1988).

5.5 STRESS

5.5.1 Introduction

At a 1986 symposium on 10 leading work-related diseases and injuries, NIOSH investigators presented a draft national strategy for the prevention of psychological disorders (ASPH/NIOSH 1988). The strategy identified the following clinical disorders as attributable to job stress:

- Affective disturbances such as anxiety, depression, and job dissatisfaction
- Maladaptive behavioral or lifestyle patterns
- Chemical dependencies and alcohol abuse

Estimates based on data obtained from the National Institute of Mental Health indicate that about 25% of the Americans aged 25 to 44 (the prime working age) suffered psychological disorders (ASPH/NIOSH 1988).

Hospital work often requires coping with some of the most stressful situations found in any workplace. Hospital workers must deal with life-threatening injuries and illnesses complicated by overwork, understaffing, tight schedules, paperwork, intricate or malfunctioning equipment, complex hierarchies of authority and skills, dependent and demanding patients, and patient deaths; all of these contribute to stress. In addition, the increasing size and bureaucracy of many hospitals may depersonalize the environment and leave many workers feeling isolated,

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fatigued, angry, powerless, and frustrated. The brunt of these feelings may be borne by other workers, patients, or the worker's family. These feelings may also be expressed as apathy, loss of self-confidence, withdrawal, or absenteeism. Failure to recognize and treat the sources of stress results in workers who suffer "burnout" (i.e., those who remain on the job but cease to function effectively).

In 1977, NIOSH investigators published a study of hospital admissions for mental health disorders among 130 major occupational categories. Of the 22 occupations with the highest admission rates for mental disorders, six were health care occupations--health technologists, practical nurses (LPN), clinical laboratory technicians, nurses' aides, health aides, registered nurses, and dental assistants (Colligan et al. 1977). Another study reported that the proportional mortality ratio (PMR) for suicide was elevated for male dentists, physicians, medical and dental technologists, and female nurses. The PMR for suicide was also elevated among chiropractors and veterinarians (NIOSH 1983c).

Hoiberg (1982) examined occupational stress and illness among white male enlisted Navy personnel and found that mess management specialists and hospital corpsmen were more frequently hospitalized for stress-related illnesses than Navy personnel in other occupational groups. She also reported that the rate of hospitalization increased with tenure; those in their second enlistment period had hospitalization rates for stress-related illnesses that were nearly five times the rates for personnel in their first enlistment period. Those in their third decade of service were hospitalized twice as frequently as personnel in their second decade of service. Hospitalization rates for neuroses, transient situational disturbances, hypertension, and ulcers exceeded the rates for six other stress-related causes of hospitalization. Hoiberg (1982) reported that the following factors contributed to the stress experienced by mess management specialists and corpsmen:

- Low job status
- Less favorable job characteristics such as work load, responsibility for the well being of others, and lack of participation in deciding work tasks
- Less satisfactory work environment composed of high physical demands, occasional high noise levels, occasional-to-frequent high temperatures, and occasionally dangerous work.

This study (Hoiberg 1982) reinforces existing information on stress among nurses and other occupational groups involved in direct patient care; it also indicates that hospital food service work should be considered a high-stress occupation.

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5.5.2 Hospital Locations Associated with Stress

Workers are most likely to encounter severe stress in intensive care units, burn units, emergency rooms, and operating rooms.

5.5.2.1 Intensive Care Unit

One of the most stressful areas of the hospital is the intensive care unit (ICU). Several studies of ICU nurses indicate that the following factors also lead to stress (Huckabay and Jagla 1979; Bailey et al. 1980; Gribbins and Marshall 1982):

- Interpersonal conflicts (nurse-physician, nurse-nurse, and nurse-supervisor)
- Knowledge base (complex disease states, treatments, and equipment)
- Management of the unit (staffing problems)
- Nature of direct patient care (emergencies, attempts to prolong life, sudden death, and the deaths of special patients)
- Physical work environment (malfunctioning or noisy equipment, lack of space, and physical injury)
- Lack of administrative rewards (pay, benefits, and advancement opportunity)

5.5.2.2 Neonatal Intensive Care Unit

Gribbins and Marshall (1982) also examined stress among nurses in the neonatal intensive care unit (NICU). Over several years of employment, nurses progressed through various stages of stress. Initially the nurses were concerned about their competence in the new job. Later they raised questions about the job itself (e.g., they questioned the quality of life for NICU survivors). Still later they felt they had mastered the job and were indifferent because they did not receive enough positive rewards for their work. Those still in the unit after 3 years had developed a number of coping mechanisms such as humor and tolerance.

5.5.2.3 Burn Units

Koran et al. (1983) explored the problems of 37 health care workers in the burn unit of a 425-bed county general hospital to determine how their job stresses affected morale and patient care. Koran et al. described the following emotional stressors of these workers:

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- The pain suffered by patients during dressing changes and debridement
- Uncooperative behavior, expressions of hostility and rejection by patients because of the necessity to inflict pain during debridement
- Unreasonable demands made by distraught family members
- Dealing with psychiatric disorders that frequently precede or accompany severe burns
- Problems common to staff members of other ICU's, including:
 - Lifting of heavy patients
 - Exposure to mutilated bodies
 - Conflicts with administrators over staffing and scheduling
 - Lack of emotional support from physicians
 - Concern about the inevitability of mistakes
 - Anguish caused by a patient's death.

5.5.3 Potential Health Effects

Stress has been associated with loss of appetite, ulcers, mental disorders, migraines, difficulty in sleeping, emotional instability, disruption of social and family life, and the increased use of cigarettes, alcohol, and drugs. Stress can also affect worker attitudes and behavior. Some frequently reported consequences of stress among hospital workers are difficulties in communicating with very ill patients, maintaining pleasant relations with coworkers, and judging the seriousness of a potential emergency.

5.5.4 Causes of Stress

Factors commonly mentioned as causes of stress by all categories of hospital workers are as follows (NIOSH 1978c; Huckabay and Jagla 1979; Bailey 1980; Gribbins et al. 1982; Koran et al. 1983):

- Understaffing
- Role conflict and ambiguity
- Inadequate resources

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- Working in unfamiliar areas
- Excessive noise
- Lack of control (influence, power) and participation in planning and decisionmaking
- Lack of administrative rewards
- Under-utilization of talents and abilities
- Rotating shift work
- Exposure to toxic substances
- Exposure to infectious patients

Other important stress factors include job specialization, discrimination, concerns about money, lack of autonomy, work schedules, ergonomic factors, and technological changes. These factors are discussed briefly in the following subsections.

5.5.4.1 Job Specialization

Increased job specialization has made it more difficult for workers to move to higher positions in the hospital. Specialized jobs are stressful and involve a higher rate of occupational injuries such as back strain and dermatitis.

5.5.4.2 Discrimination

Despite recent trends to the contrary, women and minorities still tend to be clustered in lower-level hospital positions.

5.5.4.3 Concerns about Money

Money matters are a significant source of stress for many hospital workers. Although hospital workers' wages have increased over the past decade, the difference between the higher- and lower-paying hospital positions has also increased. Meeting financial obligations and facing the threat of possible unemployment can be real sources of stress, especially for workers who are the sole support of a family.

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5.5.4.4 Lack of Autonomy

Frustration over the frequent lack of decision-making power is a significant stressor. Nurses sometimes feel demeaned when their observations and recommendations for patient care are ignored or overruled.

5.5.4.5 Work Schedule

The effects of stress can be made worse by shift work, especially rotating shift work. A NIOSH study of the effects of rotating shifts indicated that about 25% of the 1,219 nurses in the study regularly worked rotating shifts. These nurses reported visiting clinics for medical problems significantly more often than those working regular shifts (NIOSH 1978a). More nurses on rotating shifts stated that they stayed away from work because of acute respiratory infections, upper and lower gastrointestinal symptoms, headaches, colds, and influenza. The nurses on rotating shifts also visited clinics more because of these complaints and complaints of otitis, pharyngitis, gastritis, menstrual disorders, dermatitis, nervous symptoms, sprains and strains, contusions, and crushed body parts (NIOSH 1978a).

5.5.4.6 Ergonomic Factors

Stress can also result from ergonomic factors such as the poor design of furniture, lighting, and equipment and the need to lift heavy patients.

5.5.4.7 Technological Changes

Technological changes have contributed increasingly to the stress of hospital workers in the past 5 years. The introduction of VDT's at ward desks, the rapid change in medication protocols, and the development of new procedures and equipment may all frustrate staff when they are not given adequate training and time to incorporate these changes into their work patterns.

5.5.5 Methods for Coping with Stress

Some of the methods that have successfully reduced hospital worker stress and dissatisfaction are as follows (Huckabay and Jagla 1979; Bailey et al. 1980; Koran et al. 1983):

- Regular staff meetings and discussions to communicate feelings, gain support, and share innovative ideas
- Institution of stress management programs

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- Readily available counseling from a nonjudgmental source
- Flexibility and innovation by supervisors to create alternative job arrangements
- Adequate staffing
- Reasonable shift schedules for house staff to allow adequate time for sleep each day
- Group therapy for staff with particularly difficult professional problems such as dealing with cancer patients, chronic illness, and death
- Organized and efficient work functions and environment
- Recognition of and action on legitimate complaints regarding overbearing physicians and supervisors
- Individual approaches such as relaxation exercises and biofeedback to relieve symptoms of stress until the sources are identified and evaluated
- Frequent in-service educational sessions and other opportunities to improve skills and confidence
- More flexibility and worker participation in scheduling (possibly a 10-hr, 4-day workweek)
- Scheduled rotation of unit assignments

Koran et al. (1983) attempted to improve the work environment in a burn unit by providing the nursing staff with feedback about their work setting and by helping the staff use that information to formulate and implement changes. Using survey results and a series of meetings between the staff and a psychiatrist, substantial improvements in staff morale were observed and the quality of patient care seemed to be improved. Koran et al. (1983) believed that these improvements were realized because:

- The staff was encouraged to think about the elements of their work setting in terms of those that were stressful and those that were nonstressful.
- The staff began to focus on work setting characteristics that are often overlooked, such as clarity of expectations.
- The staff attempted to effect change in only a few areas at a time rather than in many.

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- The staff's involvement in their work increased as they began to work together to effect change.
- The staff began to feel concern not only for their own patients but for all patients and staff.

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GUIDELINES FOR HEALTH CARE WORKERS

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GUIDELINES FOR HEALTH CARE WORKERS

6. HAZARDOUS WASTE DISPOSAL

Hospitals generate large amounts of diverse wastes that require disposal. Much of the waste is hazardous and must therefore be packaged, transferred, and disposed of properly to protect both the persons handling it and the environment.

Hospital wastes can be categorized as infectious or noninfectious. Infectious wastes include human, animal, or biological wastes and any items that may be contaminated with pathogens. Noninfectious wastes include toxic chemicals, cytotoxic drugs, and radioactive, flammable, and explosive wastes.

6.1 INFECTIOUS WASTES

The material in this section is extracted from the EPA Guide for Infectious Waste Management (EPA 1986). The following publications are also recommended:

- Guideline for Handwashing and Hospital Environmental Control, Section 4 (Garner and Favero 1985). This document is reprinted in Appendix 8.
- Guideline for Isolation Precautions in Hospitals (Garner and Simmons 1983). This document is reprinted in Appendix 8.
- Waste Disposal in Microbiology Laboratories, Chapter 9 (Mackel and Mallison 1981).

6.1.1 Infectious Waste Management Plan

Compliance with State and local regulations should be carefully considered when developing an infectious waste treatment plan. Each hospital should develop an infectious waste management plan that provides for (1) designation of the waste that should be managed as infectious, (2) segregation of infectious waste from the noninfectious waste, (3) packaging, (4) storage, (5) treatment, (6) disposal, (7) contingency measures for emergency situations, and (8) staff training.

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6.1.2 Types of Infectious Waste

Infectious wastes may be classified as isolation wastes, cultures and stocks of infectious agents and associated biologicals, human blood and blood products, pathological wastes, contaminated sharps, contaminated carcasses, body parts, and bedding, or miscellaneous contaminated wastes. Each of these categories is discussed briefly as follows:

- **Isolation wastes** are those generated by patients who are isolated because of communicable diseases.
- **Cultures and stocks of infectious agents and associated biologicals** include specimen cultures from medical and pathological laboratories, cultures and stocks of infectious agents from research and industrial laboratories, wastes from the production of biologicals, discarded live and attenuated vaccines, and culture dishes and devices used to transfer, inoculate, and mix cultures.
- **Human blood and blood products** include blood as well as serum, plasma, and other blood products.
- **Pathological wastes** include tissues, organs, body parts, and body fluids that are removed during surgery and autopsy.
- **Contaminated sharps** are hypodermic needles, syringes, Pasteur pipettes, broken glass, and scalpel blades. These items should be considered infectious wastes because of the possibility of contamination with blood-borne pathogens.
- **Contaminated carcasses, body parts, and bedding** emanate from animals intentionally exposed to pathogens during research, the production of biologicals, or the in vivo testing of pharmaceuticals.
- **Miscellaneous wastes** that are not designated as infectious should be assumed to be infectious and should be managed as such to maintain consistent levels of protection for both the environment and for persons handling these wastes. Miscellaneous wastes include those from surgery and autopsies, contaminated laboratory wastes, dialysis unit wastes, and contaminated equipment.
 - **Wastes from surgery and autopsies** include soiled dressings, sponges, drapes, lavage tubes, drainage sets, underpads, and surgical gloves.
 - **Contaminated laboratory wastes** include specimen containers, slides and cover slips, disposable gloves, laboratory coats, and aprons.

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- **Dialysis unit wastes** include contaminated disposable equipment and supplies such as tubing, filters, disposable sheets, towels, gloves, aprons, and laboratory coats.
- **Contaminated equipment** refers to discarded equipment and parts that are used in patient care, medical and industrial laboratories, research, and the production and testing of certain pharmaceuticals.

6.1.3 Treatment and Disposal Methods

Several methods are used for infectious waste treatment, depending on the type of waste material. These treatment methods include steam sterilization, incineration, thermal inactivation, gas/vapor sterilization, chemical disinfection, and sterilization by irradiation. After treatment, the wastes or their ashes can be disposed of by discharge into sanitary sewer systems (for liquid or ground-up waste) or burial in sanitary landfills. Acceptable treatment methods for the various types of wastes are listed in Table 6-1.

6.1.3.1 Steam Sterilization (Autoclaving)

Steam sterilization (autoclaving) involves the use of saturated steam within a pressure vessel at temperatures high enough to kill infectious agents in the waste. Sterilization is accomplished primarily by steam penetration. Steam sterilization is most effective with low-density material such as plastics. An alternative treatment method (e.g., incineration) should be used on high-density wastes such as large body parts or large quantities of animal bedding or fluids because they inhibit direct steam penetration and require longer sterilization times.

Containers that can be used effectively in steam sterilization are plastic bags, metal pans, bottles, and flasks. High-density polyethylene and polypropylene plastic should not be used in this process because they do not facilitate steam penetration to the waste load. Heat-labile plastic bags allow steam penetration of the waste, but they may crumble and melt. If heat-labile plastic bags are used, they should be placed in another heat-stable container that allows steam penetration (such as a strong paper bag), or they should be treated with gas/vapor sterilization.

The following precautions should be taken when using steam sterilization:

- Plastic bags should be placed in a rigid container before steam treatment to prevent spillage and drain clogging.

GUIDELINES FOR HEALTH CARE WORKERS

Table 6-1. Recommended techniques for treatment of infectious wastes^a

Type of infectious waste	Recommended treatment techniques [†]			
	Steam sterilization	Incineration	Thermal inactivation	Chemical disinfection [§] Other
Isolation wastes	X	X		
Cultures and stocks of infectious agents and associated biologicals	X	X	X	X
Human blood and blood products	X	X		X ^{***}
Pathological wastes	X ^{††}	X		X ^{§§}
Contaminated sharps	X	X		
Contaminated animal wastes: Carcasses and parts	X ^{††}	X		
Bedding				X

^a Taken from EPA (1986).

[†] The recommended treatment techniques are those that are most appropriate and are generally in common use; an alternative treatment technique may be used to treat infectious waste if it provides effective treatment.

[§] Chemical disinfection is most appropriate for liquids.

^{**} Discharge to the sanitary sewer for treatment in the municipal sewage system (provided that secondary treatment is available).

^{††} For aesthetic reasons, steam sterilization should be followed by incineration of the treated waste or by grinding with subsequent flushing to the sewer system in accordance with State and local regulations.

^{§§} Handling by a mortician (burial or cremation).

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- To facilitate steam penetration, bags should be opened and caps and stoppers should be loosened immediately before they are placed in the steam sterilizer.
- Care should be taken to separate infectious wastes from other hazardous wastes.

The following precautions should be taken when using steam sterilization:

- Plastic bags should be placed in a rigid container before steam treatment to prevent spillage and drain clogging.
- To facilitate steam penetration, bags should be opened and caps and stoppers should be loosened immediately before they are placed in the steam sterilizer.
- Care should be taken to separate infectious wastes from other hazardous wastes.
- Infectious waste that contains noninfectious hazards (see Section 5) should not be steam-sterilized because of the possibility that the equipment operator will be exposed to toxic, radioactive, or other hazardous chemicals.
- Waste that contains antineoplastic drugs, toxic chemicals, or chemicals that would be volatilized by steam should not be steam-sterilized.
- Persons involved in steam sterilizing should be trained in handling techniques to minimize personal exposure to hazards from these wastes. Some of these techniques include:
 - Use of protective equipment
 - Minimization of aerosol formation
 - Prevention of waste spillage during autoclave loading and unloading
 - Prevention of burns from handling hot containers
 - Management of spills
- The autoclave temperature should be checked with a recording thermometer to ensure that the proper temperature is being maintained for a long enough period during the cycle.
- Steam sterilizers should be routinely inspected and serviced, and the process should be routinely monitored to ensure that the equipment is functioning properly.

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6.1.3.2 Incineration

Incineration converts combustible materials into noncombustible residue or ash. Gases are ventilated through the incinerator stacks, and the residue or ash is disposed of in a sanitary landfill. If incinerators are properly designed, maintained, and operated, they are effective in killing organisms present in infectious waste. Although all types of infectious waste can be disposed of by incineration, the process is especially useful for aesthetic disposal of pathological wastes such as tissues and body parts.

Incineration also renders contaminated sharps unusable. The principal factors to consider when incinerating infectious wastes are variations in waste composition, the waste feed rate, and the combustion temperature. Infectious wastes containing antineoplastic drugs should be disposed of in an incinerator that provides high temperatures and enough time for the complete destruction of these compounds. The incinerator's effectiveness in disposing of chemical wastes should be documented before such use.

6.1.3.3 Thermal Inactivation

Thermal inactivation involves the treatment of waste with high temperatures to eliminate the presence of infectious agents. This method is usually used for large volumes of infectious waste. Liquid waste is collected in a vessel and heated by heat exchangers or a steam jacket surrounding the vessel. The types of pathogens in the waste determine the temperature and duration of treatment. After treatment, the contents can be discharged into the sewer in a manner that complies with State, Federal, and local requirements. Solid infectious waste is treated with dry heat in an oven, which is usually electric. This method requires higher temperatures and longer treatment cycles than steam treatment.

6.1.3.4 Gas/Vapor Sterilization

Gas/vapor sterilization uses gaseous or vaporized chemicals as the sterilizing agents. Ethylene oxide is the most commonly used agent, but should be used with caution since it is a suspected human carcinogen (see Section 5 for a discussion of ethylene oxide toxicity and work practices). Because ethylene oxide may be adsorbed on the surface of treated materials, the potential exist for worker exposure when sterilized materials are handled.

6.1.3.5 Chemical Disinfection

Chemical disinfection is the preferred treatment for liquid infectious wastes, but it can also be used in treating solid infectious waste. The following factors should be considered when using chemical disinfection:

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- Type of microorganism
- Degree of contamination
- Amount of proteinaceous material present
- Type of disinfectant
- Contact time
- Other relevant factors such as temperature, pH, mixing requirements, and the biology of the microorganism

Ultimate disposal of chemically treated waste should be in accordance with State and local requirements.

6.1.3.6 Sterilization by Irradiation

Sterilization by irradiation is an emerging technology that uses ionizing radiation. Advantages over other treatment methods are as follows:

- Electricity requirements are nominal.
- Steam is not required.
- No heat or chemicals remain in the treated waste.

The principal disadvantages are as follows:

- Capital costs are high.
- Highly trained operating and support personnel are required.
- Space requirements are great.
- The potential exists for worker exposure as a result of leaks in seals or poor work practices.
- Ultimate disposal of the radiation source may pose problems.

6.1.4 Separation of Infectious and Noninfectious Wastes

Infectious and noninfectious wastes should be separated at the point of generation. If the infectious waste contains noninfectious hazards, it should be identified and subjected to additional treatment.

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Infectious waste should be discarded into clearly identifiable containers or plastic bags that are leakproof and puncture-resistant. Red or orange bags are usually used for infectious waste. The containers should also be marked with the universal symbol for biological hazards (see Figure 6-1).

6.1.5 Packaging

Infectious wastes should be contained from the point of origin to the point at which they are no longer infectious. The packaging should be appropriate for the type of waste involved, and it must endure handling, storage, transportation, and treatment.

Liquid infectious wastes can be placed in capped or tightly stoppered bottles or flasks. Large quantities may be placed in containment tanks.

Solid or semisolid wastes may be placed in plastic bags, but the following recommendations should be heeded:

- Select tear-resistant plastic bags. Plastic bags are judged by their thickness or durability as evaluated by the ASTM dart test (ASTM 1975). Use one or both of these criteria in the procurement process. The most important consideration is tear-resistance.
- Do not place sharps, sharp items, or items with sharp corners in the bags. (Place sharps in impervious, rigid, puncture-resistant containers made of glass, metal, rigid plastic, or wood.)
- Do not load a bag beyond its weight or volume capacity.
- Keep bags from coming into contact with sharp external objects.
- Consider double bagging.

Some treatment techniques require special packaging characteristics. For example, incineration requires combustible containers, and steam sterilization requires packaging materials such as low-density plastics that allow steam penetration and evacuation of air.

6.1.6 Handling and Transportation

When the waste is to be moved about for treatment or storage, special handling or packaging may be necessary to keep bags intact and to ensure containment of the waste. The following procedures are recommended:



Figure 6-1. Universal symbol for biological hazards. The symbol is fluorescent orange or orange-red. The background may be any color that provides sufficient contrast for the symbol to be clearly defined.

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- Single-bagged waste and containers of sharps and liquids should be placed within a rigid or semirigid container such as a bucket, box, or carton lined with plastic bags.
- Containers should be covered with lids during transportation and storage.
- When handling or transporting plastic bags of infectious waste, care should be taken to prevent tearing the bags. Instead of chutes or dumbwaiters, carts should be used for transporting bags of infectious waste within the facility.
- Carts and recyclable containers that are used repeatedly for transport and treatment of bagged waste should be disinfected after each use. Single-use containers should be destroyed as part of the treatment process.
- Infectious waste should not be compacted before treatment. This process could damage the packaging and disperse the contents, or it could interfere with the effectiveness of treatment.
- Outside the hospital, infectious waste should be transported in closed, leakproof dumpsters or trucks.
- The waste should be placed in rigid or semirigid, leakproof containers before being loaded onto trucks.

6.1.7 Storage

- Infectious waste should be stored for a minimum amount of time and should be packaged securely enough to ensure containment of the waste and to prevent penetration by rodents and vermin.
- Limited access to the storage area is recommended.
- The universal biological hazard symbol (Figure 6-1) should be posted on the storage area door, waste containers, freezers, or refrigerators.
- Containers for biohazardous material should be a distinctive red or orange color.

6.1.8 Contingency Measures

Contingency measures should be developed to deal with emergencies that occur during the handling, transportation, or disposal of infectious waste. Emergencies include spills of liquid infectious waste, ruptures of plastic bags or other containers holding infectious waste, and equipment failure.

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6.1.9 Ultimate Disposal

For ultimate disposal of treated infectious waste, EPA recommends contacting State and local governments to identify approved disposal options. EPA also recommends (1) the discharge of treated liquids and ground solids (e.g., pathological wastes or small animals) to the sewer system, and (2) landfill disposal of treated solids and incinerator ash. Landfilling of infectious wastes is allowed in some States and prohibited in others. EPA recommends that only treated infectious wastes be buried in landfills. They further recommend that facilities secure the services of reputable waste handlers to ensure (to the extent possible) that ultimate disposal of hazardous wastes is performed according to applicable Federal, State, and local regulations.

6.1.10 Training

All workers who handle infectious waste should receive infectious waste management training that includes (1) explanation of the infectious waste management plan, and (2) assignment of roles and responsibilities for implementation of the plan. Refresher courses should also be given periodically.

6.2 NONINFECTIOUS WASTES

6.2.1 Chemical Wastes

Chemical wastes include toxic chemicals, cytotoxic drugs, radioactive materials, and flammable and explosive wastes. These wastes should be classified at the time of collection to avoid mixing chemicals that are incompatible (NFPA 1983). Disposal of chemical wastes should be handled in accordance with good safety practices and applicable government regulations. Persons or agencies involved with the removal of these wastes should be informed of their characteristics and hazards.

6.2.2 Cytotoxic Wastes

OSHA has issued work practice guidelines for workers who deal with cytotoxic (antineoplastic) drugs (OSHA 1986). These guidelines are reproduced as Appendix 7 of this document. They address drug preparation, drug administration, waste disposal, spills, medical surveillance, storage and transport, training, and information dissemination.

6.2.3 Radioactive Wastes

Three classes of radioactive wastes may be found in hospitals: solids, liquids, and gases. This section summarizes the recommendations of the National Council on Radiation Protection and Measurements (NCRP 1976).

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Solid radioactive wastes may include rags or papers from cleanup operations, solid chemicals, contaminated equipment, experimental animal carcasses, and human or experimental animal fecal material. Human and animal fecal material may generally be disposed of through the sanitary sewer system (NCRP 1976). For other solid wastes, disposal depends on the half-life of the radionuclide. For those nuclides with short half-lives, the solid material may be stored in a secure place until decay has occurred. Solid waste contaminated by nuclides with long half-lives should be disposed of by a licensed commercial disposal company. Contaminated equipment should be cleaned with large amounts of water, which should be disposed of as radioactive liquid waste.

Radioactive urine may generally be disposed of immediately through the sanitary sewer system, but the toilet should be flushed several times after each use (Stoner et al. 1982). In cases in which the patient has received a large dose of radioactive iodine, urine is generally collected for the first 48 hr after administration, taken to the laboratory for analysis, and flushed down the sanitary sewer system with large quantities of water. Other liquid wastes can be handled in the same manner as solid wastes. Those with short half-lives can be stored in a sealed container until the radioactivity decays; those with long half-lives should be disposed of by a licensed disposal company.

Gaseous radioactive wastes should be vented to the outside of the hospital so that recirculation of the exhaust air does not occur.

6.2.4 Flammable Wastes

Refer to Sections 3.1.3 and 3.1.4 for discussion of flammable and explosive wastes.

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6.3 REFERENCES

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EPA (1986). EPA guide for infectious waste management. Washington, DC: U.S. Environmental Protection Agency, Office of Solid Waste. NTIS No. PB 86-199130.

Garner JS, Favero MS (1985). Guideline for handwashing and hospital environmental control, 1985. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, Center for Infectious Diseases, Hospital Infections Program.

Garner JS, Simmons BP (1983). Guideline for isolation precautions in hospitals. *Infection Control* 4(Suppl):245-325.

Mackel DC, Mallison GF (1981). Waste disposal in microbiology laboratories. In: Balows A, Hausler WJ Jr, eds. Diagnostic procedures for bacterial mycotic and parasitic infections. 6th edition. Washington, DC: American Public Health Association.

NCRP (1976). Radiation protection for medical and allied health personnel. Washington, DC: National Council on Radiation Protection and Measurements, NCRP Report No. 48.

NFPA (1983). National fire codes. A compilation of NFPA codes, standards, recommended practices, and manuals. Vol 3. Quincy, MA: National Fire Protection Association, pp. 45-36.

OSHA (1986). OSHA Instruction PUB 8-1.1, Appendix A: Work practice guidelines for personnel dealing with cytotoxic (antineoplastic) drugs. Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration.

Stoner DL, Smathers JB, et al. (1982). Engineering a Safe Hospital Environment. New York, NY: John Wiley and Sons.

GUIDELINES FOR HEALTH CARE WORKERS

6.4 ADDITIONAL RESOURCES

Burchinal JC, Wallace LP (1971). A study of institutional solid wastes. Charleston, WV: University of West Virginia, Department of Civil Engineering.

NFPA (1975). Fire protection guide on hazardous materials. Boston, MA: National Fire Protection Association.

Green ME, Turk A (1978). Safety in working with chemicals. New York, NY: MacMillan.

Litsky W, Martin JW, Litsky BY (1972). Solid waste—a hospital dilemma. American Journal of Nursing 7(10)1841-1847.

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Paul RC (1964). Crush, flatten, burn, or grind? The not so simple matter of disposal. Hospitals 38:99-101.

Phillips DF (1972). When is infectious waste not infectious waste? Hospitals 46(9)56.

Rutala WA, Sarubbi FA Jr. (1983). Management of infectious waste from hospitals. Infection Control 4(4):198-204.

Schigler-Pauze (1976). Hazardous materials. New York, NY: Van Nostrand Reinhold.

Stoner DL, Smathers JB, et al. (1982). Engineering a safe hospital environment. New York, NY: John Wiley and Sons.

Tchobanoglous TE (1977). Solid wastes. New York, NY: McGraw Hill.

U.S. Department of Commerce (1974). Recommended methods of reduction, neutralization, recovery, or disposal of hazardous wastes. 16 Volumes. Washington, DC: The Department, NTIS Publication No. PB 224-79.

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7. DIRECTORY OF OCCUPATIONAL SAFETY AND HEALTH INFORMATION FOR HOSPITALS

7.1 GOVERNMENT AGENCIES AND ORGANIZATIONS

The standard-setting and enforcement responsibilities of government agencies and private accreditation organizations are described in Section 2.4. The present section lists occupational safety and health agencies and resource organizations that may be helpful in obtaining information on hospital safety and health hazards. Most of this assistance is in the form of written materials such as individual publications, newsletters, journals, and other periodicals. Some organizations also provide consultation, education conferences, and other forms of assistance. A listing of this nature is necessarily incomplete, and NIOSH welcomes information regarding organizations and publications not listed.

7.1.1 National Institute for Occupational Safety and Health (NIOSH)

One of the main functions of NIOSH is to conduct research on workplace hazards and to develop recommendations for exposure limits and safe working procedures. Many NIOSH publications are therefore applicable to hospital hazards. All requests for information concerning NIOSH publications should be sent to the following address:

National Institute for Occupational Safety and Health
Attention: Publications Dissemination
Robert A. Taft Laboratories
4676 Columbia Parkway
Cincinnati, OH 45226

Telephone: (513) 533-8287
FTS: 684-8287

NIOSH regional offices are listed below:

REGION I
Regional Program Consultant, NIOSH
DHHS/PHS/Prevention - Region I
Government Center
JFK Federal Building, Room 1401
Boston, MA 02203

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REGION IV

Regional Program Consultant, NIOSH
DHHS/PHS/Prevention - Region IV
101 Marietta Tower, Suite 1110
Atlanta, GA 30323

REGION VIII

Regional Program Consultant, NIOSH
DHHS/PHS/Prevention - Region VIII
1961 Stout Street, Room 1185
Denver, CO 80294

7.1.2 Occupational Safety and Health Administration (OSHA)

OSHA has both State and Federal offices (see the listing at the end of this section). Twenty-three States plus Puerto Rico and the Virgin Islands have their own OSHA programs. The remaining States are covered under Federal OSHA standards.

The primary function of OSHA is to see that employers comply with the health and safety provisions of the Occupational Safety and Health Act. OSHA should be contacted to:

- Request a workplace inspection
- Review records of previous inspections and citations
- Obtain information on current standards

OSHA also provides employers with a free consultation service to advise them on eliminating potential workplace hazards.

7.1.2.1 Regional Offices for the Federal Occupational Safety and Health Administration

REGION I (CT, ME, MA, NH, RI, VT)
U.S. Department of Labor - OSHA
16-18 North Street
Boston, MA 02109

REGION VI (AR, LA, NM, OK, TX)
U.S. Department of Labor - OSHA
525 Griffin Street
Federal Building, Room 602
Dallas, TX 75202

REGION II (NY, NJ, PR, VI)
U.S. Department of Labor - OSHA
1515 Broadway Street, Room 3445
New York, NY 10036

REGION VII (IA, KS, MO, NE)
U.S. Department of Labor - OSHA
911 Walnut Street, Room 406
Kansas City, MO 64106

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REGION III (DE, DC, MD, PA, VA, WV)
U.S. Department of Labor - OSHA
Gateway Building, Suite 2100
3535 Market Street
Philadelphia, PA 19104

REGION VIII (CO, MT, ND, SD, UT, WY)
U.S. Department of Labor - OSHA
Federal Building, Room 1576
1961 Stout Street
Denver, CO 80294

REGION IV (AL, FL, GA, KY, MS, NC, SC, TN)
U.S. Department of Labor - OSHA
1375 Peachtree Street, N.E., Suite 587
Atlanta, GA 30367

REGION IX (AZ, CA, HI, NV)
U.S. Department of Labor - OSHA
Box 36017
450 Golden Gate Avenue, Room 11349
San Francisco, CA 94102

REGION V (IL, IN, MN, MI, OH, WI)
U.S. Department of Labor - OSHA
230 South Dearborn Street, Room 3244
Chicago, IL 60604

REGION X (AK, ID, OR, WA)
U.S. Department of Labor - OSHA
Federal Office Building, Room 6003
909 First Avenue
Seattle, WA 98174

7.1.2.2 Offices for States that have OSHA-Approved State Plans

ALASKA

Alaska Department of Labor
P.O. Box 1149
Juneau, AK 99802

INDIANA

Indiana Department of Labor
1013 State Office Building
100 N. Senate Avenue
Indianapolis, IN 46204

ARIZONA

Occupational Safety & Health Division
Industrial Commission of Arizona
P.O. Box 19070
800 W. Washington
Phoenix, AZ 85007

IOWA

Department of Employment Services
Division of Labor Services
307 E. 7th Street
Des Moines, IA 50319

CALIFORNIA

Department of Industrial Relations
525 Golden Gate Avenue
San Francisco, CA 94102

KENTUCKY

Kentucky Labor Cabinet
U.S. Highway 127 South
Frankfort, KY 40601

CONNECTICUT

Connecticut Department of Labor
200 Folly Brook Boulevard
Wethersfield, CT 06109

MARYLAND

Department of Licensing & Regulation
Division of Labor & Industry
501 St. Paul Place
Baltimore, MD 21202

HAWAII

Labor & Industrial Relations
825 Mililani Street
Honolulu, HI 96813

MICHIGAN

Michigan Department of Labor
7150 Harris Drive
Lansing, MI 48909

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MICHIGAN (continued)

Michigan Department of Public Health
P.O. Box 30035
3500 North Logan Street
Lansing, MI 48909

MINNESOTA

Department of Labor & Industry
444 Lafayette Road
St. Paul, MN 55101

NEVADA

Department of Occupational Safety
and Health
Nevada Department of Industrial
Relations
Capitol Complex
1370 S. Curry Street
Carson City, NV 89710

NEW MEXICO

Environmental Improvement Division
Health & Environment Department
P.O. Box 968
Sante Fe, NM 87504-0968

NEW YORK

New York Department of Labor
One Main Street
Brooklyn, NY 11201

NORTH CAROLINA

North Carolina Department of Labor
214 W. Jones Street, Shore Building
Raleigh, NC 27603

OREGON

Workers' Compensation Department
Labor and Industries Building
Salem, OR 97310

PUERTO RICO

Puerto Rico Department of Labor
and Human Resources
Prudencio Reveria Martinez Building
505 Munoz Reveria Avenue
Hato Rey, Puerto Rico 00918

SOUTH CAROLINA

South Carolina Department of Labor
3600 Forest Drive
P.O. Box 11329
Columbia, SC 29211-1329

TENNESSEE

Tennessee Department of Labor
501 Union Building
Suite A, Second Floor
Nashville, TN 37219

UTAH

Utah Occupational Safety and Health
160 E. 3rd South
P.O. Box 5800
Salt Lake City, UT 84110-5800

VERMONT

Department of Labor & Industry
120 State Street
Montpelier, VT 05602

VIRGIN ISLANDS

Virgin Islands Department of Labor
P.O. Box 890
Christainsted
St. Croix, Virgin Islands 00820

VIRGINIA

Department of Labor & Industry
P.O. Box 12064
Richmond, VA 23241-0064

WASHINGTON

Department of Labor & Industries
General Administration Building
Room 334-AX-31
Olympia, WA 98504

WYOMING

Occupational Health and Safety
Department
604 E. 25th Street
Cheyenne, WY 82002

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7.1.3 The Centers for Disease Control (CDC)

The Centers for Disease Control (CDC) in Atlanta, GA, collects statistics on hospital infection control programs and publishes guidelines for infection control in hospital workers and for hospital environmental control.

7.2 HOSPITAL ASSOCIATIONS AND ORGANIZATIONS

7.2.1 American Hospital Association (AHA)

840 North Lake Shore Drive
Chicago, IL 60611

The AHA has numerous publications of interest, including those on hospital infection control, anesthetic waste gas, and hospital safety. They also sponsor conferences on hospital health and safety.

7.2.2 Federation of American Hospitals (FAH)

1405 N. Pierce, No. 311
Little Rock, AR 72207

The FAH is an organization of privately-owned and investor-owned hospitals.

7.2.3 Joint Commission on Accreditation of Healthcare Organizations (JCAHO)

875 North Michigan Avenue
Chicago, IL 60611

The JCAHO evaluates hospitals who choose to apply for accreditation every 3 years. Although their concern is primarily patient care, they have also established criteria for hospital health and safety activities.

7.3 SAFETY AND HEALTH ORGANIZATIONS

7.3.1 National Fire Protection Association (NFPA)

Batterymarch Park
Quincy, MA 02269

The NFPA has developed publications on various aspects of fire safety (e.g., extinguishers, sprinkler systems, and electrical codes). Many of their guidelines are enforced by local and State fire marshals.

GUIDELINES FOR HEALTH CARE WORKERS

7.3.2 National Safety Council (NSC)

444 North Michigan Avenue
Chicago, IL 60611

The NSC publishes general recommendations for safety standards, with particular concern for fire safety. Health care concerns are emphasized.

7.3.3 Committees on Occupational Safety and Health (COSH)

COSH groups are coalitions of workers and health professionals who are concerned about hazardous work environments. Among the services often provided by these groups are health and safety information hotlines, educational materials, conferences, research on workplace hazards, and the sharing of experiences in investigating and controlling workplace hazards. COSH groups now exist in more than 30 cities in the United States.

7.4 HEALTH PROFESSIONAL AND WORKER ORGANIZATIONS

7.4.1 American Federation of Government Employees (AFGE)

80 F Street, N.W.
Washington, DC 20001

AFGE represents several hundred thousand workers in the Veterans Administration system. They have a health and safety program.

7.4.2 American Federation of State, County, and Municipal Employees (AFSCME)

1625 L Street N.W.
Washington, DC 20036

AFSCME maintains an active health and safety staff and publishes material on hospital health and safety.

7.4.3 American Association of Occupational Health Nurses (AAOHN)

3500 Piedmont Road, N.E.
Atlanta, GA 30305

AAOHN consists of registered nurses and other health professionals interested in occupational health issues.

GUIDELINES FOR HEALTH CARE WORKERS

7.4.4 American Occupational Medical Association (AOMA)

2340 South Arlington Heights Road
Arlington Heights, IL 60005

The AOMA Committee on Occupational Health in Medical Centers has recently published guidelines.

7.4.5 Association of Hospital Employee Health Professionals

P.O. Box 2029
Chula Vista, CA 92012-2029

The members of this professional and educational organization are involved with health and safety issues in hospitals. The organization is working to establish guidelines for hospital employee health. The association publishes the Journal of Hospital Occupational Health and sponsors a 3-day national conference annually.

7.4.6 Association of Operating Room Nurses (AORN)

10170 East Mississippi Avenue
Denver, CO 80231

This organization consists of registered nurses employed in operating rooms. Their goal is to improve operating room standards.

7.4.7 Hospital Workers Union 1199, AFL-CIO

625 Broadway
New York, NY 10012

Hospital Workers Union 1199 was one of the first hospital unions to develop a full health and safety staff and program. The Union has produced many publications and holds conferences on health and safety on a regular basis.

7.4.8 College of American Pathologists (CAP)

5202 Old Orchard Road
Skokie, IL 60077

CAP has published guidelines for the operation of clinical laboratories.

GUIDELINES FOR HEALTH CARE WORKERS

7.4.9 Service Employees International Union (SEIU)

1313 L Street, N.W.
Washington, DC 20005

The SEIU maintains an active health and safety staff and publishes many materials on hospital health and safety.

7.5 MANUFACTURER'S ASSOCIATIONS

7.5.1 American Association for the Advancement of Medical Instrumentation (AAMI)

1901 North Fort Myer Drive, Suite 602
Arlington, VA 22209

The AAMI is concerned with worker safety and health in the handling of medical instruments. The association has published recommended guidelines for the use of ethylene oxide.

7.5.2 Health Industry Manufacturers Association (HIMA)

1030 15th Street, N.W.
Suite 1100
Washington, DC 20005

The HIMA represents domestic manufacturers of hospital devices and diagnostic products. They develop programs and sponsor activities on matters affecting the industry.

7.6 PUBLICATIONS

7.6.1 Newsletters

Hospital Infection Control

Published monthly by American Health Consultants, Inc., 67 Peachtree Park Drive N.E., Atlanta, GA 30309.

Infection Control Digest

Published monthly by the American Hospital Association, 840 North Lake Shore Drive, Chicago IL 60611.

GUIDELINES FOR HEALTH CARE WORKERS

Hospital Employee Health

Published monthly by the American Health Consultants, Inc., 67 Peachtree Park Drive N.E., Atlanta, GA 30309.

7.6.2 Checklists and Manuals

Health and Safety Manual for Hospitals

Prepared by the Health and Safety Department, Canadian Union of Public Employees, March 1981.

Hospital Workers: Who Cares About Your Health on the Job?

Prepared by the Public Employee Department, AFL-CIO, 815 16th Street N.W., Washington, DC 20006.

Safety and Health Hazards on the Job: A Manual for Health Care Employees

Available from the Service Employees International Union, 2020 K Street, N.W., Washington, DC 20006, 1982.

OSHA and the Hospital Manager: Checklist of OSHA Regulations for Health Care Institutions

Prepared by the Catholic Hospital Association, St. Louis, MO 63104.

Hospital Safety. Vol. I, Hospital Safety Manual. Vol. II, Hospital Hazard Recognition

Prepared by the Hospital Safety Training Program Committee, Bureau of Safety and Regulation, Michigan Department of Labor, February 1977.

Regulations for Health Care Workers

Available from the Labor Occupational Health Project (LOHP), 2521 Channing Way, Berkeley, CA 94720.

How to Look at Your Workplace

Prepared by Urban Planning Aid, 120 Boylston Street, Boston, MA 02116.

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7.6.3 Journals

American Journal of Industrial Medicine

American Journal of Public Health

Hospitals

Infection Control

Journal of Hospital Occupational Health

Journal of Occupational Medicine

Occupational Health and Safety

Occupational Health Nursing

Scandinavian Journal of Work, Environment and Health

GUIDELINES FOR HEALTH CARE WORKERS

APPENDIX 1

DISTRIBUTION OF HOSPITAL WORKERS (SIC 806) BY OCCUPATION*

Type of worker	Number	Percent [†]
Professional and technical workers:		
Professionals, technicals	883,029	22.64
Dentists	3,140	.08
Dietitians	23,708	.61
Pharmacists	16,292	.42
Physicians and osteopaths	111,406	2.86
Podiatrists	392	.01
Registered nurses	652,054	16.72
Therapists	74,552	1.91
Other	1,485	.04
Health technologists, technicians	302,047	7.74
Clinical laboratory technologists, technicians	143,610	3.68
Dental hygienists	368	.01
Health record technologists	14,279	.37
Radiologic technologists	73,971	1.90
Therapy assistants	4,130	.11
Other	65,739	1.69
Other professional, technical	157,913	4.05
Total professional and technical workers	1,342,989	34.43
Managers, professionals, proprietors	120,833	3.10
Sales workers	2,234	.06
Clerical workers	628,533	16.11
Crafts and kindred workers	98,355	2.52
Operatives	89,802	2.30
Service workers:		
Cleaning service workers	207,598	5.32
Food service workers	155,988	4.00
Miscellaneous service workers	67,645	1.73
Health service workers	1,152,104	29.54
Dental assistants	2,939	.08
Health aides excluding nursing	120,971	3.10
Health trainees	13,600	.35
Nursing aides and orderlies	667,517	17.11
Practical nurses	347,077	8.90
Total service workers	1,583,335	40.59
Laborers	34,253	.88
Total hospital workers	3,900,334	99.99

*Source: Adapted from Occupation by Industry, 1980, Census of Population, Volume 2, U.S. Department of Commerce, Bureau of the Census, 1984.

†Figures may not add because of rounding.

GUIDELINES FOR HEALTH CARE WORKERS

APPENDIX 2

NIOSH GUIDELINES FOR EVALUATION OF HOSPITAL OCCUPATIONAL HEALTH AND SAFETY PROGRAMS*

An effective hospital occupational health program should provide, but is not limited to, the following services:

- A. Preplacement physical examinations, including a complete medical history
- B. Periodic health appraisal examinations
- C. Health and safety education
- D. Immunizations
- E. Care for illness and injury at work
- F. Health counseling
- G. Environmental control and surveillance
- H. Health and safety records system
- I. Coordinated planning with hospital departments and services

The established guidelines are outlined as follows.

A. PREPLACEMENT PHYSICAL EXAMINATIONS

1. Physical examinations should be given to all new workers and should include:
 - a. Routine blood tests
 - (1) Complete blood count
 - (2) Fasting blood sugar or 2-hr postprandial
 - (3) Renal function tests
 - (4) Creatinine
 - (5) SGOT

*Adapted from: NIOSH (1977). Hospital occupational health and safety. Cincinnati, OH: U.S. Department of Health, Education and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 77-141.

GUIDELINES FOR HEALTH CARE WORKERS

- (6) SGPT
- (7) Serology for syphilis
- (8) Serology for rubella
- (9) Others at the physician's discretion, guided by the worker's medical history

- b. Routine urinalysis
 - c. Electrocardiogram for workers over age 35 at the physician's discretion
 - d. Chest X-ray, posterior and anterior and lateral
 - e. Skin testing for TB
 - f. Vision tests (near and far, with and without correction) and tonometry
 - g. Audiogram, speech range
 - h. Cervical cytology (Pap smear) for females
2. A record of the occupational history of the worker should be included in the preplacement examination.

B. PERIODIC HEALTH APPRAISAL EXAMINATIONS

Periodic health appraisal examinations should be provided for the following:

1. Workers who are exposed to hazardous environments,
2. Workers who are returning from an absence caused by illness or injury,
3. Workers who are being transferred to another department or service, and
4. Workers who are retiring.

C. HEALTH AND SAFETY EDUCATION

In addition to job orientation, a program instructed by a knowledgeable person should provide health, safety, and environmental information for all workers on a continuing basis.

The instruction should include information on safe working habits, relevant health information, and use of the occupational health unit for reporting injuries and illnesses.

GUIDELINES FOR HEALTH CARE WORKERS

D. IMMUNIZATIONS

1. Immunizations should be provided in accordance with the Centers for Disease Control (CDC) policy for hospital workers.*
2. Elective immunizations should be considered for special situations such as epidemics, unusual laboratory conditions, or accidental exposures (e.g., HBV needlestick accident).
3. A suspense system for updating immunizations should be maintained.

E. CARE FOR ILLNESS AND INJURY AT WORK

1. A specific site within the hospital should be available for workers to receive medical, psychological, and other consultative services on a 24-hr basis.
2. An adequate facility should be provided to give medical, surgical, psychological, and rehabilitative services to all workers.
3. A competent consulting staff should be maintained.
4. A formal procedure should be outlined for contacting a family or a private physician.
5. Adequate followup measures for facilitating continuity of care should be maintained for all workers.
6. Treatment and reporting of occupational injuries and illnesses should conform to the State compensation laws and to OSHA standards under Public Law 91-596, the Occupational Safety and Health Act of 1970.

F. HEALTH COUNSELING

1. A program should be made accessible and available to provide medical, psychological, and social counseling. Such counseling should include help for workers with various addictive problems (i.e., tobacco, drugs, food, and alcohol), as well as for those with problems associated with HIV infection and the HIV epidemic.
2. A formal system for referral and review should be provided for workers with problems that need professional intervention unavailable in the facility.

*See Appendix 8 of this document.

GUIDELINES FOR HEALTH CARE WORKERS

3. Where a social service or psychiatric department is not available, persons with special interests or training should be designated to assist in counseling sessions.

G. ENVIRONMENTAL CONTROL AND SURVEILLANCE

1. An environmental control and surveillance program should be part of the occupational health program and should be directed by an individual or consultant capable of managing harmful exposures in the hospital.
2. A single individual should be responsible for nuclear medicine and radiological activities.
3. Conformance should be maintained to State and Federal rules and regulations pertaining to radiation and safety hazards.

H. HEALTH AND SAFETY RECORDS SYSTEM

1. Each worker should have a health record maintained in the health unit. The record should include all examinations, reports of injuries and illnesses, reports to and from physicians, and all other safety and health matters.
2. Reports should be kept on a monthly and yearly basis to indicate injury and illness rates, accident facts, and reports on the monitoring and control of environmental hazards.
3. Records should be confidential and should be available only to appropriate personnel.

I. COORDINATED PLANNING WITH HOSPITAL DEPARTMENTS AND SERVICES

1. A committee that represents all hospital departments and services should advise the hospital administration on the policy, direction, and requirements of the occupational health program.
2. A safety committee and an infection control committee should consider the health of all workers in their planning.
3. A member of the hospital's occupational health program should be on both the safety committee and the infection control committee.

GUIDELINES FOR HEALTH CARE WORKERS

APPENDIX 3

OCCUPATIONAL HAZARDS BY LOCATION IN THE HOSPITAL*

Location	Hazard	Location	Hazard
Central supply	Ethylene oxide Infection Broken equipment (cuts) Soaps, detergents Steam Flammable gases Lifting Noise Asbestos insulation Mercury	Housekeeping	Soaps, detergents Cleaners Solvents Disinfectants Glutaraldehyde Infection Needle punctures Wastes (chemical, radioactive, infectious) Electrical hazards Lifting Climbing Slips, falls
Dialysis units	Infection Formaldehyde	Laboratory	Infectious diseases Toxic chemicals Benzene Ethylene oxide Formaldehyde Solvents Flammable and explosive agents Carcinogens Teratogens Mutagens Cryogenic hazards Wastes (chemical, radioactive, infectious) Radiation
Dental service	Mercury Ethylene oxide Anesthetic gases Ionizing radiation Infection	Laundry	Wet floors Lifting Noise Heat Burns Infection Needle punctures Detergents, soaps Bleaches Solvents Wastes (chemical and radioactive)
Food service	Wet floors Sharp equipment Noise Soaps, detergents Disinfectants Ammonia Chlorine Solvents Drain cleaners Oven cleaners Caustic solutions Pesticides Microwave ovens Steam lines Ovens Heat Electrical hazards Lifting		(Continued)

*Although this list is not exhaustive, it demonstrates the variety of hazards that can exist in a hospital environment. Stress is reported by hospital workers in all job categories and is not listed separately by location.

GUIDELINES FOR HEALTH CARE WORKERS

APPENDIX 4

CHEMICALS ENCOUNTERED IN SELECTED HOSPITAL OCCUPATIONS*

Occupation and chemical

Clinical laboratory technologists and technicians (OC 080)+:

Acetic acid
Acetic anhydride
Acetone
Acrylamide
Ammonium chloride
Ammonium hydroxide
Ammonium lauryl sulfate
Aniline
Arsenic
Barbital
Barbituric acid, 5,5-diethyl-, sodium salt
Benzene
Benzethonium chloride
Benzidine
Benzoic acid
Benzyl alcohol
Biphenylol, sodium salt, 2-
Butanol
Butanone, 2-
Butyl acetate
Butyl alcohol, sec-
Butylamine
Caffeine
Carbon tetrachloride
Cetylpyridinium chloride
Chloroform
Cholesterol
Chromium trioxide
Citric acid
Cobaltous acetate
Copper (II) sulfate (1:1)
Cyclohexanone
Dichloroethane, 1,2-
Dichloromethane
Diethylamine

(Continued)

See footnotes at end of table.

GUIDELINES FOR HEALTH CARE WORKERS

APPENDIX 4 (Continued)

CHEMICALS ENCOUNTERED IN SELECTED HOSPITAL OCCUPATIONS

Occupation and chemical

Diethylene glycol
Dinitrophenylhydrazine, 2,4-
Dioxane, 1,4-
Diphenylamine
Dipropylene glycol monoethyl ether
Ethanol, 2-butoxy
Ethyl alcohol
Ethylene glycol
Ethylenediaminetetraacetic acid
Ethylenediaminetetraacetic acid, sodium salt
Ethylenediaminetetraacetic acid, tetrasodium salt
Ethylene oxide
Ferrous sulfate
Formaldehyde
Formamide, N,N-dimethyl
Galactose
Glutaraldehyde
Glycerol
Hydrazine sulfate
Hydroxylamine
Isopropyl acetate
Isopropyl alcohol
Isopropylamine
Lactic acid
Lactose
Lead acetate
Leucine
Lithium
Lithium carbonate
Lithium chloride
Magnesium chloride
Maleic acid
Maleic anhydride
Manganese chloride
Mercaptoethanol, 2-
Mercury, ((o-carboxyphenyl) thio) ethyl-, sodium salt

(Continued)

See footnotes at end of table.

GUIDELINES FOR HEALTH CARE WORKERS

APPENDIX 4 (Continued)

CHEMICALS ENCOUNTERED IN SELECTED HOSPITAL OCCUPATIONS

Occupation and chemical

Mercuric chloride
Methanol
Methoxyethanol, 2-
Methyl paraben
Methyl-2-pentanone, 4-
Naphthol, alpha-
Naphthylamine, alpha-
Nitrilotriethanol, 2,2',2''-
Nitrobenzene
Oxalic acid
Pentanediol, 1,5-
Pentyl alcohol
Phenol
Phosphoric acid
Piperidine
Potassium chloride
Potassium cyanide
Potassium hydroxide
Propanol, 1-
Propionic acid
Propylene oxide
Pyridine
Pyrogalllic acid
Resorcinol
Silver nitrate
Sodium acetate
Sodium azide
Sodium benzoate
Sodium carbonate
Sodium chloride
Sodium dodecylbenzenesulfonate
Sodium hypochlorite
Sodium iodide
Sodium nitrate
Sodium nitrite
Sodium phosphate, dibasic

(Continued)

See footnotes at end of table.

GUIDELINES FOR HEALTH CARE WORKERS

APPENDIX 4 (Continued)

CHEMICALS ENCOUNTERED IN SELECTED HOSPITAL OCCUPATIONS

Occupation and chemical

Sorbic acid
Stearic acid
Succinic acid
Sulfanilamide
Sulfur dioxide
Sulfuric acid
Thioacetamide
Thiosemicarbazide
Thiourea
Toluene
Toluidine, ortho-
Trichloroacetic acid
Trichloroethane, 1,1,1-
Trichloroethylene
Tungstic acid
Urea
Xylene
Zinc oxide
Zinc sulfate (1:1)

Cleaners and charpersons (OC 902):

Acetic acid
Acetone
Acrylic acid, ethyl ester
Acrylontrile
Ammonium chloride
Ammonium hydroxide
Benzene
Benzoic acid
Benzothiazolethiol, 2-
Biphenylol, sodium salt, 2-
Butanol
Butanone, 2-
Butyl acetate
Carbon tetrachloride
Chloroform

(Continued)

See footnotes at end of table.

GUIDELINES FOR HEALTH CARE WORKERS

APPENDIX 4 (Continued)

CHEMICALS ENCOUNTERED IN SELECTED HOSPITAL OCCUPATIONS

Occupation and chemical

Chromium trioxide
Citric acid
Copper (II) sulfate (1:1)
Coumarin
Cyclohexanol
Dichloromethane
Dioxane, 1,4-
Dipropylene glycol monomethyl ether
Ethanol, 2-(2-ethoxyethoxy)-, acetate
Ethanol, 2-butoxy-
Ethoxyethanol, 2-
Ethyl alcohol
Ethyl ether
Ethylene glycol
Ethylene oxide
Ethylenediaminetetraacetic acid
Ethylenediaminetetraacetic acid, disodium salt
Ethylenediaminetetraacetic acid, tetrasodium salt
Formaldehyde
Glycerol
Glycolic acid
Isopropyl alcohol
Lactic acid
Maleic anhydride
Methanol
Methyl methacrylate
Methyl salicylate
Morpholine
Nitrilotriethanol, 2,2', 2''-
Nonylphenol
Oxalic acid
Pentanediol, 1,5-
Pentylphenol, para-tert
Phenol
Phenol, 4-chloro-2-cyclopentyl-
Phenylmercuric acetate

(Continued)

See footnotes at end of table.

GUIDELINES FOR HEALTH CARE WORKERS

APPENDIX 4 (Continued)

CHEMICALS ENCOUNTERED IN SELECTED HOSPITAL OCCUPATIONS

Occupation and chemical

Phosphoric acid
Phosphoric acid 2,2-dichloro-vinyl dimethyl ester
Phosphorothioic acid, 0,0-diethyl 0-(2-isopropyl-6-methyl-4-pyrimidinyl) ester
Phthalic acid, dibutyl ester
Potassium chloride
Potassium hydroxide
Propanediol, 1,2-
Propylene glycol monomethyl ether
Propylene oxide
Salicylic acid
Sodium carbonate
Sodium chloride
Sodium dodecylbenzenesulfonate
Sodium hypochlorite
Sodium lauryl sulfate
Sodium metasilicate
Sodium (I) nitrate
Sodium nitrite
Stearic acid
Styrene
Sulfuric
Tetrachloroethylene
Toluene
Triazine-2,4,6, (1H, 3H, 5H)-trione, 1,3-dichloro-, potassium salt, S-
Trichloroethane, 1,1,1-
Urea
Xylene
Zinc chloride
Zinc oxide
Zinc sulfate

(Continued)

See footnotes at end of table.

GUIDELINES FOR HEALTH CARE WORKERS

APPENDIX 4 (Continued)

CHEMICALS ENCOUNTERED IN SELECTED HOSPITAL OCCUPATIONS

Occupation and chemical

Health aides, excluding nursing (OC 922):

Acetic acid
Acetone
Ammonium hydroxide
Benzene
Benzidine
Benzoic acid
Biphenylol, 2-, sodium salt
Caffeine
Chloroform
Chromium trioxide
Citric acid
Copper sulfate
Diethylamine
Ethanol, 2-butoxy-
Ethyl alcohol
Ethyl ether
Ethylene oxide
Ethylenediaminetetraacetic acid
Formaldehyde
Glycerol
Hexamethylenetetramine
Hydrazine sulfate
Isopropyl alcohol
Lactose
Leucine
Lithium carbonate
Magnesium chloride
Menthol
Mercaptoethanol, 2-
Mercuric chloride
Mercury, ((o-carboxyphenyl) thio) ethyl-, sodium salt
Methanol
Methyl salicylate
Methyl-2-pentanone, 4-
Naphthol, alpha-

(Continued)

See footnotes at end of table.

GUIDELINES FOR HEALTH CARE WORKERS

APPENDIX 4 (Continued)

CHEMICALS ENCOUNTERED IN SELECTED HOSPITAL OCCUPATIONS

Occupation and chemical

Oxalic acid
Pentenediol, 1,4-
Pentylphenol, para-tert-
Phenobarbital
Phenol
Phosphoric acid
Potassium chloride
Potassium hydroxide
Potassium permanganate
Propylene glycol
Pyridine
Pyrogallic acid
Resorcinol
Salicylic acid
Silver nitrate
Sodium acetate
Sodium benzoate
Sodium carbonate
Sodium chloride
Sodium dodecylbenzenesulfonate
Sodium hypochlorite
Sodium lauryl sulfate
Sodium metasilicate
Sodium nitrate
Sodium nitrite
Sodium phosphate, dibasic
Sodium salicylate
Stearic acid
Styrene
Sulfuric acid
Thiopentyl sodium
Thiosemicarbazide
Toluene
Trichloroethane, 1,1,1-
Trichloroethylene

(Continued)

See footnotes at end of table.

GUIDELINES FOR HEALTH CARE WORKERS

APPENDIX 4 (Continued)

CHEMICALS ENCOUNTERED IN SELECTED HOSPITAL OCCUPATIONS

Occupation and chemical

Urea
Xylene
Zinc oxide

Health aides, orderlies, and attendants (OC 925):

Acetic acid
Acetone
Aluminum hydroxide
Ammonium chloride
Ammonium hydroxide
Ammonium lauryl sulfate
Benzethonium chloride
Biphenylol, 2-, sodium salt
Butyl acetate
Carbon tetrachloride
Citric acid
Copper sulfate
Coumarin
Dichloromethane
Diethylene glycol
Dimethoxane
Ethanol, 2-butoxy-
Ethanol, 2-ethoxy-
Ethyl alcohol
Ethyl ether
Ethylene glycol
Ethylene oxide
Ethylenediaminetetraacetic acid
Ethylenediaminetetraacetic acid, tetrasodium salt
Formaldehyde
Glycerol
Glycolic acid
Isopropyl alcohol
Isopropyl myristate
Lactose
Menthol

(Continued)

See footnotes at end of table.

GUIDELINES FOR HEALTH CARE WORKERS

APPENDIX 4 (Continued)

CHEMICALS ENCOUNTERED IN SELECTED HOSPITAL OCCUPATIONS

Occupation and chemical

Mercuric chloride
Mercury, ((o-carboxyphenyl) thio) ethyl-, sodium salt
Methanol
Methoxyflurane
Methyl salicylate
Methylparaben
Nitrilotri-2-propanol, 1,1',1"-
Nitrilotriethanol, 2,2"-
Pentanediol, 1,5-
Phosphoric acid
Phthalic acid, dibutyl ester
Potassium chloride
Potassium hydroxide
Potassium permanganate
Propylene glycol
Propylene glycol monomethyl ether
Quartz
Salicylic acid
Silver nitrate
Sodium acetate
Sodium carbonate
Sodium chloride
Sodium dodecylbenzenesulfonate
Sodium hypochlorite
Sodium lauryl sulfate
Sodium metasilicate
Sodium nitrate
Sodium nitrite
Stearic acid
Styrene
Sulfuric acid
Tetrachloroethylene
Trichloroacetic acid
Trichloroethane, 1,1,1-
Trichloroethylene

(Continued)

See footnotes at end of table.

GUIDELINES FOR HEALTH CARE WORKERS

APPENDIX 4 (Continued)

CHEMICALS ENCOUNTERED IN SELECTED HOSPITAL OCCUPATIONS

Occupation and chemical

Urea
Xylene
Zinc oxide

Practical nurses (OC 926):

Acetic acid
Acetone
Aluminum hydroxide
Ammonium chloride
Ammonium hydroxide
Benzene
Biphenylol, 2-, sodium salt
Citric acid
Clorpromazine hydrochloride
Copper sulfate
Coumarin
Dichloromethane
Ethyl alcohol
Ethyl ether
Ethylene oxide
Ethylenediaminetetraacetic acid
Ethylenediaminetetraacetic acid, tetrasodium salt
Formaldehyde
Glycerol
Isopropyl alcohol
Isopropyl myristate
Lactose
Menthol
Mercuric chloride
Mercury, ((o-carboxyphenyl) thio) ethyl-, sodium salt
Methanol
Methoxyflurane
Methyl salicylate
Methyl-2-pentanone, 4-
Methylparaben
Nitrilotri-2-propanol, 1,1'1"-

(Continued)

See footnotes at end of table.

GUIDELINES FOR HEALTH CARE WORKERS

APPENDIX 4 (Continued)

CHEMICALS ENCOUNTERED IN SELECTED HOSPITAL OCCUPATIONS

Occupation and chemical

Nitrioltriethanol, 2,2',2"-
Nitrofurazone
Pentanediol, 1,5-
Phenol
Phosphoric acid
Potassium hydroxide
Potassium permanganate
Propylene glycol
Quartz
Salicylic acid
Silver nitrate
Sodium acetate
Sodium carbonate
Sodium chloride
Sodium dodecylbenzenesulfonate
Sodium hypochlorite
Sodium iodide
Sodium lauryl sulfate
Sodium metasilicate
Sodium nitrate
Sodium nitrite
Stearic acid
Styrene
Tetrachloroethylene
Toluene
Trichloroethane, 1,1,1-
Urea
Zinc oxide

*Source: NIOSH (1984). Adapted from Report of the DSHEFS Task Force on Hospital Safety and Health. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, NIOSH Internal Report.

†Bureau of Census occupational code.

APPENDIX 5

JOINT ADVISORY NOTICE

**Protection Against Occupational Exposure To
Hepatitis B Virus (HBV) And
Human Immunodeficiency Virus (HIV)**

October 19, 1987

JOINT ADVISORY NOTICE

**Protection Against Occupational Exposure To
Hepatitis B Virus (HBV) And
Human Immunodeficiency Virus (HIV)**

I. Background:

Hepatitis B (previously called serum hepatitis) is the major infectious occupational health hazard in the health-care industry, and a model for the transmission of blood-borne pathogens. In 1985 the Centers for Disease Control (CDC) estimated [1] that there were over 200,000 cases of hepatitis B virus (HBV) infection in the U.S. each year, leading to 10,000 hospitalizations, 250 deaths due to fulminant hepatitis, 4,000 deaths due to hepatitis-related cirrhosis, and 800 deaths due to hepatitis-related primary liver cancer. More recently [2] the CDC estimated the total number of HBV infections to be 300,000 per year with corresponding increases in numbers of hepatitis-related hospitalizations and deaths. The incidence of reported clinical hepatitis B has been increasing in the United States, from 6.9/100,000 in 1978 to 9.2/100,000 in 1981 and 11.5/100,000 in 1985 [2]. The Hepatitis Branch, CDC, has estimated [unpublished] that 500-600 health-care workers whose job entails exposure to blood are hospitalized annually, with over 200 deaths (12-15 due to fulminant hepatitis, 170-200 from cirrhosis, and 40-50 from liver cancer). Studies indicate that 10% to 40% of health-care or dental workers may show serologic evidence of past or present HBV infection [3]. Health-care costs for hepatitis B and non-A, non-B hepatitis in health-care workers were estimated to be \$10 - \$12 million annually [4]. A safe, immunogenic, and effective vaccine to prevent hepatitis B has been available since 1982 and is recommended by the CDC for health-care workers exposed to blood and body fluids [1,2,5-7]. According to unpublished CDC estimates, approximately 30-40% of health-care workers in high-risk settings have been vaccinated to date.

According to the most recent data available from the CDC [8], acquired immunodeficiency syndrome (AIDS) was the 13th leading cause of years of potential life lost (82,882 years) in 1984, increasing to 11th place in 1985 (152,595 years). As of August 10, 1987, a cumulative total of 40,051 AIDS cases (of which 558 were pediatric) had been reported to the CDC, with 23,165 (57.8%) of these known to have died [9]. Although occupational HIV infection has been documented [10], no AIDS case or AIDS-related death is believed to be occupationally related. Spending within the Public Health Service related to AIDS has also accelerated rapidly, from \$5.6 million in 1982 to \$494 million in 1987, with \$791 million requested for 1988. Estimates of average lifetime costs for the care of an AIDS patient have varied considerably, but recent evidence suggests the amount is probably in the range of \$50,000 to \$75,000.

Infection with either HBV [1,2] or human immunodeficiency virus (HIV, previously called human T-lymphotrophic virus type III/lymphadenopathy-associated virus (HTLV III/LAV) or AIDS-associated retrovirus (ARV)) [11,12]

can lead to a number of life-threatening conditions, including cancer. Therefore, exposure to HBV and HIV should be reduced to the maximum extent feasible by engineering controls, work practices, and protective equipment. (Engineering controls are those methods that prevent or limit the potential for exposure at or as near as possible to the point of origin, for example by eliminating a hazard by substitution or by isolating the hazard from the work environment.)

II. Modes Of Transmission:

In the U.S., the major mode of HBV transmission is sexual, both homosexual and heterosexual. Also important is parenteral (entry into the body by a route other than the gastrointestinal tract) transmission by shared needles among intravenous drug abusers and to a lesser extent in needlestick injuries or other exposures of health-care workers to blood. HBV is not transmitted by casual contact, fecal-oral or airborne routes, or by contaminated food or drinking water [1,2,13]. Workers are at risk of HBV infection to the extent they are exposed to blood and other body fluids; employment without that exposure, even in a hospital, carries no greater risk than that for the general population [1]. Thus, the high incidence of HBV infection in some clinical settings is particularly unfortunate because the modes of transmission are well known and readily interrupted by attention to work practices and protective equipment, and because transmission can be prevented by vaccination of those without serologic evidence of previous infection.

Identified risk factors for HIV transmission are essentially identical to those for HBV. Homosexual/bisexual males and male intravenous drug abusers account for 85.4% of all AIDS cases, female intravenous drug abusers for 3.4%, and heterosexual contact for 3.8% [9]. Blood transfusion and treatment of hemophilia/coagulation disorders account for 3.0% of cases, and 1.4% are pediatric cases. In only 3.0% of all AIDS cases has a risk factor not been identified [9]. Like HBV, there is no evidence that HIV is transmitted by casual contact, fecal-oral or airborne routes, or by contaminated food or drinking water [12-14], and barriers to HBV are effective against HIV. Workers are at risk of HIV infection to the extent they are directly exposed to blood and body fluids. Even in groups that presumably have high potential exposure to HIV-contaminated fluids and tissues, e.g., health-care workers specializing in treatment of AIDS patients and the parents, spouse, children, or other persons living with AIDS patients, transmission is recognized as occurring only between sexual partners or as a consequence of mucous membrane or parenteral (including open wound) exposure to blood or other body fluids [10,11,13-16].

Despite the similarities in the modes of transmission, the risk of HBV infection in health-care settings far exceeds that for HIV infection [13,14]. For example, it has been estimated [14,17,18] that the risk of acquiring HBV infection following puncture with a needle contaminated by an HBV carrier ranges from 6% to 30%—far in excess of the risk of HIV infection under similar circumstances, which the CDC and others estimated to be a less than 1% [10,13,16].

Health-care workers with documented percutaneous or mucous-membrane exposures to blood or body fluids of HIV-infected patients have

been prospectively evaluated to determine the risk of infection after such exposures. As of June 30, 1987, 883 health-care workers have been tested for antibody to HIV in an ongoing surveillance project conducted by CDC [19]. Of these, 708 (80%) had percutaneous exposures to blood, and 175 (20%) had a mucous membrane or an open wound contaminated by blood or body fluid. Of 396 health-care workers, each of whom had only a convalescent-phase serum sample obtained and tested 90 days or more post-exposure, one—for whom heterosexual transmission could not be ruled out—was seropositive for HIV antibody. For 425 additional health-care workers, both acute- and convalescent-phase serum samples were obtained and tested; none of 74 health-care workers with nonpercutaneous exposures seroconverted, and three (0.9%) of 351 with percutaneous exposures seroconverted. None of these three health-care workers had other documented risk factors for infection.

Two other prospective studies to assess the risk of nosocomial acquisition of HIV infection for health-care workers are ongoing in the United States. As of April 30, 1987, 332 health-care workers with a total to 453 needlestick or mucous-membrane exposures to the blood or other body fluids of HIV-infected patients were tested for HIV antibody at the National Institutes of Health [20]. These exposed workers included 103 with needlestick injuries and 229 with mucous-membrane exposures; none had seroconverted. A similar study at the University of California of 129 health-care workers with documented needlestick injuries or mucous-membrane exposures to blood or other body fluids from patients with HIV infection has not identified any seroconversions [21]. Results of a prospective study in the United Kingdom identified no evidence of transmission among 150 health-care workers with parenteral or mucous-membrane exposure to blood or other body fluids, secretions, or excretions from patients with HIV infection [22].

Following needlestick injuries, one health-care worker contracted HBV but not HIV, and in another instance a health-care worker contracted cryptococcus but not HIV from patients infected with both [14]. This risk of infection by HIV and other blood-borne pathogens for which immunization is not available extends to all health-care workers exposed to blood, even those who have been immunized against HBV infection. Effective protection against blood-borne disease requires universal observation of common barrier precautions by all workers with potential exposure to blood, body fluids, and tissues [10,13].

HIV has been isolated from blood, semen, saliva, tears, urine, vaginal secretions, cerebrospinal fluid, breast milk, and amniotic fluid [10,23], but only blood and blood products, semen, vaginal secretions, and possibly breast milk (this needs to be confirmed) have been directly linked to transmission of HIV [10,13]. Contact with fluids such as saliva and tears has not been shown to result in infection [13-15]. Although other fluids have not been shown to transmit infection, all body fluids and tissues should be regarded as potentially contaminated by HBV or HIV, and treated as if they were infectious. Both HBV and HIV appear to be incapable of penetrating intact skin, but infection may result from infectious fluids coming into contact with mucous membranes or open wounds (including inapparent lesions) on the skin [14,16]. If a procedure involves the potential for skin contact with

blood or mucous membranes, then appropriate barriers to skin contact should be worn, e.g., gloves. Investigations of HBV risks associated with dental and other procedures that might produce particulates in air, e.g., centrifuging and dialysis, indicated that the particulates generated were relatively large droplets (spatter), and not true aerosols of suspended particulates that would represent a risk of inhalation exposure [24-26]. Thus, if there is the potential for splashes or spatter of blood or fluids, face shields or protective eyewear and surgical masks should be worn. Detailed protective measures for health-care workers have been addressed by the CDC [10,13,23,27-33]. These can serve as general guides for the specific groups covered, and for the development of comparable procedures in other working environments.

HIV infection is known to have been transmitted by organ transplants [34] and blood transfusions [35] received from persons who were HIV seronegative at the time of donation. Falsely negative serology can be due to improperly performed tests or other laboratory error, or testing in that "window" of time during which a recently infected person is infective but has not yet converted from seronegative to seropositive. (Detectable levels of antibodies usually develop within 6 to 12 weeks of infection [36]. A recent report [37] suggesting that this "window" may extend to 14 months is not consistent with other data, and therefore requires confirmation.) If all body fluids and tissues are treated as infectious, no additional level of worker protection will be gained by identifying seropositive patients or workers. Conversely, if worker protection and work practices were upgraded only following the return of positive HBV or HIV serology, then workers would be inadequately protected during the time required for testing. By producing a false sense of safety with "silent" HBV- or HIV-positive patients, a seronegative test may significantly reduce the level of routine vigilance and result in virus exposure. Furthermore, developing, implementing, and administering a program of routine testing would shift resources and energy away from efforts to assure compliance with infection control procedures. Therefore, routine screening of workers or patients for HIV antibodies will not substantially increase the level of protection for workers above that achieved by adherence to strict infection control procedures.

On the other hand, workers who have had parenteral exposure to fluids or tissues may wish to know whether their own antibody status converts from negative to positive. Such a monitoring program can lead to prophylactic interventions in the case of HBV infection, and CDC has published guidelines on pre- and post-exposure prophylaxis of viral hepatitis [1,2]. Future developments may also allow effective intervention in the case of HIV infection. For the present, post-exposure monitoring for HIV at least can release the affected worker from unnecessary emotional stress if infection did not occur, or allow the affected worker to protect sexual partners in the event infection is detected [10,36].

III. Summary:

The cumulative epidemiologic data indicate that transmission of HBV and HIV requires direct, intimate contact with or parenteral inoculation of blood and blood products, semen, or tissues [10,11,13,14,16,23]. The mere pres-

ence of, or casual contact with, an infected person cannot be construed as "exposure" to HBV or HIV. Although the theoretical possibility of rare or low-risk alternative modes of transmission cannot be totally excluded, the only documented occupational risks of HBV and HIV infection are associated with parenteral (including open wound) and mucous membrane exposure to blood and tissues [2,10,13,14,16]. Workers occupationally exposed to blood, body fluids, or tissues can be protected from the recognized risks of HBV and HIV infection by imposing barriers in the form of engineering controls, work practices, and protective equipment that are readily available, commonly used, and minimally intrusive.

IV. Recommendations:

General

"Exposure" (or "potential exposure") to HBV and HIV should be defined in terms of actual (or potential) skin, mucous membrane, or parenteral contact with blood, body fluids, and tissues. "Tissues" and "fluids" or "body fluids" should be understood to designate not only those materials from humans, but also potentially infectious fluids and tissues associated with laboratory investigations of HBV or HIV, e.g., organs and excreta from experimental animals, embryonated eggs, tissue or cell cultures and culture media, etc.

As the first step in determining what actions are required to protect worker health, every employer should evaluate all working conditions and the specific tasks that workers are expected to encounter as a consequence of employment. That evaluation should lead to the classification of work-related tasks to one of three categories of potential exposure (Table 1). These categories represent those tasks that require protective equipment to be worn during the task (Category I); tasks that do not require any protective equipment (Category III); and an intermediate grouping of tasks (Category II) that also do not require protective equipment, but that inherently include the predictable job-related requirement to perform Category I tasks unexpectedly or on short notice, so that these persons should have immediate access to some minimal set of protective devices. For example, law enforcement personnel or firefighters may be called upon to perform or assist in first aid or to be potentially exposed in some other way. This exposure classification applies to tasks rather than to individuals, who in the course of their daily activities may move from one exposure category to another as they perform various tasks.

For individual Category I and II tasks, engineering controls, work practices, and protective equipment should be selected after careful consideration, for each specific situation, of the overall risk associated with the task. Factors that should be included in that evaluation of risk include:

1. Type of body fluid with which there will or may be contact (e.g., blood is of greater concern than urine),
2. Volume of blood or body fluid likely to be encountered (e.g., hip replacement surgery can be very bloody while corneal transplantation is almost bloodless),

3. Probability of an exposure taking place (e.g., drawing blood will more likely lead to exposure to blood than will performing a physical examination),
4. Probable route of exposure (e.g., needlestick injuries are of greater concern than contact with soiled linens), and
5. Virus concentration in the fluid or tissue. The number of viruses per milliliter of fluid in research laboratory cultures may be orders of magnitude higher than in blood. Similarly, viruses have been less frequently found in fluids such as sweat, tears, urine, and saliva.

Engineering controls, work practices, and protective equipment appropriate to the task being performed are critical to minimize HBV and HIV exposure and to prevent infection. Adequate protection can be assured only if the appropriate controls and equipment are provided and all workers know the applicable work practices and how to properly use the required controls or protective equipment. Therefore, employers should establish a detailed work practices program that includes standard operating procedures (SOPs) for all tasks or work areas having the potential for exposure to fluids or tissues, and a worker education program to assure familiarity with work practices and the ability to use properly the controls and equipment provided.

It is essential for both the patient and the health-care worker to be fully aware of the reasons for the preventive measures used. The health-care worker may incorrectly interpret the work practices and protective equipment as signifying that a task is unsafe. The patient may incorrectly interpret the work practices or protective garb as evidence that the health-care

TABLE 1. EXPOSURE CATEGORIES

CATEGORY I. Tasks That Involve Exposure To Blood, Body Fluids, Or Tissues.

All procedures or other job-related tasks that involve an inherent potential for mucous membrane or skin contact with blood, body fluids, or tissues, or a potential for spills or splashes of them, are Category I tasks. Use of appropriate protective measures should be required for every employee engaged in Category I tasks.

CATEGORY II. Tasks That Involve No Exposure To Blood, Body Fluids, Or Tissues, But Employment May Require Performing Unplanned Category I Tasks.

The normal work routine involves no exposure to blood, body fluids, or tissues, but exposure or potential exposure may be required as a condition of employment. Appropriate protective measures should be readily available to every employee engaged in Category II tasks.

CATEGORY III. Tasks That Involve No Exposure To Blood, Body Fluids, Or Tissues, And Category I Tasks Are Not A Condition Of Employment.

The normal work routine involves no exposure to blood, body fluids, or tissues (although situations can be imagined or hypothesized under which anyone, anywhere, might encounter potential exposure to body fluids). Persons who perform these duties are not called upon as part of their employment to perform or assist in emergency medical care or first aid or to be potentially exposed in some other way. Tasks that involve handling of implements or utensils, use of public or shared bathroom facilities or telephones, and personal contacts such as handshaking are Category III tasks.

provider knows or believes the patient is infected with HBV or HIV. Therefore, worker education programs should strive to allow workers (and to the extent feasible, the clients or patients) to recognize the routine use of appropriate work practices and protective equipment as prudent steps that protect the health of all.

If the employer determines that Category I and II tasks do not exist in the workplace, then no specific personal hygiene or protective measures are required. However, these employers should ensure that workers are aware of the risk factors associated with transmission of HBV and HIV so that they can recognize situations which pose increased potential for exposure to HBV or HIV (Category I tasks) and know how to avoid or minimize personal risk. A comparable level of education is necessary for all citizens. Educational materials such as the Surgeon General's Report can provide much of the needed information [12,38].

If the employer determines that work-related Category I or II tasks exist, then the following procedures should be implemented.

Administrative

The employer should establish formal procedures to ensure that Category I and II tasks are properly identified, SOPs are developed, and employees who must perform these tasks are adequately trained and protected. If responsibility for implementation of these responsibilities is delegated to a committee, it should include both management and worker representatives. Administrative activities to enhance worker protection include:

1. Evaluating the workplace to:
 - a. Establish category of risk classifications for all routine and reasonably anticipated job-related tasks.
 - b. Identify all workers whose employment requires performance of Category I or II tasks.
 - c. Determine for identified Category I or II tasks those body fluids to which workers most probably will be exposed and the potential extent and route of exposure.
2. Developing, or supervising the development of, Standard Operating Procedures (SOPs) for each Category I and II task. These SOPs should include mandatory work practices and protective equipment for each Category I and II task.
3. Monitoring the effectiveness of work practices and protective equipment. This includes:
 - a. Surveillance of the workplace to ensure that required work practices are observed and that protective clothing and equipment are provided and properly used.
 - b. Investigation of known or suspected parenteral exposures to body fluids or tissues to establish the conditions surrounding the exposure and to improve training, work practices, or protective equipment to prevent a recurrence.

Training and Education

The employer should establish an initial and periodic training program for all employees who perform Category I and II tasks. No worker should engage in any Category I or II task before receiving training pertaining to the SOPs, work practices, and protective equipment required for that task. The training program should ensure that all workers:

1. Understand the modes of transmission of HBV and HIV.
2. Can recognize and differentiate Category I and II tasks.
3. Know the types of protective clothing and equipment generally appropriate for Category I and II tasks, and understand the basis for selection of clothing and equipment.
4. Are familiar with appropriate actions to take and persons to contact if unplanned Category I tasks are encountered.
5. Are familiar with and understand all the requirements for work practices and protective equipment specified in SOPs covering the tasks they perform.
6. Know where protective clothing and equipment is kept, how to use it properly, and how to remove, handle, decontaminate, and dispose of contaminated clothing or equipment.
7. Know and understand the limitations of protective clothing and equipment. For example, ordinary gloves offer no protection against needlestick injuries. Employers and workers should be on guard against a sense of security not warranted by the protective equipment being used.
8. Know the corrective actions to take in the event of spills or personal exposure to fluids or tissues, the appropriate reporting procedures, and the medical monitoring recommended in cases of suspected parenteral exposure.

Engineering Controls

Whenever possible, engineering controls should be used as the primary method to reduce worker exposure to harmful substances. The preferred approach in engineering controls is to use, to the fullest extent feasible, intrinsically safe substances, procedures, or devices. Substitution of a hazardous procedure or device with one that is less risky or harmful is an example of this approach, e.g., a laser scalpel reduces the risk of cuts and scrapes by eliminating the necessity to handle the conventional scalpel blade.

Isolation or containment of the hazard is an alternative engineering control technique. Disposable, puncture-resistant containers for used needles, blades, etc., isolate cut and needlestick injury hazards from the worker. Glove boxes, ventilated cabinets, or other enclosures for tissue homogenizers, sonicators, vortex mixers, etc. serve not only to isolate the hazard, but also to contain spills or splashes and prevent spatter and mist from reaching the worker.

After the potential for exposure has been minimized by engineering controls, further reductions can be achieved by work practices and, finally, personal protective equipment.

Work Practices

For all identified Category I and II tasks, the employer should have written, detailed Standard Operating Procedures (SOPs). All employees who perform Category I or II tasks should have ready access to the SOPs pertaining to those tasks.

1. Work practices should be developed on the assumption that all body fluids and tissues are infectious. General procedures to protect health-care workers against HBV or HIV transmission have been published elsewhere [1, 2, 23,28-33]. Each employer with Category I and II tasks in the workplace should incorporate those general recommendations, as appropriate, or equivalent procedures into work practices and SOPs. The importance of handwashing should be emphasized.
2. Work practices should include provision for safe collection of fluids and tissues and for disposal in accordance with applicable local, state, and federal regulations. Provision must be made for safe removal, handling, and disposal or decontamination of protective clothing and equipment, soiled linens, etc.
3. Work practices and SOPs should provide guidance on procedures to follow in the event of spills or personal exposure to fluids or tissues. These procedures should include instructions for personal and area decontamination as well as appropriate management or supervisory personnel to whom the incident should be reported.
4. Work practices should provide specific and detailed procedures to be observed with sharp objects, e.g., needles, scalpel blades. Puncture-resistant receptacles must be readily accessible for depositing these materials after use. These receptacles must be clearly marked and specific work practices provided to protect personnel responsible for disposing of them or processing their contents for reuse.

Personal Protective Equipment

Based upon the fluid or tissue to which there is potential exposure, the likelihood of exposure occurring, the potential volume of material, the probable route of exposure, and overall working conditions and job requirements, the employer should provide and maintain personal protective equipment appropriate to the specific requirements of each task.

For workers performing Category I tasks, a required minimum array of protective clothing or equipment should be specified by pertinent SOPs. All Category I tasks do not involve the same type or degree of risk, and therefore all do not require the same kind or extent of protection. Specific combinations of clothing and equipment must be tailored to specific tasks. Minimum levels of protection for Category I tasks in most cases would include use of appropriate gloves. If there is the potential for splashes, protective eyewear or face shields should be worn. Paramedics responding to an auto accident might protect against cuts on metal and glass by wearing gloves or gauntlets that are both puncture-resistant and impervious to blood. If the conditions of exposure include the potential for clothing becoming soaked with blood, protective outer garments such as impervious coveralls should be worn.

For workers performing Category II tasks, there should be ready access to appropriate protective equipment, e.g., gloves, protective eyewear, or surgi-

cal masks, specified in pertinent SOPs. Workers performing Category II tasks need not be wearing protective equipment, but they should be prepared to put on appropriate protective garb on short notice.

Medical

In addition to any health-care or surveillance required by other rules, regulations, or labor-management agreement, the employer should make available at no cost to the worker:

1. Voluntary HBV immunization for all workers whose employment requires them to perform Category I tasks and who test negative for HBV antibodies. Detailed recommendations for protecting health-care workers from viral hepatitis have been published by the CDC [1]. These recommendations include procedures for both pre- and post-exposure prophylaxis, and should be the basis for the routine approach by management to the prevention of occupational hepatitis B.
2. Monitoring, at the request of the worker, for HBV and HIV antibodies following known or suspected parenteral exposure to blood, body fluids, or tissues. This monitoring program must include appropriate provisions to protect the confidentiality of test results for all workers who may elect to participate.
3. Medical counseling for all workers found, as a result of the monitoring described above, to be seropositive for HBV or HIV. Counseling guidelines have been published by the Public Health Service [1, 2, 36].

Recordkeeping

If any employee is required to perform Category I or II tasks, the employer should maintain records documenting:

1. The administrative procedures used to classify job tasks. Records should describe the factors considered and outline the rationale for classification.
2. Copies of all SOPs for Category I and II tasks, and documentation of the administrative review and approval process through which each SOP passed.
3. Training records, indicating the dates of training sessions, the content of those training sessions along with the names of all persons conducting the training, and the names of all those receiving training.
4. The conditions observed in routine surveillance of the workplace for compliance with work practices and use of protective clothing or equipment. If noncompliance is noted, the conditions should be documented along with corrective actions taken.
5. The conditions associated with each incident of mucous membrane or parenteral exposure to body fluids or tissue, an evaluation of those conditions, and a description of any corrective measures taken to prevent a recurrence or other similar exposure.

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For further information call: National OSHA Information Office, (202) 523-8148.

APPENDIX 6

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MMWR

Supplement

MORBIDITY AND MORTALITY WEEKLY REPORT

**VIRAL
HEMORRHAGIC
FEVER:**

**INITIAL MANAGEMENT
OF
SUSPECTED AND
CONFIRMED CASES**

**U.S. Department of Health and Human Services
Public Health Service
Centers for Disease Control
Center for Infectious Diseases
Division of Viral Diseases
Atlanta, Georgia 30333**

Viral Hemorrhagic Fever: Initial Management of Suspected and Confirmed Cases

INTRODUCTION

Every year the possibility exists that travelers with viral hemorrhagic fever (VHF) transmissible from person to person—Lassa, Ebola, Marburg, or Crimean-Congo hemorrhagic fever (CCHF)—may enter the United States. Among U.S. citizens, health professionals involved in the care of patients in Africa might be most likely to be exposed to agents of these diseases. Serologic studies have indicated, however, that missionaries and Peace Corps volunteers serving in Africa without obvious or frequent exposure to ill persons may also be exposed. Additionally, travelers may enter the United States asymptotically infected with one of these viruses. Laboratory-acquired infection also remains a possibility in research or diagnostic facilities. Since guidelines concerning the approach to suspected cases of VHF were last published, in 1980 (1), approximately four cases of illness suspected of being VHF have occurred in the United States each year. None have been confirmed as VHF.

Although the source in nature of two (Ebola and Marburg) of the four viruses discussed in this document remains unknown, all four are capable of being transmitted from person to person, especially in the hospital setting. The communicability of these viruses in hospitals may vary considerably; however, the consequences of such transmission may be severe since case-fatality rates in hospital outbreaks have been high. The potential danger is increased by the fact that these illnesses begin with nonspecific symptoms that may be confused with other diseases. Therefore, appropriate barrier techniques designed to prevent transmission may not be instituted until late in the course of these illnesses, if at all. Finally, the lack of experience with these agents in the United States understandably results in confusion and anxiety on the part of physicians and other hospital personnel when a suspected importation occurs.

Since the earlier guidelines were published, additional clinical and laboratory observations have produced new information on the agents causing VHF and the illnesses they produce. Also, new information is available on treating patients with VHF. These guidelines are therefore offered to provide up-to-date information on these diseases, an organized approach to the suspected case of VHF, and guidelines concerning the handling of specimens and the care of patients. Also, a current list of persons available for consultation at CDC is included below. Because Lassa, Ebola, Marburg, and CCHF are the only hemorrhagic fevers for which person-to-person transmission has been documented, these guidelines will be limited to these four diseases. The reader is referred elsewhere for discussion of other agents that cause VHF in humans (2).

Further information and advice about the management of the patient with suspected VHF, control measures, and collection and shipment of diagnostic specimens are available on request from the following persons at CDC, Atlanta, Georgia. For all telephone numbers, dial 404-329 + extension:

1. Chief, Special Pathogens Branch, Division of Viral Diseases, Center for Infectious Diseases: Joseph B. McCormick, M.D. (ext. 3308).
2. Medical Epidemiologist, Office of the Director, Division of Viral Diseases, Center for Infectious Diseases: Jonathan E. Kaplan, M.D. (ext. 3095).
3. Director, Division of Viral Diseases, Center for Infectious Diseases: Frederick A. Murphy, D.V.M. (ext. 3574).
4. Acting Director, Office of Biosafety: John E. Forney, Ph.D. (ext. 3885).
5. After regular office hours and on weekends, the above-mentioned staff members may be contacted through the CDC duty officer (ext. 2888).

LASSA FEVER

Lassa fever first came to medical attention in 1969 when three nurses working in missionary hospitals in Nigeria became ill. Two died in Nigeria, and the third patient, who was transported to the United States while still ill, survived (3). Two persons who worked in the laboratory in the United States where virologic studies were being done also became ill; one had worked with tissue cultures and infected mice, while the other had no known contact with the virus (4,5). Since that time Lassa fever has been shown to be endemic in many areas of West and Central Africa (6). The reservoir of infection, which is caused by an arenavirus, is the multimammate rat *Mastomys natalensis*. This rodent inhabits rural areas in sub-Saharan Africa and lives in and around human dwellings (6,7).

Persons presumably acquire naturally occurring infections by contact with *M. natalensis*, either through handling the animal directly or by inhaling aerosolized excretions, such as urine. Subsequently, person-to-person transmission may occur within households and hospitals. Although one experience in Jos, Nigeria, has suggested that airborne transmission may occur (8), it is generally believed that direct contact with a patient or overt exposure to infective tissues, secretions, or excretions is necessary to transmit the infection from person to person.

The severity of illness appears to depend on the mode of transmission of the virus. Thus, in the community, where rodent-to-human transmission accounts for a substantial proportion of cases, the case-to-infection ratio may be as low as 1:30 (9). In the hospital, however, where transmission may occur by direct contact with infected secretions, excretions, or tissues, including inoculation with contaminated needles, this ratio is undoubtedly much higher. Case-fatality rates have ranged from 14% for sporadic cases in areas with endemic disease (10) to 52% for nosocomial outbreaks (8).

The incubation period of Lassa fever ranges from 6 to 21 days. Illness is usually heralded by fever, headache, myalgia, sore throat, and cough; chest and abdominal pain are also frequent complaints. In severe cases encephalopathy, hemorrhage, and shock may occur. Diagnosis can be made in three ways: by demonstrating a fourfold rise in titer of antibody to Lassa virus between acute-phase and convalescent-phase serum specimens with the indirect fluorescent antibody (IFA) technique, by detecting Lassa immunoglobulin M (IgM) antibodies, or by isolating Lassa virus from blood, urine, or throat (see HANDLING AND TRANSPORTING OF LABORATORY SPECIMENS). The diagnosis of Lassa is unlikely if no IgM or immunoglobulin G (IgG) antibody is detectable by the 14th day of illness, or if no virus is isolated from blood obtained during the first 7 days of illness. Virus isolation should be attempted only at laboratories equipped to handle viruses assigned to Biosafety Level 4 (11).

Treatment of Lassa fever is supportive and includes restoration of blood losses and maintenance of plasma volume, blood pressure, and electrolyte balance. Although immune plasma obtained from survivors of the disease has been used in severe cases, there are no data to confirm its efficacy. Preliminary data suggest that ribavirin, an antiviral compound, may be useful in the early stage of the illness (12). No Lassa fever vaccine is available.

Since the first recognized cases of Lassa fever in the United States in 1969, there has been one additional imported case of Lassa in this country, in 1976 (13). No secondary transmission following this case was noted despite intensive surveillance of close contacts. At least eight additional importations of Lassa fever have occurred in countries without endemic disease since recognition of the disease; however, no secondary transmission was identified after any of these importations (14-20). In four of these instances (15,18-20), the possibility of Lassa fever was not entertained until late in the course of illness or until after the patient had recovered, and barrier nursing techniques were not used during the acute stage of illness.

EBOLA HEMORRHAGIC FEVER

Ebola hemorrhagic fever came to medical attention in 1976 when successive outbreaks occurred in Sudan and Zaire, comprising over 500 cases (21,22). The Sudan outbreak involved workers at a cotton factory, with subsequent spread in a hospital. Nosocomial transmission was associated with direct patient contact, and particularly with nursing a patient (21). The Zaire outbreak centered around an outpatient facility; contaminated needles were involved in disseminating infection in nearly half the cases (22). The case-fatality rates in these two outbreaks were 53% and 88%, respectively. A smaller outbreak (34 cases) was investigated in Sudan in 1979 (23). Serologic studies suggest that Ebola fever is endemic in limited areas of Sudan and Zaire, as well as the Central African Republic and Kenya (24,25). Both the reservoir of the virus in nature and the source of human infection remain unknown. Classification of Ebola virus in the family Filoviridae has been proposed (26).

Once Ebola infection develops in humans, person-to-person transmission may occur, both in the community and in the hospital. Intrafamilial spread outside the hospital appears to be related to close personal contact with a case (22,23); within the hospital, injections with contaminated needles have been implicated as well (22). Evidence suggests that airborne transmission is not important in the spread of Ebola infection (21-23).

The case-to-infection ratio of Ebola fever is unknown, but serologic studies suggest that mild or inapparent infection may be common in areas with endemic disease (21,22). Person-to-person transmission in medical facilities may result in a higher case-to-infection ratio (22). Case-fatality rates may be extremely high, as illustrated by the experiences in Zaire and Sudan (21,22).

The average incubation period of Ebola fever is estimated to be 6-9 days, with a range of 2-21 days. Ebola illness begins with sudden onset of fever, accompanied by headache, myalgia, sore throat, abdominal pain, and diarrhea. A maculopapular skin rash is commonly seen in fair-skinned patients. Hemorrhage, usually from the gastrointestinal (GI) tract, is very common. The diagnosis can be made serologically by the IFA test or, preferably, by isolation of Ebola virus from the blood in the acute phase of illness. As with Lassa fever, the diagnosis of Ebola fever is unlikely if virus is not isolated from blood obtained during the first 7 days of illness, or if antibody is not present by the 14th day of illness.

Treatment of Ebola illness is supportive. Immune plasma may be effective in reducing the level of viremia (27), but controlled studies to evaluate its effect on the outcome of illness have not been done. Evidence suggests that there is no cross-protection between the Zaire and Sudan strains of the virus (28), so immune plasma may have to be specific to be effective. No studies with ribavirin or other antiviral compounds have been undertaken.

There have been no documented imported cases of Ebola fever in the United States or Europe. However, one laboratory-acquired infection occurred in Great Britain in 1976 following accidental inoculation with infected guinea pig tissue (29); the patient survived, and no secondary transmission was detected (30).

MARBURG VIRUS DISEASE

Marburg virus disease first came to medical attention in 1967 when 31 persons became ill in Europe following the importation of a group of African green monkeys from Uganda (31-33). Twenty-five of these patients were exposed directly to tissues from the monkeys. Six secondary cases occurred, all in persons who had direct contact with patients or their tissues. In 1975, a hitchhiker acquired Marburg infection in Rhodesia and then transmitted it to his girlfriend. She, in turn, transmitted it to a nurse in South Africa with whom she shared cigarettes, coffee cups, and handkerchiefs (34,35). A third outbreak of Marburg disease involved one primary and one secondary case (in the attending physician) in Kenya in 1980 (36), and a fourth involved a single case in South Africa in 1982 (37). Despite intensive investigation of these outbreaks, no natural reservoir of the Marburg virus has been identified, and the

area of endemicity has not been well defined. Morphologically, Marburg virus resembles the Ebola agent, but it is antigenically distinct. Classification in the family Filoviridae has been proposed (26).

Person-to-person transmission of Marburg disease has occurred in three of the four outbreaks that have been investigated. In each of these situations, transmission resulted from direct contact with an infected animal, an infected human, or infected tissues; there has been no evidence of airborne person-to-person transmission. The case-to-infection ratio of Marburg disease is unknown, but the case-fatality rate in the reported outbreaks has been 26%.

After an incubation period of 3-9 days, Marburg disease is heralded by fever, headache, myalgia, sore throat, dysphagia, vomiting, and diarrhea. A maculopapular skin rash is extremely common. Hemorrhage, usually from the GI tract, is a frequent finding, and disseminated intravascular coagulation (DIC) has been implicated in its pathogenesis. Diagnosis is made by IFA testing of serum specimens or by isolation of the virus from blood. As with Lassa and Ebola viruses, the diagnosis of Marburg virus disease is unlikely if virus is not isolated from blood obtained during the first 7 days of illness, or if antibody is not present by the 14th day of illness.

Treatment of Marburg virus disease is supportive. Immune plasma has been used, but its efficacy is unknown. Heparin may be useful in preventing DIC (35). No studies have evaluated the use of antiviral compounds in this disease.

Since the original Marburg disease outbreak, there have been no known cases of Marburg disease, either imported or laboratory acquired, in Europe or the United States.

CRIMEAN-CONGO HEMORRHAGIC FEVER

Crimean hemorrhagic fever was first described in 1945, following an epidemic among field workers in the Crimea in the Soviet Union. The agent was isolated in 1945 (38), and subsequent studies showed that it was identical to a virus isolated in the Congo in 1956 (39); hence, the name Crimean-Congo hemorrhagic fever (CCHF). The disease is now known to be endemic throughout Eastern Europe, Africa, and Asia (38). Its natural reservoir is wild and domesticated mammals such as sheep, cattle, goats, and hares. Over 20 species of ticks have been found to be infected; however, illness is usually transmitted to humans by the bite of an ixodid (hard) tick of the genus *Hyalomma* (38). The CCHF agent has been classified as a bunyavirus.

Once a case of human CCHF occurs, person-to-person transmission is possible, particularly in the hospital setting; nosocomial outbreaks have occurred in several countries in which the disease is endemic, including the Soviet Union, Pakistan, India, and Iraq (38,40-42). Transmission is presumed to occur by direct contact with infective blood (38,40,41). There are no data to suggest that airborne transmission is an important mode of spread. The case-to-infection ratio in CCHF is unknown, but mild and inapparent infections do occur (43). The case-fatality rate ranges from 15% among sporadic cases (43) to 70% in nosocomial outbreaks (42).

After an incubation period of 3-6 days, illness is heralded by fever, chills, headache, myalgia, abdominal pain, and vomiting. Hemorrhage is a hallmark of the disease, and vascular collapse is common. Diagnosis is made serologically by the complement-fixation, indirect-hemagglutination, or IFA tests, or by isolation of the virus from blood. Failure to detect antibody by the 20th day of illness (the antibody response in CCHF may be delayed compared with that in other VHF's) or failure to isolate virus from blood obtained during the first 7 days of illness render the diagnosis unlikely.

Treatment is supportive. Although Suleiman (41) gained the impression that immune plasma may be effective, studies testing the efficacy of immune plasma have been inconclusive (38). The use of antiviral agents in CCHF has not been investigated.

No imported or laboratory-acquired cases of CCHF have been documented in countries without endemic disease.

APPROACH TO A SUSPECTED CASE OF VHF

When confronted with a possible case of VHF, a physician should ask three questions: 1) Where has the patient been? 2) What time has elapsed between the patient's presence in the area with endemic VHF, or exposure to a person with VHF, and onset of illness? 3) What are the patient's symptoms? Careful history of the exact location of travel should be obtained. It is important to note that within the areas endemic for the various VHFs (Table 1), only specific types of exposure—direct or indirect contact with local animals or direct contact with ill persons or their tissues, secretions, or excretions—indicate the possibility of VHF. The vast majority of Americans visiting Africa and other areas with endemic VHFs will offer no history compatible with exposure to the organisms that cause VHF. Also, most travelers to urban areas, even though they may occasionally visit a rural area, will not come into contact with the virus reservoirs. An interval in excess of 3 weeks between possible exposure to VHF and onset of illness makes the diagnosis of VHF unlikely (Table 1). Since patients with VHF may present with nonspecific symptoms (fever, headache, myalgia), clinical diagnosis is very difficult, if not impossible. However, certain symptoms and signs in addition to these three (pharyngitis, conjunctivitis, vomiting, diarrhea, abdominal pain, and, most important, hemorrhagic manifestations and/or shock) should suggest the possibility of VHF (Table 1). Other febrile illnesses—malaria, typhoid fever, meningococcemia, arboviral and enteroviral infections, and leptospirosis—must be considered in the differential diagnosis.

If, having taken into account the above considerations, the physician feels the patient may have VHF, he/she should take the following actions immediately: 1) Place the patient in strict isolation, and 2) contact the local and state health departments and CDC.

ISOLATION OF PATIENTS WITH SUSPECTED AND CONFIRMED VHF

Ideally, patients with suspected or confirmed VHF should be immediately placed in a special isolation unit (such as a Vickers Bed Isolator*) designed to prevent contamination of the area outside of the patient's immediate environment. Realistically, VHF will probably be suspected or diagnosed most frequently in medical facilities that have no specialized containment rooms or Vickers Isolators available. Most hospitals in the United States, however, have rooms in which it is possible to create negative pressure compared with the outside hall and in which air can be exhausted without recirculation to other rooms. Under these circumstances, strict isolation (44) should prevent transmission to others. If possible, the patient should remain in the hospital in which he/she is initially seen. If appropriate isolation cannot be arranged in this hospital, or if the hospital staff is logistically unprepared to care for a patient with VHF, transporting the patient to another institution, preferably a local one, must be considered. However, the risk to paramedical personnel and, more important, to the patient whose medical care will be delayed must be weighed carefully in making such a decision. It is recommended that the local and state health departments or CDC be consulted about the decision to move the patient to another institution and the means by which this may be accomplished.

To minimize the risk of transmitting VHF to health personnel caring for the patient, a number of precautions should be instituted:

1. The patient should be placed in a private room that is suitable for strict isolation and that can only be entered through an anteroom. Air from the patient's room should be at negative pressure compared with that of the outside hall, and it should be discharged without recirculation (the hospital engineer should confirm this before the room is used).
2. The anteroom, which should have hand-washing facilities, should be allocated for use by persons entering and leaving the patient's room. Air from this anteroom also should not recirculate to other parts of the hospital. The anteroom should contain supplies required for day-to-day care of the patient and supplies required for decontamination of materials taken from the patient's room (see Appendix).

*Use of trade names is for identification only and does not imply endorsement by the Public Health Service or the U.S. Department of Health and Human Services.

Table 1. Clinical and epidemiologic characteristics of viral hemorrhagic fever

Characteristic	Lassa fever	Ebola hemorrhagic fever	Marburg virus disease	Crimean-Congo hemorrhagic fever
Endemic areas	West Africa (Guinea to Central Africa)	East Africa (Zaire, Sudan, Central African Republic, Kenya)	East Africa, South Africa	Eastern Europe, Asia, Africa
Etiologic-agent classification	Arenaviridae	Filoviridae (proposed)	Filoviridae (proposed)	Bunyaviridae
Reservoir in nature	Rodents (<i>Mastomys natalensis</i>)	?	?	Ticks (<i>Hyalomma</i> genus and others), wild and domesticated mammals
Modes of transmission	Rodent-to-human (virus excreted in urine); person-to-person	?	?	Tick bite; Person-to-person
Incubation period	6-21 days	2-21 days	3-9 days	3-6 days
Symptoms	% of cases	% of cases	% of cases	% of cases
Headache	50-75	75-100	75-100	75-100
Myalgia	25-50	75-100	50-75	50-75
Sore throat	75-100	75-100	50-75	25-50
Cough	50-75	25-50	5-25	25-50
Dysphagia	5-25	5-25	25-50	
Vomiting	75-100	50-75	75-100	75-100
Diarrhea	25-50	75-100	75-100	25-50
Chest pain	25-50	50-75	5-25	5-25
Abdominal pain	50-75	75-100	5-25	75-100
Signs				
Fever	75-100	75-100	75-100	75-100
Conjunctivitis	25-50	50-75	25-50	5-25
Pharyngitis	75-100	25-50	5-25	25-50
Cervical lymphadenopathy	25-50		25-50	
Abdominal tenderness	50-75	25-50		25-50
Skin rash (macular)	5-25	50-75	75-100	
Hemorrhage (skin or gastrointestinal)	25-50	75-100	25-50	75-100
Shock	25-50	25-50	25-50	50-75
Laboratory				
Leukopenia	25-50	5-25	75-100	50-75
Thrombocytopenia			75-100	75-100
Proteinuria	50-75	50-75		50-75
Disseminated intravascular coagulation			5-25	5-25

3. The external surfaces of all containers should be decontaminated before they are removed from the anteroom. Disposable linen, pajamas, and protective clothing worn by persons entering the patient's room (see below) should be double bagged in airtight bags, and the outside bag should be sponged with 0.5% sodium hypochlorite solution (10% aqueous solution of household bleach) or a suitable phenolic disinfectant (such as Lysol[®]) before being removed from the anteroom. The bag and its contents should then be incinerated. Disposable items used in patient care/management, especially those involved in obtaining laboratory specimens (see HANDLING AND TRANSPORTING OF LABORATORY SPECIMENS) should be placed in a rigid plastic container containing 0.5% sodium hypochlorite. The outside of this container should be sponged with 0.5% sodium hypochlorite or a phenolic disinfectant before being removed from the patient's room. The container should then be autoclaved and discarded or incinerated.

4. Hospital traffic past the anteroom should be minimized, preferably by locating the room at the end of a corridor, and the door of the anteroom should be kept closed. A daily log should be kept of all persons entering the patient's room (the log should include adequate information for contacting these persons).

5. All persons entering the patient's room should wear the following disposable items: gowns, face masks, goggles, gloves, and head and shoe covers. Some persons may prefer to use full-face respirators equipped with high-efficiency particulate air (HEPA) filters, or nose and mouth respirators with HEPA filters plus goggles or face shield. These items may be stored either in the anteroom or immediately outside the door to the anteroom in the hallway. Protective clothing should be removed by the individual before he/she emerges from the anteroom into the outside hallway.

6. Routine management of the patient should be organized to limit traffic, including that of medical and nursing staff, into and out of the room. Patients who are ambulatory and have few symptoms should be encouraged to take care of themselves as much as possible (for example, noting their routine vital signs and making their beds).

7. The patient should use a chemical toilet, and all bodily secretions and excretions should be treated with 0.5% sodium hypochlorite before being removed from the room.

VERIFICATION OF THE DIAGNOSIS OF VHF

Diagnosis of VHF can be confirmed by isolation of the causative virus from the blood of the patient or, in the case of Lassa fever, from the throat or urine. Diagnosis may also be made serologically, although antibodies are not usually present until the second week of illness. The Mobile Laboratory (see below) is equipped to perform serologic testing for the agents under discussion, but virus isolation must be done at a laboratory with appropriate containment facilities. The following guidelines pertain to obtaining the appropriate specimens for virus isolation.

HANDLING AND TRANSPORTING OF LABORATORY SPECIMENS

Collecting Specimens

The following initial specimens should be taken to confirm or rule out a diagnosis of VHF:

1. A throat swab placed in a plastic, screw-cap container in 1 ml of sterile, phosphate-buffered neutral saline, containing 1% human serum albumin or 25% rabbit serum albumin.

2. A clean-catch, midstream urine specimen obtained in a sterile container. Five milliliters of urine should be stabilized by the addition of either human serum albumin to a final concentration of 1% or rabbit serum albumin to a final concentration of 25% and placed in a plastic, screw-cap container.

3. Venous blood for antibody studies and virus isolation. Ten milliliters of clotted blood should be obtained in a sealed, plastic tube, if available (using vacutainers simplifies collection of multiple samples but may require using glass collection tubes). When obtaining the blood specimen, personnel should be acutely aware of the danger of accidental inoculation and of

sprays, spills, or aerosols (this obviously pertains to all specimens obtained from the patient for diagnostic purposes). Personnel should not attempt to replace the plastic needle guard on a used needle, but should discard the needle and syringe (or needle and vacutainer sleeve) into a rigid plastic container containing 0.5% sodium hypochlorite. The container should then be autoclaved and discarded or incinerated. To avoid unnecessary exposure of laboratory personnel, the blood specimen should not be centrifuged or separated.

The outside of each specimen container should be swabbed with 0.5% sodium hypochlorite or a phenolic disinfectant, and a label should be affixed with the patient's name, the date of the specimen, and the nature of the suspected infection. Specimens should then be double bagged in airtight bags and labeled similarly. Bags containing specimens should be sponged with a solution of 0.5% sodium hypochlorite or a phenolic disinfectant before being taken from the room.

Packaging and Transporting Specimens

CDC (Office of Biosafety or contacts listed in the Introduction) or the state health department should be contacted for instructions on packaging, labeling, and shipping diagnostic laboratory specimens since shipment is subject to the applicable provisions of the Public Health Service interstate quarantine regulations (45). In general, specimens should be packaged as follows:

1. Place the specimen in a securely closed, watertight, primary container (screw-cap plastic test tube or vial), and seal the cap with tape. Heat-sealed plastic vials are also ideal primary containers for etiologic agents, provided they are formulated from a plastic that is not prone to shatter at temperatures of -20 C or lower.
2. Wrap the primary container with sufficient absorbent material (for example, paper towels or tissue) to absorb the entire contents in case the container breaks or leaks.
3. Place the wrapped, sealed primary container in a durable, watertight secondary container (screw-cap metal mailing tube or sealed metal can). Screw-cap metal mailing tubes should be sealed with tape. Several primary containers of specimens, each individually wrapped in absorbent material, may be placed in the secondary container, provided that the secondary container does not contain more than 50 ml of specimen material.
4. On the outside of the secondary container, place the specimen data forms, letters, and other information identifying or describing the specimen.
5. Place the secondary container and specimen information in an outer mailing tube or box.
6. Keep the specimens for virus isolation frozen, preferably by placing dry ice around the secondary container in the mailing tube or box (specimens should be frozen initially in a -20 C or -70 C freezer, not in dry ice).
7. Contact CDC or the state health department for advice on labeling and shipping.

EXPOSURE OF LABORATORY PERSONNEL TO SPECIMENS

Laboratory personnel may have handled specimens from the patient during tests carried out early in the illness, before the diagnosis of VHF was considered. Additionally, once the diagnosis is considered, certain routine laboratory tests required for management of the patient may be necessary before the Mobile Laboratory is established (see CLINICAL MANAGEMENT OF PATIENTS WITH SUSPECTED VHF—THE MOBILE LABORATORY). Any person testing laboratory specimens from patients suspected of having VHF should wear surgical gloves and a full-face respirator with an HEPA filter. Care should be taken to minimize use of potentially hazardous procedures, such as ones that produce aerosols, and use of potentially hazardous equipment, such as glass microhematocrit tubes. Laboratory tests should be done in special areas with a Class 2A biological safety cabinet (11). All personnel who handled these specimens when not adequately protected should be placed under surveillance (see IDENTIFICATION, SURVEILLANCE, AND MANAGEMENT OF CONTACTS OF PATIENTS WITH VHF). The equipment used to carry out these tests should be decontaminated before being returned to routine use (see DECONTAMINATION PROCEDURES).

CLINICAL MANAGEMENT OF PATIENTS WITH SUSPECTED VHF— THE MOBILE LABORATORY

Case Management

The management of patients severely ill with VHF represents a major challenge to the practitioner of intensive-care medicine. The details of patient management cannot be covered in this document, and no attempt has been made to do so. A few general observations follow; further details may be obtained from the references.

The pathogenesis of VHFs is not clearly understood. Multiple organ systems may be affected by a viral infection that, although not highly inflammatory, is widely disseminated. A hallmark of these diseases is presence of high concentrations of virus in the blood for 2 weeks or longer. Many deaths occur among patients who are admitted during the second week of illness and who may be dehydrated and have low blood pressure. Thus, careful management of fluid and electrolyte balance from the onset of disease is perhaps the most important aid to recovery. Enzyme studies reveal that the liver is regularly affected, although it is doubtful that it is very often damaged sufficiently to cause death. The case-fatality rate in these diseases is higher for persons with overt bleeding than for those without hemorrhage. DIC has been documented only in patients with Marburg disease and CCHF, but its presence may help explain the clinical illness associated with the other hemorrhagic fevers as well. Detection and treatment of bleeding should be given high priority. Other acute problems that may occur include myocarditis and pericarditis, pleural effusion, intrauterine death, and spontaneous abortion.

Therapy is mainly supportive. Immune plasma obtained from persons who have survived the infection in question is frequently used for patients with VHF. However, the efficacy of such treatment has not been established. It is suggested that, if used, immune plasma should be administered early in the illness, preferably in the first week. The simultaneous presence of the virus and its naturally occurring antibodies in the blood of patients during the second week of illness suggests that some of the pathologic effects may be caused by deposition of antigen-antibody complexes. Administering immune plasma under such circumstances may only aggravate the patient's condition. Preliminary studies in Sierra Leone suggest that the antiviral agent ribavirin, if administered during the first week of illness, may be helpful in treating Lassa fever (12). This drug has not been studied in connection with the other hemorrhagic fevers.

Mobile Laboratory

Any delay must be avoided in processing routine laboratory specimens necessary for care of the critically ill patient. In the past, however, there has been some reluctance to expose laboratory personnel or equipment to possible contamination with VHF viruses. Therefore, CDC has procured a Vickers Mobile Laboratory*, which can be transported within hours to any hospital in the United States where a person suspected of having VHF is hospitalized (46). A qualified laboratory technician experienced in working with VHF materials is available to accompany the laboratory equipment. The Mobile Laboratory includes facilities for performing routine hematologic and blood chemistry studies, coagulation studies, and urinalysis, as well as routine (bacterial) microbiologic cultures. Serologic studies for the agents causing VHF can be done in the Mobile Laboratory, but facilities are not adequate for attempting virus isolation. The laboratory is designed to facilitate the care of the ill patient so that transportation to another medical facility is unnecessary.

The Mobile Laboratory is to be installed in a hospital room with similar features to those of the patient's room and from which air can be exhausted to the outside of the hospital. It is preferable that this room be near the patient's room, have an anteroom or area for dressing, and have shower facilities. The room must have an 8-foot long table or counter with 4 feet of overhead clearance and an additional 8-10 linear feet of counterspace. Eight to ten electrical outlets will be required. Further information concerning the Mobile Laboratory can be obtained by contacting any of the persons listed in the INTRODUCTION.

Autopsy and Handling of the Corpse

Careful consideration should be given to the potential risks and benefits of performing an autopsy on anyone suspected of having died from VHF. If an autopsy must be done, extreme precautions must be taken to prevent dissemination of the virus. Double gloves, cap and gown, waterproof apron and shoe coverings, and full-face respirators equipped with HEPA filters should be worn. Methods should be used to avoid or minimize aerosolization of tissues (e.g., bone should be cut with a hand saw rather than an electric saw). All effluents resulting from the autopsy should be decontaminated before they are washed down the drain, and the autopsy room should be decontaminated after the procedure.

The body should not be embalmed. Rather, the body should be placed in an airtight bag and either cremated or placed in a sealed casket for burial.

DECONTAMINATION PROCEDURES

Conveyances (ambulances, for example), transport and bed isolation units, and hospital rooms can be decontaminated by applying a 0.5% sodium hypochlorite solution or a phenolic disinfectant to all exposed surfaces.

Patient care/management items (such as endoscopes) and laboratory equipment used to process specimens from patients with suspected VHF before the Mobile Laboratory is in place should be decontaminated before being returned to routine use. Surfaces in contact with potentially contaminated liquids, such as flow-through optical and sampling systems, can be decontaminated by flushing with 0.5% sodium hypochlorite. Sufficient solution should be used for the fluid to enter waste-disposal reservoirs in the instruments. Smaller reusable items, such as pipettes, should be immersed in 0.5% sodium hypochlorite and autoclaved. Disposable laboratory materials, such as pipette tips, plastic cuvettes, and excess specimens, should be placed in a rigid plastic container containing 0.5% sodium hypochlorite and autoclaved and discarded or incinerated.

IDENTIFICATION, SURVEILLANCE, AND MANAGEMENT OF CONTACTS OF PATIENTS WITH VHF

A contact is defined as a person who has been exposed to an infected person or his/her secretions, excretions, or tissues in such a way as to be at risk of acquiring the infection. For VHF, this includes anyone who has been associated with an infected person—at any time from onset of fever to 3 weeks later—in any of the following ways:

1. Shared the same residence
2. Had face-to-face contact (within 3 feet) with the patient
3. Had skin or mucous membrane contact and/or a needle stick or other penetrating injury with the patient's secretions, excretions, blood, or tissues

CDC will work with state and local health authorities, as appropriate, to implement surveillance and management of contacts of patients with VHF. Initially, clinicians and hospital authorities should compile a list of individuals to be placed under surveillance, including their addresses and telephone numbers. The usual method of surveillance involves having the individual under surveillance record his/her temperature twice daily and report immediately any temperature of 101 F or greater or any symptoms of illness to the public health officer responsible for surveillance. Any person with a temperature of 101 F or more or other symptoms or signs suggestive of VHF within 3 weeks after exposure should be placed in isolation and treated as a suspected case.

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APPENDIX**Suggested List of Essential Supplies and Equipment
To Be Kept in Anteroom Adjoining Patient's Room (Excluding Medications)**

Equipment for full physical examination
Emergency equipment
Portable X-ray machine
Electrocardiogram machine
Intravenous equipment and supplies
Tourniquets
Dry gauze
Alcohol swabs
Needles and adapters
Syringes
Blood tubes for complete blood count,
blood chemistry, and coagulation studies
Containers with Hanks' solution with 1% human
serum albumin or 25% rabbit serum albumin
for specimens of throat washing and urine
Printed specimen labels with patient's name
Marker pens
Plastic airtight bags, large and small
Large plastic trash bags
0.5% sodium hypochlorite (10% aqueous
solution of household bleach), Lysol*
solution
Chemical toilet
Urinals
Bed linen (disposable)
Pajamas (disposable)
Thermometers (disposable)
Toiletries, etc. (disposable)

*Use of trade names is for identification only and does not imply endorsement by the Public Health Service or the U.S. Department of Health and Human Services.


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Recommendation of the Immunization Practices Advisory Committee (ACIP)

Recommendations for Protection Against Viral Hepatitis

The following statement updates all previous recommendations on use of immune globulins for protection against viral hepatitis (MMWR 1981;30:423-35) and use of hepatitis B vaccine and hepatitis B immune globulin for prophylaxis of hepatitis B (MMWR 1982;31:317-28 and MMWR 1984;33:285-90).

INTRODUCTION

The term "viral hepatitis" is commonly used for several clinically similar diseases that are etiologically and epidemiologically distinct (1). Two of these, hepatitis A (formerly called infectious hepatitis) and hepatitis B (formerly called serum hepatitis) have been recognized as separate entities since the early 1940s and can be diagnosed with specific serologic tests. The third, currently known as non-A, non-B hepatitis, is probably caused by at least two different agents, and lacking specific diagnostic tests, remains a disease diagnosed by exclusion. It is an important form of acute viral hepatitis in adults and currently accounts for most post-transfusion hepatitis in the United States. An epidemic type of non-A, non-B hepatitis, which is probably spread by the fecal-oral route and is different from the types seen in the United States, has been described in parts of Asia and North Africa (2).

A fourth type of hepatitis, delta hepatitis, has recently been characterized as an infection dependent on hepatitis B virus. It may occur as a coinfection with acute hepatitis B infection or as superinfection of a hepatitis B carrier (3).

HEPATITIS SURVEILLANCE

Approximately 21,500 cases of hepatitis A, 24,300 cases of hepatitis B, 3,500 cases of non-A, non-B hepatitis, and 7,100 cases of hepatitis type unspecified were reported in the United States in 1983. Most cases of each type occur among young adults. Since reporting from many localities is incomplete, the actual number of hepatitis cases occurring annually is thought to be several times the reported number.

IMMUNE GLOBULINS

Immune globulins used in medical practice are sterile solutions of antibodies (immunoglobulins) from human plasma. They are prepared by cold ethanol fractionation of large plasma pools and contain 10%-18% protein. In the United States, plasma is primarily obtained from professional donors. Only plasma shown to be free of hepatitis B surface antigen (HBsAg) is used to prepare immune globulins.

Immune globulin (IG) (formerly called "immune serum globulin," ISG, or "gamma globulin") produced in the United States contains antibodies against the hepatitis A virus (anti-HAV) and the hepatitis B surface antigen (anti-HBs). Tests of IG lots prepared since 1977 indicate that both types of antibody have uniformly been present. Hepatitis B immune globulin (HBIG) is an IG prepared from plasma containing high titers of anti-HBs.

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ACIP: Viral Hepatitis – Continued

Neither IG nor HBIG commercially available in the United States transmits hepatitis or other viral infections. There is no evidence that the causative agent of AIDS (human T-lymphotropic virus type III/lymphadenopathy-associated virus [HTLV-III/LAV]) has been transmitted by IG or HBIG (4).

Serious adverse effects from immune globulins administered as recommended have been exceedingly rare. Standard immune globulins are prepared for intramuscular use and should not be given intravenously. Two preparations for intravenous use in immunodeficient and other selected patients have recently become available in the United States but are not recommended for hepatitis prophylaxis. Immune globulins are not contraindicated for pregnant women.

HEPATITIS A

Hepatitis A is caused by the hepatitis A virus (HAV), a 27-nm ribonucleic acid (RNA) agent that is a member of the picornavirus family. The illness caused by HAV characteristically has an abrupt onset with fever, malaise, anorexia, nausea, abdominal discomfort, and jaundice. Severity is related to age. In children, most infections are asymptomatic, and illness is usually not accompanied by jaundice. Most infected adults become symptomatically ill with jaundice. Fatality among reported cases is infrequent (about 0.6%).

Hepatitis A is primarily transmitted by person-to-person contact, generally through fecal contamination. Transmission is facilitated by poor personal hygiene, poor sanitation, and intimate (intra-household or sexual) contact. Common-source epidemics from contaminated food and water also occur. Sharing utensils or cigarettes or kissing are not believed to transmit the infection.

The incubation period of hepatitis A is 15-50 days (average 28-30). High concentrations of HAV (10^8 particles/g) are found in stools of infected persons. Fecal virus excretion reaches its highest concentration late in the incubation period and early in the prodromal phase of illness, and diminishes rapidly once jaundice appears. Greatest infectivity is during the 2-week period immediately before the onset of jaundice. Viremia is of short duration; virus has not been found in urine or other body fluids. A chronic carrier state with HAV in blood or feces has not been demonstrated. Transmission of HAV by blood transfusion has occurred but is rare.

The diagnosis of acute hepatitis A is confirmed by finding IgM-class anti-HAV in serum collected during the acute or early convalescent phase of disease. IgG-class anti-HAV, which appears in the convalescent phase of disease and remains detectable in serum thereafter, apparently confers enduring protection against disease. Commercial tests are available to detect IgM anti-HAV and total anti-HAV in serum.

Although the incidence of hepatitis A in the United States has decreased over the last 15 years, it is still a common infection in older children and young adults. About 38% of reported hepatitis cases in this country are attributable to hepatitis A.

Recommendations for IG prophylaxis of hepatitis A. Numerous field studies conducted in the past 4 decades confirm that IG given before exposure or during the incubation period of hepatitis A is protective against clinical illness (5-7). Its prophylactic value is greatest (80%-90%) when given early in the incubation period and declines thereafter (7).

Preexposure prophylaxis. The major group for whom preexposure prophylaxis is recommended is international travelers. The risk of hepatitis A for U.S. citizens traveling abroad varies with living conditions, incidence of hepatitis A infection in areas visited, and length of stay (8,9). In general, travelers to developed areas of western Europe, Japan, and Australia are at no greater risk of infection than in the United States. In contrast, travelers to developing

ACIP: Viral Hepatitis – Continued

countries may be at significant risk of infection. In such areas, the best way to prevent hepatitis A and other enteric diseases is to avoid potentially contaminated water or food. Drinking water (or beverages with ice) of unknown purity and eating uncooked shellfish or uncooked fruits or vegetables that are not peeled (or prepared) by the traveler should be avoided.

IG is recommended for travelers to developing countries if they will be eating in settings of poor or uncertain sanitation (some restaurants or homes) or will be visiting extensively with local persons, especially young children, in settings with poor sanitary conditions. Persons who plan to reside in developing areas for long periods should receive IG regularly if they anticipate exposure as described above or will be living in rural areas with poor sanitation.

For such travelers, a single dose of IG of 0.02 ml/kg is recommended if travel is for less than 2 months. For prolonged travel, 0.06 ml/kg should be given every 5 months. For persons who require repeated IG prophylaxis, screening for total anti-HAV antibodies before travel may be useful to define susceptibility and eliminate unnecessary doses of IG in those who are immune.

Postexposure prophylaxis. A serologic test for the diagnosis of acute hepatitis A is now widely available. Since only 38% of acute hepatitis cases in the United States result from hepatitis A, serologic confirmation of hepatitis A in the index case is recommended before treatment of contacts. Serologic screening of contacts for anti-HAV before giving IG is not recommended because screening is more costly than IG and would delay its administration.

IG should be given as soon as possible after exposure; giving IG more than 2 weeks after exposure is not indicated.

Specific recommendations for IG prophylaxis of hepatitis A depend on the nature of the HAV exposure:

1. **Close personal contact.** IG is recommended for all household and sexual contacts of persons with hepatitis A.
2. **Day-care centers.** Day-care facilities with children in diapers can be important settings for HAV transmission (10-12). IG should be administered to all staff and attendees of day-care centers or homes if: (a) one or more hepatitis A cases are recognized among children or employees; or (b) cases are recognized in two or more households of center attendees. When an outbreak (hepatitis cases in three or more families) occurs, IG should also be considered for members of households whose diapered children attend. In centers not enrolling children in diapers, IG need only be given to classroom contacts of an index case.
3. **Schools.** Contact at elementary and secondary schools is usually not an important means of transmitting hepatitis A. Routine administration of IG is not indicated for pupils and teachers in contact with a patient. However, when epidemiologic study clearly shows the existence of a school- or classroom-centered outbreak, IG may be given to those who have close personal contact with patients.
4. **Institutions for custodial care.** Living conditions in some institutions, such as prisons and facilities for the developmentally disabled, favor transmission of hepatitis A. When outbreaks occur, giving IG to residents and staff who have close contact with patients with hepatitis A may reduce the spread of disease. Depending on the epidemiologic circumstances, prophylaxis can be limited in extent or can involve the entire institution.
5. **Hospitals.** Routine IG prophylaxis for hospital personnel is not indicated. Rather, sound hygienic practices should be emphasized. Staff education should point out the risk of exposure to hepatitis A and emphasize precautions regarding direct contact with potentially infective materials (13).

ACIP: Viral Hepatitis – Continued

Outbreaks of hepatitis A among hospital staff occur occasionally, usually in association with an unsuspected index patient who is fecally incontinent. Large outbreaks have occurred among staff and family contacts of infected infants in neonatal intensive-care units. In outbreaks, prophylaxis of persons exposed to feces of infected patients may be indicated.

6. *Offices and factories.* Routine IG administration is not indicated under the usual office or factory conditions for persons exposed to a fellow worker with hepatitis A. Experience shows that casual contact in the work setting does not result in virus transmission.
7. *Common-source exposure.* IG might be effective in preventing foodborne or waterborne hepatitis A if exposure is recognized in time. However, IG is not recommended for persons exposed to a common source of hepatitis infection after cases have begun to occur in those exposed, since the 2-week period during which IG is effective will have been exceeded.

If a foodhandler is diagnosed as having hepatitis A, common-source transmission is possible but uncommon. IG should be administered to other foodhandlers but is usually not recommended for patrons. However, IG administration to patrons may be considered if (a) the infected person is directly involved in handling, without gloves, foods that will not be cooked before they are eaten; (b) the hygienic practices of the foodhandler are deficient; and (c) patrons can be identified and treated within 2 weeks of exposure. Situations where repeated exposures may have occurred, such as in institutional cafeterias, may warrant stronger consideration of IG use.

For postexposure IG prophylaxis, a single intramuscular dose of 0.02 ml/kg is recommended.

HEPATITIS B

Hepatitis B virus (HBV) infection is a major cause of acute and chronic hepatitis, cirrhosis, and primary hepatocellular carcinoma worldwide. The frequency of HBV infection and patterns of transmission vary markedly in different parts of the world. In the United States, western Europe, and Australia, it is a disease of low endemicity, with only 0.1%-0.5% of the population being virus carriers and infection occurring primarily during adulthood. In contrast, HBV infection is highly endemic in China and Southeast Asia, sub-Saharan Africa, most Pacific islands, and the Amazon Basin; in these areas, 5%-15% of the population carry the virus, and most persons acquire infection at birth or during childhood. In other parts of the world, HBV is moderately endemic, and 1%-4% of persons are HBV carriers. Recommendations for prophylaxis of hepatitis B will vary in accordance with local patterns of HBV transmission. The recommendations that follow are intended for use in the United States.

Hepatitis B infection is caused by the HBV, a 42-nm, double-shelled deoxyribonucleic acid (DNA) virus. Several well-defined antigen-antibody systems have been associated with HBV infection (Table 1). HBsAg, formerly called "Australia antigen" or "hepatitis-associated antigen," is found on the surface of the virus and on accompanying 22-nm spherical and tubular forms. HBsAg can be identified in serum 30-60 days after exposure to HBV and persists for variable periods. The various subtypes (adr, adw, ayw, ayr) of HBsAg provide useful epidemiologic markers. Antibody against HBsAg (anti-HBs) develops after a resolved infection and is responsible for long-term immunity. Anti-HBc, the antibody to the core antigen (an internal component of the virus), develops in all HBV infections and persists indefinitely. IgM anti-HBc appears early in infection and persists for 6 or more months; it is a reliable marker of acute or recent HBV infection. The hepatitis B e antigen (HBeAg) is a third antigen, presence of which correlates with HBV replication and high infectivity. Antibody to HBeAg (anti-HBe) develops in most HBV infections and correlates with lower infectivity.

ACIP: Viral Hepatitis – Continued

The onset of acute hepatitis B is generally insidious. Clinical symptoms and signs include various combinations of anorexia, malaise, nausea, vomiting, abdominal pain, and jaundice. Skin rashes, arthralgias, and arthritis can also occur. Overall fatality rates for reported cases generally do not exceed 2%. The incubation period of hepatitis B is long—45-160 days (average 60-120).

TABLE 1. Hepatitis nomenclature

Abbreviation	Term	Comments
Hepatitis A		
HAV	Hepatitis A virus	Etiologic agent of "infectious" hepatitis; a picornavirus; single serotype.
Anti-HAV	Antibody to HAV	Detectable at onset of symptoms; lifetime persistence.
IgM anti-HAV	IgM class antibody to HAV	Indicates recent infection with hepatitis A; positive up to 4-6 months after infection.
Hepatitis B		
HBV	Hepatitis B virus	Etiologic agent of "serum" or "long-incubation" hepatitis; also known as Dane particle.
HBsAg	Hepatitis B surface antigen	Surface antigen(s) of HBV detectable in large quantity in serum; several subtypes identified.
HBeAg	Hepatitis B e antigen	Soluble antigen; correlates with HBV replication, high titer HBV in serum, and infectivity of serum.
HBcAg	Hepatitis B core antigen	No commercial test available.
Anti-HBs	Antibody to HBsAg	Indicates past infection with and immunity to HBV, passive antibody from HBIG, or immune response from HBV vaccine.
Anti-HBe	Antibody to HBeAg	Presence in serum of HBsAg carrier suggests lower titer of HBV.
Anti-HBc	Antibody to HBcAg	Indicates past infection with HBV at some undefined time.
IgM anti-HBc	IgM class antibody to HBcAg	Indicates recent infection with HBV; positive for 4-6 months after infection.
Delta hepatitis		
δ virus	Delta virus	Etiologic agent of delta hepatitis; may only cause infection in presence of HBV.
δ -Ag	Delta antigen	Detectable in early acute delta infection.
Anti- δ	Antibody to delta antigen	Indicates past or present infection with delta virus.
Non-A, non-B hepatitis		
NANB	Non-A, non-B hepatitis	Diagnosis of exclusion. At least two candidate viruses; epidemiology parallels that of hepatitis B.
Epidemic non-A, non-B hepatitis		
Epidemic NANB	Epidemic non-A, non-B hepatitis	Causes large epidemics in Asia, North Africa; fecal-oral or waterborne.
Immune globulins		
IG	Immune globulin (previously ISG, immune serum globulin, or gamma globulin)	Contains antibodies to HAV, low titer antibodies to HBV.
HBIG	Hepatitis B immune globulin	Contains high titer antibodies to HBV.

ACIP: Viral Hepatitis – Continued

HBV infection in the United States. The estimated lifetime risk of HBV infection in the United States varies from almost 100% for the highest-risk groups to approximately 5% for the population as a whole. An estimated 200,000 persons, primarily young adults, are infected each year. One-quarter become ill with jaundice; more than 10,000 patients require hospitalization; and an average of 250 die of fulminant disease each year. Between 6% and 10% of young adults with HBV infection become carriers. The United States currently contains an estimated pool of 500,000-1,000,000 infectious carriers. Chronic active hepatitis develops in over 25% of carriers and often progresses to cirrhosis. Furthermore, HBV carriers have a risk of developing primary liver cancer that is 12-300 times higher than that of other persons. It is estimated that 4,000 persons die from hepatitis B-related cirrhosis each year in this country and that more than 800 die from hepatitis B-related liver cancer.

The role of the HBV carrier is central in the epidemiology of HBV transmission. A carrier is defined as a person who is HBsAg-positive on at least two occasions at least 6 months apart. Although the degree of infectivity is best correlated with HBeAg-positivity, any person positive for HBsAg is potentially infectious. The likelihood of developing the carrier state varies inversely with the age at which infection occurs. During the perinatal period, HBV transmitted from HBeAg-positive mothers results in HBV carriage in up to 90% of infected infants, whereas 6%-10% of acutely infected adults become carriers.

Carriers and persons with acute infection have highest concentrations of HBV in the blood and serous fluids; less is present in other body fluids, such as saliva and semen. Transmission occurs via percutaneous or permucosal routes. Infective blood or body fluids can be introduced by contaminated needles or through sexual contact. Infection can occur in settings of continuous close personal contact, such as in households or among children in institutions for the mentally retarded, presumably via inapparent or unnoticed contact of infectious secretions with skin lesions or mucosal surfaces. Transmission of infection by transfusion of contaminated blood or blood products has been greatly reduced since the advent of routine screening with highly sensitive tests for HBsAg. HBV is not transmitted via the fecal-oral route or by contamination of food or water.

Serologic surveys demonstrate that, although HBV infection is uncommon among adults in the general population, it is highly prevalent in certain groups. Those at risk, based on the prevalence of serologic markers of infection, are described in Table 2. Immigrants/refugees and their descendants from areas of high HBV endemicity are at high risk of acquiring HBV infection. Homosexually active men and users of illicit injectable drugs are among the highest-risk groups, acquiring infection soon after adopting these lifestyles (10%-20%/year). Inmates of prisons have high prevalence of HBV markers usually because of prior parenteral drug abuse; actual risk of transmission in prisons is also associated with parenteral drug abuse in prisons. Patients and staff in custodial institutions for the mentally retarded are also at increased risk of having HBV infection. Classroom contacts, particularly teachers or instructors, of some deinstitutionalized carriers may also be at higher risk than the general population. Household contacts and sexual partners of HBV carriers are at increased risk, as are hemodialysis patients and recipients of certain pooled plasma products.

There is increased risk for medical and dental workers and related laboratory and support personnel who have contact with blood. Employment in a hospital without exposure to blood carries no greater risk than that for the general population.

Hepatitis B prophylaxis. Two types of products are available for prophylaxis against hepatitis B. Hepatitis B vaccine, licensed in 1981, provides active immunization against HBV infection, and its use is recommended for both pre- and postexposure prophylaxis. IG products provide temporary, passive protection and are indicated only in certain postexposure settings.

ACIP: Viral Hepatitis – Continued

IG and HBIG. IG and HBIG contain different amounts of anti-HBs. IG is prepared from plasma that is not preselected for anti-HBs content. Since 1977, all lots tested have contained anti-HBs at a titer of at least 1:100 by radioimmunoassay (RIA). HBIG is prepared from plasma preselected for high-titer anti-HBs. In the United States, HBIG has an anti-HBs titer of higher than 1:100,000 by RIA. There is no evidence that the causative agent of AIDS (HTLV-III/LAV) has been transmitted by IG or HBIG (4).

Hepatitis B vaccine. Hepatitis B vaccine licensed in the United States is a suspension of inactivated, alum-adsorbed 22-nm surface antigen particles that have been purified from human plasma by a combination of biophysical (ultracentrifugation) and biochemical procedures. Inactivation is a threefold process using 8M urea, pepsin at pH 2, and 1:4000 formalin. These treatment steps have been shown to inactivate representatives of all classes of viruses found in human blood, including the causative agent of AIDS (HTLV-III/LAV) (14). HB vaccine contains 20 µg/ml of HBsAg protein.

After a series of three intramuscular doses of hepatitis B vaccine, over 90% of healthy adults develop protective antibody (15,16). A course of three 10-µg doses induces antibody in virtually all infants and children from birth through 9 years of age. The deltoid (arm) is the recommended site for hepatitis B vaccination in adults; immunogenicity of vaccine in adults is significantly lower when injections are given in the buttock (81%) (17). The immunogenicity of the intradermal route has not yet been clearly established.

Field trials of the U.S.-manufactured vaccine have shown 80%-95% efficacy in preventing infection or hepatitis among susceptible persons (16,18). Protection against illness is virtually complete for persons who develop adequate antibody levels* after vaccination. The duration of protection and need for booster doses are not yet defined. However, only 10%-15% of per-

*Adequate antibody is 10 or more sample ratio units (SRU) by RIA or positive by enzyme immunoassay.

TABLE 2. Prevalence of hepatitis B serologic markers in various population groups

Population group	Prevalence of serologic markers of HBV infection	
	HBsAg (%)	All markers (%)
High risk		
Immigrants/refugees from areas of high HBV endemicity	13	70-85
Clients in institutions for the mentally retarded	10-20	35-80
Users of illicit parenteral drugs	7	60-80
Homosexually active men	6	35-80
Household contacts of HBV carriers	3-6	30-60
Patients of hemodialysis units	3-10	20-80
Intermediate risk		
Health-care workers—frequent blood contact	1-2	15-30
Prisoners (male)	1-8	10-80
Staff of institutions for the mentally retarded	1	10-25
Low risk		
Health-care workers—no or infrequent blood contact	0.3	3-10
Healthy adults (first-time volunteer blood donors)	0.3	3-5

ACIP: Viral Hepatitis – Continued

sons who develop adequate antibody after three vaccine doses will lose antibody within 4 years, and among those who lose antibody, protection against viremic infection and liver inflammation appears to persist. Immunogenicity and efficacy of the licensed vaccine in hemodialysis patients is much lower than in normal adults; protection may last only as long as adequate antibody levels persist (19).

Vaccine usage. Primary vaccination consists of three intramuscular doses of vaccine, with the second and third doses given 1 and 6 months, respectively, after the first. Adults and older children should be given 20 μ g (1.0 ml) per dose, while children under 10 years should receive 10 μ g (0.5 ml) per dose. For patients undergoing hemodialysis and for other immunosuppressed patients, a 40- μ g (2.0-ml) dose should be used. Vaccine doses administered at longer intervals provide equally satisfactory protection, but optimal protection is not conferred until after the third dose. Hepatitis B vaccine should only be given in the deltoid muscle in adults and children or in the anterolateral thigh muscle in infants and neonates. Since hepatitis B vaccine is an inactivated (noninfective) product, it is presumed that there will be no interference with other simultaneously administered vaccines.

Data are not available on the safety of the vaccine for the developing fetus. Because the vaccine contains only noninfectious HBsAg particles, there should be no risk to the fetus. In contrast, HBV infection in a pregnant woman may result in severe disease for the mother and chronic infection for the newborn. Pregnancy should not be considered a contraindication to the use of this vaccine for persons who are otherwise eligible.

Vaccine storage. Vaccine should be stored at 2 C-8 C (36 F-46 F) but not frozen. *Freezing destroys the potency of the vaccine.*

Side effects and adverse reactions. The most common side effect observed in prevaccination trials was soreness at the injection site. Among an estimated 750,000 vaccinees, approximately 100 episodes of severe illness have been reported after receipt of vaccine. These have included arthralgias, neurologic reactions (such as Guillain-Barré syndrome), and other illnesses. The rate of Guillain-Barré syndrome following HB vaccine does not appear to be significantly increased above that observed in normal adults. Such temporally associated illnesses are not considered to be etiologically related to hepatitis B vaccine.

Effect of vaccination on carriers and immune persons. The vaccine produces neither therapeutic nor adverse effects in HBV carriers (20). Vaccination of individuals who possess antibodies against HBV from a previous infection is not necessary but will not cause adverse effects. Such individuals will have a postvaccination increase in their anti-HBs levels. Passively acquired antibody, whether from HBIG or IG administration or from the transplacental route, will not interfere with active immunization (21).

Prevaccination serologic screening for susceptibility. The decision to screen potential vaccine recipients for prior infection depends on three variables: (1) the cost of vaccination; (2) the cost of testing for susceptibility; and (3) the expected prevalence of immune individuals in the group. Figure 1 shows the relative cost-effectiveness of screening, given different costs of screening tests and the expected prevalence of immunity. In constructing the figure, the assumption was made that the cost of three doses of vaccine is \$100 and that there are additional costs for administration. For any combination of screening costs and immunity to hepatitis, the cost-effectiveness can be estimated. For example, if the expected prevalence of serologic markers for HBV is over 20%, screening is cost-effective if costs of screening are no greater than \$30 per person. If the expected prevalence of markers is less than 8%, and if the costs of screening are greater than \$10 per person, vaccination without screening is cost-effective.

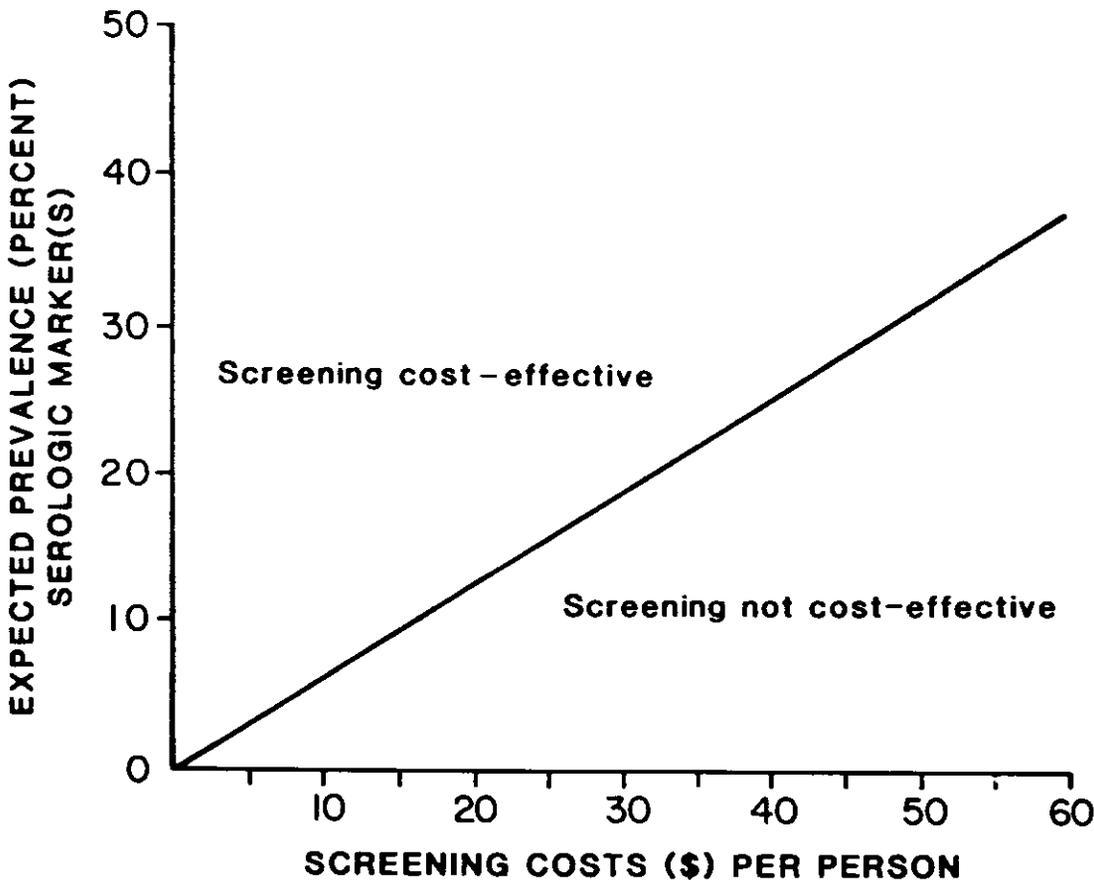
ACIP: Viral Hepatitis – Continued

Screening in groups with the highest risk of HBV infection (Table 2) will be cost-effective unless testing costs are extremely high. For groups at intermediate risk, cost-effectiveness of screening may be marginal, and vaccination programs may or may not utilize screening. For groups with a low expected prevalence of HBV serologic markers, such as health professionals in their training years, screening will not be cost-effective.

For routine screening, only one antibody test, either anti-HBc or anti-HBs, need be used. Anti-HBc will identify all previously infected persons, both carriers and noncarriers, but will not discriminate between members of the two groups. Anti-HBs will identify those previously infected, except carriers. For groups expected to have carrier rates of under 2%, such as health-care workers, neither test has a particular advantage. For groups with higher carrier rates, anti-HBc may be preferred to avoid unnecessary vaccination of carriers. If the RIA anti-HBs test is used for screening, a minimum of 10 RIA sample ratio units should be used to designate immunity (2.1 is the usual designation of a positive test). If enzyme immunoassay (EIA) is used, the manufacturers' recommended positive is appropriate.

Serologic confirmation of postvaccination immunity and revaccination of nonresponders. When given in the deltoid, hepatitis B vaccine produces protective antibody (anti-HBs) in more than 90% of healthy persons. Testing for immunity following vaccination is not recommended routinely but is advised for persons whose subsequent management depends on

FIGURE 1. Cost-effectiveness of prevaccination screening of hepatitis B virus vaccine candidates*



*See text for assumptions.

ACIP: Viral Hepatitis – Continued

knowing their immune status, such as dialysis patients and staff, and for persons in whom a suboptimal response may be anticipated, such as those who have received vaccine in the buttock.

Revaccination of persons who do not respond to primary series (nonresponders) produces adequate antibody in only one-third when the primary vaccination has been given in the deltoid. Therefore, revaccination of nonresponders to deltoid injection is not recommended routinely. For persons who did not respond to a primary vaccine series given in the buttock, preliminary data from two small studies suggest that revaccination in the arm induces adequate antibody in over 75%. Revaccination should be strongly considered for such persons.

Preexposure vaccination. Persons at substantial risk of acquiring HBV infection who are demonstrated or judged likely to be susceptible should be vaccinated. They include:

1. **Health-care workers.** The risk of health-care workers acquiring HBV infection depends on the frequency of exposure to blood or blood products and on the frequency of needlesticks. These risks vary during the training and working career of each individual but are often highest during the professional training period. For this reason, it is recommended that vaccination be completed during training in schools of medicine, dentistry, nursing, laboratory technology, and other allied health professions.

The risk of HBV infection for hospital personnel can vary both among hospitals and within hospitals. In developing specific immunization strategies, hospitals should use available published data about the risk of infection (22-24) and may wish to evaluate their own clinical and institutional experience with hepatitis B. Studies in urban centers have indicated that occupational groups with frequent exposure to blood and/or needles have the highest risk of acquiring HBV infection, including (but not limited to) the following groups: medical technologists, operating room staff, phlebotomists and intravenous therapy nurses, surgeons and pathologists, and oncology and dialysis unit staff. Groups shown to be at increased risk in some hospitals include: emergency room staff, nursing personnel, and staff physicians.

Other health-care workers based outside hospitals who have frequent contact with blood or blood products are also at increased risk of acquiring HBV infection. These include (but are not limited to): dental professionals (dentists, oral surgeons, dental hygienists), laboratory and blood bank technicians, dialysis center staff, emergency medical technicians, and morticians.

2. **Clients and staff of institutions for the mentally retarded.** Susceptible clients and staff who work closely with clients of institutions for the mentally retarded should be vaccinated. Risks for staff are comparable to those for health-care personnel in other high-risk environments. However, the risk in institutional environments is associated, not only with blood exposure, but also with bites and contact with skin lesions and other infective secretions. Susceptible clients and staff who live or work in smaller (group) residential settings with known HBV carriers should also receive hepatitis B vaccine.
3. **Hemodialysis patients.** Numerous studies have established the high risk of HBV transmission in hemodialysis units. Although recent data have shown not only a decrease in the rate of HBV infection in hemodialysis units but also a lower vaccine efficacy in these patients, vaccination is recommended for susceptible patients. Environmental control measures and regular serologic screening (based on immune status) of patients should be maintained.
4. **Homosexually active men.** Susceptible homosexually active men should be vaccinated regardless of their ages or duration of their homosexual practices. It is important to

ACIP: Viral Hepatitis – Continued

vaccinate persons as soon as possible after their homosexual activity begins. Homosexually active women are not at increased risk of sexually transmitted HBV infection.

5. *Users of illicit injectable drugs.* All users of illicit injectable drugs who are susceptible to HBV should be vaccinated as early as possible after their drug use begins.
6. *Recipients of certain blood products.* Patients with clotting disorders who receive clotting factor concentrates have an elevated risk of acquiring HBV infection. Vaccination is recommended for these persons and should be initiated at the time their specific clotting disorder is identified. Screening is recommended for patients who have already received multiple infusions of these products.
7. *Household and sexual contacts of HBV carriers.* Household contacts of HBV carriers are at high risk of acquiring HBV infection. Sexual contacts appear to be at greatest risk. When HBV carriers are identified through routine screening of donated blood, diagnostic testing in hospitals, prenatal screening, screening of refugees, or other screening programs, they should be notified of their status and their susceptible household contacts vaccinated.

Families accepting orphans or unaccompanied minors from countries of high HBV endemicity should have the child screened for HBsAg, and if positive, family members should be vaccinated.

8. *Other contacts of HBV carriers.* Persons in casual contact with carriers at schools, offices, etc., are at minimal risk of acquiring HBV infection, and vaccine is not routinely recommended for them. However, classroom contacts of deinstitutionalized mentally retarded HBV carriers who behave aggressively or have special medical problems that increase the risk of exposure to their blood or serous secretions may be at risk. In such situations, vaccine may be offered to classroom contacts.
9. *Special high-risk populations.* Some American populations, such as Alaskan Eskimos, native Pacific islanders, and immigrants and refugees from areas with highly endemic disease (particularly eastern Asia and sub-Saharan Africa) have high HBV infection rates. Depending on specific epidemiologic and public health considerations, more extensive vaccination programs should be considered.
10. *Inmates of long-term correctional facilities.* The prison environment may provide a favorable setting for the transmission of HBV because of the frequent use of illicit injectable drugs and homosexual practices. Moreover, it provides an access point for vaccination of parenteral drug abusers. Prison officials should consider undertaking screening and vaccination programs directed at those who abuse drugs before or while in prison.
11. *Heterosexually active persons.* Heterosexually active persons with multiple sexual partners are at increased risk of acquiring HBV infection; risk increases with increasing sexual activity. Vaccination should be considered for persons who present for treatment of sexually transmitted diseases and who have histories of sexual activity with multiple partners.
12. *International travelers.* Vaccination should be considered for persons who plan to reside more than 6 months in areas with high levels of endemic HBV and who will have close contact with the local population. Vaccination should also be considered for short-term travelers who are likely to have contact with blood from or sexual contact with residents of areas with high levels of endemic disease. Hepatitis B vaccination of travelers ideally should begin 6 months before travel in order to complete the full vaccine series; however, a partial series will offer some protection against HBV infection.

ACIP: Viral Hepatitis – Continued

Postexposure prophylaxis for hepatitis B. Prophylactic treatment to prevent hepatitis B infection after exposure to HBV should be considered in the following situations: perinatal exposure of an infant born to an HBsAg-positive mother; accidental percutaneous or per-mucosal exposure to HBsAg-positive blood; or sexual exposure to an HBsAg-positive person.

Recent studies have established the relative efficacies of immune globulins and/or hepatitis B vaccine in various exposure situations. For perinatal exposure to an HBsAg-positive, HBeAg-positive mother, a regimen combining one dose of HBIG at birth with the hepatitis B vaccine series started soon after birth is 85%-90% effective in preventing development of the HBV carrier state (25,27). Regimens involving either multiple doses of HBIG alone, or the vaccine series alone, have 70%-75% efficacy, while a single dose of HBIG alone has only 50% efficacy (28).

For accidental percutaneous exposure or sexual exposure, only regimens including HBIG and/or IG have been studied. A regimen of two HBIG doses, one given after exposure and one a month later, is about 75% effective in preventing hepatitis B following percutaneous exposure; a single dose of HBIG has similar efficacy when used following sexual exposure (29-31).

(Continued on page 329)

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IG may have some effect in preventing clinical hepatitis B following percutaneous exposures and can be considered as an alternative to HBIG when it is not possible to obtain HBIG.

Recommendations on postexposure prophylaxis are based on the efficacy data discussed above and on the likelihood of future HBV exposure of the person requiring treatment. In perinatal exposure and percutaneous exposure of high-risk health-care personnel, a regimen combining HBIG with hepatitis B vaccine will provide both short- and long-term protection, will be less costly than the two-dose HBIG treatment alone, and is the treatment of choice.

Perinatal exposure. One of the most efficient modes of HBV transmission is from mother to infant during birth. If the mother is positive for both HBsAg and HBeAg, about 70%-90% of infants will become infected, and up to 90% of these infected infants will become HBV carriers. If the HBsAg-positive carrier mother is HBeAg-negative, or if anti-HBe is present, transmission occurs less frequently and rarely leads to the HBV carrier state. However, severe acute disease, including fatal fulminant hepatitis in the neonate, has been reported (32,33). Prophylaxis of infants from all HBsAg-positive mothers is recommended, regardless of the mother's HBeAg or anti-HBe status.

The efficacy of a combination of HBIG plus the hepatitis B vaccine series has been confirmed in recent studies. Although the following regimen is recommended (Table 3), other schedules have also been effective (25-27,34). The major consideration for all these regimens is the need to give HBIG as soon as possible after delivery.

HBIG (0.5 ml [10 µg]) should be administered intramuscularly after physiologic stabilization of the infant and preferably within 12 hours of birth. Hepatitis B vaccine should be administered intramuscularly in three doses of 0.5 ml (10 µg) each. The first dose should be given concurrently with HBIG but at a different site. If vaccine is not available at birth, the first vaccine dose may be given within 7 days of birth. The second and third doses should be given 1 month and 6 months, respectively, after the first. Testing for HBsAg and anti-HBs is recommended at 12-15 months to monitor the final success or failure of therapy. If HBsAg is not detectable, and anti-HBs is present, the child has been protected. Testing for anti-HBc is not useful, since maternal anti-HBc may persist for more than 1 year; the utility of testing for IgM anti-HBc is currently being evaluated. HBIG administered at birth should not interfere with oral polio and diphtheria-tetanus-pertussis vaccines administered at 2 months of age.

Maternal screening. Since efficacy of the treatment regimen depends on administering HBIG on the day of birth, it is vital that HBsAg-positive mothers be identified before delivery. Mothers belonging to groups known to be at high risk of acquiring HBV infection (Table 4)

TABLE 3. Hepatitis B virus postexposure recommendations

Exposure	HBIG		Vaccine	
	Dose	Recommended timing	Dose	Recommended timing
Perinatal	0.5 ml IM	Within 12 hours	0.5 ml (10 µg) IM of birth	Within 12 hours of birth* repeat at 1 and 6 months
Sexual	0.06 ml/kg IM	Single dose within 14 days of sexual contact	†	—

*The first dose can be given the same time as the HBIG dose but at a different site.

†Vaccine is recommended for homosexual men and for regular sexual contacts of HBV carriers and is optional in initial treatment of heterosexual contacts of persons with acute HBV.

ACIP: Viral Hepatitis – Continued

should be tested routinely for HBsAg during a prenatal visit. If a mother belonging to a high-risk group has not been screened prenatally, HBsAg screening should be done at the time of delivery, or as soon as possible thereafter, and the infant treated as above if the mother is HBsAg-positive. If the mother is identified as HBsAg-positive more than 1 month after giving birth, the infant should be screened for HBsAg, and if negative, treated with hepatitis B vaccine and HBIG.

The appropriate obstetric and pediatric staff should be notified directly of HBsAg-positive mothers, so the staff may take appropriate precautions to protect themselves and other patients from infectious material, blood, and secretions, and so the neonate may receive therapy without delay after birth.

Acute exposure to blood that contains (or might contain) HBsAg. For accidental percutaneous or permucosal exposure to blood that is known to contain or might contain HBsAg, the decision to provide prophylaxis must take into account several factors: (1) the hepatitis B vaccination status of the exposed person; (2) whether the source of blood is known or unknown; and (3) whether the HBsAg status of the source is known or unknown. Such exposures usually occur in persons who are candidates for hepatitis B vaccine; for any exposure in a person not previously vaccinated, hepatitis B vaccination is recommended.

The following outline and table summarize prophylaxis for percutaneous (needlestick or bite), ocular, or mucous-membrane exposure to blood according to the source of exposure and vaccination status of the exposed person (Table 5). For greatest effectiveness, passive prophylaxis with HBIG (or IG) should be given as soon as possible after exposure (its value beyond 7 days of exposure is unclear).

1. *Exposed person not previously vaccinated.* Hepatitis B vaccination should be considered the treatment of choice. Depending on the source of the exposure, HBsAg testing of the source and additional prophylaxis of the exposed person may be warranted (see below). Screening the exposed person for immunity should be considered if such screening is cost-effective (as discussed in preexposure prophylaxis) and if this will not delay treatment beyond 7 days.
 - a. *Source known HBsAg-positive.* A single dose of HBIG (0.06 ml/kg) should be given as soon as possible after exposure and within 24 hours, if possible. The first dose of hepatitis B vaccine (20 µg) should be given intramuscularly at a separate site within 7 days of exposure, and the second and third doses given 1 month and 6 months later (Table 5).[†] If HBIG cannot be obtained, IG in an equivalent dosage (0.06 ml/kg) may provide some benefit.

[†]For persons who are not given hepatitis B vaccine, a second dose of HBIG should be given 1 month after the first dose.

TABLE 4. Women for whom prenatal HBsAg screening is recommended

1. Women of Asian, Pacific island, or Alaskan Eskimo descent, whether immigrant or U.S.-born.
 2. Women born in Haiti or sub-Saharan Africa.
 3. Women with histories of:
 - a. Acute or chronic liver disease.
 - b. Work or treatment in a hemodialysis unit.
 - c. Work or residence in an institution for the mentally retarded.
 - d. Rejection as a blood donor.
 - e. Blood transfusion on repeated occasions.
 - f. Frequent occupational exposure to blood in medico-dental settings.
 - g. Household contact with an HBV carrier or hemodialysis patient.
 - h. Multiple episodes of venereal diseases.
 - i. Percutaneous use of illicit drugs.
-

ACIP: Viral Hepatitis — Continued

- b. *Source known, HBsAg status unknown.* The following guidelines are suggested based on the relative probability that the source is HBsAg-positive and on the consequent risk of HBV transmission:
- (1) *High risk that the source is HBsAg-positive, such as patients with a high risk of HBV carriage (Table 2) or patients with acute or chronic liver disease (serologically undiagnosed).* The exposed person should be given the first dose of hepatitis B vaccine (20 µg) within 1 week of exposure and vaccination completed as recommended. The source person should be tested for HBsAg. If positive, the exposed person should be given HBIG (0.06 ml/kg) if within 7 days of exposure.
 - (2) *Low risk that the source is positive for HBsAg.* The exposed person should be given the first dose of hepatitis B vaccine (20 µg) within 1 week of exposure and vaccination completed as recommended. Testing of the source person is not necessary.
- c. *Source unknown.* The exposed person should be given the first dose of hepatitis B vaccine (20 µg) within 7 days of exposure and vaccination completed as recommended.
2. *Exposed person previously vaccinated against hepatitis B.* For percutaneous exposures to blood in persons who have previously received one or more doses of hepatitis B vaccine, the decision to provide additional prophylaxis will depend on the source of exposure and on whether the vaccinated person has developed anti-HBs following vaccination.
- a. *Source known HBsAg-positive.* The exposed person should be tested for anti-HBs unless he/she has been tested within the last 12 months. If the exposed person has adequate[§] antibody, no additional treatment is indicated.

[§]Adequate antibody is 10 SRU or more by RIA or positive by EIA.

TABLE 5. Recommendations for hepatitis B prophylaxis following percutaneous exposure

Source	Exposed person	
	Unvaccinated	Vaccinated
HBsAg-positive	<ol style="list-style-type: none"> 1. HBIG x 1 immediately* 2. Initiate HB vaccine[†] series. 	<ol style="list-style-type: none"> 1. Test exposed person for anti-HBs[§] 2. If inadequate antibody,[¶] HBIG (x1) immediately plus HB vaccine booster dose.
Known source		
High-risk HBsAg-positive	<ol style="list-style-type: none"> 1. Initiate HB vaccine series 2. Test source for HBsAg. If positive, HBIG x 1. 	<ol style="list-style-type: none"> 1. Test source for HBsAg only if exposed is vaccine nonresponder; if source is HBsAg-positive, give HBIG x 1 immediately plus HB vaccine booster dose
Low-risk HBsAg-positive	Initiate HB vaccine series.	Nothing required.
Unknown source	Initiate HB vaccine series.	Nothing required.

*HBIG dose 0.06 ml/kg IM.

[†]HB vaccine dose 20 µg IM for adults; 10 µg IM for infants or children under 10 years of age. First dose within 1 week; second and third doses, 1 and 6 months later.

[§] See text for details.

[¶] Less than 10 SRU by RIA, negative by EIA.

ACIP: Viral Hepatitis – Continued

- (1) If the exposed person has not completed vaccination and has inadequate levels of antibody, one dose of HBIG (0.06 ml/kg) should be given immediately and vaccination completed as scheduled.
 - (2) If the exposed person has inadequate antibody on testing or has previously not responded to vaccine, one dose of HBIG should be given immediately and a booster dose of vaccine (1 ml or 20 µg) given at a different site.
 - (3) If the exposed person shows inadequate antibody on testing but is known to have had adequate antibody in the past, a booster dose of hepatitis B vaccine (1 ml or 20 µg) should be given.
- b. *Source known, HBsAg status unknown.*
- (1) *High risk that the source is HBsAg-positive.* Additional prophylaxis is necessary only if the exposed person is a known vaccine nonresponder. In this circumstance, the source should be tested for HBsAg and, if positive, the exposed person treated with one dose of HBIG (0.06 ml/kg) immediately and a booster dose of vaccine (1 ml or 20 µg) at a different site. In other circumstances, screening of the source for HBsAg and the exposed person for anti-HBs is not routinely recommended, because the actual risk of HBV infection is very low (less than 1 per 1,000).[¶]
 - (2) *Low risk that the source is HBsAg-positive.* The risk of HBV infection is minimal. Neither testing of the source for HBsAg, nor testing of the exposed person for anti-HBs, is recommended.
- c. *Source unknown.* The risk of HBV infection is minimal. No treatment is indicated.

Sexual contacts of persons with acute HBV infection. Sexual contacts of HBsAg-positive persons are at increased risk of acquiring HBV infection, and HBIG has been shown to be 75% effective in preventing such infections (37). Because data are limited, the period after sexual exposure during which HBIG is effective is unknown, but extrapolation from other settings makes it unlikely that this period would exceed 14 days. Prescreening sexual partners for susceptibility before treatment is recommended if it does not delay treatment beyond 14 days after last exposure. Testing for anti-HBc is the most efficient prescreening test to use in this population group.

A single dose of HBIG (0.06 ml/kg) is recommended for susceptible individuals who have had sexual contact with an HBsAg-positive person, if HBIG can be given within 14 days of the last sexual contact, and for persons who will continue to have sexual contact with an individual with acute hepatitis B before loss of HBsAg in that individual. In exposures between heterosexuals, hepatitis B vaccination may be initiated at the same time as HBIG prophylaxis; such treatment may improve efficacy of postexposure treatment. However, since 90% of persons with acute HBV infection become HBsAg-negative within 15 weeks of diagnosis, the potential for repeated exposure to HBV is limited. Hepatitis B vaccine is, therefore, optional in initial treatment for such exposures. If vaccine is not given, a second dose of HBIG should be given if the index patient remains HBsAg-positive for 3 months after detection. If the index patient is a known carrier or remains positive for 6 months, hepatitis B vaccine should be offered to regular sexual contacts. For exposures among homosexual men, the hepatitis B vaccine series should be initiated at the time HBIG is given, since hepatitis B vaccine is recommended for all susceptible homosexual men. Additional doses of HBIG are unnecessary if vaccine is given. IG

[¶]Estimated by multiplying the risk of vaccine nonresponse in the exposed person (.10) by the risk of the needle source being HBsAg-positive (.05) by the risk of HBV infection in a susceptible person having an HBsAg-positive needle-stick injury (.20).

ACIP: Viral Hepatitis – Continued

is an alternative to HBIG when it is not possible to obtain HBIG.

Household contacts of persons with acute HBV infection. Prophylaxis for other household contacts of persons with acute HBV infection is not indicated unless they have had identifiable blood exposure to the index case, such as by sharing toothbrushes or razors. Such exposures should be treated similarly to sexual exposures. If the index patient becomes a hepatitis B carrier, all household contacts should be given hepatitis B vaccine.

DELTA HEPATITIS

The delta virus (also known as hepatitis D virus [HDV] by some investigators) is a defective virus that may only cause infection in the presence of active HBV infection. The delta virus has been characterized as a particle of 35-37 nm in size, consisting of RNA (mw 500,000) as genetic material and an internal protein antigen (delta-antigen), coated with HBsAg as the surface protein (3). Infection may occur as either coinfection with hepatitis B or superinfection of a hepatitis B carrier, each of which usually cause an episode of acute hepatitis. Coinfection usually resolves, while superinfection frequently causes chronic delta infection and chronic active hepatitis. Both types of infection may cause fulminant hepatitis.

Delta infection may be diagnosed by detection of delta-antigen in serum during early infection and by the appearance of delta antibody during or after infection. Routes of delta transmission appear to be similar to those of hepatitis B. In the United States, delta infection occurs most commonly among persons at high risk of acquiring HBV infection, such as drug addicts and hemophilia patients.

A test for detection of delta antibody is expected to be commercially available soon. Other tests (delta antigen, IgM anti-delta) are available only in research laboratories.

Since the delta virus is dependent on hepatitis B for replication, prevention of hepatitis B infection, either preexposure or postexposure, will suffice to prevent delta infection in a person susceptible to hepatitis B. Known episodes of perinatal, sexual, or percutaneous exposure to sera or persons positive for both HBV and delta virus should be treated exactly as such exposures to hepatitis B alone.

Persons who are HBsAg carriers are at risk of delta infection, especially if they participate in activities that put them at high risk of repeated exposure to hepatitis B (parenteral drug abuse, homosexuality). However, at present there are no products available that might prevent delta infection in HBsAg carriers either before or after exposure.

NON-A, NON-B HEPATITIS

United States. Non-A, non-B hepatitis that presently occurs in the United States has epidemiologic characteristics similar to those of hepatitis B, occurring most commonly following blood transfusion and parenteral drug abuse. Multiple episodes of non-A, non-B hepatitis have been observed in the same individuals and may be due to different agents. Chronic hepatitis following acute non-A, non-B hepatitis infection varies in frequency from 20% to 70%. Experimental studies in chimpanzees have confirmed the existence of a carrier state, which may be present in up to 8% of the population.

Although several studies have attempted to assess the value of prophylaxis with IG against non-A, non-B hepatitis, the results have been equivocal, and no specific recommendations can be made (35,36). However, for persons with percutaneous exposure to blood from a patient with non-A, non-B hepatitis, it may be reasonable to administer IG (0.06 ml/kg) as soon as possible after exposure.

Epidemic (fecal-oral) non-A, non-B hepatitis. In recent years, epidemics of non-A, non-B hepatitis spread by water or close personal contact have been reported from several areas of Southeast Asia (Indian subcontinent, Burma) and north Africa (2). Such epidemics generally

ACIP: Viral Hepatitis — Continued

affect adults and cause unusually high mortality in pregnant women. The disease has been transmitted to experimental animals, and candidate viruses have been identified; however, no serologic tests have yet been developed (37).

Epidemic non-A, non-B hepatitis has not been recognized in the United States or western Europe, and it is unknown whether the causative agent is present in these areas.

Travelers to areas having epidemic non-A, non-B hepatitis may be at some risk of acquiring this disease by close contact or by contaminated food or water. The value of IG in preventing this infection is unknown. The best prevention of infection is to avoid potentially contaminated food or water, as with hepatitis A and other enteric infections.

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MORBIDITY AND MORTALITY WEEKLY REPORT

Recommendations of the Immunization Practices Advisory Committee

Update on Hepatitis B Prevention

INTRODUCTION

Hepatitis B virus (HBV) infection is a major cause of acute and chronic hepatitis, cirrhosis, and primary hepatocellular carcinoma in the United States and worldwide. Since 1982, a safe and effective hepatitis B (HB) vaccine manufactured from human plasma has been available in the United States. This vaccine has been recommended as preexposure prophylaxis for persons at high or moderate risk of HBV infection (1). In addition, the combination of HB vaccine and hepatitis B immunoglobulin (HBIG) has been recommended for postexposure prophylaxis in susceptible persons who have perinatal or needle-stick exposure to known HBV-positive persons or their blood.

This statement provides an update on HB vaccine usage and on its impact on disease incidence in the 5 years following its licensure. In addition, it provides both recommendations for using a new HB vaccine produced in yeast by recombinant DNA technology and an assessment of the need for HB vaccine booster doses for persons who have received the initial three-dose regimen. Basic recommendations on preexposure and postexposure usage of HB vaccine and on prevaccination serologic testing for susceptibility to hepatitis B are unchanged. Previous recommendations should be consulted for a complete discussion of the usage of HB vaccine (1).

PLASMA-DERIVED HB VACCINE

Patterns of Usage to Date

Since the plasma-derived HB vaccine became available in June 1982, 4,400,000 doses have been distributed in the United States, and an estimated 1,400,000 persons have completed the three-dose series (Merck Sharp & Dohme, unpublished data). During this 5-year period, vaccination programs and overall vaccine usage have focused primarily on three risk groups—persons who work in health-care professions and have exposure to blood, staff and clients of institutions for the developmentally disabled, and staff and patients in hemodialysis units. Although no precise figures are available, it is estimated that more than 85% of distributed vaccine has been used for these groups.

Development of vaccination programs for health-care workers has progressed steadily since vaccine licensure. Several surveys of hospitals in 1985 showed that

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between 49% and 68% of hospitals had established HB vaccination programs and that the number has increased steadily each year (CDC, unpublished data). Large hospitals (>500 beds) were most likely to establish programs (90%). However, by June 1985, 60% of hospitals with fewer than 100 beds also had begun vaccination programs. In 75% of the programs, vaccination was recommended for high-risk health-care workers (as defined by the hospital), and, in 77%, the hospital paid for these vaccinations. In addition, 70% of states had established programs for vaccinating health-care workers under state jurisdiction (CDC, unpublished data).

In spite of these programs, the actual use of vaccine in high-risk health-care professions has been modest. One statewide survey showed that, in hospitals with HB vaccine programs, only 36% of persons at high risk had actually received vaccine (CDC, unpublished data). In one survey in three large cities, only 24% of physicians had received vaccine (CDC, unpublished data). National surveys have shown higher rates of vaccination among dentists (44% in early 1986) and hemodialysis staff (an estimated 44% in 1985); however, even these rates fall well short of optimal coverage (CDC, unpublished data).

Development of vaccination programs has also progressed for several other groups at high risk of HBV infection. By mid-1985, 94% of states had established vaccination programs for the developmentally disabled in institutions under state jurisdiction, and 75% had programs for staff of such facilities (CDC, unpublished data). By 1986, an estimated 27% of the developmentally disabled had received HB vaccine (Merck Sharp & Dohme, unpublished data). In addition, wide-scale programs directed at vaccinating all susceptible persons were established in 1981 for Alaskan Natives and in 1985 for the population of American Samoa.

Nevertheless, there has been little progress in developing vaccination programs for other major risk groups, including parenteral drug abusers, homosexual men, and heterosexually active persons with multiple sexual partners. Few states have established programs for offering vaccine to any of these groups, and private usage of vaccine among these groups is believed to be limited.

Impact on Disease Incidence

The incidence of reported hepatitis B has increased steadily over the last decade. Hepatitis B is now the most commonly reported type of hepatitis in the United States. In 1978, 15,000 cases of clinical hepatitis B were reported to CDC, for an incidence rate of 6.9/100,000 population. At that time, CDC estimated that there were actually 200,000 persons with HBV infection and that 50,000 of these had clinically confirmed cases with jaundice. The incidence rate of reported disease increased 33%, to 9.2/100,000, in 1981, the year prior to vaccine availability. It continued to increase during the initial 4 years of vaccine availability, reaching a rate of 11.5/100,000 in 1985 (2). Based on a comparison with the overall infection rate estimated in 1978, the incidence of HBV infection in the United States is now estimated at over 300,000 cases per year.

The apparent lack of impact of HB vaccine on the incidence of hepatitis B is attributable to several factors. First, the majority of acute hepatitis B cases now occur in three groups: homosexual men, parenteral drug abusers, and persons acquiring disease through heterosexual exposure (3). None of these groups is being reached effectively by current HB vaccine programs. In contrast, fewer than 10% of cases occur in health-care workers, the institutionalized developmentally disabled, and other groups currently accounting for the bulk of vaccine usage. Finally, up to 30% of

ACIP: Hepatitis B – Continued

patients deny any of the recognized risk factors, even after careful questioning. No effective strategy has been devised to prevent disease among this group, although some are probably undisclosed members of the three major risk groups.

A reduction in the incidence of hepatitis B can be expected only if significant proportions of persons at high risk receive vaccine. Increased efforts are needed to develop programs to vaccinate persons in all high-risk groups and to increase compliance among those who are susceptible in areas where programs are established. To have any effect on the incidence of hepatitis B, use of HB vaccine in the United States must extend beyond the current groups of recipients.

NEW RECOMBINANT DNA HB VACCINE**Formulation**

In July 1986, a new, genetically engineered HB vaccine (Recombivax HB®; Merck Sharp & Dohme) was licensed by the U.S. Food and Drug Administration. This vaccine, as formulated, has an immunogenicity comparable to that of the currently available plasma-derived vaccine (Heptavax B®; Merck Sharp & Dohme). The two vaccines are also comparably effective when given with HBIG to prevent perinatal HBV transmission. The new vaccine provides an alternative to the plasma-derived HB vaccine for almost all groups at risk of HBV infection.

The recombinant vaccine is produced by *Saccharomyces cerevisiae* (common baker's yeast) into which a plasmid containing the gene for the Hepatitis B surface antigen (HBsAg) subtype adw has been inserted (4). HBsAg is harvested by lysing the yeast cells and is separated from yeast components by hydrophobic interaction and size-exclusion chromatography. The purified HBsAg protein undergoes sterile filtration and treatment with formalin prior to packaging. The vaccine is packaged to contain 10µg HBsAg protein per ml, adsorbed with 0.5 mg/ml aluminum hydroxide; a 1:20,000 concentration of thimerosal is added as a preservative.

The recombinant HBsAg takes the form of 17-25 nm spherical particles, similar in appearance to human plasma-derived HBsAg. The recombinant particles differ in that the HBsAg is not glycosylated, whereas up to 25% of plasma-derived HBsAg is glycosylated. The vaccine contains more than 95% HBsAg protein. Yeast-derived protein can constitute up to 4% of the final product, but no yeast DNA is detectable in the vaccine.

Immunogenicity and Efficacy

The immunogenicity of the recombinant HB vaccine is comparable to that of the plasma-derived product (5). When given in a three-dose series (10µg per dose), recombinant HB vaccine induces protective antibodies (anti-HBs*) in over 95% of healthy adults 20-39 years of age. Studies comparing antibody responses of healthy adults show equal rates of seroconversion following the three doses of either the recombinant vaccine (10µg per dose) or the plasma-derived vaccine (20µg per dose). However, the geometric mean titers (GMT) of antibodies developed by recipients of the recombinant vaccine have ranged from equal to to 30% as high as those developed by recipients of the plasma-derived vaccine. The recombinant vaccine, like the plasma-derived vaccine, produces a somewhat lower antibody response in older adults than in younger adults (5).

In studies using three 5-µg doses of recombinant vaccine for children <12 years of age, over 99% of the recipients have developed protective levels of antibodies. Hemodialysis patients develop a poorer response to the recombinant vaccine than do

*Greater than 10 milli-International Units (mIU)/ml of anti-HBs, approximately equal to 10 sample ratio units by radioimmunoassay or positive by enzyme immunoassay.

ACIP: Hepatitis B – Continued

healthy adults. For example, in one study using three 40- μ g doses of recombinant HB vaccine, only 64% of vaccine recipients developed protective levels of antibodies.

The recombinant HB vaccine has been shown to prevent HBV infection of vaccinated chimpanzees challenged intravenously with HBV of either adw or ayr subtypes. In studies of infants born to HBsAg- and HBeAg-positive mothers, the combination of HBIG (0.5 cc at birth) and recombinant HB vaccine (5 μ g in each of three doses) protected 94% of infants from developing the chronic carrier state, an efficacy equalling that of HBIG plus plasma-derived HB vaccine (6). The simultaneous administration of HBIG did not interfere with induction of anti-HBs antibody response by the recombinant HB vaccine.

There have been no large-scale efficacy trials of recombinant vaccine in adults. Nevertheless, the immunogenicity studies, the challenge studies using chimpanzees, and the efficacy trials of the HB vaccine and HBIG in infants born to mothers who are carriers of HBV strongly suggest that the efficacy of recombinant HB vaccine in adults is comparable to that of the plasma-derived product.

Safety

Because only the portion of the HBV viral genome that codes for the surface coat of the virus (HBsAg) is present in the recombinant yeast cells, no potentially infectious viral DNA or complete viral particles can be produced. No human or animal plasma or other blood derivative is used in the preparation of recombinant HB vaccine.

During prelicensure trials, approximately 4,500 persons received at least one dose, and 2,700 persons completed the vaccine series (5). Reported side effects were similar in extent and variety to those following administration of the plasma-derived vaccine. Seventeen percent of those vaccinated experienced soreness at the injection site, and 15% experienced mild systemic symptoms (fever, headache, fatigue, and nausea). To date, no severe side effects have been observed, nor have significant allergic reactions been reported. Although yeast-derived proteins may constitute up to 4% of the protein in the vaccine, no adverse reactions that could be related to changes in titers of antibodies to yeast-derived antigens occurred during clinical trials.

Early concerns about safety of plasma-derived HB vaccine, especially the concern that infectious agents such as human immunodeficiency virus (HIV) present in donor plasma pools might contaminate the final product, have proven to be unfounded (7). There are no data to indicate that the recombinant vaccine is potentially or actually safer than the currently licensed plasma-derived product.

Dosage and Schedule

The recombinant HB vaccine is given in a series of three doses over a 6-month period. The second dose is administered 1 month after the first, and the third dose, 5 months after the second. For normal adults and children >10 years of age, the recommended dose is 10 μ g (1 ml) intramuscularly in each of the three inoculations. Children <11 years of age should receive a 5- μ g dose (0.5 ml) by the same schedule. Newborns of mothers who are carriers of HBsAg should receive the three-dose series (5 μ g per dose) by the same schedule; however, the first dose, which is given at birth, should be combined with a single dose of HBIG (0.5 ml) given intramuscularly at another site.

The recommended dose of recombinant HB vaccine for hemodialysis patients or other immunosuppressed persons is 40 μ g, which is identical to the dose of plasma-derived vaccine recommended for these groups. A specially formulated preparation

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(40 μ g HBsAg protein/ml adsorbed with 0.5 mg aluminum hydroxide) is being developed for these patients. At present, it is not advisable to administer the standard formulation of recombinant HB vaccine to these patients because this would require a large volume (4.0 cc), which is inconvenient for injection in the deltoid muscle, and would contain more aluminum hydroxide (2.0 mg) than currently recommended as an adjuvant in vaccines (1.25 mg per dose). Only plasma-derived vaccine should be used for these patients.

As with plasma-derived vaccine, recombinant HB vaccine should only be given to older children and adults in the deltoid muscle and to neonates or infants in the anterolateral thigh muscle. The vaccine should be stored at 2 C to 6 C (36 F to 43 F) and *should not be frozen*; freezing destroys the potency of this vaccine.

The response to vaccination by the standard schedule using one or two doses of plasma-derived vaccine followed by the remaining doses of recombinant vaccine has not been studied. However, because the immunogenicities of the two vaccines are similar, it is likely that the response will be comparable to that induced by three doses of either vaccine alone. The response to revaccination with the recombinant vaccine following nonresponse to an initial series of plasma vaccine has not been evaluated.

Indications for Use

The indications for use of the recombinant HB vaccine are identical to those for the plasma-derived product, except that the present formulation of the recombinant HB vaccine should not be used for hemodialysis patients or other immunosuppressed persons (Table 1) (1). For other groups, including persons with Down's syndrome, there are no data indicating that the recombinant HB vaccine is either superior or inferior to the plasma-derived HB vaccine for any preexposure or postexposure indication.

Precautions

The recombinant HB vaccine contains only noninfectious HBsAg particles; therefore, vaccination of a pregnant woman should entail no risk to either the woman or the fetus. Furthermore, HBV infection in a pregnant woman can result in severe disease for the mother and chronic infection of the newborn. Pregnancy should not be

TABLE 1. Persons for whom hepatitis B vaccine is recommended or should be considered*

Preexposure

Persons for whom vaccine is recommended:

- Health-care workers having blood or needle-stick exposures
- Clients and staff of institutions for the developmentally disabled
- Hemodialysis patients
- Homosexually active men
- Users of illicit injectable drugs
- Recipients of certain blood products
- Household members and sexual contacts of HBV carriers
- Special high-risk populations

Persons for whom vaccine should be considered:

- Inmates of long-term correctional facilities
- Heterosexually active persons with multiple sexual partners
- International travelers to HBV endemic areas

Postexposure

- Infants born to HBV positive mothers
- Health-care workers having needle-stick exposures to human blood

*Detailed information on recommendations for HB vaccination is available (1).

ACIP: Hepatitis B – Continued

considered a contraindication for women in high-risk groups who are eligible to receive this vaccine.

NEED FOR VACCINE BOOSTER DOSES**Long-Term Protection by Plasma-Derived HB Vaccine**

In short-term efficacy studies, the plasma-derived HB vaccine provided protection against HBV infection for 85%-95% of vaccine recipients, including virtually all those who developed adequate levels of antibodies (see footnote on pg. 355) (8,9). A recent evaluation of the long-term protection afforded by this vaccine (>5 years) provides a basis for recommendations concerning the need for booster doses in previously vaccinated persons (10).

Currently available data indicate that vaccine-induced antibody levels decline significantly (10). Antibody may decrease to low levels for 30%-40% of vaccinated adults who initially develop adequate levels of antibody during the 5 years after vaccination, and it may become undetectable in 10%-15% of them. The duration of antibody persistence is directly related to the peak level achieved after the third dose of vaccine (11). The longer persistence of detectable levels of antibody observed in children and young adults (<20 years of age) is consistent with the higher peak response in these age groups.

Studies of the licensed plasma-derived HB vaccine in adults have demonstrated that, in spite of declining levels of antibody, protection against clinical (or viremic) HBV infection persists for >5 years (10). Although the risks of HBV infection appear to increase as antibody levels become low or undetectable, the resultant infections are almost always innocuous and do not cause detectable viremia, liver inflammation, or clinical illness. These infections are detected by serologic evidence of an increase of anti-HBs levels associated with the appearance of antibody to the hepatitis B core antigen (anti-HBc). To date, only one transient viremic infection has been recognized in a vaccine responder within 72 months after vaccination. This infection produced mild alanine aminotransferase elevation, but no clinical illness (10). Thus, among adults who have responded to the vaccine, protection against clinically significant HBV infection appears to outlast the presence of detectable anti-HBs and can persist for ≥ 2 years among vaccine recipients whose antibodies have declined to low or undetectable levels.

For infants born to mothers who are carriers of HBV, there are insufficient data to assess duration of antibody persistence and protection against clinically significant HBV infection with the U.S. plasma-derived vaccine. One study, in a developing country (Senegal) and using a different plasma-derived HB vaccine, has demonstrated that protection against viremic HBV infection can decline within 6 years in infants vaccinated between 6 months and 2 years of age (12). Firm data on the duration of protection among infants receiving the vaccines licensed in the United States will be necessary before recommendations on booster doses can be made for this group.

Postvaccination Testing of Response to Vaccine

When properly administered, HB vaccine produces anti-HBs in more than 90% of healthy persons. Testing for immunity following vaccination has been recommended only for persons in whom suboptimal response to vaccine is anticipated, including persons who received vaccine in the buttock or persons, such as hemodialysis patients, whose subsequent management depends on knowing their immune status (1). Revaccination, which has produced adequate antibody in only 30%-50% of persons who have not responded to primary vaccination in the deltoid, is not routinely recommended (1,10).

ACIP: Hepatitis B – Continued

Vaccine program coordinators in hospitals may decide to test vaccine recipients serologically to assess their antibody responses, even though such postvaccination testing is not routinely recommended. Persons electing to do postvaccination testing should be aware of potential difficulties in interpreting the results. Serologic testing within 6 months of completing the primary series will differentiate persons who respond to vaccine from those who fail to respond. However, the results of testing undertaken more than 6 months after completion of the primary series are more difficult to interpret. A vaccine recipient who is negative for anti-HBs between 1 and 5 years after vaccination can be 1) a primary nonresponder who remains susceptible to hepatitis B or 2) a vaccine responder whose antibody levels have decreased below detectability but who is still protected against clinical HBV disease (10).

There is no need for routine anti-HBs testing 1 to 5 years after vaccination unless there has been a decision to provide booster doses for persons who are anti-HBs negative. This strategy is medically acceptable, but costly, and will prevent few additional cases of disease because of the excellent long-term protection already provided by the primary series of vaccine.

Recommendations for Booster Doses

Adults and children with normal immune status. For adults and children with normal immune status, the antibody response to properly administered vaccine is excellent, and protection lasts for at least 5 years. *Booster doses of vaccine are not routinely recommended, nor is routine serologic testing to assess antibody levels in vaccine recipients necessary during this period.* The possible need for booster doses after longer intervals will be assessed as additional information becomes available.

Hemodialysis patients. For hemodialysis patients, in whom vaccine-induced protection is less complete and may persist only as long as antibody levels remain above 10 mIU/ml, the need for booster doses should be assessed by semiannual antibody testing (13). Booster doses should be given when antibody levels decline below 10 mIU/ml.

Postexposure Prophylaxis of Persons Exposed to HBsAg Positive Needle Sticks

In vaccinated persons who experience percutaneous or needle exposure to HBsAg-positive blood, serologic testing to assess immune status is recommended unless testing within the previous 12 months has indicated adequate levels of antibody. If the exposed person is tested and found to have an inadequate antibody level, treatment with HBIG and/or a booster dose of vaccine is indicated, depending on whether vaccination has been completed and whether the person is known to have previously responded to HB vaccine. Detailed recommendations on prophylaxis in this situation are provided in the previous recommendations for HB vaccine (1).

Dosage

When indicated, HB vaccine recipients can be given booster doses of either plasma-derived or recombinant HB vaccine. Booster doses of either vaccine induce prompt anamnestic responses in over 90% of persons who initially respond to vaccine but subsequently lose detectable antibody (14,15). The booster dose for normal adults is 20 μ g of plasma-derived vaccine or 10 μ g of recombinant vaccine. For newborns and children <10 years of age, the dose is half that recommended for adults. For hemodialysis patients, a dose of 40 μ g of plasma-derived vaccine is recommended; a formulation of recombinant HB vaccine is not yet available for this

ACIP: Hepatitis B – Continued

group. Vaccine should be given in the deltoid muscle. Buttock injection does not induce adequate levels of antibody.

Precautions

Reported adverse effects following booster doses have been limited to soreness at the injection site. Data are not available on the safety of the vaccine for the developing fetus, but there should be no risk because both plasma-derived and recombinant HB vaccines are inactivated and do not contain live virus particles. Booster doses need not be withheld from pregnant women who are at ongoing risk of HBV infection.

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MMWR

Supplement

MORBIDITY AND MORTALITY WEEKLY REPORT

**Recommendations for
Prevention of HIV
Transmission in Health-Care
Settings**

U. S. Department of Health and Human Services
Public Health Service
Centers for Disease Control
Atlanta, Georgia 30333

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Recommendations for Prevention of HIV Transmission in Health-Care Settings

Introduction

Human immunodeficiency virus (HIV), the virus that causes acquired immunodeficiency syndrome (AIDS), is transmitted through sexual contact and exposure to infected blood or blood components and perinatally from mother to neonate. HIV has been isolated from blood, semen, vaginal secretions, saliva, tears, breast milk, cerebrospinal fluid, amniotic fluid, and urine and is likely to be isolated from other body fluids, secretions, and excretions. However, epidemiologic evidence has implicated only blood, semen, vaginal secretions, and possibly breast milk in transmission.

The increasing prevalence of HIV increases the risk that health-care workers will be exposed to blood from patients infected with HIV, especially when blood and body-fluid precautions are not followed for all patients. Thus, this document emphasizes the need for health-care workers to consider **all** patients as potentially infected with HIV and/or other blood-borne pathogens and to adhere rigorously to infection-control precautions for minimizing the risk of exposure to blood and body fluids of all patients.

The recommendations contained in this document consolidate and update CDC recommendations published earlier for preventing HIV transmission in health-care settings: precautions for clinical and laboratory staffs (1) and precautions for health-care workers and allied professionals (2); recommendations for preventing HIV transmission in the workplace (3) and during invasive procedures (4); recommendations for preventing possible transmission of HIV from tears (5); and recommendations for providing dialysis treatment for HIV-infected patients (6). These recommendations also update portions of the "Guideline for Isolation Precautions in Hospitals" (7) and reemphasize some of the recommendations contained in "Infection Control Practices for Dentistry" (8). The recommendations contained in this document have been developed for use in health-care settings and emphasize the need to treat blood and other body fluids from **all** patients as potentially infective. These same prudent precautions also should be taken in other settings in which persons may be exposed to blood or other body fluids.

Definition of Health-Care Workers

Health-care workers are defined as persons, including students and trainees, whose activities involve contact with patients or with blood or other body fluids from patients in a health-care setting.

Health-Care Workers with AIDS

As of July 10, 1987, a total of 1,875 (5.8%) of 32,395 adults with AIDS, who had been reported to the CDC national surveillance system and for whom occupational information was available, reported being employed in a health-care or clinical laboratory setting. In comparison, 6.8 million persons—representing 5.6% of the U.S. labor force—were employed in health services. Of the health-care workers with AIDS, 95% have been reported to exhibit high-risk behavior; for the remaining 5%, the means of HIV acquisition was undetermined. Health-care workers with AIDS were significantly more likely than other workers to have an undetermined risk (5% versus 3%, respectively). For both health-care workers and non-health-care workers with AIDS, the proportion with an undetermined risk has not increased since 1982.

AIDS patients initially reported as not belonging to recognized risk groups are investigated by state and local health departments to determine whether possible risk factors exist. Of all health-care workers with AIDS reported to CDC who were initially characterized as not having an identified risk and for whom follow-up information was available, 66% have been reclassified because risk factors were identified or because the patient was found not to meet the surveillance case definition for AIDS. Of the 87 health-care workers currently categorized as having no identifiable risk, information is incomplete on 16 (18%) because of death or refusal to be interviewed; 38 (44%) are still being investigated. The remaining 33 (38%) health-care workers were interviewed or had other follow-up information available. The occupations of these 33 were as follows: five physicians (15%), three of whom were surgeons; one dentist (3%); three nurses (9%); nine nursing assistants (27%); seven housekeeping or maintenance workers (21%); three clinical laboratory technicians (9%); one therapist (3%); and four others who did not have contact with patients (12%). Although 15 of these 33 health-care workers reported parenteral and/or other non-needlestick exposure to blood or body fluids from patients in the 10 years preceding their diagnosis of AIDS, none of these exposures involved a patient with AIDS or known HIV infection.

Risk to Health-Care Workers of Acquiring HIV in Health-Care Settings

Health-care workers with documented percutaneous or mucous-membrane exposures to blood or body fluids of HIV-infected patients have been prospectively evaluated to determine the risk of infection after such exposures. As of June 30, 1987, 883 health-care workers have been tested for antibody to HIV in an ongoing surveillance project conducted by CDC (9). Of these, 708 (80%) had percutaneous exposures to blood, and 175 (20%) had a mucous membrane or an open wound contaminated by blood or body fluid. Of 396 health-care workers, each of whom had only a convalescent-phase serum sample obtained and tested ≥ 90 days post-exposure, one—for whom heterosexual transmission could not be ruled out—was seropositive for HIV antibody. For 425 additional health-care workers, both acute- and convalescent-phase serum samples were obtained and tested; none of 74 health-care workers with nonpercutaneous exposures seroconverted, and three (0.9%) of 351

with percutaneous exposures seroconverted. None of these three health-care workers had other documented risk factors for infection.

Two other prospective studies to assess the risk of nosocomial acquisition of HIV infection for health-care workers are ongoing in the United States. As of April 30, 1987, 332 health-care workers with a total of 453 needlestick or mucous-membrane exposures to the blood or other body fluids of HIV-infected patients were tested for HIV antibody at the National Institutes of Health (10). These exposed workers included 103 with needlestick injuries and 229 with mucous-membrane exposures; none had seroconverted. A similar study at the University of California of 129 health-care workers with documented needlestick injuries or mucous-membrane exposures to blood or other body fluids from patients with HIV infection has not identified any seroconversions (11). Results of a prospective study in the United Kingdom identified no evidence of transmission among 150 health-care workers with parenteral or mucous-membrane exposures to blood or other body fluids, secretions, or excretions from patients with HIV infection (12).

In addition to health-care workers enrolled in prospective studies, eight persons who provided care to infected patients and denied other risk factors have been reported to have acquired HIV infection. Three of these health-care workers had needlestick exposures to blood from infected patients (13-15). Two were persons who provided nursing care to infected persons; although neither sustained a needlestick, both had extensive contact with blood or other body fluids, and neither observed recommended barrier precautions (16,17). The other three were health-care workers with non-needlestick exposures to blood from infected patients (18). Although the exact route of transmission for these last three infections is not known, all three persons had direct contact of their skin with blood from infected patients, all had skin lesions that may have been contaminated by blood, and one also had a mucous-membrane exposure.

A total of 1,231 dentists and hygienists, many of whom practiced in areas with many AIDS cases, participated in a study to determine the prevalence of antibody to HIV; one dentist (0.1%) had HIV antibody. Although no exposure to a known HIV-infected person could be documented, epidemiologic investigation did not identify any other risk factor for infection. The infected dentist, who also had a history of sustaining needlestick injuries and trauma to his hands, did not routinely wear gloves when providing dental care (19).

Precautions To Prevent Transmission of HIV

Universal Precautions

Since medical history and examination cannot reliably identify all patients infected with HIV or other blood-borne pathogens, blood and body-fluid precautions should be consistently used for all patients. This approach, previously recommended by CDC (3,4), and referred to as "universal blood and body-fluid precautions" or "universal precautions," should be used in the care of all patients, especially including those in emergency-care settings in which the risk of blood exposure is increased and the infection status of the patient is usually unknown (20).

1. All health-care workers should routinely use appropriate barrier precautions to prevent skin and mucous-membrane exposure when contact with blood or other body fluids of any patient is anticipated. Gloves should be worn for touching blood and body fluids, mucous membranes, or non-intact skin of all patients, for handling items or surfaces soiled with blood or body fluids, and for performing venipuncture and other vascular access procedures. Gloves should be changed after contact with each patient. Masks and protective eyewear or face shields should be worn during procedures that are likely to generate droplets of blood or other body fluids to prevent exposure of mucous membranes of the mouth, nose, and eyes. Gowns or aprons should be worn during procedures that are likely to generate splashes of blood or other body fluids.
2. Hands and other skin surfaces should be washed immediately and thoroughly if contaminated with blood or other body fluids. Hands should be washed immediately after gloves are removed.
3. All health-care workers should take precautions to prevent injuries caused by needles, scalpels, and other sharp instruments or devices during procedures; when cleaning used instruments; during disposal of used needles; and when handling sharp instruments after procedures. To prevent needlestick injuries, needles should not be recapped, purposely bent or broken by hand, removed from disposable syringes, or otherwise manipulated by hand. After they are used, disposable syringes and needles, scalpel blades, and other sharp items should be placed in puncture-resistant containers for disposal; the puncture-resistant containers should be located as close as practical to the use area. Large-bore reusable needles should be placed in a puncture-resistant container for transport to the reprocessing area.
4. Although saliva has not been implicated in HIV transmission, to minimize the need for emergency mouth-to-mouth resuscitation, mouthpieces, resuscitation bags, or other ventilation devices should be available for use in areas in which the need for resuscitation is predictable.
5. Health-care workers who have exudative lesions or weeping dermatitis should refrain from all direct patient care and from handling patient-care equipment until the condition resolves.
6. Pregnant health-care workers are not known to be at greater risk of contracting HIV infection than health-care workers who are not pregnant; however, if a health-care worker develops HIV infection during pregnancy, the infant is at risk of infection resulting from perinatal transmission. Because of this risk, pregnant health-care workers should be especially familiar with and strictly adhere to precautions to minimize the risk of HIV transmission.

Implementation of universal blood and body-fluid precautions for all patients eliminates the need for use of the isolation category of "Blood and Body Fluid Precautions" previously recommended by CDC (7) for patients known or suspected to be infected with blood-borne pathogens. Isolation precautions (e.g., enteric, "AFB" [7]) should be used as necessary if associated conditions, such as infectious diarrhea or tuberculosis, are diagnosed or suspected.

Precautions for Invasive Procedures

In this document, an invasive procedure is defined as surgical entry into tissues, cavities, or organs or repair of major traumatic injuries 1) in an operating or delivery

room, emergency department, or outpatient setting, including both physicians' and dentists' offices; 2) cardiac catheterization and angiographic procedures; 3) a vaginal or cesarean delivery or other invasive obstetric procedure during which bleeding may occur; or 4) the manipulation, cutting, or removal of any oral or perioral tissues, including tooth structure, during which bleeding occurs or the potential for bleeding exists. The universal blood and body-fluid precautions listed above, combined with the precautions listed below, should be the minimum precautions for all such invasive procedures.

1. All health-care workers who participate in invasive procedures must routinely use appropriate barrier precautions to prevent skin and mucous-membrane contact with blood and other body fluids of all patients. Gloves and surgical masks must be worn for all invasive procedures. Protective eyewear or face shields should be worn for procedures that commonly result in the generation of droplets, splashing of blood or other body fluids, or the generation of bone chips. Gowns or aprons made of materials that provide an effective barrier should be worn during invasive procedures that are likely to result in the splashing of blood or other body fluids. All health-care workers who perform or assist in vaginal or cesarean deliveries should wear gloves and gowns when handling the placenta or the infant until blood and amniotic fluid have been removed from the infant's skin and should wear gloves during post-delivery care of the umbilical cord.
2. If a glove is torn or a needlestick or other injury occurs, the glove should be removed and a new glove used as promptly as patient safety permits; the needle or instrument involved in the incident should also be removed from the sterile field.

Precautions for Dentistry*

Blood, saliva, and gingival fluid from all dental patients should be considered infective. Special emphasis should be placed on the following precautions for preventing transmission of blood-borne pathogens in dental practice in both institutional and non-institutional settings.

1. In addition to wearing gloves for contact with oral mucous membranes of all patients, all dental workers should wear surgical masks and protective eyewear or chin-length plastic face shields during dental procedures in which splashing or spattering of blood, saliva, or gingival fluids is likely. Rubber dams, high-speed evacuation, and proper patient positioning, when appropriate, should be utilized to minimize generation of droplets and spatter.
2. Handpieces should be sterilized after use with each patient, since blood, saliva, or gingival fluid of patients may be aspirated into the handpiece or waterline. Handpieces that cannot be sterilized should at least be flushed, the outside surface cleaned and wiped with a suitable chemical germicide, and then rinsed. Handpieces should be flushed at the beginning of the day and after use with each patient. Manufacturers' recommendations should be followed for use and maintenance of waterlines and check valves and for flushing of handpieces. The same precautions should be used for ultrasonic scalers and air/water syringes.

*General infection-control precautions are more specifically addressed in previous recommendations for infection-control practices for dentistry (8).

3. Blood and saliva should be thoroughly and carefully cleaned from material that has been used in the mouth (e.g., impression materials, bite registration), especially before polishing and grinding intra-oral devices. Contaminated materials, impressions, and intra-oral devices should also be cleaned and disinfected before being handled in the dental laboratory and before they are placed in the patient's mouth. Because of the increasing variety of dental materials used intra-orally, dental workers should consult with manufacturers as to the stability of specific materials when using disinfection procedures.
4. Dental equipment and surfaces that are difficult to disinfect (e.g., light handles or X-ray-unit heads) and that may become contaminated should be wrapped with impervious-backed paper, aluminum foil, or clear plastic wrap. The coverings should be removed and discarded, and clean coverings should be put in place after use with each patient.

Precautions for Autopsies or Morticians' Services

In addition to the universal blood and body-fluid precautions listed above, the following precautions should be used by persons performing postmortem procedures:

1. All persons performing or assisting in postmortem procedures should wear gloves, masks, protective eyewear, gowns, and waterproof aprons.
2. Instruments and surfaces contaminated during postmortem procedures should be decontaminated with an appropriate chemical germicide.

Precautions for Dialysis

Patients with end-stage renal disease who are undergoing maintenance dialysis and who have HIV infection can be dialyzed in hospital-based or free-standing dialysis units using conventional infection-control precautions (21). Universal blood and body-fluid precautions should be used when dialyzing all patients.

Strategies for disinfecting the dialysis fluid pathways of the hemodialysis machine are targeted to control bacterial contamination and generally consist of using 500-750 parts per million (ppm) of sodium hypochlorite (household bleach) for 30-40 minutes or 1.5%-2.0% formaldehyde overnight. In addition, several chemical germicides formulated to disinfect dialysis machines are commercially available. None of these protocols or procedures need to be changed for dialyzing patients infected with HIV.

Patients infected with HIV can be dialyzed by either hemodialysis or peritoneal dialysis and do not need to be isolated from other patients. The type of dialysis treatment (i.e., hemodialysis or peritoneal dialysis) should be based on the needs of the patient. The dialyzer may be discarded after each use. Alternatively, centers that reuse dialyzers—i.e., a specific single-use dialyzer is issued to a specific patient, removed, cleaned, disinfected, and reused several times on the same patient only—may include HIV-infected patients in the dialyzer-reuse program. An individual dialyzer must never be used on more than one patient.

Precautions for Laboratories[†]

Blood and other body fluids from all patients should be considered infective. To supplement the universal blood and body-fluid precautions listed above, the following precautions are recommended for health-care workers in clinical laboratories.

[†]Additional precautions for research and industrial laboratories are addressed elsewhere (22,23).

1. All specimens of blood and body fluids should be put in a well-constructed container with a secure lid to prevent leaking during transport. Care should be taken when collecting each specimen to avoid contaminating the outside of the container and of the laboratory form accompanying the specimen.
2. All persons processing blood and body-fluid specimens (e.g., removing tops from vacuum tubes) should wear gloves. Masks and protective eyewear should be worn if mucous-membrane contact with blood or body fluids is anticipated. Gloves should be changed and hands washed after completion of specimen processing.
3. For routine procedures, such as histologic and pathologic studies or microbiologic culturing, a biological safety cabinet is not necessary. However, biological safety cabinets (Class I or II) should be used whenever procedures are conducted that have a high potential for generating droplets. These include activities such as blending, sonicating, and vigorous mixing.
4. Mechanical pipetting devices should be used for manipulating all liquids in the laboratory. Mouth pipetting must not be done.
5. Use of needles and syringes should be limited to situations in which there is no alternative, and the recommendations for preventing injuries with needles outlined under universal precautions should be followed.
6. Laboratory work surfaces should be decontaminated with an appropriate chemical germicide after a spill of blood or other body fluids and when work activities are completed.
7. Contaminated materials used in laboratory tests should be decontaminated before reprocessing or be placed in bags and disposed of in accordance with institutional policies for disposal of infective waste (24).
8. Scientific equipment that has been contaminated with blood or other body fluids should be decontaminated and cleaned before being repaired in the laboratory or transported to the manufacturer.
9. All persons should wash their hands after completing laboratory activities and should remove protective clothing before leaving the laboratory.

Implementation of universal blood and body-fluid precautions for **all** patients eliminates the need for warning labels on specimens since blood and other body fluids from all patients should be considered infective.

Environmental Considerations for HIV Transmission

No environmentally mediated mode of HIV transmission has been documented. Nevertheless, the precautions described below should be taken routinely in the care of **all** patients.

Sterilization and Disinfection

Standard sterilization and disinfection procedures for patient-care equipment currently recommended for use (25,26) in a variety of health-care settings—including hospitals, medical and dental clinics and offices, hemodialysis centers, emergency-care facilities, and long-term nursing-care facilities—are adequate to sterilize or disinfect instruments, devices, or other items contaminated with blood or other body fluids from persons infected with blood-borne pathogens including HIV (21,23).

Instruments or devices that enter sterile tissue or the vascular system of any patient or through which blood flows should be sterilized before reuse. Devices or items that contact intact mucous membranes should be sterilized or receive high-level disinfection, a procedure that kills vegetative organisms and viruses but not necessarily large numbers of bacterial spores. Chemical germicides that are registered with the U.S. Environmental Protection Agency (EPA) as "sterilants" may be used either for sterilization or for high-level disinfection depending on contact time.

Contact lenses used in trial fittings should be disinfected after each fitting by using a hydrogen peroxide contact lens disinfecting system or, if compatible, with heat (78 C-80 C [172.4 F-176.0 F]) for 10 minutes.

Medical devices or instruments that require sterilization or disinfection should be thoroughly cleaned before being exposed to the germicide, and the manufacturer's instructions for the use of the germicide should be followed. Further, it is important that the manufacturer's specifications for compatibility of the medical device with chemical germicides be closely followed. Information on specific label claims of commercial germicides can be obtained by writing to the Disinfectants Branch, Office of Pesticides, Environmental Protection Agency, 401 M Street, SW, Washington, D.C. 20460.

Studies have shown that HIV is inactivated rapidly after being exposed to commonly used chemical germicides at concentrations that are much lower than used in practice (27-30). Embalming fluids are similar to the types of chemical germicides that have been tested and found to completely inactivate HIV. In addition to commercially available chemical germicides, a solution of sodium hypochlorite (household bleach) prepared daily is an inexpensive and effective germicide. Concentrations ranging from approximately 500 ppm (1:100 dilution of household bleach) sodium hypochlorite to 5,000 ppm (1:10 dilution of household bleach) are effective depending on the amount of organic material (e.g., blood, mucus) present on the surface to be cleaned and disinfected. Commercially available chemical germicides may be more compatible with certain medical devices that might be corroded by repeated exposure to sodium hypochlorite, especially to the 1:10 dilution.

Survival of HIV in the Environment

The most extensive study on the survival of HIV after drying involved greatly concentrated HIV samples, i.e., 10 million tissue-culture infectious doses per milliliter (31). This concentration is at least 100,000 times greater than that typically found in the blood or serum of patients with HIV infection. HIV was detectable by tissue-culture techniques 1-3 days after drying, but the rate of inactivation was rapid. Studies performed at CDC have also shown that drying HIV causes a rapid (within several hours) 1-2 log (90%-99%) reduction in HIV concentration. In tissue-culture fluid, cell-free HIV could be detected up to 15 days at room temperature, up to 11 days at 37 C (98.6 F), and up to 1 day if the HIV was cell-associated.

When considered in the context of environmental conditions in health-care facilities, these results do not require any changes in currently recommended sterilization, disinfection, or housekeeping strategies. When medical devices are contaminated with blood or other body fluids, existing recommendations include the cleaning of these instruments, followed by disinfection or sterilization, depending on the type of medical device. These protocols assume "worst-case" conditions of

extreme virologic and microbiologic contamination, and whether viruses have been inactivated after drying plays no role in formulating these strategies. Consequently, no changes in published procedures for cleaning, disinfecting, or sterilizing need to be made.

Housekeeping

Environmental surfaces such as walls, floors, and other surfaces are not associated with transmission of infections to patients or health-care workers. Therefore, extraordinary attempts to disinfect or sterilize these environmental surfaces are not necessary. However, cleaning and removal of soil should be done routinely.

Cleaning schedules and methods vary according to the area of the hospital or institution, type of surface to be cleaned, and the amount and type of soil present. Horizontal surfaces (e.g., bedside tables and hard-surfaced flooring) in patient-care areas are usually cleaned on a regular basis, when soiling or spills occur, and when a patient is discharged. Cleaning of walls, blinds, and curtains is recommended only if they are visibly soiled. Disinfectant fogging is an unsatisfactory method of decontaminating air and surfaces and is not recommended.

Disinfectant-detergent formulations registered by EPA can be used for cleaning environmental surfaces, but the actual physical removal of microorganisms by scrubbing is probably at least as important as any antimicrobial effect of the cleaning agent used. Therefore, cost, safety, and acceptability by housekeepers can be the main criteria for selecting any such registered agent. The manufacturers' instructions for appropriate use should be followed.

Cleaning and Decontaminating Spills of Blood or Other Body Fluids

Chemical germicides that are approved for use as "hospital disinfectants" and are tuberculocidal when used at recommended dilutions can be used to decontaminate spills of blood and other body fluids. Strategies for decontaminating spills of blood and other body fluids in a patient-care setting are different than for spills of cultures or other materials in clinical, public health, or research laboratories. In patient-care areas, visible material should first be removed and then the area should be decontaminated. With large spills of cultured or concentrated infectious agents in the laboratory, the contaminated area should be flooded with a liquid germicide before cleaning, then decontaminated with fresh germicidal chemical. In both settings, gloves should be worn during the cleaning and decontaminating procedures.

Laundry

Although soiled linen has been identified as a source of large numbers of certain pathogenic microorganisms, the risk of actual disease transmission is negligible. Rather than rigid procedures and specifications, hygienic and common-sense storage and processing of clean and soiled linen are recommended (26). Soiled linen should be handled as little as possible and with minimum agitation to prevent gross microbial contamination of the air and of persons handling the linen. All soiled linen should be bagged at the location where it was used; it should not be sorted or rinsed in patient-care areas. Linen soiled with blood or body fluids should be placed and transported in bags that prevent leakage. If hot water is used, linen should be washed

with detergent in water at least 71 C (160 F) for 25 minutes. If low-temperature (≤ 70 C [158 F]) laundry cycles are used, chemicals suitable for low-temperature washing at proper use concentration should be used.

Infective Waste

There is no epidemiologic evidence to suggest that most hospital waste is any more infective than residential waste. Moreover, there is no epidemiologic evidence that hospital waste has caused disease in the community as a result of improper disposal. Therefore, identifying wastes for which special precautions are indicated is largely a matter of judgment about the relative risk of disease transmission. The most practical approach to the management of infective waste is to identify those wastes with the potential for causing infection during handling and disposal and for which some special precautions appear prudent. Hospital wastes for which special precautions appear prudent include microbiology laboratory waste, pathology waste, and blood specimens or blood products. While any item that has had contact with blood, exudates, or secretions may be potentially infective, it is not usually considered practical or necessary to treat all such waste as infective (23,26). Infective waste, in general, should either be incinerated or should be autoclaved before disposal in a sanitary landfill. Bulk blood, suctioned fluids, excretions, and secretions may be carefully poured down a drain connected to a sanitary sewer. Sanitary sewers may also be used to dispose of other infectious wastes capable of being ground and flushed into the sewer.

Implementation of Recommended Precautions

Employers of health-care workers should ensure that policies exist for:

1. Initial orientation and continuing education and training of all health-care workers—including students and trainees—on the epidemiology, modes of transmission, and prevention of HIV and other blood-borne infections and the need for routine use of universal blood and body-fluid precautions for all patients.
2. Provision of equipment and supplies necessary to minimize the risk of infection with HIV and other blood-borne pathogens.
3. Monitoring adherence to recommended protective measures. When monitoring reveals a failure to follow recommended precautions, counseling, education, and/or re-training should be provided, and, if necessary, appropriate disciplinary action should be considered.

Professional associations and labor organizations, through continuing education efforts, should emphasize the need for health-care workers to follow recommended precautions.

Serologic Testing for HIV Infection

Background

A person is identified as infected with HIV when a sequence of tests, starting with repeated enzyme immunoassays (EIA) and including a Western blot or similar, more specific assay, are repeatedly reactive. Persons infected with HIV usually develop antibody against the virus within 6-12 weeks after infection.

The sensitivity of the currently licensed EIA tests is at least 99% when they are performed under optimal laboratory conditions on serum specimens from persons infected for ≥ 12 weeks. Optimal laboratory conditions include the use of reliable reagents, provision of continuing education of personnel, quality control of procedures, and participation in performance-evaluation programs. Given this performance, the probability of a false-negative test is remote except during the first several weeks after infection, before detectable antibody is present. The proportion of infected persons with a false-negative test attributed to absence of antibody in the early stages of infection is dependent on both the incidence and prevalence of HIV infection in a population (Table 1).

The specificity of the currently licensed EIA tests is approximately 99% when repeatedly reactive tests are considered. Repeat testing of initially reactive specimens by EIA is required to reduce the likelihood of laboratory error. To increase further the specificity of serologic tests, laboratories must use a supplemental test, most often the Western blot, to validate repeatedly reactive EIA results. Under optimal laboratory conditions, the sensitivity of the Western blot test is comparable to or greater than that of a repeatedly reactive EIA, and the Western blot is highly specific when strict criteria are used to interpret the test results. The testing sequence of a repeatedly reactive EIA and a positive Western blot test is highly predictive of HIV infection, even in a population with a low prevalence of infection (Table 2). If the Western blot test result is indeterminant, the testing sequence is considered equivocal for HIV infection.

TABLE 1. Estimated annual number of patients infected with HIV not detected by HIV-antibody testing in a hypothetical hospital with 10,000 admissions/year*

Beginning prevalence of HIV infection	Annual incidence of HIV infection	Approximate number of HIV-infected patients	Approximate number of HIV-infected patients not detected
5.0%	1.0%	550	17-18
5.0%	0.5%	525	11-12
1.0%	0.2%	110	3-4
1.0%	0.1%	105	2-3
0.1%	0.02%	11	0-1
0.1%	0.01%	11	0-1

*The estimates are based on the following assumptions: 1) the sensitivity of the screening test is 99% (i.e., 99% of HIV-infected persons with antibody will be detected); 2) persons infected with HIV will not develop detectable antibody (seroconvert) until 6 weeks (1.5 months) after infection; 3) new infections occur at an equal rate throughout the year; 4) calculations of the number of HIV-infected persons in the patient population are based on the mid-year prevalence, which is the beginning prevalence plus half the annual incidence of infections.

When this occurs, the Western blot test should be repeated on the same serum sample, and, if still indeterminate, the testing sequence should be repeated on a sample collected 3-6 months later. Use of other supplemental tests may aid in interpreting of results on samples that are persistently indeterminate by Western blot.

Testing of Patients

Previous CDC recommendations have emphasized the value of HIV serologic testing of patients for: 1) management of parenteral or mucous-membrane exposures of health-care workers, 2) patient diagnosis and management, and 3) counseling and serologic testing to prevent and control HIV transmission in the community. In addition, more recent recommendations have stated that hospitals, in conjunction with state and local health departments, should periodically determine the prevalence of HIV infection among patients from age groups at highest risk of infection (32).

Adherence to universal blood and body-fluid precautions recommended for the care of all patients will minimize the risk of transmission of HIV and other blood-borne pathogens from patients to health-care workers. The utility of routine HIV serologic testing of patients as an adjunct to universal precautions is unknown. Results of such testing may not be available in emergency or outpatient settings. In addition, some recently infected patients will not have detectable antibody to HIV (Table 1).

Personnel in some hospitals have advocated serologic testing of patients in settings in which exposure of health-care workers to large amounts of patients' blood may be anticipated. Specific patients for whom serologic testing has been advocated include those undergoing major operative procedures and those undergoing treatment in critical-care units, especially if they have conditions involving uncontrolled bleeding. Decisions regarding the need to establish testing programs for patients should be made by physicians or individual institutions. In addition, when deemed appropriate, testing of individual patients may be performed on agreement between the patient and the physician providing care.

In addition to the universal precautions recommended for all patients, certain additional precautions for the care of HIV-infected patients undergoing major surgical operations have been proposed by personnel in some hospitals. For example, surgical procedures on an HIV-infected patient might be altered so that hand-to-hand passing of sharp instruments would be eliminated; stapling instruments rather than

TABLE 2. Predictive value of positive HIV-antibody tests in hypothetical populations with different prevalences of infection

	Prevalence of infection	Predictive value of positive test*
Repeatedly reactive enzyme immunoassay (EIA) [†] }	0.2%	28.41%
	2.0%	80.16%
	20.0%	98.02%
Repeatedly reactive EIA followed by positive Western blot (WB) [‡] }	0.2%	99.75%
	2.0%	99.97%
	20.0%	99.99%

*Proportion of persons with positive test results who are actually infected with HIV.

[†]Assumes EIA sensitivity of 99.0% and specificity of 99.5%.

[‡]Assumes WB sensitivity of 99.0% and specificity of 99.9%.

hand-suturing equipment might be used to perform tissue approximation; electrocautery devices rather than scalpels might be used as cutting instruments; and, even though uncomfortable, gowns that totally prevent seepage of blood onto the skin of members of the operative team might be worn. While such modifications might further minimize the risk of HIV infection for members of the operative team, some of these techniques could result in prolongation of operative time and could potentially have an adverse effect on the patient.

Testing programs, if developed, should include the following principles:

- Obtaining consent for testing.
- Informing patients of test results, and providing counseling for seropositive patients by properly trained persons.
- Assuring that confidentiality safeguards are in place to limit knowledge of test results to those directly involved in the care of infected patients or as required by law.
- Assuring that identification of infected patients will not result in denial of needed care or provision of suboptimal care.
- Evaluating prospectively 1) the efficacy of the program in reducing the incidence of parenteral, mucous-membrane, or significant cutaneous exposures of health-care workers to the blood or other body fluids of HIV-infected patients and 2) the effect of modified procedures on patients.

Testing of Health-Care Workers

Although transmission of HIV from infected health-care workers to patients has not been reported, transmission during invasive procedures remains a possibility. Transmission of hepatitis B virus (HBV)—a blood-borne agent with a considerably greater potential for nosocomial spread—from health-care workers to patients has been documented. Such transmission has occurred in situations (e.g., oral and gynecologic surgery) in which health-care workers, when tested, had very high concentrations of HBV in their blood (at least 100 million infectious virus particles per milliliter, a concentration much higher than occurs with HIV infection), and the health-care workers sustained a puncture wound while performing invasive procedures or had exudative or weeping lesions or microlacerations that allowed virus to contaminate instruments or open wounds of patients (33,34).

The hepatitis B experience indicates that only those health-care workers who perform certain types of invasive procedures have transmitted HBV to patients. Adherence to recommendations in this document will minimize the risk of transmission of HIV and other blood-borne pathogens from health-care workers to patients during invasive procedures. Since transmission of HIV from infected health-care workers performing invasive procedures to their patients has not been reported and would be expected to occur only very rarely, if at all, the utility of routine testing of such health-care workers to prevent transmission of HIV cannot be assessed. If consideration is given to developing a serologic testing program for health-care workers who perform invasive procedures, the frequency of testing, as well as the issues of consent, confidentiality, and consequences of test results—as previously outlined for testing programs for patients—must be addressed.

Management of Infected Health-Care Workers

Health-care workers with impaired immune systems resulting from HIV infection or other causes are at increased risk of acquiring or experiencing serious complications of infectious disease. Of particular concern is the risk of severe infection following exposure to patients with infectious diseases that are easily transmitted if appropriate precautions are not taken (e.g., measles, varicella). Any health-care worker with an impaired immune system should be counseled about the potential risk associated with taking care of patients with any transmissible infection and should continue to follow existing recommendations for infection control to minimize risk of exposure to other infectious agents (7,35). Recommendations of the Immunization Practices Advisory Committee (ACIP) and institutional policies concerning requirements for vaccinating health-care workers with live-virus vaccines (e.g., measles, rubella) should also be considered.

The question of whether workers infected with HIV—especially those who perform invasive procedures—can adequately and safely be allowed to perform patient-care duties or whether their work assignments should be changed must be determined on an individual basis. These decisions should be made by the health-care worker's personal physician(s) in conjunction with the medical directors and personnel health service staff of the employing institution or hospital.

Management of Exposures

If a health-care worker has a parenteral (e.g., needlestick or cut) or mucous-membrane (e.g., splash to the eye or mouth) exposure to blood or other body fluids or has a cutaneous exposure involving large amounts of blood or prolonged contact with blood—especially when the exposed skin is chapped, abraded, or afflicted with dermatitis—the source patient should be informed of the incident and tested for serologic evidence of HIV infection after consent is obtained. Policies should be developed for testing source patients in situations in which consent cannot be obtained (e.g., an unconscious patient).

If the source patient has AIDS, is positive for HIV antibody, or refuses the test, the health-care worker should be counseled regarding the risk of infection and evaluated clinically and serologically for evidence of HIV infection as soon as possible after the exposure. The health-care worker should be advised to report and seek medical evaluation for any acute febrile illness that occurs within 12 weeks after the exposure. Such an illness—particularly one characterized by fever, rash, or lymphadenopathy—may be indicative of recent HIV infection. Seronegative health-care workers should be retested 6 weeks post-exposure and on a periodic basis thereafter (e.g., 12 weeks and 6 months after exposure) to determine whether transmission has occurred. During this follow-up period—especially the first 6-12 weeks after exposure, when most infected persons are expected to seroconvert—exposed health-care workers should follow U.S. Public Health Service (PHS) recommendations for preventing transmission of HIV (36,37).

No further follow-up of a health-care worker exposed to infection as described above is necessary if the source patient is seronegative unless the source patient is at high risk of HIV infection. In the latter case, a subsequent specimen (e.g., 12 weeks following exposure) may be obtained from the health-care worker for antibody

testing. If the source patient cannot be identified, decisions regarding appropriate follow-up should be individualized. Serologic testing should be available to all health-care workers who are concerned that they may have been infected with HIV.

If a patient has a parenteral or mucous-membrane exposure to blood or other body fluid of a health-care worker, the patient should be informed of the incident, and the same procedure outlined above for management of exposures should be followed for both the source health-care worker and the exposed patient.

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MORBIDITY AND MORTALITY WEEKLY REPORT

- 785 Tuberculosis and Acquired Immunodeficiency Syndrome — New York City
- 795 ACIP: Poliomyelitis Prevention: Enhanced-Potency Inactivated Poliomyelitis Vaccine — Supplementary Statement

Epidemiologic Notes and Reports**Tuberculosis and Acquired Immunodeficiency Syndrome — New York City**

In recent years, reported tuberculosis (TB) cases in New York City (NYC) have increased substantially, in large part related to coexisting human immunodeficiency virus (HIV) and *Mycobacterium tuberculosis* infection. From 1984 to 1986, reported TB cases increased by 36%, or 593 cases (from 1,630 to 2,223 cases) (Figure 1), a numerical increase greater than that for any state or any other city in the nation. By comparison, during the same period, reported cases for the entire nation increased 2%, or 513 (from 22,255 to 22,768).

Because the increased TB morbidity in NYC was concurrent with the acquired immunodeficiency syndrome (AIDS) epidemic and was concentrated in the group with 80% of all NYC AIDS patients (males 20-49 years of age), a special study was conducted to evaluate the hypothesis that increased TB morbidity might be related to AIDS. The NYC TB registry for 1979 through 1985 and the NYC AIDS registry for 1981 through 1985 were matched.* To determine differences in clinical, demographic, and behavioral characteristics of persons with one or both diseases, patients with both TB and AIDS (TB/AIDS) were compared with AIDS patients without TB and with TB patients without AIDS. Only adults and adolescents (persons 13 years of age or older at diagnosis) were compared because no pediatric patients with both diseases were identified.

TB/AIDS Patients

The 261 patients common to both registries constituted 2% of the 11,231 adult and adolescent TB patients reported to the NYC TB registry from 1979 through 1985 and 5% of the 4,892 adult and adolescent AIDS patients reported to the NYC AIDS registry from 1981 through 1985. Eighty-seven percent (226) of these 261 patients were male; 52% (136) were black; 29% (76) were Hispanic; and 19% (49) were non-Hispanic white. The median age for diagnosis of both TB and AIDS was 34 years.

*These time intervals were chosen because AIDS was first recognized nationally in 1981 and because it was noted that the diagnosis of tuberculosis often preceded the diagnosis of AIDS by months or years.

A notice regarding changes in telephone numbers throughout the Centers for Disease Control and the Agency for Toxic Substances and Disease Registry appears on page 800.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES / PUBLIC HEALTH SERVICE

TB and AIDS – Continued

The date on which the first *M. tuberculosis*-positive specimen was taken was available for 258 TB/AIDS patients. For these patients, TB had been diagnosed a median of 2 months before AIDS diagnosis (range: 94 months before AIDS diagnosis to 28 months after AIDS diagnosis). For 65% of the patients, TB was diagnosed within 6 months before or after AIDS diagnosis.

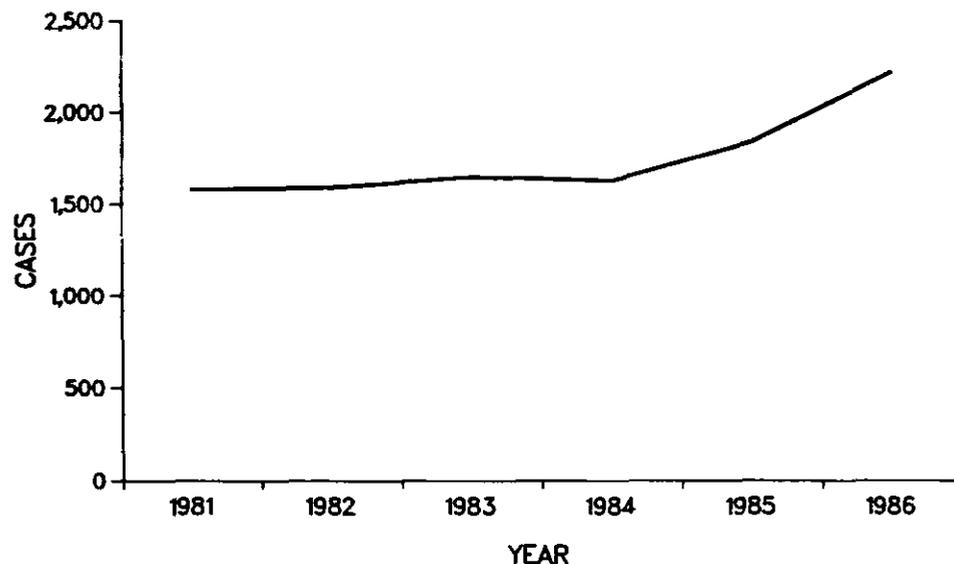
Adult and Adolescent AIDS Patients With and Without TB

TB/AIDS patients and AIDS patients without TB were similar in median age at AIDS diagnosis (34 compared with 36 years) and in gender. However, TB/AIDS patients were more likely to be non-Haitian black, Haitian, and Hispanic than AIDS patients without TB (Table 1). In addition, TB/AIDS patients reported intravenous (IV) drug abuse more frequently and homosexual/bisexual activity alone less frequently than patients with AIDS alone. Among non-Haitian-black IV drug abusers, the percentage of TB/AIDS patients (10%) was more than twice that among both those with a history of homosexual/bisexual behavior (4%) and those with neither risk factor (4%) (Table 2). Among non-Hispanic-white IV drug abusers, the percentage of TB/AIDS patients (5%) was more than twice that among both those with a history of homosexual/bisexual behavior (2%) and those with neither risk factor (0%). Among Hispanic IV drug abusers, the percentage of TB/AIDS patients (8%) was higher than that among those with a history of homosexual/bisexual behavior (5%) and more than twice that among those with neither risk factor (3%). Thus, when the data on AIDS patients was adjusted for race/ethnicity, those AIDS patients who were IV drug abusers were significantly more likely to develop tuberculosis than those who were not (Mantel-Haenszel $\chi^2 = 18.7$, $p < 0.0001$).

Adult and Adolescent TB Patients With and Without AIDS

TB/AIDS patients were younger (median age at TB diagnosis: 34 years compared with 44 years) and more likely to be male than TB patients without AIDS. In addition, they were more likely at TB diagnosis to have more than one site of disease, extrapulmonary TB, and a nonreactive tuberculin skin test (Table 3). TB/AIDS patients with a pulmonary site of disease were less likely to have cavitory disease.

FIGURE 1. Reported tuberculosis cases, by year – New York City, 1981-1986



TB and AIDS – Continued

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Editorial Note: The data from this study, as well as other evidence presented below, suggest that human immunodeficiency virus (HIV) infection is causing a resurgence of TB in NYC. Three findings from this study support the hypothesis that AIDS is associated with the observed increase in TB morbidity. First, the increase in TB cases was concentrated in the sex and age group containing the majority of NYC AIDS patients (males 20-49 years of age). Second, a relatively high proportion of AIDS patients (5%) also had clinically active TB. Third, among patients with both diseases, TB diagnoses clustered in time around the AIDS diagnoses.

Perhaps the strongest evidence to date for a causal association between TB and HIV infection comes from a study among a cohort of 519 IV drug abusers in NYC who

TABLE 1. Adult and adolescent AIDS patients with TB (TB/AIDS) and without TB, by race/ethnicity and AIDS risk factor – New York City, 1981-1985

Characteristics	TB/AIDS (n=261)		AIDS Only (n=4,631)	
	No.	(%)	No.	(%)
Race/Ethnicity				
Black, Non-Haitian	107	(41)	1,279	(28)
Haitian	29	(11)	119	(3)
Hispanic	76	(29)	1,077	(23)
White, Non-Hispanic	49	(19)	2,113	(46)
Other/Unknown	0	–	43	(1)
Risk Factor				
IV Drug Abuse	127	(49)	1,303	(28)
Homosexuality/Bisexuality	81	(31)	2,709	(58)
Both of Above	22	(8)	265	(6)
Other	31	(12)	354	(8)

TABLE 2. Intravenous (IV) drug abuse and homosexuality/bisexuality among adult and adolescent AIDS patients* with TB (TB/AIDS) and without TB, by race/ethnicity and AIDS risk factor – New York City, 1981-1985

Race/Ethnicity	IV Drug Abuse			Homo/Bisexuality			Both Factors			Neither Factor		
	AIDS Cases	TB/AIDS Cases		AIDS Cases	TB/AIDS Cases		AIDS Cases	TB/AIDS Cases		AIDS Cases	TB/AIDS Cases	
		No.	(%)		No.	(%)		No.	(%)		No.	(%)
Black, Non-Haitian	669	70	(10)	509	21	(4)	101	12	(12)	107	4	(4)
White, Non-Hispanic	191	9	(5)	1,803	36	(2)	107	4	(4)	61	0	(0)
Hispanic	555	44	(8)	436	23	(5)	74	6	(8)	88	3	(3)
Total	1,415	123	(9)	2,748	80	(3)	282	22	(8)	256	7	(3)

*Excludes 148 Haitian AIDS patients, 29 of whom also had TB, and 43 patients with other or unknown race/ethnicity, none of whom also had TB.

TB and AIDS – Continued

were followed from 1984 through 1986 (1). In this group, 12 of the 279 persons with serologic evidence of HIV infection or clinical AIDS developed TB, whereas none of the 240 HIV-negative persons developed TB ($p = 0.0005$, Fischer's exact test).

Other evidence that HIV infection and AIDS may be responsible for the resurgence of TB in NYC includes the fact that NYC, the area with the largest increase in TB in the nation, has also reported more AIDS cases than any other area in the nation. The nearly 600 additional TB cases in 1986 (compared with 1984) exceeds the increase in the entire nation as a whole. Through 1986, 7,891 patients with AIDS, or 27% of the nation's cumulative reported cases (29,121), were NYC residents. Data also indicate that the greatest increases in TB in NYC occurred in areas of the city with a high incidence of AIDS.

Data suggest that HIV infection in the absence of AIDS is associated with increased TB morbidity (New York City Department of Health, unpublished data). In this study, 58 males who were 25-44 years of age and did not have AIDS but were hospitalized for suspected TB[†] consented to HIV antibody testing. Thirty-one (53%) of them were HIV positive.

Previously published studies have linked TB to AIDS in Florida (2-3), Newark (4), Connecticut (5), and San Francisco (6). Increased TB morbidity has been associated with HIV infection in Dade County, Florida (7). Of 71 consecutive TB patients seen at

[†]All 58 patients were later found positive for *M. tuberculosis*.

TABLE 3. Adult and adolescent TB patients with AIDS (TB/AIDS) and without AIDS, by demographic group and clinical characteristics of TB – New York City, 1979-1985

Characteristics at TB Diagnosis	TB/AIDS (n = 261)		TB Only (n = 10,970)	
	No.	(%)	No.	(%)
Sex				
Male	226	(87)	7,351	(67)
Female	35	(13)	3,619	(33)
Age 20-49 Years				
Yes	244	(93)	6,219	(57)
No	17	(7)	4,751	(43)
Disease Sites				
Multiple*	62	(24)	415	(4)
One, Extrapulmonary	58	(22)	1,741	(16)
One, Pulmonary	141	(54)	8,814	(80)
Tuberculin Skin Test[†]				
Nonreactive	50	(58)	792	(18)
Reactive	36	(42)	3,686	(82)
Chest X-ray[‡]				
Normal	13	(8)	269	(3)
Abnormal, Noncavitary	131	(80)	5,410	(66)
Abnormal, Cavitary	20	(12)	2,576	(31)

*Includes at least one extrapulmonary site.

[†]Includes only patients with known tuberculin skin test results.

[‡]Includes only those with pulmonary disease and known chest X-ray results.

TB and AIDS – Continued

the Dade County Public Health Department, 31% (22) were HIV positive. Two of these 22 patients met the former CDC surveillance criteria for AIDS; ten (45%) of the 22 had extrapulmonary TB and would thus meet the revised CDC surveillance case definition for AIDS (8).

There are two possible mechanisms by which the immunodeficiency caused by HIV infection may increase the risk of tuberculosis. HIV-related immunodeficiency could increase susceptibility to new infection and permit that infection to rapidly progress to clinically apparent disease, or it may allow a previously latent tuberculous infection to progress to clinically apparent disease. Although the clinical and radiographic evidence of tuberculosis in AIDS patients is often similar to the pattern observed in nonimmunodeficient patients with primary or recently acquired infection, the clustering of TB diagnoses around the time of the AIDS diagnoses suggests that most tuberculosis in patients with AIDS results from reactivation of a previously acquired latent infection. The present annual risk of new tuberculous infection in the United States is too low to account for the high incidence of tuberculosis among AIDS patients. Thus, most tuberculosis in AIDS patients is probably due to the reactivation of latent infections.

The registry match indicates that TB/AIDS patients in NYC are predominantly IV drug abusers. Fifty-seven percent of the TB/AIDS patients in this study were IV drug abusers, whereas 34% of AIDS patients without TB had this risk factor. The number of reported TB patients in NYC who are IV drug abusers is currently unknown. There are an estimated 200,000 IV drug abusers in NYC, 30,000 of whom are enrolled in methadone treatment programs. These estimates, along with the fact that 12 TB cases developed in a cohort of 519 IV drug abusers, that IV drug abuse is the most common risk factor among TB/AIDS patients, and that NYC had 600 more cases in 1986 than it had in 1984, suggest that many unreported or unidentified TB cases may be occurring annually among HIV-positive IV drug abusers. Identifying tuberculin-positive IV drug abusers and giving them isoniazid preventive therapy, regardless of their age, may prevent TB among this group.

The registry match also indicates that most TB/AIDS patients in NYC are members of racial and ethnic minorities. Eighty-one percent of the TB/AIDS patients were black (including Haitian) or Hispanic, whereas 53% of AIDS patients without TB and 68% of TB patients without AIDS (50% black and 18% Hispanic) belonged to these groups.

Patients with AIDS or HIV infection who also develop TB often have clinical findings⁵ that are different from those of TB patients without immunodeficiency (2-8), and a high index of suspicion and special diagnostic studies are often needed to establish the diagnosis of TB in these patients (9). HIV-infected persons who have active TB should be treated in accordance with recently published guidelines (9).

HIV testing of all TB patients should be considered because of the implications of HIV seropositivity for patient management (10). There is some evidence that TB patients with HIV infection do not respond to standard therapies as well as patients without HIV infection. Some reports have suggested a higher incidence of adverse drug reactions (6) and a higher treatment-failure rate during therapy (4). Therefore, CDC and the American Thoracic Society have recommended a more aggressive approach to treatment of TB in HIV-infected patients (9,11). Treatment should initially include at least three of the drugs available for treatment of TB, should continue for

⁵Multiple disease sites, extrapulmonary involvement, loss of tuberculin skin reactivity, and, among patients with pulmonary disease, noncavitary chest X-rays.

TB and AIDS – Continued

a minimum of 9 months, and should last for at least 6 months after the patient becomes negative for *M. tuberculosis*. HIV-infected patients with tuberculosis should receive frequent and careful monitoring for adverse drug effects during therapy and should be periodically evaluated for signs of relapse after therapy is complete. To prevent the transmission of HIV, persons being tested for HIV infection should be counseled in accordance with current recommendations (12).

Increases in TB morbidity may occur in other areas as the prevalence of HIV increases in these areas. Health departments should conduct surveys of the prevalence of HIV infection among TB patients in their jurisdictions. CDC is currently working with health departments in 30 metropolitan areas to plan and implement such surveys.

(Continued on page 795)

*TB and AIDS – Continued**References*

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- 817 Tuberculosis, Final Data – United States, 1986
- 820 Influenza Update – United States
- 821 Revision of HIV Classification Codes
- 832 *Haemophilus influenzae* Type b Vaccine
- 832 Third National Environmental Health Conference

MORBIDITY AND MORTALITY WEEKLY REPORT

Epidemiologic Notes and Reports
Tuberculosis, Final Data – United States, 1986

In 1986, 22,768 cases of tuberculosis (9.4/100,000 U.S. population) were reported to CDC. These data represent an increase of 2.6% in the number of reported cases, or 567 more than the 22,201 cases reported in 1985 (9.3/100,000 population). If the trend of decline observed between 1981 and 1984 had continued through 1986, 4,832 fewer cases would have been expected during the period 1985-1986 than were actually reported.

The number of reported cases of tuberculosis increased in 25 states and the District of Columbia. The largest increases occurred in New York (+357), New Jersey (+179), Michigan (+75), Arkansas (+63), Florida (+53), and North Carolina (+53). The largest increases in cities with a population of 250,000 or more were reported from New York City (+380), Detroit (+74), New Orleans (+29), Memphis (+27), and Jacksonville (+23).

From 1985 to 1986, the number of tuberculosis cases increased for all racial/ethnic groups except American Indians/Alaskan Natives (Table 1). The largest increases occurred among blacks (+367) and white Hispanics (+123). The 25- to 44-year age group had the most substantial increase in cases (+558). In this group, cases among blacks increased by 250 (from 2,943 to 3,193), or 8.5%; cases among non-Hispanic whites increased by 164 (from 1,520 to 1,684), or 10.8%; and cases among white Hispanics, by 151 (from 1,123 to 1,274), or 13.4%. Increases occurred among both males and females and among persons born in the United States and in foreign countries.

Reported by: Div of Tuberculosis Control, Center for Prevention Svcs, CDC.

Editorial Note: From 1963 to 1985, the incidence rate of tuberculosis in the United States declined an average of 5.9% annually. The average annual decline from 1981 to 1984 was 1,706 cases (6.7%). In contrast, the decrease from 1984 to 1985 was 54 cases (0.2%) (1). 1986 marks the first occurrence of a substantial increase in indigenous tuberculosis morbidity since 1953, the year when uniform national reporting was fully implemented. Previously, increases in the number of cases reported had been due either to changes in reporting criteria (1963 and 1975) or to a sudden influx of refugees from Kampuchea, Laos, and Vietnam (1980).

The most substantial increases in number of cases from 1985 to 1986 occurred among blacks, non-Hispanic whites, and white Hispanics in the 25- to 44-year age

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES / PUBLIC HEALTH SERVICE

Tuberculosis – Continued

group. In contrast, the number of reported tuberculosis cases among children under 5 years of age decreased substantially. This age-specific variation in tuberculosis morbidity indirectly suggests that the recent increase in tuberculosis may be the result of endogenous reactivation of latent, subclinical tuberculous infection rather than of increased transmission.

The increase was greater in New York City than in any other locality. For the past several years, New York City has reported a large increase in tuberculosis among 25- to 44-year-old males that has coincided with the epidemic of acquired immunodeficiency syndrome (AIDS) (2). Matching of AIDS and tuberculosis cases on citywide registries revealed that 5% (261) of the first 4,892 adult and adolescent patients reported as having AIDS also had tuberculosis. For the majority of New York City patients, diagnosis of tuberculosis preceded the diagnosis of AIDS. Furthermore, when 58 male patients with tuberculosis in the 25- to 44-year age group were tested,

TABLE 1. Changes in the number of reported tuberculosis cases and the incidence rates (per 100,000 population), by patients' age, race/ethnicity, sex, and country of origin – United States, 1985 and 1986

Patient Characteristics	Tuberculosis Cases					
	1985		1986		Change	
	No.	Rate	No.	Rate	No.	(%)
Age (years)						
0-4	789	4.4	724	4.0	-65	(-8.2)
5-14	472	1.4	490	1.4	+18	(+3.8)
15-24	1,672	4.2	1,719	4.4	+47	(+2.8)
25-44	6,758	9.2	7,316	9.6	+558	(+8.3)
45-64	6,138	13.7	6,119	13.6	-19	(-0.3)
≥65	6,356	22.3	6,393	21.9	+37	(+0.6)
Unknown	16	—	7	—	—	—
Race/Ethnicity						
White, Non-Hispanic	8,453	4.5	8,539	4.6 *	+86	(+1.0)
White, Hispanic	3,032	17.5 †	3,155	17.7 †	+123	(+4.1)
Black‡	7,719	26.7	8,086	27.6	+367	(+4.8)
Asian/Pacific Islander§	2,530	49.6	2,572	50.4 *	+42	(+1.7)
American Indian/ Alaskan Native	397	25.0	335	21.1 *	-62	(-15.6)
Unknown	70	—	81	—	—	—
Sex						
Male	14,496	12.5	14,835	12.6	+339	(+2.3)
Female	7,704	6.3	7,933	6.4	+229	(+3.0)
Unknown	1	—	0	—	—	—
Country of Origin¶						
United States	15,641	NA **	16,039	NA **	+398	(+2.5)
Puerto Rico	172	NA **	210	NA **	+38	(+22.1)
Foreign Countries	4,390	NA **	4,513	NA **	+123	(+2.8)
Total	22,201	9.3	22,768	9.4	+567	(+2.6)

*Based on 1985 population estimates.

†Based on total Hispanic population.

‡Includes Hispanics.

¶Excludes cases among patients from Texas because that state did not report country of origin in 1985.

**NA = Not available.

Tuberculosis – Continued

53% (31) were positive for human immunodeficiency virus (HIV) antibody (New York City Department of Health, unpublished data).

In Florida, 10% (109) of the first 1,094 patients reported as having AIDS also had tuberculosis (3). The proportion of known AIDS patients with tuberculosis was 2% among non-Hispanic whites, 7% among Hispanics, 15% among blacks (excluding Haitians), and 29% among Haitians (4). In Dade County, Florida, 31% of the consecutively tested patients with tuberculosis were HIV positive (5).

Available data reinforce previous *MMWR* reports (2,3) and suggest that the number of patients known to have both tuberculosis and AIDS may represent only a small proportion of the patients with tuberculosis who are infected with HIV. HIV infection, when acquired by a patient with latent tuberculous infection, seems to allow the progression to overt clinical tuberculosis. Thus, HIV infection may be largely responsible for the increase in tuberculosis in New York City and Florida. Epidemiologic investigations and HIV seroprevalence surveys among patients with tuberculosis will enable investigators to determine the full extent to which HIV is responsible for the increase in tuberculosis morbidity.

Because increases in tuberculosis were also observed among foreign-born persons, Asians/Pacific Islanders, and females, factors other than HIV infection probably contributed to the increased morbidity in 1986. As reported previously, Hispanics and Asians/Pacific Islanders recently arriving in the United States are at high risk for tuberculosis. The number of these patients in younger age groups suggests that many cases among these populations are potentially preventable (6,7).

To reverse the current trend of increasing tuberculosis morbidity, both a more aggressive search for cases and the use of preventive therapy among high-risk populations will be necessary. Although all persons with tuberculous infection should be offered preventive therapy according to current guidelines (8), immigrants and refugees who have recently arrived from areas with a high prevalence of tuberculosis (6) and persons with HIV infection (9) should receive special attention.

Because HIV infection appears to be a significant risk factor for developing tuberculosis, CDC has recommended that HIV-infected individuals be given a tuberculin skin test (9). Although some HIV-infected persons may be anergic, a positive test is meaningful. Because of the risk of developing tuberculosis, HIV-infected persons who have or have had a positive tuberculin skin test should receive preventive therapy with isoniazid after active tuberculosis has been ruled out, regardless of their age. All patients with risk factors for tuberculosis and AIDS should be routinely counseled and tested for HIV antibody. HIV testing of other patients with tuberculosis should also be considered because of the implications of HIV seropositivity for patient management (9).

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Supplement

MORBIDITY AND MORTALITY WEEKLY REPORT

1988
Agent Summary Statement
for Human Immunodeficiency Virus

and

Report on Laboratory-Acquired
Infection with
Human Immunodeficiency Virus

U.S. Department of Health and Human Services
Public Health Service
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Center for Infectious Diseases
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Agent Summary Statement for Human Immunodeficiency Viruses (HIVs) Including HTLV-III, LAV, HIV-1, and HIV-2*

INTRODUCTION

In 1984, the Centers for Disease Control (CDC) and the National Institutes of Health (NIH), in consultation with experts from academic institutions, industry, and government, published the book *Biosafety in Microbiological and Biomedical Laboratories ("Guidelines")*[†] (1).

These *Guidelines* are based on combinations of standard and special practices, equipment, and facilities recommended for use in working with infectious agents in various laboratory settings. The recommendations are advisory; they provide a general code for operating microbiologic and biomedical laboratories.

One section of the *Guidelines* is devoted to standard and special microbiologic practices, safety equipment, and facilities for biosafety levels (BSL) 1 through 4. Another section contains specific agent summary statements, each consisting of a brief description of laboratory-associated infections, the nature of laboratory hazards, and recommended precautions for working with the causative agent. The authors realized that the discovery of the availability of information about these agents would necessitate updating the agent summary. Such a statement for human immunodeficiency virus (HIV) (called HTLV-III/LAV when the *Guidelines* were published) was published in *MMWR* in 1986 (2). The HIV agent summary statement printed in this *Supplement* updates the 1986 statement.

Attached to the updated HIV agent summary statement are the essential elements for BSL 2 and 3 laboratories, reproduced from the *Guidelines* (1) (see Addendum 1, p. 6). BSL 2 and 3 laboratory descriptions are included because they are recommended for laboratory personnel working with HIV, depending on the concentration or quantity of virus or the type of laboratory procedures used.

*The information and recommendations contained in this document were developed and compiled by the Division of Safety, National Institute of Allergy and Infectious Diseases, the National Cancer Institute, and the Clinical Center of the National Institutes of Health; Food and Drug Administration; and the following CDC units: AIDS Program, Hospital Infections Program, Office of the Director, Center for Infectious Diseases; the Training and Laboratory Program Office; and the Office of Biosafety, Office of the Centers Director; Representatives of the following organizations also collaborated in the effort: the American Academy of Microbiology, the American Biological Safety Association, the American Society for Microbiology, the American Society for Clinical Pathology, the Association of State and Territorial Public Health Laboratory Directors, the College of American Pathologists, the Pharmaceutical Manufacturers Association, and the Walter Reed Army Institute for Research.

[†]Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402, Stock #01702300167-1; or from National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161, Stock #PB84-206879.

The HIV agent summary statement does not specifically address safety measures for collecting and handling clinical specimens. Nonetheless, it has been recommended that blood and body-fluid precautions consistently be used for **ALL** specimens from **ALL** patients. This approach, referred to as "universal blood and body-fluid precautions" or "universal precautions," eliminates the need to identify all patients infected with HIV (or other bloodborne pathogens) (3). This subject is also covered in other publications (3-8).

Laboratory directors, supervisors, and others are asked to attach a copy of this revised "1988 Agent Summary Statement for Human Immunodeficiency Virus" to each copy of the *Guidelines* and to all copies of their laboratory biosafety manual; they should review the recommended precautions with laboratory personnel, provide appropriate training in practices and operation of facilities, and ensure that all personnel demonstrate proficiency **BEFORE** being allowed to work with HIV. The laboratory director (or the designated laboratory supervisor) is responsible for biosafety in the laboratory and must establish and implement practices, facilities, equipment, training, and work assignments as appropriate (9).

HIV AGENT SUMMARY STATEMENT

Agent: HIVs Including HTLV-III, LAV, HIV-1, and HIV-2

In the period 1984-1986, several health-care workers (HCWs) who had no recognized risk behavior for acquired immunodeficiency syndrome (AIDS) were reported to have HIV infection (10-15). Only one of these HCWs was identified as a laboratory worker. These and other reports assessed the risk of work-related HIV infection for all HCWs as being very low (3,6,10-12,14-18).

In 1985, anecdotal reports were received indicating that workers in two different HIV-reagent-production laboratories had been exposed to droplets and splashed liquid from a vessel containing concentrated virus. One of several workers had been cut by glass from a broken carboy that contained HIV-infected cells and medium. None of the persons exposed in these episodes had developed antibody to HIV or had clinical signs of infection 18 and 20 months, respectively, after the reported exposure.

In 1987, CDC received reports that three HCWs had HIV infection; none of the infections were associated with needlesticks or cuts. Two of these HCWs were clinical laboratory workers (11). One was a phlebotomist whose face and mouth were splattered with a patient's blood when the rubber stopper was suddenly expelled from a blood-collection tube. The second was a medical technologist who inadvertently spilled blood on her arms and forearms while using an apheresis apparatus to process blood from an HIV-seropositive patient.

In September 1987, a production-laboratory worker was reported to have HIV infection (18). This person worked with large concentrations of HIV in a BSL 3 facility. HIV was isolated from the worker's blood; the isolate was genetically indistinguishable from the strain of virus being cultivated in the laboratory. No risk factors were identified, and the worker recalled no specific incident that might have led to infection. However, there were instances of leakage of virus-positive culture fluid from equipment and contamination of the work area and centrifuge rotors. The report

concluded that the most plausible source of exposure was contact of the worker's gloved hand with virus-culture supernatant, followed by inapparent exposure to skin.

In October 1987, a second person who worked in another HIV production facility was reported to have HIV infection (18). This laboratory was a well-equipped BSL 3 facility, and BSL 3 practices were being followed. This worker reported having sustained a puncture wound to a finger while cleaning equipment used to concentrate HIV.

Laboratory Hazards

HIV has been isolated from blood, semen, saliva, tears, urine, cerebrospinal fluid, amniotic fluid, breast milk, cervical secretions, and tissue of infected persons and experimentally infected nonhuman primates. In the laboratory, virus should be presumed to be present in all HIV cultures, in all materials derived from HIV cultures, and in/on all equipment and devices coming into direct contact with any of these materials.

In the laboratory, the skin (especially when scratches, cuts, abrasions, dermatitis, or other lesions are present) and mucous membranes of the eye, nose, mouth, and possibly the respiratory tract should be considered as potential pathways for entry of virus. Needles, sharp instruments, broken glass, and other sharp objects must be carefully handled and properly discarded. Care must be taken to avoid spilling and splashing infected cell-culture liquid and other virus-containing materials.

Recommended Precautions

1. BSL 2 standards and special practices, containment equipment, and facilities, as described in the CDC-NIH publication *Biosafety in Microbiological and Biomedical Laboratories (Guidelines)*, are recommended for activities involving all clinical specimens, body fluids, and tissues from humans or from infected or inoculated laboratory animals. These are the same standards and practices recommended for handling all clinical specimens. For example, and for emphasis:
 - a. Use of syringes, needles, and other sharp instruments should be avoided if possible. Used needles and disposable cutting instruments should be discarded into a puncture-resistant container with a lid. Needles should not be re-sheathed, bent, broken, removed from disposable syringes, or otherwise manipulated by hand.
 - b. Protective gloves should be worn by all personnel engaged in activities that may involve direct contact of skin with potentially infectious specimens, cultures, or tissues. Gloves should be carefully removed and changed when they are visibly contaminated. Personnel who have dermatitis or other lesions on the hands and who may have indirect contact with potentially infectious material should also wear protective gloves. Hand washing with soap and water immediately after infectious materials are handled and after work is completed—**EVEN WHEN GLOVES HAVE BEEN WORN** as described above—should be a routine practice.
 - c. Generation of aerosols, droplets, splashes, and spills should be avoided. A biological safety cabinet should be used for all procedures that might generate aerosols or droplets and for all infected cell-culture manipulations. The *Guidelines* (pp. 11-13) contain additional precautions for operating at BSL 2.

2. Activities such as producing research-laboratory-scale amounts of HIV, manipulating concentrated virus preparations, and conducting procedures that may produce aerosols or droplets should be performed in a BSL 2 facility with the additional practices and containment equipment recommended for BSL 3 (19) (*Guidelines*, pp. 14-17).
3. Activities involving industrial-scale, large-volume production or high concentration and manipulation of concentrated HIV should be conducted in a BSL 3 facility using BSL 3 practices and equipment (19).
4. BSL 2 practices, containment equipment, and facilities for animals are recommended for activities involving nonhuman primates and any animals experimentally infected or inoculated with HIV. Because laboratory animals may bite, throw feces or urine, or expectorate at humans, animal-care personnel, investigators, technical staff, and other persons who enter the animal rooms should wear coats, protective gloves, coveralls or uniforms, and—as appropriate—face shields or surgical masks and eye shields to protect the skin and mucous membranes of the eyes, nose, and mouth.
5. All laboratory glassware, disposable material, and waste material suspected or known to contain HIV should be decontaminated, preferably in an autoclave, before it is washed, discarded, etc. An alternate method of disposing of solid wastes is incineration.
6. Laboratory workers should wear laboratory coats, gowns, or uniforms when working with HIV or with material known or suspected to contain HIV. There is no evidence that laboratory clothing poses a risk for HIV transmission; however, clothing that becomes contaminated with HIV preparations should be decontaminated before being laundered or discarded. Laboratory personnel must remove laboratory clothing before going to nonlaboratory areas.
7. Work surfaces should be decontaminated with an appropriate chemical germicide after procedures are completed, when surfaces are overtly contaminated, and at the end of each work day. Many commercially available chemical disinfectants (5,20-23) can be used for decontaminating laboratory work surfaces, for some laboratory instruments, for spot cleaning of contaminated laboratory clothing, and for spills of infectious materials. Prompt decontamination of spills should be standard practice.
8. Universal precautions are recommended for handling all human blood specimens for hematologic, microbiologic, chemical, serologic testing; these are the same precautions for preventing transmission of all bloodborne infections including hepatitis B (17,21,24,25). It is not certain how effective 56 C-60 C heat is in destroying HIV in serum (22,23,26), but heating small volumes of serum for 30 minutes at 56 C before serologic testing reduces residual infectivity to below detectable levels. Such treatment causes some false-positive results in HIV enzyme immunoassays (27-30) and may also affect some biochemical assays performed on serum (27,31,32).
9. Human serum from any source that is used as a control or reagent in a test procedure should be handled at BSL 2 (*Guidelines*, pp. 11-13). Addendum 2 (p. 16) to this report is a statement issued by CDC on the use of all human control and reagent serum specimens shipped to other laboratories. The Food and Drug Administration requires that manufacturers of human serum reagents use a similarly worded statement.

10. Medical surveillance programs should be in place in all laboratories that test specimens, do research, or produce reagents involving HIV. The nature and scope of a surveillance program will vary according to institutional policy and applicable local, state, and Federal regulations (9).
11. If a laboratory worker has a parenteral or mucous-membrane exposure to blood, body fluid, or viral-culture material, the source material should be identified and, if possible, tested for the presence of virus. If the source material is positive for HIV antibody, virus, or antigen, or is not available for examination, the worker should be counseled regarding the risk of infection and should be evaluated clinically and serologically for evidence of HIV infection. The worker should be advised to report on and to seek medical evaluation of any acute febrile illness that occurs within 12 weeks after the exposure (3). Such an illness—particularly one characterized by fever, rash, or lymphadenopathy—may indicate recent HIV infection. If seronegative, the worker should be retested 6 weeks after the exposure and periodically thereafter (e.g., at 12 weeks and 6 months after exposure). During this follow-up period—especially during the first 6-12 weeks after exposure, when most infected persons are expected to show serologic evidence of infection—exposed workers should be counseled to follow Public Health Service recommendations for preventing transmission of HIV (3,14,25,33). It is recommended that all institutions establish written policies regarding the management of laboratory exposure to HIV; such policies should deal with confidentiality, counseling, and other related issues.
12. Other primary and opportunistic pathogenic agents may be present in the body fluids and tissues of persons infected with HIV. Laboratory workers should follow accepted biosafety practices to ensure maximum protection against inadvertent laboratory exposure to agents that may also be present in clinical specimens (34-36).
13. Unless otherwise dictated by institutional policy, the laboratory director (or designated laboratory supervisor) is responsible for carrying out the biosafety program in the laboratory. In this regard, the laboratory director or designated supervisor should establish the biosafety level for each component of the work to be done and should ensure that facilities and equipment are adequate and in good working order, that appropriate initial and periodic training is provided to the laboratory staff, and that recommended practices and procedures are strictly followed (9).
14. Attention is directed to a "Joint Advisory Notice" of the Departments of Labor and Health and Human Services (9) that describes the responsibility of employers to provide "safe and healthful working conditions" to protect employees against occupational infection with HIV. The notice defines three exposure categories of generic job-related tasks and describes the protective measures required for employees involved in each exposure category. These measures are: administrative measures, training and education programs for employees, engineering controls, work practices, medical and health-care practices, and record-keeping. The recommendations in this report are consistent with the "Joint Advisory Notice"; managers/directors of all biomedical laboratories are urged to read this notice.

ADDENDUM 1

LABORATORY BIOSAFETY LEVEL CRITERIA

Biosafety Level 2

Biosafety Level 2 is similar to Level 1 and is suitable for work involving agents that represent a moderate hazard for personnel and the environment. It differs in that a) laboratory personnel have specific training in handling pathogenic agents and are directed by competent scientists, b) access to the laboratory is limited when work is being conducted, and c) certain procedures in which infectious aerosols are created are conducted in biological safety cabinets or other physical containment equipment.

The following standard and special practices, safety equipment, and facilities apply to agents assigned to Biosafety Level 2:

A. Standard microbiological practices

1. Access to the laboratory is limited or restricted by the laboratory director when work with infectious agents is in progress.
2. Work surfaces are decontaminated at least once a day and after any spill of viable material.
3. All Infectious liquid or solid waste is decontaminated before being disposed of.
4. Mechanical pipetting devices are used; mouth pipetting is prohibited.
5. Eating, drinking, smoking, and applying cosmetics are not permitted in the work area. Food must be stored in cabinets or refrigerators designed and used for this purpose only. Food storage cabinets or refrigerators should be located outside the work area.
6. Persons are to wash their hands when they leave the laboratory after handling infectious material or animals.
7. All procedures are performed carefully to minimize the creation of aerosols.

B. Special practices

1. Contaminated materials that are to be decontaminated away from the laboratory are placed in a durable, leakproof container that is closed before being removed from the laboratory.
2. The laboratory director limits access to the laboratory. In general, persons who are at increased risk of acquiring infection or for whom infection may be unusually hazardous are not allowed in the laboratory or animal rooms. The director has the final responsibility for assessing each circumstance and determining who may enter or work in the laboratory.
3. The laboratory director establishes policies or procedures whereby only persons who have been advised of the potential hazard and who meet any specific entry requirements (e.g., vaccination) enter the laboratory or animal rooms.
4. When an infectious agent being worked with in the laboratory requires special provisions for entry (e.g., vaccination), a hazard warning sign that incorporates the universal biohazard symbol is posted on the access door to the laboratory work area. The hazard warning sign identifies the infec-

tious agent, lists the name and telephone number of the laboratory director or other responsible person(s), and indicates the special requirement(s) for entering the laboratory.

5. An insect and rodent control program is in effect.
6. Laboratory coats, gowns, smocks, or uniforms are worn while in the laboratory. Before leaving the laboratory for nonlaboratory areas (e.g., cafeteria, library, administrative offices), this protective clothing is removed and left in the laboratory or covered with a clean coat not used in the laboratory.
7. Animals not involved in the work being performed are not permitted in the laboratory.
8. Special care is taken to avoid having skin be contaminated with infectious material; gloves should be worn when handling infected animals and when skin contact with infectious material is unavoidable.
9. All waste from laboratories and animal rooms is appropriately decontaminated before disposal.
10. Hypodermic needles and syringes are used only for parenteral injection and aspiration of fluids from laboratory animals and diaphragm bottles. Only needle-locking syringes or disposable syringe-needle units (i.e., the needle is integral to the syringe) are used for the injection or aspiration of infectious fluid. Extreme caution should be used when handling needles and syringes to avoid autoinoculation and the generation of aerosols during use and disposal. A needle should not be bent, sheared, replaced in the sheath or guard, or removed from the syringe following use. The needle and syringe should be promptly placed in a puncture-resistant container and decontaminated, preferably by autoclaving, before discard or reuse.
11. Spills and accidents that result in overt exposures to infectious material are immediately reported to the laboratory director. Medical evaluation, surveillance, and treatment are provided as appropriate, and written records are maintained.
12. When appropriate, considering the agent(s) handled, baseline serum samples for laboratory and other at-risk personnel are collected and stored. Additional serum specimens may be collected periodically, depending on the agents handled or on the function of the facility.
13. A biosafety manual is prepared or adopted. Personnel are advised of special hazards and are required to read instructions on practices and procedures and to follow them.

C. Containment equipment

Biological safety cabinets (Class I or II) or other appropriate personal-protection or physical-containment devices are used when:

1. Procedures with a high potential for creating infectious aerosols are conducted. These may include centrifuging, grinding, blending, vigorous shaking or mixing, sonic disruption, opening containers of infectious materials whose internal pressures may be different from ambient pressures, inoculating animals intranasally, and harvesting infected tissues from animals or eggs.
2. High concentrations or large volumes of infectious agents are used. Some types of materials may be centrifuged in the open laboratory if sealed heads

or centrifuge safety cups are used and if the containers are opened only in a biological safety cabinet.

D. Laboratory facilities

1. The laboratory is designed so that it can be easily cleaned.
2. Bench tops are impervious to water and resistant to acids, alkalis, organic solvents, and moderate heat.
3. Laboratory furniture is sturdy, and spaces between benches, cabinets, and equipment are accessible for cleaning.
4. Each laboratory contains a sink for hand washing.
5. If the laboratory has windows that open, they are fitted with fly screens.
6. An autoclave for decontaminating infectious laboratory wastes is available.

Biosafety Level 3

Biosafety Level 3 is applicable to clinical, diagnostic, teaching, research, or production facilities in which work is done with indigenous or exotic agents that may cause serious or potentially lethal disease as a result of exposure by inhalation. Laboratory personnel have specific training in handling pathogenic and/or potentially lethal agents and are supervised by competent scientists who are experienced in working with these agents. All procedures involving the manipulation of infectious material are conducted within biological safety cabinets or other physical containment devices or by personnel wearing appropriate personal-protection clothing and devices. The laboratory has special engineering and design features. It is recognized, however, that many existing facilities may not have all the facility safeguards recommended for Biosafety Level 3 (e.g., access zone, sealed penetrations, and directional airflow). In these circumstances, acceptable safety may be achieved for routine or repetitive operations (e.g., diagnostic procedures involving the propagation of an agent for identification, typing, and susceptibility testing) in laboratories in which facility features satisfy Biosafety Level 2 recommendations if the recommended "Standard Microbiological Practices," "Special Practices," and "Containment Equipment" for Biosafety Level 3 are rigorously followed. The decision to implement this modification of Biosafety Level 3 recommendations should be made only by the laboratory director.

The following standard and special safety practices, equipment, and facilities apply to agents assigned to Biosafety Level 3:

A. Standard microbiological practices

1. Work surfaces are decontaminated at least once a day and after any spill of viable material.
2. All infectious liquid or solid waste is decontaminated before being disposed of.
3. Mechanical pipetting devices are used; mouth pipetting is prohibited.
4. Eating, drinking, smoking, storing food, and applying cosmetics are not permitted in the work area.
5. Persons wash their hands after handling infectious materials and animals and every time they leave the laboratory.
6. All procedures are performed carefully to minimize the creation of aerosols.

B. Special practices

1. Laboratory doors are kept closed when experiments are in progress.

2. Contaminated materials that are to be decontaminated at a site away from the laboratory are placed in a durable, leakproof container that is closed before being removed from the laboratory.
3. The laboratory director controls access to the laboratory and limits access only to persons whose presence is required for program or support purposes. Persons who are at increased risk of acquiring infection or for whom infection may be unusually hazardous are not allowed in the laboratory or animal rooms. The director has the final responsibility for assessing each circumstance and determining who may enter or work in the laboratory.
4. The laboratory director establishes policies and procedures whereby only persons who have been advised of the potential biohazard, who meet any specific entry requirements (e.g., vaccination), and who comply with all entry and exit procedures enter the laboratory or animal rooms.
5. When infectious materials or infected animals are present in the laboratory or containment module, a hazard warning sign (incorporating the universal biohazard symbol) is posted on all laboratory and animal-room access doors. The hazard warning sign identifies the agent, lists the name and telephone number of the laboratory director or other responsible person(s), and indicates any special requirements for entering the laboratory, such as the need for vaccinations, respirators, or other personal-protection measures.
6. All activities involving infectious materials are conducted in biological safety cabinets or other physical-containment devices within the containment module. No work is conducted in open vessels on the open bench.
7. The work surfaces of biological safety cabinets and other containment equipment are decontaminated when work with infectious materials is finished. Plastic-backed paper toweling used on nonperforated work surfaces within biological safety cabinets facilitates clean-up.
8. An insect and rodent control program is in effect.
9. Laboratory clothing that protects street clothing (e.g., solid-front or wrap-around gowns, scrub suits, coveralls) is worn in the laboratory. Laboratory clothing is not worn outside the laboratory, and it is decontaminated before being laundered.
10. Special care is taken to avoid skin contamination with infectious materials; gloves are worn when handling infected animals and when skin contact with infectious materials is unavoidable.
11. Molded surgical masks or respirators are worn in rooms containing infected animals.
12. Animals and plants not related to the work being conducted are not permitted in the laboratory.
13. All waste from laboratories and animal rooms is appropriately decontaminated before being disposed of.
14. Vacuum lines are protected with high-efficiency particulate air (HEPA) filters and liquid disinfectant traps.
15. Hypodermic needles and syringes are used only for parenteral injection and aspiration of fluids from laboratory animals and diaphragm bottles. Only needle-locking syringes or disposable syringe-needle units (i.e., the needle

is integral to the syringe) are used for the injection or aspiration of infectious fluids. Extreme caution is used when handling needles and syringes to avoid autoinoculation and the generation of aerosols during use and disposal. A needle should not be bent, sheared, replaced in the sheath or guard, or removed from the syringe following use. The needle and syringe should be promptly placed in a puncture-resistant container and decontaminated, preferably by autoclaving, before being discarded or reused.

16. Spills and accidents that result in overt or potential exposures to infectious material are immediately reported to the laboratory director. Appropriate medical evaluation, surveillance, and treatment are provided, and written records are maintained.
17. Baseline serum samples for all laboratory and other at-risk personnel are collected and stored. Additional serum specimens may be collected periodically, depending on the agents handled or the function of the laboratory.
18. A biosafety manual is prepared or adopted. Personnel are advised of special hazards and are required to read instructions on practices and procedures and to follow them.

C. Containment equipment

Biological safety cabinets (Class I, II, or III) or other appropriate combinations of personal-protection or physical-containment devices (e.g., special protective clothing, masks, gloves, respirators, centrifuge safety cups, sealed centrifuge rotors, and containment caging for animals) are used for all activities with infectious materials that pose a threat of aerosol exposure. These include: manipulation of cultures and of clinical or environmental material that may be a source of infectious aerosols; the aerosol challenge of experimental animals; harvesting of tissues or fluids from infected animals and embryonated eggs; and necropsy of infected animals.

D. Laboratory facilities

1. The laboratory is separated from areas that are open to unrestricted traffic flow within the building. Passage through two sets of doors is the basic requirement for entry into the laboratory from access corridors or other contiguous areas. Physical separation of the high-containment laboratory from access corridors or other laboratories or activities may also be provided by a double-doored clothes-change room (showers may be included), airlock, or other access facility that requires passing through two sets of doors before entering the laboratory.
2. The interior surfaces of walls, floors, and ceilings are water resistant so that they can be easily cleaned. Penetrations in these surfaces are sealed or capable of being sealed to facilitate decontaminating the area.
3. Bench tops are impervious to water and resistant to acids, alkalis, organic solvents, and moderate heat.
4. Laboratory furniture is sturdy, and spaces between benches, cabinets, and equipment are accessible for cleaning.
5. Each laboratory contains a sink for washing hands. The sink is foot, elbow, or automatically operated and is located near the laboratory exit door.
6. Windows in the laboratory are closed and sealed.
7. Access doors to the laboratory or containment module are self-closing.

8. An autoclave for decontaminating laboratory wastes is available, preferably within the laboratory.
9. A ducted exhaust-air ventilation system is provided. This system creates directional airflow that draws air into the laboratory through the entry area. The exhaust air is not recirculated to any other area of the building, is discharged to the outside, and is dispersed away from occupied areas and air intakes. Personnel must verify that the direction of the airflow is proper (i.e., into the laboratory). The exhaust air from the laboratory room can be discharged to the outside without being filtered or otherwise treated.
10. The HEPA-filtered exhaust air from Class I or Class II biological safety cabinets is discharged directly to the outside or through the building exhaust system. Exhaust air from Class I or II biological safety cabinets may be recirculated within the laboratory if the cabinet is tested and certified at least every 12 months. If the HEPA-filtered exhaust air from Class I or II biological safety cabinets is to be discharged to the outside through the building exhaust system, it is connected to this system in a manner (e.g., thimble-unit connection) that avoids any interference with the air balance of the cabinets or building exhaust system.

VERTEBRATE ANIMAL BIOSAFETY LEVEL CRITERIA

Animal Biosafety Level 2

A. Standard practices

1. Doors to animal rooms open inward, are self-closing, and are kept closed when infected animals are present.
2. Work surfaces are decontaminated after use or spills of viable materials.
3. Eating, drinking, smoking, and storing of food for human use are not permitted in animal rooms.
4. Personnel wash their hands after handling cultures and animals and before leaving the animal room.
5. All procedures are carefully performed to minimize the creation of aerosols.
6. An insect and rodent control program is in effect.

B. Special practices

1. Cages are decontaminated, preferably by autoclaving, before being cleaned and washed.
2. Surgical-type masks are worn by all personnel entering animal rooms housing nonhuman primates.
3. Laboratory coats, gowns, or uniforms are worn while in the animal room. This protective clothing is removed before leaving the animal facility.
4. The laboratory or animal-facility director limits access to the animal room only to personnel who have been advised of the potential hazard and who need to enter the room for program or service purposes when work is in progress. In general, persons who may be at increased risk of acquiring

infection or for whom infection might be unusually hazardous are not allowed in the animal room.

5. The laboratory or animal-facility director establishes policies and procedures whereby only persons who have been advised of the potential hazard and who meet any specific requirements (e.g., vaccination) may enter the animal room.
6. When an infectious agent in use in the animal room requires special-entry provisions (e.g., vaccination), a hazard warning sign (incorporating the universal biohazard symbol) is posted on the access door to the animal room. The hazard warning sign identifies the infectious agent, lists the name and telephone number of the animal-facility supervisor or other responsible person(s), and indicates the special requirement(s) for entering the animal room.
7. Special care is taken to avoid contaminating skin with infectious material; gloves should be worn when handling infected animals and when skin contact with infectious materials is unavoidable.
8. All waste from the animal room is appropriately decontaminated—preferably by autoclaving—before being disposed of. Infected animal carcasses are incinerated after being transported from the animal room in leakproof, covered containers.
9. Hypodermic needles and syringes are used only for the parenteral injection or aspiration of fluids from laboratory animals and diaphragm bottles. Only needle-locking syringes or disposable syringe-needle units (i.e., the needle is integral to the syringe) are used for the injection or aspiration of infectious fluids. A needle should not be bent, sheared, replaced in the sheath or guard, or removed from the syringe following use. The needle and syringe should be promptly placed in a puncture-resistant container and decontaminated, preferably by autoclaving, before being discarded or reused.
10. If floor drains are provided, the drain taps are always filled with water or a suitable disinfectant.
11. When appropriate, considering the agents handled, baseline serum samples from animal-care and other at-risk personnel are collected and stored. Additional serum samples may be collected periodically, depending on the agents handled or the function of the facility.

C. Containment equipment

Biological safety cabinets, other physical-containment devices, and/or personal-protection devices (e.g., respirators, face shields) are used when procedures with a high potential for creating aerosols are conducted. These include necropsy of infected animals, harvesting of infected tissues or fluids from animals or eggs, intranasal inoculation of animals, and manipulation of high concentrations or large volumes of infectious materials.

D. Animal facilities

1. The animal facility is designed and constructed to facilitate cleaning and housekeeping.
2. A sink for washing hands is available in the room that houses infected animals.
3. If the animal facility has windows that open, they are fitted with fly screens.

4. It is recommended, but not required, that the direction of airflow in the animal facility is inward and that exhaust air is discharged to the outside without being recirculated to other rooms.
5. An autoclave that can be used for decontaminating infectious laboratory waste is available in the same building that contains the animal facility.

Animal Biosafety Level 3

A. Standard practices

1. Doors to animal rooms open inward, are self-closing, and are kept closed when work with infected animals is in progress.
2. Work surfaces are decontaminated after use or after spills of viable materials.
3. Eating, drinking, smoking, and storing of food for human use are not permitted in the animal room.
4. Personnel wash their hands after handling cultures or animals and before leaving the laboratory.
5. All procedures are carefully performed to minimize the creation of aerosols.
6. An insect and rodent control program is in effect.

B. Special practices

1. Cages are autoclaved before bedding is removed and before they are cleaned and washed.
2. Surgical-type masks or other respiratory protection devices (e.g., respirators) are worn by personnel entering rooms that house animals infected with agents assigned to Biosafety Level 3.
3. Wrap-around or solid-front gowns or uniforms are worn by personnel entering the animal room. Front-button laboratory coats are unsuitable. Protective gowns must remain in the animal room and must be decontaminated before being laundered.
4. The laboratory director or other responsible person limits access to the animal room only to personnel who have been advised of the potential hazard and who need to enter the room for program or service purposes when infected animals are present. In general, persons who may be at increased risk of acquiring infection or for whom infection might be unusually hazardous are not allowed in the animal room.
5. The laboratory director or other responsible person establishes policies and procedures whereby only persons who have been advised of the potential hazard and meet any specific requirements (e.g., vaccination) may enter the animal room.
6. Hazard warning signs (incorporating the universal biohazard warning symbol) are posted on access doors to animal rooms containing animals infected with agents assigned to Biosafety Level 3 are present. The hazard warning sign should identify the agent(s) in use, list the name and telephone number of the animal room supervisor or other responsible person(s), and indicate any special conditions of entry into the animal room (e.g., the need for vaccinations or respirators).
7. Personnel wear gloves when handling infected animals. Gloves are removed aseptically and autoclaved with other animal room waste before being disposed of or reused.

8. All wastes from the animal room are autoclaved before being disposed of. All animal carcasses are incinerated. Dead animals are transported from the animal room to the incinerator in leakproof, covered containers.
9. Hypodermic needles and syringes are used only for gavage or parenteral injection or aspiration of fluids from laboratory animals and diaphragm bottles. Only needle-locking syringes or disposable syringe-needle units (i.e., the needle is integral to the syringe) are used. A needle should not be bent, sheared, replaced in the sheath or guard, or removed from the syringe following use. The needle and syringe should be promptly placed in a puncture-resistant container and decontaminated, preferably by autoclaving, before being discarded or reused. When possible, cannulas should be used instead of sharp needles (e.g., gavage).
10. If floor drains are provided, the drain traps are always filled with water or a suitable disinfectant.
11. If vacuum lines are provided, they are protected with HEPA filters and liquid disinfectant traps.
12. Boots, shoe covers, or other protective footwear and disinfectant footbaths are available and used when indicated.

C. Containment equipment

1. Personal-protection clothing and equipment and/or other physical-containment devices are used for all procedures and manipulations of infectious materials or infected animals.
2. The risk of infectious aerosols from infected animals or their bedding can be reduced if animals are housed in partial-containment caging systems, such as open cages placed in ventilated enclosures (e.g., laminar-flow cabinets), solid-wall and -bottom cages covered by filter bonnets, or other equivalent primary containment systems.

D. Animal facilities

1. The animal facility is designed and constructed to facilitate cleaning and housekeeping and is separated from areas that are open to unrestricted personnel traffic within the building. Passage through two sets of doors is the basic requirement for entry into the animal room from access corridors or other contiguous areas. Physical separation of the animal room from access corridors or from other activities may also be provided by a double-doored clothes change room (showers may be included), airlock, or other access facility that requires passage through two sets of doors before entering the animal room.
2. The interior surfaces of walls, floors, and ceilings are water resistant so that they can be cleaned easily. Penetrations in these surfaces are sealed or capable of being sealed to facilitate fumigation or space decontamination.
3. A foot, elbow, or automatically operated sink for hand washing is provided near each animal-room exit door.
4. Windows in the animal room are closed and sealed.
5. Animal room doors are self-closing and are kept closed when infected animals are present.
6. An autoclave for decontaminating wastes is available, preferably within the animal room. Materials to be autoclaved outside the animal room are transported in a covered, leakproof container.

7. An exhaust-air ventilation system is provided. This system creates directional airflow that draws air into the animal room through the entry area. The building exhaust can be used for this purpose if the exhaust air is not recirculated to any other area of the building, is discharged to the outside, and is dispersed away from occupied areas and air intakes. Personnel must verify that the direction of the airflow is proper (i.e., into the animal room). The exhaust air from the animal room that does not pass through biological safety cabinets or other primary containment equipment can be discharged to the outside without being filtered or otherwise treated.
8. The HEPA-filtered exhaust air from Class I or Class II biological safety cabinets or other primary containment devices is discharged directly to the outside or through the building's exhaust system. Exhaust air from these primary containment devices may be recirculated within the animal room if the cabinet is tested and certified at least every 12 months. If the HEPA-filtered exhaust air from Class I or Class II biological safety cabinets is discharged to the outside through the building exhaust system, it is connected to this system in a manner (e.g., thimble-unit connection) that avoids any interference with the air balance of the cabinets or building exhaust system.

ADDENDUM 2

CDC cautionary notice for all human-serum-derived reagents used as controls:

WARNING: Because no test method can offer complete assurance that laboratory specimens do not contain HIV, hepatitis B virus, or other infectious agents, this specimen should be handled at the BSL 2 as recommended for any potentially infectious human serum or blood specimen in the CDC-NIH manual, *Biosafety in Microbiological and Biomedical Laboratories*, 1984, pages 11-13.

If additional statements describing the results of any heat treatment or serologic procedure(s) already performed on the human-serum reagent or control are used in conjunction with the above cautionary notice, these statements should be worded so as not to diminish the impact of the warning that emphasizes the need for universal precautions.

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**Occupationally Acquired Human
Immunodeficiency Virus Infections in
Laboratories Producing Virus Concentrates in
Large Quantities:
Conclusions and Recommendations of an Expert Team
Convened by the Director of the
National Institutes of Health (NIH)**

*Reported by Division of Safety, National Institutes of Health**

INTRODUCTION

The recommendations of the expert team are directed to industrial-scale facilities for the production of large quantities of highly concentrated HIV. Their recommendations are similar to and complement those in the preceding "1988 Agent Summary Statement for Human Immunodeficiency Virus," which updates the one published in 1986 (1). Laboratory directors and others responsible for the health and safety of laboratory employees working with HIV and HIV-containing material should carefully consider these relevant recommendations and guidelines in developing an appropriate safety program.

COMMITTEE REPORT

Two workers in different laboratories producing large quantities of highly concentrated HIV have been reported to have laboratory-acquired HIV infections (1). One worker's infection was presumed to be caused by "undetected skin contact with virus culture supernatant" (2). The other worker's infection followed "an injury with a potentially contaminated needle" (2). After the first case was identified, the Director of NIH convened a team of experts to investigate the incidents and to visit seven different laboratories that produced large volumes of HIV. After facilities inspections and separate, confidential interviews with the workers, the team prepared a report of their findings. The conclusions and recommendations from that report follow.

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The most probable cause for the first laboratory-acquired infection was inapparent parenteral exposure. Frequent opportunities for unrecognized direct contact with contaminated materials and surfaces were reported to be present. Gloves of questionable integrity, skin cuts and abrasions, and one episode of a dermatitis-like condition represented portals for possible exposure and routes of infection. The inexperience of the first infected worker in microbiologic procedures and Biosafety Level (BSL) 3 practices, coupled with the reliance on obtaining necessary skills through on-the-job training in a setting in which episodes of contamination may have occurred frequently, suggests that the worker might not have possessed an appropriate level of proficiency when the infection may have occurred.

The most probable cause for the second worker's infection was parenteral inoculation. This worker recalled incurring an injury with a blunt cannula approximately 6 months before the first seropositive sample. Incidents of contamination, such as those reported by the first worker, occurred infrequently in the second worker's laboratory.

Aerosol transmission is considered to be the least likely cause of infection in both cases. Operations in which aerosols may have been generated were carried out in biological safety cabinets to reduce the potential for inhalation exposure. Although some aerosols may have been released during the few reported rotor-seal failures involving the continuous-flow zonal centrifuge, the potential for contact exposure was greater. Aerosol transmission was unlikely because: a) in situations in which overt aerosol exposure has occurred in laboratory and production operations involving HIV, no exposed workers have seroconverted; b) no evidence exists that suggests aerosols may be a natural mode of HIV transmission; c) the probable cause identified above is consistent with documented modes of transmission of bloodborne pathogens in the laboratory.

The occurrence of these two infections emphasizes the finite risk that exists for laboratory workers who handle concentrated preparations of HIV. The conclusions of a National Cancer Institute prospective cohort study (2) indicate that this risk is low and may be similar to the risk for infection of health-care workers who have experienced a needlestick injury.

The occupational risk for infection by parenteral exposure is substantially reduced or eliminated by strict adherence to BSL 2 practices. The recommended use of BSL 3 practices for highly concentrated preparations of HIV is appropriate. The review of these two infected laboratory workers does not suggest the need to alter current CDC/NIH biosafety recommendations for HIV or for patient care (3), research (1), or virus production. There is a need, however, for more proficiency and discipline in laboratory safety practices.

The following recommendations will help assure maintenance of a safe and healthy environment for laboratory and production-facility workers who handle concentrated preparations of HIV:

A. Strictly adhere to standard microbiologic practices and techniques

The most important recommendation is to adhere strictly to standard microbiologic practices and techniques. Persons working with HIV must be aware of potential hazards and must be trained and proficient in practice and techniques necessary for self-protection. Employees must be informed that parenteral exposure is the most serious potential hazard for causing a laboratory-acquired infection. They must be able to recognize how such

exposures occur and how they can be prevented. Although on-the-job training is an acceptable approach for learning techniques and practices, it is imperative that proficiency be obtained **BEFORE** virus is actually handled.

B. Assure that workers are proficient in virus-handling techniques

Selection criteria for employees who will work in production operations or with concentrated preparations of HIV should require experience in the handling of human pathogens or tissue cultures. If an employee has not had such experience, s/he should participate in carefully structured, well-supervised on-the-job training programs.

The director or person in charge of the laboratory or production facility must ensure that personnel are appropriately trained and are proficient in practices and techniques necessary for self-protection. Initial work activities should not include the handling of virus. A progression of work activities should be assigned as techniques are learned and proficiency is developed. Virus should only be introduced into the work activities after the supervisor is confident it can be handled safely.

C. Monitor work practices

Periodically, the biosafety officer or a person with expertise in biosafety should closely observe practices and techniques used in handling HIV. This can be helpful in identifying activities or behavior that may increase the potential for contact with contaminated material or for inapparent parenteral exposures. If deficiencies are noticed, corrective measures should be specified and implemented.

D. Continuously reinforce safe practices

Practices that reduce the potential for direct contact and inapparent parenteral exposure should be continuously reinforced:

- Gloves should always be worn when concentrated preparations of HIV are handled and when contact with a contaminated surface or material may be unavoidable. If a gloved hand accidentally touches a contaminated surface or material, the glove should be removed immediately and the hands washed.
- Work surfaces should be decontaminated at the end of each day and any time contamination is recognized.
- Workers must develop the habit of keeping hands away from the eyes, nose, and mouth in order to avoid potential exposure of mucous membranes. Wearing filter masks and eye goggles or face shields may assist in accomplishing this objective.
- Needles and sharp implements must not be used when HIV is handled unless no acceptable alternative is available. When possible, unbreakable containers should be substituted for glassware, in order to avoid accidental cuts from broken pieces.
- In the absence of advice and consent of an occupational physician or nurse, no worker should handle any virus-containing material when s/he has cuts or skin abrasions on the hands or wrists.

E. Establish a medical surveillance serology program

Each medical facility should have a medical-surveillance serology program. Serum samples should be obtained at least once a year and analyzed for

seroconversion. Results should be reported to individual workers in a timely manner. Counseling services should be available for workers who have positive serologic results. Procedures that maintain strict confidentiality should be adopted.

F. Revalidate integrity of process, transport, and containment equipment

The operational integrity of all equipment used to process, transport, and contain fluids containing HIV should be revalidated at least once a year. The integrity of such equipment should be revalidated after any system failure that releases contaminated fluids into the work environment.

G. Develop production processes that enhance biosafety

Efforts should be made to explore and use production systems and strategies that reduce operational complexity and manual manipulations.

H. Validate efficacy of decontamination methods

Special attention should be given to demonstrating the adequacy of decontamination methods when high organic content, such as cellular debris, is present.

I. Sponsor and conduct biosafety training initiatives

Responsible institutions should orient such programs toward the application of biosafety practices to work involving HIV. Presentation strategies and materials to make the training widely available should be encouraged.

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- 241 Update on Influenza Activity — United States and Worldwide, with Recommendations for Influenza Vaccine Composition for the 1988–89 Season

Epidemiologic Notes and Reports

Update: Acquired Immunodeficiency Syndrome and Human Immunodeficiency Virus Infection Among Health-Care Workers

Acquired immunodeficiency syndrome (AIDS) among health-care workers in the United States results primarily from human immunodeficiency virus (HIV) infections that occur outside of the health-care setting. However, a small number of health-care workers have been infected with HIV through occupational exposures, and one such worker has developed AIDS after documented seroconversion. This report summarizes and updates both national surveillance data for AIDS among health-care workers and data from prospective studies on the risk of HIV transmission in the health-care setting.

Health-Care Workers with AIDS

The AIDS case report form used by CDC requests that state and local health departments collect information on employment since 1978 in a health-care or clinical laboratory setting. For surveillance purposes, any person who indicates such employment is classified as a health-care worker.

As of March 14, 1988, a total of 55,315 adults with AIDS had been reported to CDC. Occupational information was available for 47,532 of these persons, 2,586 (5.4%) of whom were classified as health-care workers. A similar proportion (5.7%) of the U.S. labor force was employed in health services (1).

Forty-six states, the District of Columbia, and Puerto Rico have reported health-care workers with AIDS. Like other AIDS patients, health-care workers with AIDS had a median age of 35 years. Males accounted for 91.6% of health-care workers with AIDS and 92.4% of other patients with AIDS. The majority of health-care workers with AIDS (62.8%) and of other AIDS patients (60.5%) were white.

Ninety-five percent of the health-care workers with AIDS were classified into known transmission categories (Table 1). Health-care workers with AIDS were significantly less likely than others with AIDS to be intravenous drug abusers and more likely to be homosexual or bisexual men. They were also less likely to have a known risk factor reported ($p < 0.001$).

AIDS and HIV – Continued

To determine the possible cause of HIV infection, state and local health departments investigate those AIDS patients reported as having no identified risk. As of March 14, 1988, investigations had been completed for 121 of the 215 health-care workers initially reported with undetermined risk. Risk factors were identified for 80 (66.1%) of these. Of the 135 health-care workers who remain in the undetermined-risk category, 41 (30.4%) could not be reclassified after follow-up; 20 (14.8%) had either died or refused to be interviewed; and 74 (54.8%) are still under investigation.

Overall, 5.3% of health-care workers with AIDS had an undetermined risk. When examined by year of report to CDC, the proportion of such health-care workers appears to have increased from 1.5% in 1982 to 6.2% in 1987. However, 71 of the 135 health-care workers for whom risk is still undetermined have been reported since March 1987, and 80.0% of these 71 cases are still under investigation. The proportion of other AIDS patients with an undetermined risk has also increased over time. However, previous experience suggests that other risk factors for HIV infection will be identified for many of these persons when investigations have been completed (2). Ten percent of all reported AIDS patients with undetermined risk are health-care workers; this proportion has not changed over time.

A health-care worker reported to have developed AIDS after a well-documented occupational exposure to blood and HIV seroconversion is included among the 80 health-care workers who were reclassified after follow-up. The worker was accidentally self-injected with several milliliters of blood from a hospitalized patient with AIDS while filling a vacuum collection tube. Investigation revealed no other risk factors for this health-care worker.

Forty-one health-care workers could not be reclassified after investigation; 68.3% were men. In contrast, 23.0% of individuals employed in hospitals and health services in the United States are men (1). These 41 health-care workers comprised eight physicians, four of whom were surgeons; one dentist; five nurses; eleven nursing assistants or orderlies; seven housekeeping or maintenance workers; four clinical laboratory technicians; one respiratory therapist; one paramedic; one mortician; and two others who had no contact with patients or clinical specimens. A comparison of

TABLE 1. Comparison of health-care workers with AIDS and other AIDS patients reported to CDC, by transmission category – through March 14, 1988

Transmission Category	Health-Care Workers with AIDS		Other AIDS Patients	
	No.	(%)	No.	(%)
Homosexual or Bisexual Male	1,916	(74.1)*	28,820	(64.1)
Heterosexual Intravenous Drug Abuser	161	(6.2)*	8,263	(18.4)
Homosexual or Bisexual Male and Intravenous Drug Abuser	187	(7.2)	3,267	(7.3)
Hemophilia/Coagulation Disorder	20	(0.8)	451	(1.0)
Heterosexual	119	(4.6)	1,772	(3.9)
Blood/Blood Component Recipient	47	(1.8)	1,105	(2.5)
Other [†]	1	(<1.0)	0	(0.0)
Undetermined [‡]	135	(5.3)*	1,268	(2.8)
Total	2,586	(100.0)	44,946	(100.0)

* $p < 0.001$, chi square analysis.

[†]Represents health-care worker who seroconverted to HIV and developed AIDS after documented needlestick exposure to blood.

[‡]Includes patients who are under investigation, who died or refused interview, or for whom no risk was identified after follow-up.

AIDS and HIV – Continued

the occupations of these 41 health-care workers with those of health-care workers for whom risk factors and job information were available showed that maintenance workers were the only occupational group significantly more likely to have an undetermined risk (7 [17.1%] of 41 health-care workers with undetermined risk, compared with 160 [7.1%] of 2,263 health-care workers with identified risk, $p = 0.02$).

Seventeen of the 41 investigated health-care workers with undetermined risk (including two of the seven maintenance workers) reported needlestick and/or mucous-membrane exposures to the blood or body fluids of patients during the 10 years preceding their diagnosis of AIDS. However, none of the patients was known to be infected with HIV at the time of exposure, and none of the health-care workers was evaluated at the time of exposure to document seroconversion to HIV antibody. None of the remaining 24 health-care workers reported needlestick or other nonparenteral exposures to blood or body fluids.

Other Health-Care and Laboratory Workers with HIV Infection

As of December 31, 1987, 1,176 health-care workers had been enrolled and tested for HIV antibody in ongoing CDC surveillance of health-care workers exposed to blood or other body fluids from HIV-infected patients. Of the 1,070 workers tested ≥ 90 days after exposure, 870 (81.3%) had parenteral exposures to blood; 104 (9.7%) had exposures of mucous membrane or nonintact skin to blood; and 96 (9.0%) had exposures to other body fluids (Table 2).

Four (0.5%) of the 870 workers with parenteral exposures to blood were seropositive for HIV antibody (upper bound of the 95% confidence interval [CI] = 1.1%). However, one of these four was not tested until 10 months after exposure (3,4). In addition, this worker had an HIV-seropositive sexual partner, and heterosexual acquisition of infection could not be excluded. Of the 489 health-care workers who sustained parenteral exposures to blood and for whom both acute- and convalescent-phase serum samples had been obtained, three, or 0.6%, seroconverted to HIV within 6 months of exposure (upper bound of the 95% CI = 1.6%) (4-6). Investigation revealed no nonoccupational risk factors for these three workers.

Two other ongoing prospective studies assess the risk of nosocomial acquisition of HIV infection among health-care workers in the United States (7,8). As of April 30, 1987, the National Institutes of Health had tested 103 health-care workers with documented needlestick injuries and 691 health-care workers with more than 2,000 cutaneous or mucous-membrane exposures to blood or other body fluids of

TABLE 2. HIV infection among health-care workers, by type of exposure and body fluid – CDC Prospective Study, August 15, 1983–December 31, 1987

Type of Exposure	No. of Health-Care Workers with Exposure to				No. of Infections
	Blood	Saliva	Urine	Other/Unknown	
Parenteral (needlestick or cut with sharp object)	870	7	3	21	4*
Contamination of mucous-membrane, open wound, or nonintact skin	104	42	12	11	0

*All four health-care workers had parenteral exposure to HIV-infected blood; risk is 4/870, or 0.5% (upper bound of 95% confidence interval = 1.1%).

AIDS and HIV – Continued

HIV-infected patients; none had seroconverted (7). As of March 15, 1988, a similar study at the University of California of 235 health-care workers with 644 documented needlestick injuries or mucous-membrane exposures had identified one seroconversion following a needlestick (9; University of California, San Francisco, unpublished data). Prospective studies in the United Kingdom and Canada show no evidence of HIV transmission among 220 health-care workers with parenteral, mucous-membrane, or cutaneous exposures (10,11).

In addition to the health-care workers enrolled in these longitudinal surveillance studies and the case reported here, six persons from the United States and four persons from other countries who denied other risk factors for HIV infection have reportedly seroconverted to HIV after parenteral, nonintact skin, or mucous-membrane exposures to HIV-infected blood or concentrated virus in a health-care or laboratory setting (Table 3) (12-20). Six additional health-care workers with no other identified risk factors reportedly acquired HIV infection, but the date of seroconversion is unknown (3,15,21-23).

Reported by: AIDS Program, Hospital Infections Program, Center for Infectious Diseases, CDC.

Editorial Note: These data are consistent with previous observations that the occupational risk of acquiring HIV in health-care settings is low and is most often associated with percutaneous inoculation of blood from a patient with HIV infection. Prospective surveillance studies, which provide data on the magnitude of the risk of HIV infection, indicate that the risk of seroconversion following needlestick exposures to blood from HIV-infected patients is less than 1.0%. The level of risk associated with the exposure of nonintact skin or mucous membranes is likely far less than that associated with needlestick exposures. Individual published case reports must be interpreted with caution because they provide no data on the frequency of occupational exposures to HIV or the proportion of exposures resulting in seroconversion.

The reasons that a higher proportion of health-care workers with AIDS have no identified risk than do other persons with AIDS are unknown. They could include a tendency of health-care workers not to report behavioral risk factors for HIV infection, the occupational risk of HIV infection as a result of blood exposure, or both. The first hypothesis is suggested by the overrepresentation of men among these health-care workers, a finding that is similar to the overrepresentation of men among AIDS patients infected with HIV through sexual activity or intravenous drug abuse. The second hypothesis is suggested by the documentation of HIV transmission in the health-care setting. Similar hypotheses may be raised for the apparent excess of maintenance personnel among health-care workers with no identified risk for AIDS. Occupationally acquired HIV infection in such workers would be difficult to determine unless the source patient or clinical specimen was known to be HIV-positive, the occupational exposure had been well documented, and the HIV seroconversion of the health-care worker had been detected.

The increasing number of persons being treated for HIV-associated illnesses makes it likely that more health-care workers will encounter patients infected with HIV. The risk of transmission of HIV can be minimized if health-care workers use care while performing all invasive procedures, adhere rigorously to previously published recommendations, and use universal precautions when caring for all patients (5). In addition, employers should instruct health-care workers on the need for routine use of universal precautions, provide equipment and clothing necessary to minimize the risk of infection, and monitor workers' adherence to these precautions (5,24).

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TABLE 3. HIV-infected health-care workers with no reported nonoccupational risk factors and for whom case histories have been published in the scientific literature

Cases with Documented Seroconversion					
Case	Occupation	Country	Type of Exposure	Source	Reference
1*	NS [†]	United States	Needlestick	AIDS patient	This report
2	NS	United States	Needlestick	AIDS patient	(4,6)
3	NS	United States	Needlestick	AIDS patient	(5)
4	NS	United States	2 Needlesticks	AIDS patient, HIV-infected patient	(5)
5	NS	United States	Needlestick	AIDS patient	(9)
6	Nurse	England	Needlestick	AIDS patient	(12)
7	Nurse	France	Needlestick	HIV-infected patient	(13)
8	Nurse	Martinique	Needlestick	AIDS patient	(14)
9	Research lab worker	United States	Cut with sharp object	Concentrated virus	(15,16)
10	Home health- care provider	United States	Cutaneous [‡]	AIDS patient	(17)
11	NS	United States	Nonintact skin	AIDS patient	(18)
12	Phlebotomist	United States	Mucous-membrane	HIV-infected patient	(18)
13	Technologist	United States	Nonintact skin	HIV-infected patient	(18)
14	NS	United States	Needlestick	AIDS patient	(19)
15	Nurse	Italy	Mucous-membrane	HIV-infected patient	(20)
Cases without Documented Seroconversion					
Case	Occupation	Country	Type of Exposure	Source	Reference
1	NS	United States	Puncture wound	AIDS patient	(3,4)
2	NS	United States	2 Needlesticks	2 AIDS patients	(3)
3	Research lab worker	United States	Nonintact skin	Concentrated virus	(15,16)
4	Home health- care provider	England	Nonintact skin	AIDS patient	(21)
5	Dentist	United States	Multiple needlesticks	Unknown	(22)
6*	Technician	Mexico	Multiple needle- sticks and mucous-membrane	Unknown	(23)
7	Lab worker	United States	Needlestick, puncture wound	Unknown	(3)

*Health-care worker diagnosed with AIDS.

[†]NS = not specified.

[‡]Mother who provided nursing care for her child with HIV infection; extensive contact with the child's blood and body secretions and excretions occurred; the mother did not wear gloves and often did not wash her hands immediately after exposure.

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MORBIDITY AND MORTALITY WEEKLY REPORT

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Perspectives in Disease Prevention and Health Promotion**Update: Universal Precautions for Prevention of Transmission of Human Immunodeficiency Virus, Hepatitis B Virus, and Other Bloodborne Pathogens in Health-Care Settings****Introduction**

The purpose of this report is to clarify and supplement the CDC publication entitled "Recommendations for Prevention of HIV Transmission in Health-Care Settings" (1).*

In 1983, CDC published a document entitled "Guideline for Isolation Precautions in Hospitals" (2) that contained a section entitled "Blood and Body Fluid Precautions." The recommendations in this section called for blood and body fluid precautions when a patient was known or suspected to be infected with bloodborne pathogens. In August 1987, CDC published a document entitled "Recommendations for Prevention of HIV Transmission in Health-Care Settings" (1). In contrast to the 1983 document, the 1987 document recommended that blood and body fluid precautions be consistently used for all patients regardless of their bloodborne infection status. This extension of blood and body fluid precautions to all patients is referred to as "Universal Blood and Body Fluid Precautions" or "Universal Precautions." Under universal precautions, blood and certain body fluids of all patients are considered potentially infectious for human immunodeficiency virus (HIV), hepatitis B virus (HBV), and other bloodborne pathogens.

*The August 1987 publication should be consulted for general information and specific recommendations not addressed in this update.

Copies of this report and of the *MMWR* supplement entitled *Recommendations for Prevention of HIV Transmission in Health-Care Settings* published in August 1987 are available through the National AIDS Information Clearinghouse, P.O. Box 6003, Rockville, MD 20850.

Update: HIV — Continued

Universal precautions are intended to prevent parenteral, mucous membrane, and nonintact skin exposures of health-care workers to bloodborne pathogens. In addition, immunization with HBV vaccine is recommended as an important adjunct to universal precautions for health-care workers who have exposures to blood (3,4).

Since the recommendations for universal precautions were published in August 1987, CDC and the Food and Drug Administration (FDA) have received requests for clarification of the following issues: 1) body fluids to which universal precautions apply, 2) use of protective barriers, 3) use of gloves for phlebotomy, 4) selection of gloves for use while observing universal precautions, and 5) need for making changes in waste management programs as a result of adopting universal precautions.

Body Fluids to Which Universal Precautions Apply

Universal precautions apply to blood and to other body fluids containing visible blood. Occupational transmission of HIV and HBV to health-care workers by blood is documented (4,5). **Blood is the single most important source of HIV, HBV, and other bloodborne pathogens in the occupational setting. Infection control efforts for HIV, HBV, and other bloodborne pathogens must focus on preventing exposures to blood as well as on delivery of HBV immunization.**

Universal precautions also apply to semen and vaginal secretions. Although both of these fluids have been implicated in the sexual transmission of HIV and HBV, they have not been implicated in occupational transmission from patient to health-care worker. This observation is not unexpected, since exposure to semen in the usual health-care setting is limited, and the routine practice of wearing gloves for performing vaginal examinations protects health-care workers from exposure to potentially infectious vaginal secretions.

Universal precautions also apply to tissues and to the following fluids: cerebrospinal fluid (CSF), synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, and amniotic fluid. The risk of transmission of HIV and HBV from these fluids is unknown; epidemiologic studies in the health-care and community setting are currently inadequate to assess the potential risk to health-care workers from occupational exposures to them. However, HIV has been isolated from CSF, synovial, and amniotic fluid (6-8), and HBsAg has been detected in synovial fluid, amniotic fluid, and peritoneal fluid (9-11). One case of HIV transmission was reported after a percutaneous exposure to bloody pleural fluid obtained by needle aspiration (12). Whereas aseptic procedures used to obtain these fluids for diagnostic or therapeutic purposes protect health-care workers from skin exposures, they cannot prevent penetrating injuries due to contaminated needles or other sharp instruments.

Body Fluids to Which Universal Precautions Do Not Apply

Universal precautions do not apply to feces, nasal secretions, sputum, sweat, tears, urine, and vomitus unless they contain visible blood. The risk of transmission of HIV and HBV from these fluids and materials is extremely low or nonexistent. HIV has been isolated and HBsAg has been demonstrated in some of these fluids; however, epidemiologic studies in the health-care and community setting have not implicated these fluids or materials in the transmission of HIV and HBV infections (13,14). Some of the above fluids and excretions represent a potential source for nosocomial and community-acquired infections with other pathogens, and recommendations for preventing the transmission of nonbloodborne pathogens have been published (2).

Update: HIV – Continued

Precautions for Other Body Fluids in Special Settings

Human breast milk has been implicated in perinatal transmission of HIV, and HBsAg has been found in the milk of mothers infected with HBV (10,13). However, occupational exposure to human breast milk has not been implicated in the transmission of HIV nor HBV infection to health-care workers. Moreover, the health-care worker will not have the same type of intensive exposure to breast milk as the nursing neonate. Whereas universal precautions do not apply to human breast milk, gloves may be worn by health-care workers in situations where exposures to breast milk might be frequent, for example, in breast milk banking.

Saliva of some persons infected with HBV has been shown to contain HBV-DNA at concentrations 1/1,000 to 1/10,000 of that found in the infected person's serum (15). HBsAg-positive saliva has been shown to be infectious when injected into experimental animals and in human bite exposures (16–18). However, HBsAg-positive saliva has not been shown to be infectious when applied to oral mucous membranes in experimental primate studies (18) or through contamination of musical instruments or cardiopulmonary resuscitation dummies used by HBV carriers (19,20). Epidemiologic studies of nonsexual household contacts of HIV-infected patients, including several small series in which HIV transmission failed to occur after bites or after percutaneous inoculation or contamination of cuts and open wounds with saliva from HIV-infected patients, suggest that the potential for salivary transmission of HIV is remote (5,13,14,21,22). One case report from Germany has suggested the possibility of transmission of HIV in a household setting from an infected child to a sibling through a human bite (23). The bite did not break the skin or result in bleeding. Since the date of seroconversion to HIV was not known for either child in this case, evidence for the role of saliva in the transmission of virus is unclear (23). Another case report suggested the possibility of transmission of HIV from husband to wife by contact with saliva during kissing (24). However, follow-up studies did not confirm HIV infection in the wife (21).

Universal precautions do not apply to saliva. General infection control practices already in existence — including the use of gloves for digital examination of mucous membranes and endotracheal suctioning, and handwashing after exposure to saliva — should further minimize the minute risk, if any, for salivary transmission of HIV and HBV (1,25). Gloves need not be worn when feeding patients and when wiping saliva from skin.

Special precautions, however, are recommended for dentistry (1). Occupationally acquired infection with HBV in dental workers has been documented (4), and two possible cases of occupationally acquired HIV infection involving dentists have been reported (5,26). During dental procedures, contamination of saliva with blood is predictable, trauma to health-care workers' hands is common, and blood spattering may occur. Infection control precautions for dentistry minimize the potential for nonintact skin and mucous membrane contact of dental health-care workers to blood-contaminated saliva of patients. In addition, the use of gloves for oral examinations and treatment in the dental setting may also protect the patient's oral mucous membranes from exposures to blood, which may occur from breaks in the skin of dental workers' hands.

Use of Protective Barriers

Protective barriers reduce the risk of exposure of the health-care worker's skin or mucous membranes to potentially infective materials. For universal precautions,

Update: HIV – Continued

protective barriers reduce the risk of exposure to blood, body fluids containing visible blood, and other fluids to which universal precautions apply. Examples of protective barriers include gloves, gowns, masks, and protective eyewear. Gloves should reduce the incidence of contamination of hands, but they cannot prevent penetrating injuries due to needles or other sharp instruments. Masks and protective eyewear or face shields should reduce the incidence of contamination of mucous membranes of the mouth, nose, and eyes.

Universal precautions are intended to supplement rather than replace recommendations for routine infection control, such as handwashing and using gloves to prevent gross microbial contamination of hands (27). Because specifying the types of barriers needed for every possible clinical situation is impractical, some judgment must be exercised.

The risk of nosocomial transmission of HIV, HBV, and other bloodborne pathogens can be minimized if health-care workers use the following general guidelines:[†]

1. Take care to prevent injuries when using needles, scalpels, and other sharp instruments or devices; when handling sharp instruments after procedures; when cleaning used instruments; and when disposing of used needles. Do not recap used needles by hand; do not remove used needles from disposable syringes by hand; and do not bend, break, or otherwise manipulate used needles by hand. Place used disposable syringes and needles, scalpel blades, and other sharp items in puncture-resistant containers for disposal. Locate the puncture-resistant containers as close to the use area as is practical.
2. Use protective barriers to prevent exposure to blood, body fluids containing visible blood, and other fluids to which universal precautions apply. The type of protective barrier(s) should be appropriate for the procedure being performed and the type of exposure anticipated.
3. Immediately and thoroughly wash hands and other skin surfaces that are contaminated with blood, body fluids containing visible blood, or other body fluids to which universal precautions apply.

Glove Use for Phlebotomy

Gloves should reduce the incidence of blood contamination of hands during phlebotomy (drawing blood samples), but they cannot prevent penetrating injuries caused by needles or other sharp instruments. The likelihood of hand contamination with blood containing HIV, HBV, or other bloodborne pathogens during phlebotomy depends on several factors: 1) the skill and technique of the health-care worker, 2) the frequency with which the health-care worker performs the procedure (other factors being equal, the cumulative risk of blood exposure is higher for a health-care worker who performs more procedures), 3) whether the procedure occurs in a routine or emergency situation (where blood contact may be more likely), and 4) the prevalence of infection with bloodborne pathogens in the patient population. The likelihood of infection after skin exposure to blood containing HIV or HBV will depend on the concentration of virus (viral concentration is much higher for hepatitis B than for HIV), the duration of contact, the presence of skin lesions on the hands of the health-care worker, and — for HBV — the immune status of the health-care worker. Although not accurately quantified, the risk of HIV infection following intact skin contact with infective blood is certainly much less than the 0.5% risk following percutaneous

[†]The August 1987 publication should be consulted for general information and specific recommendations not addressed in this update.

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needlestick exposures (5). In universal precautions, *all* blood is assumed to be potentially infective for bloodborne pathogens, but in certain settings (e.g., volunteer blood-donation centers) the prevalence of infection with some bloodborne pathogens (e.g., HIV, HBV) is known to be very low. Some institutions have relaxed recommendations for using gloves for phlebotomy procedures by skilled phlebotomists in settings where the prevalence of bloodborne pathogens is known to be very low.

Institutions that judge that routine gloving for *all* phlebotomies is not necessary should periodically reevaluate their policy. Gloves should always be available to health-care workers who wish to use them for phlebotomy. In addition, the following general guidelines apply:

1. Use gloves for performing phlebotomy when the health-care worker has cuts, scratches, or other breaks in his/her skin.
2. Use gloves in situations where the health-care worker judges that hand contamination with blood may occur, for example, when performing phlebotomy on an uncooperative patient.
3. Use gloves for performing finger and/or heel sticks on infants and children.
4. Use gloves when persons are receiving training in phlebotomy.

Selection of Gloves

The Center for Devices and Radiological Health, FDA, has responsibility for regulating the medical glove industry. Medical gloves include those marketed as sterile surgical or nonsterile examination gloves made of vinyl or latex. General purpose utility ("rubber") gloves are also used in the health-care setting, but they are not regulated by FDA since they are not promoted for medical use. There are no reported differences in barrier effectiveness between intact latex and intact vinyl used to manufacture gloves. Thus, the type of gloves selected should be appropriate for the task being performed.

The following general guidelines are recommended:

1. Use sterile gloves for procedures involving contact with normally sterile areas of the body.
2. Use examination gloves for procedures involving contact with mucous membranes, unless otherwise indicated, and for other patient care or diagnostic procedures that do not require the use of sterile gloves.
3. Change gloves between patient contacts.
4. Do not wash or disinfect surgical or examination gloves for reuse. Washing with surfactants may cause "wicking," i.e., the enhanced penetration of liquids through undetected holes in the glove. Disinfecting agents may cause deterioration.
5. Use general-purpose utility gloves (e.g., rubber household gloves) for housekeeping chores involving potential blood contact and for instrument cleaning and decontamination procedures. Utility gloves may be decontaminated and reused but should be discarded if they are peeling, cracked, or discolored, or if they have punctures, tears, or other evidence of deterioration.

Waste Management

Universal precautions are not intended to change waste management programs previously recommended by CDC for health-care settings (1). Policies for defining, collecting, storing, decontaminating, and disposing of infective waste are generally determined by institutions in accordance with state and local regulations. Information

Update: HIV – Continued

regarding waste management regulations in health-care settings may be obtained from state or local health departments or agencies responsible for waste management.

Reported by: Center for Devices and Radiological Health, Food and Drug Administration, Hospital Infections Program, AIDS Program, and Hepatitis Br, Div of Viral Diseases, Center for Infectious Diseases, National Institute for Occupational Safety and Health, CDC.

Editorial Note: Implementation of universal precautions does not eliminate the need for other category- or disease-specific isolation precautions, such as enteric precautions for infectious diarrhea or isolation for pulmonary tuberculosis (1,2). In addition to universal precautions, detailed precautions have been developed for the following procedures and/or settings in which prolonged or intensive exposures to blood occur: invasive procedures, dentistry, autopsies or morticians' services, dialysis, and the clinical laboratory. These detailed precautions are found in the August 21, 1987, "Recommendations for Prevention of HIV Transmission in Health-Care Settings" (1). In addition, specific precautions have been developed for research laboratories (28).

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*Update: HIV — Continued**References*

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OSHA work-practice guidelines for personnel dealing with cytotoxic (antineoplastic) drugs

Abstract: Work-practice guidelines for personnel dealing with cytotoxic drugs (CDs) are presented.

Current practices in the preparation, storage, administration, and disposal of CDs may expose pharmacists, nurses, physicians, and other health-care workers to high environmental levels of these drugs. OSHA has developed these guidelines to protect health-care workers from unnecessary exposure to CDs.

A brief summary of the short-term and long-term hazards known to be associated with these drugs is presented. The risks to workers handling CDs are a com-

bined result of the drugs' inherent toxicity and the extent to which workers are directly exposed to CDs via inhalation, absorption, and ingestion.

Work-practice guidelines that can limit the exposure of workers to CDs and the equipment necessary to carry out these practices properly are described.

Index terms: Antineoplastic agents; Equipment; Guidelines; Health care; Occupational Safety and Health Administration; Personnel; Safety; Toxicity, environmental

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Preface

It is not uncommon for health-care professionals to regard themselves as immune from any harm arising from their work. Thus, during the course of treating their patients, they may inadvertently expose themselves and their staff to hazardous substances while taking every precaution to ensure that the administered drugs are protected from contamination. The guidelines that follow have been developed in response to requests for assistance from a number of disparate sources, including health-care personnel concerned with the potential harm that may result from exposure to cytotoxic drugs (CDs).

The guidelines (not to be confused with mandatory standards) are designed to assist all health-care personnel, including physicians, nurses, pharmacists, aides, and the numerous and diverse health-care support staff who may be exposed to cytotoxic drugs through inhalation, skin absorption, or trauma. We are aware that the drugs are prepared and administered in a wide variety of

places, ranging from physicians' private consulting rooms to large pharmaceutical preparation rooms. We cannot cover every situation, but we offer what we believe is the most reasonable course of action, whether dealing with the drugs as a routine health-care procedure or during an emergency situation such as a large spill. Because of the widespread use of these drugs and the general lack of written policies or standard operating procedures in most facilities, we hope this instruction will fulfill the need to provide a description of the potential hazards of CDs, as well as the proper safety procedures, personal protective equipment, and engineering controls for CDs that will reduce contamination of workers.

The reader must be reminded that persons involved in health care, whether professionals or nonprofessionals, are workers and that the hospital, clinic, pharmacy, or even consulting room is a workplace. Some of the methods recommended may seem to be more suited to a nonclinical workplace, in particular, the suggested use of goggles

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where appropriate and a respirator where a biological safety cabinet is not available. Such recommendations must be considered in the light in which they are proffered; health professionals must walk the narrow line between alarming their patients unnecessarily and protecting their own health. We are aware of incidents in which nurses, ridding syringes of air, inadvertently sprayed their eyes with a drug aerosol. If health professionals are ROUTINELY careful during such procedures, goggles will not be essential. Similarly, if a biological safety cabinet is not in place, we know of no way of avoiding inhalation of a carcinogen other than by using an appropriate respirator.

Two elements are essential to ensure proper workplace practices:

- Education and training of all staff involved in handling any aspect of CDs.
- A biological safety cabinet (BSC).

The costs of implementing the former and installing the latter are relatively minor. The potential benefits are major.

Finally, we are grateful to our reviewers, including those who reviewed the document informally. We have incorporated as many of their recommendations and corrections as possible, and we are aware of the need to revise and update this document from time to time.

I. Introduction

A. Current practices in the preparation, storage, administration, and disposal of the widely used group of antineoplastic (anti-new-growth; anticancer) drugs—also called cytotoxic drugs (CDs) because they are toxic to cells—may expose pharmacists, nurses, physicians, and other health-care workers to high environmental levels of these drugs.

1. Although little research has been done on the long-term risks at the levels of exposure encountered by unprotected health-care workers, these drugs have been associated with human cancers at high (therapeutic) levels of exposure¹⁻⁹ and are carcinogens and teratogens in many animal species.^{4,9}
2. Under current work practices, CDs have demonstrated the ability to cause elevations in sister chromatid exchanges and chromosome breakage in circulating lymphocytes and mutagenic activity in urine.
3. In addition, many of these drugs have been shown to cause a variety of acute effects in humans, such as localized skin necrosis (death of tissue) after surface contact with abraded skin¹⁰ or damage to normal skin.¹¹

B. Several sets of work-practice guidelines have been issued by various professional bodies in the United States and by foreign institutions.¹²⁻²⁵ The volume of requests to OSHA indicates a broader interest among administrators and health-care professionals who are not aware of, or who have not had access to, these guidelines. Moreover, recent surveys reveal that there is little standardization of work practices and that proper practices and adequate protective equipment are not currently being used. Therefore, OSHA considers implementation of its work-practice guidelines important for protecting workers against these serious occupational hazards. The following information contained in sections II, III, and IV

1. Provides a brief summary of the short-term and long-term hazards now known to be associated with the drugs;
 2. Lists work-practice guidelines that can limit the exposure of workers to CDs and the equipment necessary to carry out these practices properly; and
 3. Lists the CDs currently in use (Table 1).
- C. These guidelines are addressed to persons who have a broad spectrum of qualifications and experience, and some readers may find them repetitious and too detailed. However, even the most qualified professionals do not always observe elementary and essential workplace safety practices; therefore, we have taken the precaution of covering as much detail as is considered essential to good work practice. Any repetition is an attempt to make each section complete.

II. Cytotoxic Drugs and Sites of Potential Risks

A. Cancer Chemotherapy.

1. The attempt to stop or reverse the growth of malignant growing cells with drugs began in the late 1940s, when mechlorethamine hydrochloride and its derivatives were first used therapeutically. Currently, approximately 30 cancer CDs are available commercially in the United States; these are administered to an estimated 200,000–400,000 patients annually (Table 1). Consequently, several thousand health-care employees may be exposed yearly to a variety of risks.
2. From the time of their initial use, these drugs were known to be potentially harmful to workers dealing with them. The mechlorethamine drugs are extremely irritating to mucous mem-

Table 1.
Antineoplastic Agents Currently in Use^a

Type of Agent	Trade Name
<i>Alkylating Agents</i>	
Cisplatin	Platinol
Cyclophosphamide	Cytoxan
Mechlorethamine hydrochloride ^b	Mustargen
Thiotepa	
Carmustine	BiCNU
Streptozocin	Zanosar
Busulfan	Myleran
Chlorambucil	Leukeran
Lomustine	CeeNu
Melphalan	Alkeran
Teosulfan	
Uracil mustard	
Chlornaphazine	
Dacarbazine	DTIC-Dome
<i>Antimetabolites</i>	
Cytarabine	Cytosar-U
Fluorouracil	Adrucil
Methotrexate	Mexate
Mercaptopurine	Purinethol
Azathioprine	Imuran
Procarbazine	Matulane
<i>Antibiotics</i>	
Doxorubicin hydrochloride	Adriamycin
Bleomycin sulfate	Blenoxane
Dactinomycin	Cosmegen
Daunorubicin hydrochloride	Cerubidine
Mithramycin	Mithracin
Mitomycin	Mutamycin
<i>Mitotic Inhibitors (Vinca alkaloids)</i>	
Vincristine sulfate	Oncovin
Vinblastine sulfate	Velban
Etoposide	
<i>Miscellaneous</i>	
Asparaginase	Elspar
<i>Investigational Drugs</i>	
Azacitidine	
Amsacrine	
Teniposide	
Ifosfamide	
Mitoxantrone hydrochloride	
Vindesine	

^a This is not a complete list; it requires periodic updating.

^b Referred to in these guidelines as nitrogen mustard.

branes, eyes, and skin.²⁶ Other agents developed later on, such as fluorouracil, also have well-known topical effects.¹¹ Spills of agents such as doxorubicin onto abraded skin can lead to severe soft-tissue injury, such as necrosis and sloughing of exposed areas,¹⁰ as well as possible effects on the fetus.²⁷ Symptoms such as lightheadedness, dizziness, nausea, headache, and possible allergic reaction also have been described in nurses after the preparation of antineoplastic drugs and their subsequent administration in unventilated areas.^{28,29}

3. The potential for harmful effects developing over a longer term is also well known. Most CDs either bind directly to

genetic material, in the cell nucleus, or affect cellular protein synthesis and may therefore damage growth and reproduction of normal cells as well.

B. Various Studies.

1. One study, on chlorambucil, shows that chromosome damage to cells among people to whom the drug is administered is related to both dose and duration of therapy and is cumulative.³⁰ Evidence that these drugs induce malignant tumors in animals and neoplasms and leukemias in humans to whom they are administered was available as early as the 1940s and 1950s, and continued to mount in the succeeding decades.⁶⁻⁹
2. In vivo, in vitro, and human studies have implicated antineoplastic drugs in chromosomal damage and teratogenesis (malformation), as well as carcinogenesis (cancer induction).^{8,27,30-32} Testicular and ovarian dysfunction including permanent sterility have been demonstrated in male and female patients, respectively, who have received CDs either singly or in combination. Congenital malformations have been attributed to fluorouracil.²⁷ A study from Finland also indicates an association between CDs and fetal malformations in pregnant nurses who work with CDs.³¹ While this needs to be confirmed, fetal loss associated with cytotoxic drugs has been reported among nurses in Finnish hospitals.³³
3. Finally, organ damage also has been associated with CDs, not only in animals^{34,35} and human patients receiving long-term therapy³⁴ but also among employees. Liver damage has been reported in nurses working on an oncology ward; the damage appeared to be related to the intensity and duration of work exposure.³⁶
4. Various studies have shown that current practices expose workers to substantial amounts of these drugs and that these drugs may increase the risk of long-term harm. Detectable amounts of various drugs have been found in the urine of health-care workers handling them.³⁷ Attempts also have been made to show that mutagenic activity in urine and chromosome damage are increased in workers handling CDs without proper protection and safe workplace practices.
 - a. Pharmacists who reconstituted anticancer drugs showed increasingly mutagenic urine over the period of exposure; when

they stopped handling the drugs, mutagenic activity fell within two days to the level of unexposed controls.³⁸ Also, the installation of a vertical-flow containment hood, or biological safety cabinet (BSC), has been shown to reduce the levels of mutagenic substances in the urine of pharmacy workers preparing CDs.³⁹

- b. A variety of chemical or physical agents have been associated with mutagenesis. Hair dyes and cigarette smoke are two that may concern health-care personnel. Smokers exposed to CDs exhibit greater urine mutagenicity than smokers who did not handle CDs.⁴⁰ Smokers who do not take simple protective measures such as gloving and hand washing may take in additional amounts of the drug orally through contaminated cigarettes. Other studies have shown a definite and significant reduction of urine mutagenicity in both smokers and nonsmokers who work with the agents when their work practices have improved.⁴¹
- c. Though the levels of absorption that may have taken place during work are hard to assess, it is essential to minimize exposure to these potent carcinogens and teratogens.

III. Current Practices in Preparation, Use, and Disposal: Points of Exposure for Personnel

Note: The risks to workers handling CDs are a combined result of the drugs' inherent toxicity and the extent to which workers are directly exposed to CDs on the job. The main routes of exposure are through the *inhalation* of drug dusts or droplets, *absorption* through the skin, and *ingestion* through contact with contaminated food or cigarettes. Opportunity for exposure may occur at many points in the handling of these drugs.

A. Survey of Current Work Practices.

A 1982 survey of 21 cancer centers in the United States revealed little standardization of work practices, equipment, or training for personnel administering injectable CDs.⁴² In only 10 centers were the necessary BSCs used for preparation. A 1983 survey of 10 hospital oncology clinics⁴³ showed that 9 did not use BSCs for preparation and that use of gloves was routine in only 3 clinics. Eating and drinking occurred in seven of the preparation rooms, greatly increasing the probability of oral intake of the drugs. Wastes were disposed of in covered receptacles in only seven of the preparation rooms. Air monitoring showed substantial air levels of the two drugs in most common use in these clinics. Based on these studies, the need for the

adoption of guidelines, the provision of proper protection and equipment, and the use of appropriate training is crucial.

B. Pharmacy or Other Preparation Areas.

1. In large oncology centers, CDs are usually prepared in the pharmacy by pharmacy personnel, but in many hospitals and smaller centers they may be prepared by physicians or nurses in patient-care or staff areas that are often inadequately ventilated.²⁸ Many CDs must be dissolved, transferred from one container to another, or manipulated before they can be administered to patients. Even if care is taken, opportunity for absorption through inhalation or direct skin contact may occur.^{15,43} Examples of manipulations that can cause splattering, spraying, and aerosol generation include:
 - a. Withdrawing needles from drug vials,
 - b. Transferring drug with syringes and needles or filter straws,
 - c. Breaking open ampuls, and
 - d. Expelling air from a drug-filled syringe.
2. Aerosols can be generated by these activities, exposing not only the employee immediately involved but also staff and patients in the surrounding areas.²⁵ A properly enclosed and ventilated work area, respiratory and skin protection, and training in the proper handling of these drugs is essential.^{20,25,28,43,44} Smoking, drinking, applying cosmetics, and eating where these drugs are prepared, stored, or used should *never* take place because these practices greatly increase the chance of exposure.²⁵
3. Even in the pharmacy, where protective clothing and gloves are worn and careful aseptic techniques are used as a matter of course, opportunities for exposure can occur. A horizontal-airflow, clean workbench is often used to provide an aseptic environment for the preparation of injectable drugs. Because this unit provides a flow of filtered air originating at the back of the work space and exiting toward the employee using the unit, it provides protection for the drugs but increases the likelihood of exposure to the preparer of the drugs and the other personnel who may be in the room. The preparer and others are exposed to the aerosols generated during preparation procedures.
 - a. Class II vertical-flow containment hoods, also called biological safety cabinets (BSCs), provide appropriate protection.^{44,45}

- b. Type A BSCs are the minimal requirement. Type A hoods that are vented (some of these are now classified as type B3) are preferred.¹⁸

C. Administration of Drugs to Patients.

1. The administration of drugs to patients is generally carried out by nurses or physicians. Injecting the drug into the i.v. line, clearing air from the syringe or infusion line, and leakage at the tubing, syringe, or stopcock connection present opportunities for both skin contact and aerosol generation leading to respiratory exposure. Clipping used needles and crushing used syringes, standard practice in some work situations, may produce a considerable aerosol.⁴³
2. Excreta from patients who have received certain antineoplastic drugs may contain high concentrations of the drug or hazardous metabolites. For example, patients receiving cyclophosphamide excrete large amounts of the drug and mutagenic metabolites.^{46,47} Patients treated with cisplatin excrete potentially hazardous amounts of the drug.⁴⁸ Handling urine or urine-soaked sheets may lead to dangerous exposure. Nursing and housekeeping personnel may be exposed to CDs if they are not made aware of the potential hazard and not trained to take precautions.

D. Disposal of Drugs and Contaminated Materials.

1. Materials that have been used in the preparation and administration of CDs, such as gloves, gowns, syringes, or vials, present a possible source of exposure or injury to support and housekeeping staff, as well as other health-care workers not involved with their preparation and administration. The use of properly labeled, sealed, and covered containers, handled only by trained and protected personnel, should be routine. Spills also represent a hazard, and all employees should be familiar with appropriate spill procedures for their own protection.

IV. Guidelines for the Handling of Cytotoxic Drugs

A. Drug Preparation.

1. Personal Protective Equipment.

- a. New research indicates that surgical latex gloves are less permeable to many CDs than the polyvinyl chloride gloves recommended in older guidelines.^{18,49,50} Surgical latex gloves therefore should be used for the preparation of CDs unless the

manufacturer specifically stipulates that some other glove provides better protection. (Powdered gloves should *never* be used.) A double layer of gloves is substantially less permeable and should be used if double-gloving does not interfere with technique. Because all gloves are permeable to some extent and their permeability increases with time,⁴⁹ they should be changed regularly (hourly is preferable) or immediately if they are torn or punctured.

- b. A protective disposable gown made of lint-free, low-permeability fabric with a closed front, long sleeves, and elastic or knit-closed cuffs must be worn, with the cuffs tucked under the gloves. Gowns and gloves in use should not be worn outside the preparation area.
 - c. A BSC is essential for the preparation of CDs, but where one is not currently available, a respirator with a high-efficiency filter, preferably a powered air-purifying respirator used by personnel who have been trained to use respirators, provides the best protection until a BSC is installed. We realize that this is a departure from the usual hospital/clinic/pharmacy procedures, but in this case we are dealing with a variety of known carcinogens and therefore appropriate preventive measures are necessary.
 - d. Surgical masks do *not* protect against the breathing of aerosols. A plastic face shield or splash goggles complying with American National Standards Institute 28.7.1-1968 criteria also should be worn if a BSC is not in use and an eyewash fountain made available. (See the Preface.)
2. *Preparation Area.* It is suggested that all CDs be prepared in one central area. If this is not practical, the number of areas used for preparation should be minimized. If possible, an isolated BSC where only CDs are prepared should be designated. Warning signs designating the area as a CD-preparation area, which should not be entered by unauthorized staff, should be clearly posted. Procedures for handling spills should also be posted. Eating, drinking, smoking, chewing gum, applying cosmetics, and storing food in or near the preparation area should be forbidden.
 - a. A Class II BSC that meets current National Sanitation Foundation Standard 49⁵¹ must be used.^{17-19,44,52} The blower on the vertical-airflow hood should be on at all times, 24 hours a day, seven days a week. Venting to the outside is preferable where feasible and is required with a Type B BSC. If the hood has an outside exhaust system, filtered exhaust to the outside should be at an appropriate level and away from air-

intake units. BSCs should be certified by a qualified technician every six months or any time the cabinet is moved.

- b. Technicians servicing these cabinets or changing high-efficiency particulate air (HEPA) filters should be warned of the nature of CDs and should use the same personal protective equipment as an employee dealing with a large spill (see A.I.). Special containment procedures that should be used to avoid contamination, both of the service personnel and the room, have been described in detail previously.⁴⁴
 - c. All used gowns and gloves and disposable materials used in preparation should be disposed of according to the hospital's toxic-waste procedures and as described in the section on waste disposal (see IV, D.).
3. *Preparation Equipment.* Work with CDs must be carried out in a BSC on a disposable, plastic-backed paper liner, which should be changed after preparation is completed for the day, or after a shift, whichever comes first. Syringes and i.v. sets with Luer-Lok fittings should always be used, and syringes should always be large enough so that they need never be more than three-fourths full. A nonsplash disposal-collection vessel, such as a plastic or metal tray lined with sterile gauze pads, should be on hand to collect excess solution. All necessary items should be placed within the BSC before work is begun, and all extraneous items should be kept out of the work area in order to avoid contamination.
- a. The work areas should be provided with a closable, puncture-resistant, shatter-proof container for disposal of contaminated sharp and breakable materials. Labeled sealable plastic or wire-tie bags, as described in the section on waste disposal, should be on hand so that all boxes and other contaminated materials, including gloves, gowns, and paper liners, can be immediately placed in them and disposed of according to the hospital's toxic-waste procedures.
 - b. The cabinet should be cleaned daily with 70% alcohol and decontaminated weekly, whenever spills occur, or when the cabinet requires service or certification. Ordinary decontamination procedures, which include fumigation with a germicidal agent, are inappropriate in a BSC used for CDs because such procedures do not deactivate the drugs and in addition may cause chemical reactions.⁵² Decontamination should consist of surface cleaning with high pH agents followed by thorough rinsing. Removable work trays, if present, should be removed, and the back of the

work tray and the sump below should be included in the cleaning.

4. *Work Practices in Preparation.* Proper aseptic techniques are essential for worker protection, but because it is generally accepted that these techniques are essential for patient safety, it is assumed they will already be standard practice in drug preparation. Therefore, general principles of aseptic technique will not be described here. It should be noted, however, that BSC benches differ from horizontal-flow units in several ways, thus requiring special precautions: Manipulations should not be performed close to the work surface, and unsterilized items, including liners and hands, must be kept downstream from the working area. Operators should be trained in these techniques.⁵²
- a. *Syringes and I.V. Bottles.* These should be labeled with the patient's name and room number, drug name, and quantity per total volume, route of administration, date and time prepared, dose, expiration date, and storage requirements if the drug is not to be transported immediately. All syringes, i.v. bags, and bottles containing CDs should be labeled with a distinctive warning label such as "Chemotherapy—handle with gloves—dispose of properly."
 - b. *Needles.* The use of large-bore needles, #18 or #20, will ensure that high-pressure syringing of the solutions is avoided. However, some experienced personnel believe that large-bore needles are more likely to drip. The needle should be chosen with these advantages or disadvantages in mind.
 1. Drug administration sets should be attached and primed within the hood, before the drug is added to the fluid, to obviate the need to prime the set in a less well controlled environment and to ensure that any fluid that escapes during priming contains no drug.
 2. All syringes and needles used in the course of preparation should be placed in the puncture-proof container for disposal without being crushed, clipped, or capped. (Some professionals believe that capping the needle before disposal reduces the generation of aerosols; others warn that it increases the chances of needle sticks.)
 - c. *Handling Vials.* Medication vials should not be vented unless a BSC is used as the work area or unless a hydrophobic filter-needle unit is available to eliminate pressure.⁵³ Syringe and needle fittings should

be of the Luer-Lok variety.

1. Diluent should be added slowly to the vial by alternately injecting small amounts and allowing displaced air to escape into the syringe. (All the diluent should not be injected at once because a large volume of displaced air can cause the syringe's plunger to back up and possibly spray the drug or cause leakage around the needles.) When all diluent has been added, a small amount of additional air may be withdrawn to create a negative pressure in the vial, but this should *not* be expelled into room air because it may contain drug residue. It should either be injected into a vacuum vial or remain in the syringe to be discarded.
 2. A sterile gauze pad should be wrapped around the needle and vial top when solution is withdrawn (employees should take care to avoid needle sticks during this procedure). The drug should be withdrawn from the vial while negative pressure is maintained. (The technique has been described previously.³⁴) If this use of negative pressure is considered impossible, a syringe should be filled with air equal to the volume of drug required, and the solution should be withdrawn by alternately injecting small amounts of air into the vial and withdrawing equal amounts of liquid until the required volume is withdrawn. The drug should be cleared from the needle and hub (neck) of the syringe before separation to avoid spraying on separation.
- d. Handling Ampuls.** Any material remaining in the top of an ampul should be tapped down before the ampul is opened. A sterile gauze pad should be wrapped around the ampul neck before the top is broken to protect against cuts and to catch aerosolized material.
1. The ampul top should not be removed close to the employee's face. If diluent is to be added, it should be injected slowly down the inside wall of the ampul. The ampul should be tilted gently to ensure that all the powder is wet before it is agitated to dissolve the contents.
 2. The needle should be held vertically with the needle upward; the syringe should be tapped to remove air bubbles, and the air bubbles should be expelled into sterile gauze, not into the air.

B. Drug Administration.

1. Personal Protective Equipment. Consider-

ation should be given by personnel administering CDs to wearing the following items:

- a. A gown, as described in the section on drug preparation.
- b. Disposable surgical latex gloves, double pairs if appropriate.
- c. A surgical mask also may be used, but it should be noted that this provides only minimal protection against CD aerosols and is no substitute for the proper procedures, which have been described.

To avoid alarm or misunderstanding, patients should be informed that any protective equipment in use is necessary for the protection of workers against the directly irritating effects of the drugs to eyes and skin (long-term as well as short-term effects of the drug already should have been discussed with patients in terms of potential risks to themselves).

2. CD-Administration Equipment. Protective equipment and other necessary items may be packaged together and labeled as a CD-administration kit, which should include:

- a. Personal protective equipment as described in IV, A.1;
- b. Gauze (4" X 4") for cleanup;
- c. Alcohol wipes;
- d. Disposable plastic-backed absorbent liner;
- e. Empty vials to be used as receptacles for excess drug solution;
- f. A puncture-proof container for needles and syringes;
- g. A 4-mil sealable plastic or wire-tie bag (with warning label) large enough to contain waste materials, and accessory warning labels;
- i. If additional preparation that cannot be done in a BSC is required before administration, a respirator (see IV, A.1.) used perhaps in a specially assigned side room, splash-proof goggles, and a 32-oz bottle of sterile isotonic eye and face wash should be readily available for emergencies.

3. Work Practices. Personnel should follow safe work practices including the following:

- a. Hands should be washed before gloves are put on. Gowns or gloves that become contaminated should be changed immediately.
- b. Infusion sets and pumps, which should have Luer-Lok fittings, should be watched for signs of leakage during use. A plastic-backed absorbent pad should be placed under the tubing during administration to catch any leakage. The line should be bled into gauze inside a sealable plastic bag.

- c. Priming should be carried out under a BSC. However, if i.v. sets are primed or air is expelled from syringes at the bedside, gauze in a plastic bag should be used as a receptacle. Syringes, i.v. bottles and bags, and pumps should be wiped clean of any drug contamination with an alcohol wipe. Needles and syringes should not be crushed or clipped but should be placed in a puncture-resistant container to go into the CD-disposal bag, along with all other contaminated materials. The bag should be disposed of in accordance with the hospital's toxic-waste-disposal procedures.
- d. Protective goggles should be wiped several times with an alcohol wipe and properly rinsed. Hands should be washed after removal of gloves. All gauze and alcohol wipes must be put in an appropriate container for disposal.

Note: Currently, a large number of investigational CDs are under clinical study in health-care facilities. Personnel not directly involved in the investigation should not administer these drugs unless they have received adequate instructions regarding safe handling procedures.

C. Caring for Patients Receiving CDs.

1. *Personal Protective Equipment.* Personnel dealing with blood, vomitus, or excreta from patients who have received CDs in the last 48 hours should wear surgical latex gloves and disposable gowns, to be discarded after each use as described in the section on waste disposal. (No protective equipment is necessary for ordinary patient contact for employees not dealing with drug administration or bodily secretions.) Hands should be washed after removal of gloves or after contact with the above substances.
2. *Linen.* Linen contaminated with CDs, blood, vomitus, or excreta from a patient who has received CDs up to 48 hours before should be placed in a specially marked laundry bag, and the laundry bag should be placed in a labeled impervious bag. This laundry bag and its contents should be prewashed, and then the linens should be added to other laundry for an additional wash. Laundry personnel should wear surgical latex gloves and gowns while handling this material. (No additional gain is made by autoclaving items contaminated with CDs, unless they are also contaminated with infectious waste.)

D. Waste Disposal.

1. *Equipment.* Cytotoxic-waste-disposal sealable plastic or wire-tie bags of 4-mil-

thick polyethylene or 2-mil-thick polypropylene, labeled with a cytotoxic hazard label and colored differently from other hospital trash bags, should be used for the routine accumulation and collection of used containers, syringes, discarded gloves, gowns, goggles, and any other disposable material. All CD-related wastes should be put into these bags and not into any other container.

- a. Needles, syringes, and breakable items should be placed in a plastic vial or puncture-proof box before they are placed into the bag. Needles should not be clipped or capped, and syringes should not be crushed. The bag should be kept inside a covered waste container clearly labeled "cytotoxic waste only."
 - b. At least one such receptacle should be located in every area where the drugs are prepared or administered so that the waste need not be moved from one area to another. The bag should be sealed when it is filled, and the carton should be taped.
2. *Handling.* Housekeeping personnel must wear gowns and surgical latex gloves when handling the waste containers, and they should be instructed on the necessity of handling this waste with care and on procedures governing spills and leaks.
 3. *Disposal.* These wastes must be handled separately from other hospital trash and must be regarded as toxic (hazardous) wastes and disposed of in accordance with applicable regulations.⁵⁵
 - a. Disposal in a licensed sanitary landfill for toxic wastes is an acceptable alternative. If waste is to be picked up by a commercial disposal firm, the company must be licensed, and the waste must be held in a secure area in covered, labeled drums lined with 6.5-mil polyethylene liners.
 - b. Chemical inactivation of CDs is often ineffective and may produce by-products that are more mutagenic than the parent drug.¹⁸ Therefore, with the exception of nitrogen mustard, which can be safely inactivated by sodium thiosulfate, chemical inactivation should be avoided until safe chemical procedures are developed.

E. Spills.

1. *General Procedure.* Spills and breakages should be cleaned up immediately by a properly protected person trained in the appropriate procedures. Broken glass should be carefully removed. A spill should be identified with a warning sign so that other persons in the area will not be contaminated.
2. *Personnel Contamination.* Overt contami-

nation of gloves or gowns, or direct skin or eye contact should be treated as follows:

- a. Immediately remove the gloves or gown;
 - b. Wash the affected skin area immediately with soap (not germicidal cleaner) and water. For eye exposure, immediately flood the affected eye with water or isotonic eyewash designated for that purpose for at least five minutes;
 - c. Obtain medical attention immediately.
3. **Cleanup of Small Spills.** Spills of less than 5 mL or 5 g outside a hood should be cleaned immediately by personnel wearing gowns and double surgical latex gloves and eye protection.
- a. Liquids should be wiped with absorbent gauze pads; solids should be wiped with wet absorbent gauze. The spill areas then should be cleaned (three times) using a detergent solution followed by clean water.
 - b. Any glass fragments should be placed in a small cardboard or plastic container and then into a CD-disposal bag, along with the used absorbent pads and any non-cleanable contaminated items.
 - c. Glassware or other contaminated reusable items should be placed in a plastic bag and washed in a sink with detergent by a trained employee wearing double surgical latex gloves.
4. **Cleanup of Large Spills.** For spills of amounts larger than 5 mL or 5 g, spread should be limited by gently covering with absorbent sheets or spill-control pads or pillows or, if a powder is involved, with damp cloths or towels. Be sure not to generate aerosols. Access to the spill areas should be restricted.
- a. Protective apparel should be used (see E.3.), with the addition of a respirator when there is any danger of airborne powder or an aerosol being generated. The dispersal of CD particles into surrounding air and the possibility of inhalation is a serious matter and should be treated as such.
 - b. Chemical inactivators, with the exception of sodium thiosulfate, which can be used safely to inactivate nitrogen mustard, may produce hazardous by-products¹⁸ and should not be applied to the absorbed drug.
 - c. All contaminated surfaces should be thoroughly cleaned with detergent solution and then wiped with clean water. All contaminated absorbents and other materials should be disposed of in the CD-disposal bag.
5. **Spills in Hoods.** Decontamination of all interior hood surfaces may be required

after the *above procedures have been followed*. If the HEPA filter of a hood is contaminated, the unit must be labeled "Do not use—contaminated," and the filter must be changed and disposed of properly as soon as possible by trained personnel wearing protective equipment. Protective goggles should be cleaned with an alcohol wipe after the cleanup.

6. **Spill Kits.** Spill kits, clearly labeled, should be kept in or near preparation and administrative areas. It is suggested that kits include a respirator, chemical splash goggles, two pairs of gloves, two sheets (12" X 12") of absorbent material, 250-mL and 1-L spill-control pillows, and a small scoop to collect glass fragments. Absorbents should be incinerable. Finally, the kit should contain two large CD-waste-disposal bags.

F. Medical Surveillance.

1. Routine Procedures.

- a. All employees with potential exposure to CDs through preparation, administration, housekeeping, waste disposal, transport, or storage of CDs, in addition to being fully informed of all potential dangers and the need to take adequate precautions, should have a preplacement physical examination. Care should be taken to note any risk factors in the history, and a complete blood count including differential should be taken to provide a baseline.
- b. Currently, no techniques exist for screening individual employees that would indicate the level of exposure reliably, though group screening for urine mutagenesis or for the presence of certain CDs in urine may be recommended by medical staff.
- c. A registry of all staff who routinely prepare or administer CDs should be permanently maintained, with the number recorded of each drug the employee has prepared or administered, if this is feasible.

2. **Acute Exposures.** After an acute exposure, the treatment procedure described in section E on spills should be followed, and the employee should receive a physical examination with particular attention to the eyes, buccal and nasal mucous membranes, and skin. Acute exposures include needle sticks from needles attached to syringes containing the drugs. However, needle sticks received by laboratory personnel dealing with the blood of patients being treated with CDs do not constitute a special hazard and require only ordinary needle-stick pro-

cedures. Needle sticks, as with all other acute exposures, should be recorded both on incident forms and in the employee's medical record.

3. **Pregnancy.** On the basis of the available evidence, it seems reasonable to assume that if appropriate procedures are followed and proper equipment and protection are provided, reproductive hazards will be reduced.
 - a. Employees should be fully informed of the potential reproductive hazards and, if they so request, staff members who are pregnant or breast-feeding should be transferred to comparable duties that do not involve handling CDs.
 - b. A similar policy covering male or female personnel who are actively trying to conceive a child should be established.

G. Storage and Transport.

1. **Storage Areas.** Access to areas where CDs are stored should be limited to authorized personnel. Such areas should be posted with a large warning sign, a list of all drugs covered by CD policies, and a sign detailing spill procedures. Facilities used for storing CDs, if possible, should not be used for other drugs and should be designed to prevent containers from falling to the floor. Warning labels should be applied to all CD containers, as well as the shelves and bins where these containers are permanently stored.
2. **Receiving Damaged CD Packages.** Damaged cartons should be opened in an isolated area by an employee wearing the same protective equipment as is used in preparation (including a powered air-purifying respirator) without a hood.
 - a. Broken containers and contaminated packaging mats should be placed in a puncture-resistant receptacle and then in CD disposal bags, which should be closed and placed into appropriate receptacles, both of which are described in section D on waste disposal.
 - b. The appropriate protective equipment and waste-disposal materials should be kept in the area where shipments are received, and employees should be trained in their use and the risks of exposure to CDs.
3. **Transport.** Within the medical facility, drugs should be securely capped or sealed and packaged in impervious packing material for transport.
 - a. Personnel involved in transporting CDs should be cautioned and trained in the necessary procedures should a spill occur, including sealing off the contaminated

area and calling for appropriate assistance.

- b. All drugs should be labeled with a warning label and clearly identified as cytotoxics. Transport methods that produce stress on contents, such as pneumatic tubes, should not be used to transport CDs.

H. Training and Information Dissemination.

1. **Training and Personnel.** All personnel involved in any aspect of the handling of CDs (shipment-receiving personnel, physicians, nurses, pharmacists, housekeepers, employees involved in the transport or storage of drugs) must receive an orientation to CDs, including their known risks, relevant techniques and procedures for their handling, the proper use of protective equipment and materials, spill procedures, and medical policies (including those dealing with pregnancy and with staff actively trying to conceive children). Prospective temporary and permanent employees who will be required to work with CDs should receive notice of this requirement. Medical staff who are not hospital employees should be informed of hospital policies and of the expectation that they will comply with these policies.
2. **Evaluation of Staff Performance.** Knowledge and competence of personnel should be evaluated after the first orientation or training session, and then yearly, or more often if a need is perceived. Evaluation may involve direct observation of an individual's performance on the job. In addition, non-CD solutions may be used to evaluate preparation technique; quinine, which will fluoresce under ultraviolet light, provides an easy mechanism for the detection of clumsy technique.
3. **Information.** The pharmacy should maintain a loose-leaf, index card, or computerized file containing information on the toxicity, acute-exposure treatment, chemical inactivators, solubility, and stability of the CDs used in the institution. This file should be available to employees. (Any special instructions for the handling of specific drugs should be included in the orientation and training sessions.) If drugs are administered in a centralized area, such as an oncology floor, a copy of this file should be available there. Summaries of relevant procedures should be posted in the appropriate work areas. A complete policy and procedures manual should be made available to all employees.

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APPENDIX 8

REPRINTS OF GUIDELINES FOR THE PREVENTION AND CONTROL OF NOSOCOMIAL INFECTIONS

**CDC GUIDELINE FOR
ISOLATION PRECAUTIONS IN HOSPITALS**

Julia S. Garner, RN, MS

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AND

**CDC GUIDELINE FOR INFECTION CONTROL
IN HOSPITAL PERSONNEL**

Walter W. Williams, MD, MPH

Part of the Manual Entitled
Guidelines for Prevention and Control of Nosocomial Infections

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

Public Health Service
Centers for Disease Control
Center for Infectious Diseases
Hospital Infections Program
Atlanta, Georgia 30333



September 1983

**TO: Hospital Infection Control Committees
State Epidemiologists
State Public Health Laboratory Directors**

**SUBJECT: Guideline for Isolation Precautions in Hospitals and
Guideline for Infection Control in Hospital Personnel**

The Hospital Infections Program of the Center for Infectious Diseases is distributing under this cover the new CDC guidelines on hospital infection control. The two guidelines, "Guideline for Isolation Precautions in Hospitals" and "Guideline for Infection Control in Hospital Personnel," are the same guidelines that were published in a special supplement to the July/August 1983 issue of the journal Infection Control. In hospitals, the new guidelines and section dividers should be inserted in the blue notebook manual, Guidelines for the Prevention and Control of Nosocomial Infections, which CDC sent to each hospital in 1981. In health departments, the materials may be placed with other reference material from CDC.

CDC cannot fill requests for additional copies of these guidelines. The "Guideline for Isolation Precautions in Hospitals" and color-coded instruction cards will be available in 2-4 weeks for purchase from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402; these supersede and replace the manual entitled "Isolation Techniques for Use in Hospitals, 2nd Edition 1975," and accompanying cards, which have been sold by the Superintendent of Documents since 1970.

The "Guideline for Infection Control in Hospital Personnel" and the "Guideline for Isolation Precautions in Hospitals" will be available in 4-6 weeks for purchase in single or multiple copies from the National Technical Information Service, U.S. Department of Commerce, Springfield, Virginia 22161. In addition to these two new guidelines, NTIS also sells the other guidelines in this series in looseleaf form, with or without the 3-ring binder with dividers to hold them.

Walter R. Dowdle, Ph.D.
Director
Center for Infectious Diseases

Preface to the Guidelines Series

The *Guidelines for the Prevention and Control of Nosocomial Infections* is a series of guidelines intended for use by hospital personnel who are responsible for infection surveillance and control activities. The guidelines have been derived from a variety of sources, including studies conducted by the Centers for Disease Control and by others and have undergone extensive review by experts, many of whom are engaged in the daily practice of infection surveillance and control. The guidelines are assembled in loose-leaf form to allow for periodic revisions and additions, since we fully expect the guidelines to change as new knowledge is acquired.

The titles of the various guidelines are listed below. Others may be added in the future. Within each guideline the date of original publication and subsequent revision, if any, appear at the bottom of each page. Additional copies of all guidelines are available from:

National Technical Information Service
U.S. Department of Commerce
Springfield, Virginia 22161

Titles of Published Guidelines

Guideline for Prevention of Catheter-associated Urinary Tract Infections
Guideline for Hospital Environmental Control
Guideline for Prevention of Intravascular Infections
Guideline for Prevention of Surgical Wound Infections
Guideline for Prevention of Nosocomial Pneumonia
Guideline for Isolation Precautions in Hospitals
Guideline for Infection Control in Hospital Personnel

Proposed Guideline Topics

Guideline for Prevention of Infections during Total Parenteral Nutrition
Guideline for Surveillance of Nosocomial Infections
Guideline on the Role of the Microbiology Laboratory in Infection Control

All comments, suggestions, and criticisms of the guidelines should be sent to:

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For Sale By Superintendent Of Documents; Washington, D.C.

Guideline for Isolation Precautions in Hospitals

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Preface

The first Centers for Disease Control (CDC) recommendations for isolation appeared in the manual *Isolation Techniques for Use in Hospitals*, published in 1970. The second edition of the manual was published first in 1975 and with minor revisions in 1978. All have been reprinted many times. Because knowledge of the epidemiology of infectious diseases can change, isolation recommendations should be revised periodically. Furthermore, CDC recognizes the need to keep isolation recommendations current by including newly described syndromes, such as toxic shock syndrome and acquired immunodeficiency syndrome, and emerging pathogens, such as multiply-resistant microorganisms and *Legionella pneumophila*.

The 1983 CDC recommendations for isolation precautions have been developed as a guideline, similar to those recently published on other topics. The title of the isolation recommendations has been changed to include the word "guideline," and it will become part of the CDC series entitled *Guidelines for the Prevention and Control of Nosocomial Infections*. Adult and pediatric infectious disease specialists,

hospital epidemiologists, infection control nurses, and a surgeon served in a working group to give CDC consultation by outside experts.

The isolation precautions presented in this guideline are considered to be a collection of prudent practices recommended by CDC personnel and a panel of outside experts. Some of the isolation recommendations are based on well-documented modes of transmission identified in epidemiologic studies. Other recommendations are based on a reasonable theoretical rationale, as evidenced by consensus of the working group members. Since there have been few studies to test the efficacy of isolation recommendations, members of the working group did not rank the recommendations by the degree to which they have been substantiated by scientific data or the strength of the working group's opinion on their effectiveness or practical value. The recommendations presented in this guideline may be modified as necessary for an individual hospital and are not meant to restrict hospitals from requiring additional precautions. The guideline will be revised as the need is recognized.

Section 1: Introduction

MAJOR CHANGES IN GUIDELINE FOR ISOLATION PRECAUTIONS IN HOSPITALS FROM PREVIOUS EDITIONS OF ISOLATION MANUAL

The Guideline for Isolation Precautions in Hospitals contains many important changes from previous editions of the manual *Isolation Techniques for Use in Hospitals*:

1. Rather than recommending only an isolation system based on categories of isolation, we have included an alternative system: disease-specific isolation precautions. For the first time, hospitals can choose *one* of these alternative systems for isolation—or they can, of course, design their own system. Some hospitals may prefer to continue using the more familiar, convenient, and simple category-specific isolation precautions. Disease-specific isolation precautions, however, may be more economical, in that only the particular precautions to interrupt transmission of the specific disease are recommended, so time and materials are not spent on unnecessary precautions. With disease-specific isolation precautions, we recommend using a single instruction card on which the need for specific precautions can be shown by checking appropriate items and filling in blanks. When isolation categories are used, we still recommend using standard color-coded category-specific instruction cards; however, the colors have been changed and the cards have been revised to correspond to changes made in the category-specific recommendations.
 2. Major changes have been made in the titles of and specifications for categories of isolation and the diseases or conditions requiring specific categories of isolation.
 - a. We have retained 3 categories of isolation (Strict Isolation, Respiratory Isolation, and Enteric Precautions) with modifications. We have substantially modified Enteric Precautions to minimize unnecessary use of gowns and gloves. This modification has permitted infections formerly under Excretion Precautions to be combined with those under Enteric Precautions. We have added and deleted diseases from Strict Isolation and Respiratory Isolation.
 - b. We have created 4 new categories of isolation (for a total of 7 categories): Contact Isolation, Tuberculosis Isolation, Drainage/Secretion Precautions, and Blood/Body Fluid Precautions.
 - 1) Contact Isolation is intended for patients with highly transmissible or epidemiologically important infections that do not require Strict Isolation, for example, patients infected or colonized by multiply-resistant bacteria.
 - 2) Tuberculosis Isolation was created because of the unique precautions needed to interrupt tuberculosis transmission; pulmonary and laryngeal tuberculosis have been removed from the Respiratory Isolation category. It is called AFB Isolation (for acid-fast bacilli) on the instruction card to protect the patient's privacy.
 - 3) The category Drainage/Secretion Precautions was created by combining and modifying Wound and Skin Precautions, Discharge (lesion) Precautions, and Secretion (oral) Precautions found in previous editions.
 - 4) Blood/Body Fluid Precautions is intended both for patients with infective blood, as in malaria, and for patients with infective blood and body fluids, as in hepatitis B; the old category of Blood Precautions has been eliminated.
 - c. We have eliminated the category Protective Isolation but discuss special infection problems related to compromised patients (see Care of Severely Compromised Patients).
 3. We have identified the secretions, excretions, body fluids, and tissues that are or might be infective for each disease or condition that requires isolation precautions. Such identification will permit personnel to determine when to use gowns and gloves and how to handle used articles when taking care of patients on isolation precautions.
 4. With some diseases or conditions, isolation precautions for infants and young children are different from those for other patients. For example, we recommend more stringent isolation precautions for infants and young children with acute respiratory infections than for adults because of the greater risk of spread and consequences of infection in infants and young children.
 5. We have added a section on modifications of isolation precautions in intensive care units and in newborn and infant nurseries.
 6. We have added a number of diseases and commonly used synonyms to the alphabetical listing of diseases or conditions that require isolation precautions to assist personnel in locating them more rapidly.
 7. We have deleted the section describing the special precautions that are necessary for smallpox; we now recommend that the State Health Department and CDC be consulted about any suspected case of smallpox, Lassa fever, or other viral hemorrhagic fevers, such as Marburg virus disease, for advice about management of the patient and contacts.
 8. We have deleted the section on recommendations for disinfection and sterilization of patient-care objects; we now refer the reader to the CDC Guideline for Hospital Environmental Control: Cleaning, Disinfection, and Sterilization of Hospital Equipment.
- Nevertheless, the Guideline for Isolation Precautions in Hospitals, like the 2 previous editions of the isolation manual, is still intended primarily for acute-care hospitals, al-

though it may be applicable to some extended-care and other patient-care institutions. It is designed to establish a balance between isolation precautions that are ideal and those that are practical. Once again, it is designed to eliminate ritual and to establish effective precautions that isolate the disease and not the patients. Since gaps still exist in knowledge of the epidemiology of some diseases, we expect disagreement with some of our recommendations. Hospitals are encouraged to modify or supplement these recommendations to meet their own needs.

DECIDING WHICH SYSTEM OF ISOLATION PRECAUTIONS TO USE IN YOUR HOSPITAL

To use the new approaches introduced in this guideline most effectively, each hospital's infection control committee must thoroughly review the entire guideline and *MAKE A DECISION* regarding which of the alternative systems of isolation precautions to use.

The first step is for all members of the committee who will participate in this decision to review the entire guideline carefully. This is necessary because the Guideline for Isolation Precautions in Hospitals contains many changes in recommended procedures as well as format from the previous manual *Isolation Techniques for Use in Hospitals*. To facilitate this review, we have summarized the most important changes in the introduction to the guideline and have included the rationale for these changes in other sections of the document.

The second step is for the infection control committee to *MAKE A DECISION* as to whether their hospital will use System A, the Category-Specific System, or System B, the Disease-Specific System, both of which are thoroughly described in this guideline. Of course, in some hospitals the committee may decide instead to use the information and recommendations in this guideline to create their own system of isolation precautions. However, from a logistical point of view, *the committee should not try to combine different elements taken from both systems*, because mixing the 2 approaches may lead to confusion among hospital personnel who are expected to apply the isolation precautions in patient care. Personnel throughout the hospital who will be using isolation precautions should be trained to apply only the *system* that is officially adopted by the infection control committee.

In deciding between the 2 alternative systems, the committee members should consider the relative advantages and disadvantages of each approach. Most importantly, the category-specific system (System A) is a simpler system that requires patient-care personnel to learn only a few set routines for applying isolation precautions (corresponding to the 7 categories), but because many different diseases are grouped into a few categories, some unnecessary precautions will be applied to some diseases (some degree of over-isolation). Alternatively, the disease-specific system (System B) ensures that the

isolation precautions applied are only ones required to interrupt transmission of the infection; since the set of precautions is individualized to each disease, this system requires more training and a much higher level of attention on the part of patient-care personnel for it to be applied correctly in all cases. Use of this system, however, should result in less over-isolation.

In the process of customizing the isolation procedures, some hospitals may need to revise their current practices only slightly, whereas others may choose to adopt an entirely new approach (eg, switching from the traditional category-specific system to the new disease-specific system). Major changes in isolation precautions will affect nursing personnel in particular, and factors such as whether primary nursing or team nursing is used in the hospital may influence the decision to change. The personnel who are in the best position to project benefits and anticipate problems stemming from revising isolation policies and procedures are those involved in infection control, particularly those involved in regular ward rounds and ongoing consultation with patient-care personnel about isolation precautions; therefore, they are probably in the best position to advise the infection control committee and other policymakers about the feasibility of proposed changes.

If the committee *HAS DECIDED* to use System A or System B in the hospital, the third step is to prepare a hospital isolation guide or manual which could simply incorporate the specific parts of this guideline that pertain to the particular approach adopted. If System A, the Category-Specific System, has been adopted, they should construct a manual containing introductory material from Section 1, Section 2 (pages 7-8), part of Section 3 (pages 9-46), and Section 4 (pages 80-81) of this guideline. Alternatively, if System B, the Disease-Specific System has been adopted, they should construct a manual containing introductory material from Section 1, Section 2 (pages 7-8), part of Section 3 (pages 9-13 and 47-79), and Section 4 (pages 80-81) of this guideline. Since this guideline is in the public domain, and thus not subject to the copyright laws, these sections may be duplicated for use as needed by hospitals or produced by commercial vendors.

The fourth step is to distribute the system-specific isolation guide to the hospital's patient-care personnel. One copy should be put in a convenient place in every nursing station, and relevant parts of the guide should simultaneously be incorporated into the standing procedure manuals of the Nursing Service and other applicable hospital departments.

The fifth step is to put the new system into action and keep it running as smoothly as possible. This requires planning and delivering effective in-service training to those who will apply the system, monitoring performance to assure compliance and detect problems, and making adjustments as necessary.

By following these 5 decision-making and implementation steps, the hospital can produce a management system for applying isolation precautions based on the latest recommendations, yet customized most appropriately to its own unique needs.

Section 2: Rationale and Responsibilities for Isolation Precautions

RATIONALE FOR ISOLATION PRECAUTIONS

Spread of infection within a hospital requires 3 elements: a source of infecting organisms, a susceptible host, and a means of transmission for the organism.

Source

The source of the infecting agent may be patients, personnel, or on occasion, visitors, and may include persons with acute disease, persons in the incubation period of the disease, or persons who are colonized by the infectious agent but have no apparent disease. Another source of infection can be the person's own endogenous flora (autogenous infection). Other potential sources are inanimate objects in the environment that have become contaminated, including equipment and medications.

Host

Patients' resistance to pathogenic microorganisms varies greatly. Some persons may be immune to or able to resist colonization by an infectious agent; others exposed to the same agent may establish a commensal relationship with the infecting organism and become asymptomatic carriers; still others may develop clinical disease. Persons with diabetes mellitus, lymphoma, leukemia, neoplasia, granulocytopenia, or uremia and those treated with certain antimicrobials, corticosteroids, irradiation, or immunosuppressive agents may be particularly prone to infection. Age, chronic debilitating disease, shock, coma, traumatic injury, or surgical procedures also make a person more susceptible.

Transmission

Microorganisms are transmitted by various routes, and the same microorganism may be transmitted by more than 1 route. For example, varicella-zoster virus can spread either by the airborne route (droplet nuclei) or by direct contact. The differences in infectivity and in the mode of transmission of the various agents form the basis for the differences in isolation precautions that are recommended in this guideline.

There are 4 main routes of transmission—contact, vehicle, airborne, and vectorborne.

A. Contact transmission, the most important and frequent means of transmission of nosocomial infections, can be divided into 3 subgroups: direct contact, indirect contact, and droplet contact.

1. Direct contact—This involves direct physical transfer between a susceptible host and an infected or colonized person, such as occurs when hospital personnel turn patients, give baths, change dressings, or perform other procedures requiring direct personal contact. Direct contact can also occur between 2 patients, 1 serving as the source

- of infection and the other as a susceptible host.
2. Indirect contact—This involves personal contact of the susceptible host with a contaminated intermediate object, usually inanimate, such as bed linens, clothing, instruments, and dressings.
3. Droplet contact—Infectious agents may come in contact with the conjunctivae, nose, or mouth of a susceptible person as a result of coughing, sneezing, or talking by an infected person who has clinical disease or is a carrier of the organism. This is considered "contact" transmission rather than airborne since droplets usually travel no more than about 3 feet.

- B. The vehicle route applies in diseases transmitted through these contaminated items:
1. food, such as in salmonellosis
 2. water, such as in legionellosis
 3. drugs, such as in bacteremia resulting from infusion of a contaminated infusion product
 4. blood, such as in hepatitis B, or non-A, non-B hepatitis.

C. Airborne transmission occurs by dissemination of either droplet nuclei (residue of evaporated droplets that may remain suspended in the air for long periods of time) or dust particles in the air containing the infectious agent. Organisms carried in this manner can be widely dispersed by air currents before being inhaled by or deposited on the susceptible host.

D. Vectorborne transmission is of greater concern in tropical countries, for example, with mosquito-transmitted malaria. It is of little significance in hospitals in the United States.

Isolation precautions are designed to prevent the spread of microorganisms among patients, personnel, and visitors. Since agent and host factors are more difficult to control, interruption of the chain of infection in the hospital is directed primarily at transmission. The isolation precautions recommended in this guideline are based on this concept.

Nevertheless, placing a patient on isolation precautions often presents certain disadvantages to both the hospital and the patient. Some isolation precautions may be time-consuming and add to the cost of hospitalization. They may make frequent visits by physicians, nurses, and other personnel inconvenient, and they may make it difficult for hospital personnel to give the prompt and frequent care that is sometimes required. The occasional recommendation of a private room under some circumstances uses valuable space that might otherwise accommodate several patients. Moreover, forced solitude deprives the patient of normal social relationships and may be psychologically injurious, especially for children. In an attempt to balance the disadvan-

tages of placing a patient on isolation precautions against the various hazards posed by transmissible infections, we have tried to design "degrees of isolation."

In general, it is safer to "over-isolate" than to "under-isolate," particularly when the diagnosis is uncertain and several diseases are seriously being considered. For the patient who appears to have a disease requiring isolation precautions, it is important to institute appropriate isolation precautions immediately rather than wait for confirmation of the diagnosis. Furthermore, certain general precautions may be required even though the patient does not fully meet the criteria for specific isolation precautions. For example, patients with bacteriuria and indwelling urinary catheters are known to serve as reservoirs of infection for roommates who also have indwelling urinary catheters. Passive carriage on the hands of personnel who provide urinary catheter care transmits these infections. Thus, noninfected patients with catheters should not, *where practical*, share rooms with catheterized patients who have bacteriuria.

Isolation precautions also may have to be modified for a patient who needs constant care or whose clinical condition may require emergency intervention such as those in intensive care units or nurseries. When such modifications are made, it is essential that the risk to other patients or hospital personnel of acquiring nosocomial infection be minimized.

RESPONSIBILITIES FOR CARRYING OUT ISOLATION PRECAUTIONS

The hospital is responsible for ensuring that patients are placed on appropriate isolation precautions. Each hospital should designate clearly, as a matter of policy, the personnel responsible for placing a patient on isolation precautions and the personnel who have the ultimate authority to make decisions regarding isolation precautions when conflicts arise.

All personnel—physicians, nurses, technicians, students, and others—are responsible for complying with isolation precautions and for tactfully calling observed infractions to the attention of offenders. Physicians should observe the proper isolation precautions at all times; they must teach by example. The responsibilities of hospital personnel for carrying out isolation precautions cannot be effectively dictated but must arise from a personal sense of responsibility.

Patients also have a responsibility for complying with isolation precautions. The appropriate measures should be explained to the patient by physicians and nurses. An important general patient responsibility is handwashing after touching infective material and potentially contaminated articles.

Infractions of the isolation protocol by some are sufficient to negate the conscientious efforts of others. The maxim holds true: "The chain is no stronger than its weakest link."

Section 3: Techniques and Recommendations for Isolation Precautions

TECHNIQUES FOR ISOLATION PRECAUTIONS

This section contains information essential to understanding and properly using the isolation precautions that appear in the guideline and on the instruction cards. Many of the techniques and recommendations for isolation precautions are appropriate not only for patients known or suspected to be infected but also for routine patient care. For example, gowns are appropriate for patient-care personnel when soiling with feces is likely, whether or not the patient is known or suspected to be infected with an enteric pathogen, and caution should be used when handling any used needle.

Handwashing

Handwashing is the single most important means of preventing the spread of infection. Personnel should always wash their hands, even when gloves are used, after taking care of an infected patient or one who is colonized with microorganisms of special clinical or epidemiologic significance, for example, multiply-resistant bacteria. In addition, personnel should wash their hands after touching excretions (feces, urine, or material soiled with them) or secretions (from wounds, skin infections, etc.) before touching any patient again. Hands should also be washed before performing invasive procedures, touching wounds, or touching patients who are particularly susceptible to infection. Hands should be washed between all patient contacts in intensive care units and newborn nurseries. (See Guideline for Hospital Environmental Control: Antiseptics, Handwashing, and Handwashing Facilities.)

When taking care of patients infected (or colonized) with virulent or epidemiologically important microorganisms, personnel should consider using antiseptics for handwashing rather than soap and water, especially in intensive care units. Antiseptics will inhibit or kill many microorganisms that may not be completely removed by normal handwashing; antiseptics that have a residual effect will continue to suppress microbial growth well after handwashing. Such antiseptics should not be used as a substitute for adequate handwashing, however.

Private Room

In general, a private room can reduce the possibility of transmission of infectious agents in 2 ways. First, it separates infected or colonized patients from susceptible patients and thus lessens the chance for transmission by any route. Second, it may act as a reminder for personnel to wash their hands before leaving the room and contacting other patients, especially if a sink is available at the doorway. Nevertheless, a private room is not necessary to prevent the spread of many infections.

A private room is indicated for patients with infections that are highly infectious or are caused by microorganisms that are likely to be virulent when transmitted. A private room is also indicated if patient hygiene is poor, for ex-

ample, if a patient does not wash hands after touching infective material (feces and purulent drainage or secretions), contaminates the environment, or shares contaminated articles. Such patients may include infants, children, and patients who have altered mental status. A private room may also be indicated for patients colonized with microorganisms of special clinical or epidemiologic significance, for example, multiply-resistant bacteria. Finally, a private room may be indicated for patients whose blood is infective, for example, hepatitis B, if profuse bleeding is likely to cause environmental contamination.

In addition to handwashing facilities, a private room should contain bathing and toilet facilities if the room is used for patients requiring isolation precautions. Toilet facilities obviate the need for portable commodes or special precautions for transporting commodes, bedpans, and urinals. An anteroom between the room and the hall, especially for rooms housing patients with highly infectious diseases spread by airborne transmission, will help maintain isolation precautions by reducing the possibility of airborne spread of infectious agents from the room into the corridor whenever the door of the room is opened. Anterooms also provide storage space for supplies, such as gowns, gloves, and masks.

For a few infections, a private room with special ventilation is indicated. We define special ventilation as that which results in negative air pressure in the room in relation to the anteroom or hall, when the room door is closed. The ventilation air, which should generally result in 6 air changes per hour, preferably should be discharged outdoors away from intake vents or receive high efficiency filtration before being recirculated to other rooms.

Roommates for Patients on Isolation Precautions

If infected or colonized patients are not placed in private rooms, they should be placed with appropriate roommates. Generally, infected patients should not share a room with a patient who is likely to become infected or in whom consequences of infection are likely to be severe.

When an infected patient shares a room with noninfected patients, it is assumed that patients and personnel will take measures to prevent the spread of infection. For example, a patient whose fecal material is infective may be in a room with others as long as he or she is cooperative, washes hands carefully, and does not have such severe diarrhea or fecal incontinence that either roommates or objects used by them become contaminated. Likewise, personnel need to wear gloves and wash hands when indicated and ensure that contaminated articles are discarded or returned for decontamination and reprocessing. When these conditions cannot be met, a private room is advisable.

In general, patients infected by the same microorganism may share a room. Also, infants and young children with the same respiratory clinical syndrome, for example, croup, may share a room. Such grouping (or cohorting) of patients

is especially useful during outbreaks when there is a shortage of private rooms.

Masks

In general, masks are recommended to prevent transmission of infectious agents through the air. Masks protect the wearer from inhaling 1) large-particle aerosols (droplets) that are transmitted by close contact and generally travel only short distances (about 3 feet) and 2) small-particle aerosols (droplet nuclei) that remain suspended in the air and thus travel longer distances. Masks might also prevent transmission of some infections that are spread by direct contact with mucous membranes, because masks may discourage personnel from touching the mucous membranes of their eyes, nose, and mouth until after they have washed their hands and removed the mask. The high efficiency disposable masks are more effective than cotton gauze or paper tissue masks in preventing airborne and droplet spread.

If the infection is transmitted by large-particle aerosols (droplets), we recommend masks only for those close to the patient. If the infection is transmitted over longer distances by air, we recommend masks for all persons entering the room. When masks are indicated, they should be used only once (because masks become ineffective when moist) and discarded in an appropriate receptacle; masks should not be lowered around the neck and reused. All masks should cover both the nose and the mouth.

Gowns

In general, gowns are recommended to prevent soiling of clothing when taking care of patients. Gowns are not necessary for most patient care because such soiling is not likely. However, gowns are indicated when taking care of patients on isolation precautions if clothes are likely to be soiled with infective secretions or excretions, for example, when changing the bed of an incontinent patient who has infectious diarrhea or when holding an infant who has a respiratory infection. Furthermore, gowns are indicated, even when gross soiling is not anticipated, for all persons entering the room of patients who have infections that if transmitted in hospitals frequently cause serious illness, for example, varicella (chickenpox) or disseminated zoster. When gowns are indicated, they should be worn only once and then discarded in an appropriate receptacle. Clean, freshly laundered or disposable gowns may be worn in most circumstances. In some instances, as with extensive burns or extensive wounds, sterile gowns may be worn when changing dressings.

Gloves

In general, there are 3 distinct reasons for wearing gloves. First, gloves reduce the possibility that personnel will become infected with microorganisms that are infecting patients; for example, gloves should prevent personnel from developing herpetic whitlow after giving oral care or suctioning a patient with oral herpes simplex infections. Second, gloves reduce the likelihood that personnel will transmit their own endogenous microbial flora to patients; for example, sterile gloves are used for this reason when personnel perform operations or touch open surgical wounds. Third, gloves reduce the possibility that personnel will become transiently colonized with microorganisms that can be transmitted to other patients. Under most conditions, such transient colonization can be eliminated by handwashing. Thus,

in hospitals where handwashing is performed carefully and appropriately by all personnel, gloves are theoretically not necessary to prevent transient colonization of personnel and subsequent transmission by them to others. However, since handwashing practices are thought to be inadequate in most hospitals, gloves appear to be a practical means of preventing transient hand colonization and spread of some infections. Therefore, for many diseases or conditions listed in this guideline, wearing gloves is indicated for touching the excretions, secretions, blood, or body fluids that are listed as infective material. Gloves may not be needed if "no touch" technique (not touching infective materials with hands) can be used.

When gloves are indicated, disposable single-use gloves (sterile or nonsterile, depending on the purpose for use) should be worn. Used gloves should be discarded into an appropriate receptacle. After direct contact with a patient's excretions or secretions, when taking care of that patient, gloves should be changed if care of that patient has not been completed.

Bagging of Articles

Used articles may need to be enclosed in an impervious bag before they are removed from the room or cubicle of a patient on isolation precautions. Such bagging is intended to prevent inadvertent exposures of personnel to articles contaminated with infective material and prevent contamination of the environment. Most articles do not need to be bagged unless they are contaminated (or likely to be contaminated) with infective material. (See the Tables, which contain an alphabetical listing of diseases, for identification of the infective material for each disease.) A single bag is probably adequate if the bag is impervious and sturdy (not easily penetrated) and if the article can be placed in the bag without contaminating the outside of the bag; otherwise, double bagging should be used. Bags should be labeled or be a particular color designated solely for contaminated articles or infectious wastes.

Disposable Patient-care Equipment

A variety of disposable patient-care equipment is available and should be considered for patients on isolation precautions. Use of these disposable articles reduces the possibility that equipment will serve as a fomite, but they must be disposed of safely and adequately. Equipment that is contaminated (or likely to be contaminated) with infective material should be bagged, labeled, and disposed of in accordance with the hospital's policy for disposal of infectious wastes. Local regulations may call for incineration or disposal in an authorized sanitary landfill without the bag's being opened. No special precautions are indicated for disposable patient-care equipment that is not contaminated (or likely to be contaminated) with infective material. (See Guideline for Hospital Environmental Control: Housekeeping Services and Waste Disposal.)

Reusable Patient-care Equipment

Ideally, such equipment should be returned to a central processing area for decontamination and reprocessing by trained personnel. When contaminated with infective material, equipment should be bagged and labeled before being removed from the patient's room or cubicle and remain bagged until decontaminated or sterilized. Special procedure trays should be separated into component parts and handled ap-

appropriately (some components can be discarded; others may need to be sent to the laundry or central services for reprocessing). (See Guideline for Hospital Environmental Control: Cleaning, Disinfection, and Sterilization of Hospital Equipment.)

Needles and Syringes

In general, personnel should use caution when handling all used needles and syringes because it is usually not known which patient's blood is contaminated with hepatitis virus or other microorganisms. To prevent needle-stick injuries, used needles should not be recapped; they should be placed in a prominently labeled, puncture-resistant container designated specifically for this purpose. Needles should not be purposely bent or broken by hand, because accidental needle puncture may occur. When some needle-cutting devices are used, blood may spatter onto environmental surfaces; however, currently no data are available from controlled studies examining the effect, if any, of these devices on the incidence of needle-transmissible infections. If the patient's blood is infective, disposable syringes and needles are preferred. If reusable syringes are used, they should be bagged and returned for decontamination and reprocessing. (See Guideline for Hospital Environmental Control: Cleaning, Disinfection, and Sterilization of Hospital Equipment.)

Sphygmomanometer and Stethoscope

No special precautions are indicated unless this equipment is contaminated (or likely to be contaminated) with infective material. If contaminated, the equipment should be disinfected in the manner appropriate to the object and to the etiologic agent that necessitated isolation precautions. (See Guideline for Hospital Environmental Control: Cleaning, Disinfection, and Sterilization of Hospital Equipment.)

Thermometers

Thermometers from patients on isolation precautions should be sterilized or receive high-level disinfection before being used by another patient. (See Guideline for Hospital Environmental Control: Cleaning, Disinfection, and Sterilization of Hospital Equipment.)

Linen

In general, soiled linen should be handled as little as possible and with a minimum of agitation to prevent gross microbial contamination of the air and of persons handling the linen. Soiled linen from patients on isolation precautions should be put in a laundry bag in the patient's room or cubicle. The bag should be labeled or be a particular color (for example, red) specifically designated for such linen so that whoever receives the linen knows to take the necessary precautions. Linens will require less handling if the bag is hot-water-soluble because such bags can be placed directly into the washing machine; however, a hot-water soluble bag may need to be double-bagged because they are generally easily punctured or torn or may dissolve when wet. Linen from patients on isolation precautions should not be sorted before being laundered. If mattresses and pillows are covered with impervious plastic, they can be cleaned by wiping with a disinfectant-detergent. (See Guideline for Hospital Environmental Control: Laundry Services.)

Dishes

No special precautions are necessary for dishes unless they are visibly contaminated with infective material, for example, with blood, drainage, or secretions. Disposable dishes

contaminated with infective material can be handled as disposable patient-care equipment. Reusable dishes, utensils, and trays contaminated with infective material should be bagged and labeled before being returned to the food service department. Food service personnel who handle these dishes should wear gloves, and they should wash their hands before handling clean dishes or food.

Drinking Water

No special precautions are indicated for drinking water. Containers used to hold water for patients on isolation precautions and glasses should be handled as dishes.

Dressings and Tissues

All dressings, paper tissues, and other disposable items soiled with infective material (respiratory, oral, or wound secretions) should be bagged and labeled and disposed of in accordance with the hospital's policy for disposal of infectious wastes. Local regulations may call for incineration or disposal in an authorized sanitary landfill without being opened. (See Guideline for Hospital Environmental Control: Housekeeping Services and Waste Disposal.)

Urine and Feces

Urine and feces from patients on isolation precautions can be flushed down the toilet if the hospital uses a municipal or other safe sewage treatment system. A urinal or bedpan from a patient on isolation precautions should be cleaned and disinfected or sterilized before being used by another patient. (See Guideline for Hospital Environmental Control: Cleaning, Disinfection, and Sterilization of Hospital Equipment.)

Laboratory Specimens

In general, each specimen should be put in a well-constructed container with a secure lid to prevent leaking during transport. Care should be taken when collecting specimens to avoid contamination of the outside of the container. If the outside of the container is visibly contaminated, it should be cleaned or disinfected or be placed in an impervious bag. Specimens from patients on isolation precautions may need to be placed in an impervious bag and labeled before being removed from the room or cubicle; bagging is intended to prevent inadvertent exposures of laboratory or transport personnel to infective material and prevent contamination of the environment. Whether specimens from patients on isolation precautions need to be bagged before being sent to the laboratory will depend on the kind of specimen and container, the procedures for collecting specimens, and the methods for transporting and receiving specimens in the hospital laboratory.

Patient's Chart

The chart should not be allowed to come into contact with infective material or objects that may be contaminated with infective material.

Visitors

Visitors should talk with a nurse before entering the room or cubicle of a patient on isolation precautions and, if indicated, should be instructed in the appropriate use of gown, mask, gloves, or other special precautions.

Transporting Infected or Colonized Patients

Patients infected with virulent or epidemiologically important microorganisms should leave their room only for essential purposes. Appropriate barriers (masks, impervious dressings, etc.) to prevent transmission should be used by

the patient and transport personnel. Personnel in the area to which the patient is to be taken should be notified of the impending arrival of the patient and of precautions to be used to prevent transmission of infection. Patients should be alerted to the potential spread of their disease and informed as to how they can assist in maintaining a barrier against transmission of their infection to others.

Clothing

Clothing soiled with infective material should be bagged before being sent home or to the hospital laundry; it should be washed with a detergent and, if possible, hot water and bleach.

Books, Magazines, and Toys

In general, any of these articles visibly soiled with infective material should be disinfected or destroyed. A child with an infection that may be spread by fomites or by contact transmission should not share toys with other children.

Routine Cleaning

The same routine daily cleaning procedures used in other hospital rooms should be used to clean rooms or cubicles of patients on isolation precautions. Cleaning equipment used in rooms of patients whose infection requires a private room should be disinfected before being used in other patient rooms. For example, dirty water should be discarded, wiping cloths and mop heads should be laundered and thoroughly dried, and buckets should be disinfected before being refilled. If cleaning cloths and mop heads are contaminated with infective material or blood, they should be bagged and labeled before being sent to the laundry. (See Guideline for Hospital Environmental Control: Housekeeping Services and Waste Disposal.)

Terminal Cleaning

When isolation precautions have been discontinued, the remaining infection control responsibilities relate to the inanimate environment. Therefore, certain epidemiologic aspects of environmental transmission should be kept in mind by personnel involved with terminal cleaning (cleaning after the patient has been taken off isolation precautions or has ceased to be a source of infection). Although microorganisms may be present on walls, floors, and table tops in rooms used for patients on isolation precautions, these environmental surfaces, unless visibly contaminated, are rarely associated with transmission of infections to others. In contrast, microorganisms on contaminated patient-care equipment are frequently associated with transmission of infections to other patients when such equipment is not appropriately decontaminated and reprocessed. Therefore, terminal cleaning should primarily be directed toward those items that have been in direct contact with the patient or in contact with the patient's infective material (excretions, secretions, blood, or body fluids). Disinfectant-detergent solution used during terminal cleaning should be freshly prepared. Terminal cleaning of rooms (or cubicles) consists of the following:

- a. Generally, housekeeping personnel should use the same precautions to protect themselves during terminal cleaning that they would use if the patient were still in the room; however, masks are not needed if they had been indicated previously only for direct or close patient contact.
- b. All nondisposable receptacles (drainage bottles, urinals,

bedpans, flowmeter jars, thermometer holders, etc.) should be returned for decontamination and reprocessing. Articles that are contaminated (or likely to be contaminated) with infective material should be bagged and labeled before being sent for decontamination and reprocessing.

- c. All disposable items should be discarded. Articles that are contaminated (or likely to be contaminated) with infective material should be bagged, labeled, and disposed of in accordance with the hospital's policy on disposal of infectious wastes. Local regulations may call for the bag's incineration or disposal in an authorized sanitary landfill without being opened. No special precautions are indicated for disposal of items that are not contaminated (or not likely to be contaminated) with infective material.
- d. All equipment that is not sent to central services or discarded should be cleaned with a disinfectant-detergent solution.
- e. All horizontal surfaces of furniture and mattress covers should be cleaned with a disinfectant-detergent solution.
- f. All floors should be wet-vacuumed or mopped with a disinfectant-detergent solution. (For recommendations on carpets, see Guideline for Hospital Environmental Control: Housekeeping Services and Waste Disposal.)
- g. Routine washing of walls, blinds, and curtains is not indicated; however, these should be washed if they are visibly soiled. Cubicle curtains should be changed if visibly soiled.
- h. Disinfectant fogging is an unsatisfactory method of decontaminating air and surfaces and thus should not be used.
- i. Airing a room from which a patient has been discharged is not an effective terminal disinfection procedure and is not necessary.
- j. The State Health Department and the Centers for Disease Control, Hospital Infections Program, should be consulted about cleaning the room of a patient who has suspected smallpox, Lassa fever, Ebola fever, or other hemorrhagic fevers, such as Marburg disease.

Postmortem Handling of Bodies

Generally, personnel should use the same precautions to protect themselves during postmortem handling of bodies that they would use if the patient were still alive; however, masks are usually not necessary unless aerosols are expected to be generated. Autopsy personnel should be notified about the patient's disease status so that appropriate precautions can be maintained during and after autopsy. State or local regulations may call for additional special precautions for postmortem handling of bodies.

Miscellaneous

- a. Isolation carts—Some institutions use pre-stocked isolation carts that contain equipment and supplies for isolation precautions. These can be wheeled to the general area where needed but should be placed in a clean area. Carts should be kept adequately stocked with all necessary supplies.
- b. Admission—If a susceptible person has been exposed recently to an infectious disease requiring isolation

precautions, the physician should postpone elective admission or prescribe appropriate isolation precautions for a nonelective admission. This situation is most likely to occur with children or young adults.

- c. Prophylaxis and immunization—When used appropriately, prophylactic antimicrobials and active or

passive immunization may prevent or ameliorate the course of infections to which patients or personnel have been exposed. These measures should be considered as adjuncts to isolation precautions in preventing the spread of disease (see Guideline for Infection Control in Hospital Personnel).

Alternative Systems for Isolation Precautions

SYSTEM A. CATEGORY-SPECIFIC ISOLATION PRECAUTIONS

Category-specific isolation precautions is 1 of 2 isolation systems recommended by CDC. This system was the only one recommended in the first 2 editions of the CDC manual, *Isolation Techniques for Use in Hospitals*. Isolation categories are derived by grouping diseases for which similar isolation precautions are indicated. For diseases to be grouped into isolation categories, more isolation precautions must be required with some diseases than just those that are necessary to prevent transmission of those diseases. (Hospitals wishing to avoid overuse of isolation precautions may use the alternative isolation system, disease-specific isolation precautions.) Nevertheless, category-specific isolation precautions have advantages in that they are easier to administer and to teach personnel.

Seven isolation categories are used: Strict Isolation, Contact Isolation, Respiratory Isolation, Tuberculosis (AFB) Isolation, Enteric Precautions, Drainage/Secretion Precautions, and Blood/Body Fluid Precautions. The specifications for each category and the diseases and conditions included in the category are discussed below. (Additional information essential to understanding and properly using category-specific isolation precautions is contained in the preceding section, Techniques for Isolation Precautions, and in Table A, Category-Specific Isolation Precautions.)

Strict Isolation

Strict Isolation is an isolation category designed to prevent transmission of highly contagious or virulent infections that may be spread by both air and contact.

Specifications for Strict Isolation

1. Private room is indicated; door should be kept closed. In general, patients infected with the same organism may share a room.
2. Masks are indicated for all persons entering the room.
3. Gowns are indicated for all persons entering the room.
4. Gloves are indicated for all persons entering the room.
5. Hands must be washed after touching the patient or potentially contaminated articles and before taking care of another patient.
6. Articles contaminated with infective material should be discarded or bagged and labeled before being sent for decontamination and reprocessing.

Diseases Requiring Strict Isolation

Diphtheria, pharyngeal
Lassa fever and other viral hemorrhagic fevers, such as Marburg virus disease*
Plague, pneumonic
Smallpox*
Varicella (chickenpox)
Zoster, localized in immunocompromised patient or disseminated

Contact Isolation

Contact Isolation is designed to prevent transmission of highly transmissible or epidemiologically important infections (or colonization) that do not warrant Strict Isolation.

All diseases or conditions included in this category are spread primarily by close or direct contact. Thus, masks, gowns, and gloves are recommended for anyone in close or direct contact with any patient who has an infection (or colonization) that is included in this category. For individual diseases or conditions, however, 1 or more of these 3 barriers may not be indicated. For example, masks and gloves are not generally indicated for care of infants and young children with acute viral respiratory infections, gowns are not generally indicated for gonococcal conjunctivitis in newborns, and masks are not generally indicated for care of patients infected with multiply-resistant microorganisms, except those with pneumonia. Therefore, some degree of "over-isolation" may occur in this category.

Specifications for Contact Isolation

1. Private room is indicated. In general, patients infected with the same organism may share a room. During outbreaks, infants and young children with the same respiratory clinical syndrome may share a room.
2. Masks are indicated for those who come close to the patient.
3. Gowns are indicated if soiling is likely.
4. Gloves are indicated for touching infective material.
5. Hands must be washed after touching the patient or potentially contaminated articles and before taking care of another patient.
6. Articles contaminated with infective material should be discarded or bagged and labeled before being sent for decontamination and reprocessing.

Diseases or Conditions Requiring Contact Isolation

Acute respiratory infections in infants and young children, including croup, colds, bronchitis, and bronchiolitis caused by respiratory syncytial virus, adenovirus, coronavirus, influenza viruses, parainfluenza viruses, and rhinovirus
Conjunctivitis, gonococcal, in newborns
Diphtheria, cutaneous
Endometritis, group A *Streptococcus*
Furunculosis, staphylococcal, in newborns
Herpes simplex, disseminated, severe primary or neonatal
Impetigo
Influenza, in infants and young children
Multiply-resistant bacteria, infection or colonization (any site) with any of the following:

1. Gram-negative bacilli resistant to all aminoglycosides that are tested. (In general, such organisms should be resistant to gentamicin, tobramycin, and amikacin for these special precautions to be indicated.)
 2. *Staphylococcus aureus* resistant to methicillin (or nafcillin or oxacillin if they are used instead of methicillin for testing)
 3. *Pneumococcus* resistant to penicillin
 4. *Haemophilus influenzae* resistant to ampicillin (beta-lactamase positive) and chloramphenicol
 5. Other resistant bacteria may be included if they are judged by the infection control team to be of special clinical and epidemiologic significance.
- Pediculosis

*A private room with special ventilation is indicated.

Pharyngitis, infectious, in infants and young children
 Pneumonia, viral, in infants and young children
 Pneumonia, *Staphylococcus aureus* or group A *Streptococcus*
 Rabies
 Rubella, congenital and other
 Scabies
 Scalded skin syndrome, staphylococcal (Ritter's disease)
 Skin, wound, or burn infection, major (draining and not covered by dressing or dressing does not adequately contain the purulent material) including those infected with *Staphylococcus aureus* or group A *Streptococcus*
 Vaccinia (generalized and progressive eczema vaccinatum)

Respiratory Isolation

Respiratory Isolation is designed to prevent transmission of infectious diseases primarily over short distances through the air (droplet transmission). Direct and indirect contact transmission occurs with some infections in this isolation category but is infrequent.

Specifications for Respiratory Isolation

1. Private room is indicated. In general, patients infected with the same organism may share a room.
2. Masks are indicated for those who come close to the patient.
3. Gowns are not indicated.
4. Gloves are not indicated.
5. Hands must be washed after touching the patient or potentially contaminated articles and before taking care of another patient.
6. Articles contaminated with infective material should be discarded or bagged and labeled before being sent for decontamination and reprocessing.

Diseases Requiring Respiratory Isolation

Epiglottitis, *Haemophilus influenzae*
 Erythema infectiosum
 Measles
 Meningitis

Haemophilus influenzae, known or suspected
 Meningococcal, known or suspected
 Meningococcal pneumonia
 Meningococemia
 Mumps

Pertussis (whooping cough)
 Pneumonia, *Haemophilus influenzae*, in children (any age)

Tuberculosis Isolation (AFB Isolation)

Tuberculosis Isolation (AFB Isolation) is an isolation category for patients with pulmonary TB who have a positive sputum smear or a chest X-ray that strongly suggests current (active) TB. Laryngeal TB is also included in this isolation category. In general, infants and young children with pulmonary TB do not require isolation precautions because they rarely cough, and their bronchial secretions contain few AFB, compared with adults with pulmonary TB. On the instruction card, this category is called AFB (for acid-fast bacilli) Isolation to protect the patient's privacy.

Specifications for Tuberculosis Isolation (AFB Isolation)

1. Private room with special ventilation is indicated; door should be kept closed. In general, patients infected with the same organism may share a room.
2. Masks are indicated only if the patient is coughing and does not reliably cover mouth.

3. Gowns are indicated only if needed to prevent gross contamination of clothing.
4. Gloves are not indicated.
5. Hands must be washed after touching the patient or potentially contaminated articles and before taking care of another patient.
6. Articles are rarely involved in transmission of TB. However, articles should be thoroughly cleaned and disinfected, or discarded.

Enteric Precautions

Enteric Precautions are designed to prevent infections that are transmitted by direct or indirect contact with feces. Hepatitis A is included in this category because it is spread through feces, although the disease is much less likely to be transmitted after the onset of jaundice. Most infections in this category primarily cause gastrointestinal symptoms, but some do not. For example, feces from patients infected with "poliovirus" and coxsackieviruses are infective, but these infections do not usually cause prominent gastrointestinal symptoms.

Specifications for Enteric Precautions

1. Private room is indicated if patient hygiene is poor. A patient with poor hygiene does not wash hands after touching infective material, contaminates the environment with infective material, or shares contaminated articles with other patients. In general, patients infected with the same organism may share a room.
2. Masks are not indicated.
3. Gowns are indicated if soiling is likely.
4. Gloves are indicated if touching infective material.
5. Hands must be washed after touching the patient or potentially contaminated articles and before taking care of another patient.
6. Articles contaminated with infective material should be discarded or bagged and labeled before being sent for decontamination and reprocessing.

Diseases Requiring Enteric Precautions

Amebic dysentery
 Cholera
 Coxsackievirus disease
 Diarrhea, acute illness with suspected infectious etiology
 Echovirus disease
 Encephalitis (unless known not to be caused by enteroviruses)
 Enterocolitis caused by *Clostridium difficile* or *Staphylococcus aureus*
 Enteroviral infection
 Gastroenteritis caused by
 Campylobacter species
 Cryptosporidium species
 Dientamoeba fragilis
 Escherichia coli (enterotoxigenic, enteropathogenic, or enteroinvasive)
 Giardia lamblia
 Salmonella species
 Shigella species
 Vibrio parahaemolyticus
 Viruses—including Norwalk agent and rotavirus
Yersinia enterocolitica
 Unknown etiology but presumed to be an infectious agent

Hand, foot, and mouth disease
 Hepatitis, viral, type A
 Herpangina
 Meningitis, viral (unless known not to be caused by enteroviruses)
 Necrotizing enterocolitis
 Pleurodynia
 Poliomyelitis
 Typhoid fever (*Salmonella typhi*)
 Viral pericarditis, myocarditis, or meningitis (unless known not to be caused by enteroviruses).

Drainage/Secretion Precautions

Drainage/Secretion Precautions are designed to prevent infections that are transmitted by direct or indirect contact with purulent material or drainage from an infected body site. This newly created isolation category includes many infections formerly included in Wound and Skin Precautions, Discharge (lesion), and Secretion (oral) Precautions, which have been discontinued. Infectious diseases included in this category are those that result in the production of infective purulent material, drainage, or secretions, unless the disease is included in another isolation category that requires more rigorous precautions. For example, minor or limited skin, wound, or burn infections are included in this category, but major skin, wound, or burn infections are included in Contact Isolation. (If you have questions about a specific disease, see the alphabetical listing of infectious diseases in Table A, Category-Specific Isolation Precautions.)

Specifications for Drainage/Secretion Precautions

1. Private room is not indicated.
2. Masks are not indicated.
3. Gowns are indicated if soiling is likely.
4. Gloves are indicated for touching infective material.
5. Hands must be washed after touching the patient or potentially contaminated articles and before taking care of another patient.
6. Articles contaminated with infective material should be discarded or bagged and labeled before being sent for decontamination and reprocessing.

Diseases Requiring Drainage/Secretion Precautions

The following infections are examples of those included in this category provided they are *not* a) caused by multiply-resistant microorganisms, b) major (draining and not covered by a dressing or dressing does not adequately contain the drainage) skin, wound, or burn infections, including those caused by *Staphylococcus aureus* or group A *Streptococcus*, or c) gonococcal eye infections in newborns. See Contact Isolation if the infection is 1 of these 3.

Abscess, minor or limited
 Burn infection, minor or limited
 Conjunctivitis
 Decubitus ulcer, infected, minor or limited
 Skin infection, minor or limited
 Wound infection, minor or limited

Blood/Body Fluid Precautions

Blood/Body Fluid Precautions are designed to prevent infections that are transmitted by direct or indirect contact with infective blood or body fluids. Infectious diseases included in this category are those that result in the production of infective blood or body fluids, unless the disease is in-

cluded in another isolation category that requires more rigorous precautions, for example, Strict Isolation. (If you have questions about a specific disease, see the alphabetical listing of infectious diseases in Table A, Category-Specific Isolation Precautions.) For some diseases included in this category, such as malaria, only blood is infective; for other diseases, such as hepatitis B (including antigen carriers), blood and body fluids (saliva, semen, etc.) are infective.

Specifications for Blood/Body Fluid Precautions

1. Private room is indicated if patient hygiene is poor. A patient with poor hygiene does not wash hands after touching infective material, contaminates the environment with infective material, or shares contaminated articles with other patients. In general, patients infected with the same organism may share a room.
2. Masks are not indicated.
3. Gowns are indicated if soiling of clothing with blood or body fluids is likely.
4. Gloves are indicated for touching blood or body fluids.
5. Hands must be washed immediately if they are potentially contaminated with blood or body fluids and before taking care of another patient.
6. Articles contaminated with blood or body fluids should be discarded or bagged and labeled before being sent for decontamination and reprocessing.
7. Care should be taken to avoid needle-stick injuries. Used needles should not be recapped or bent; they should be placed in a prominently labeled, puncture-resistant container designated specifically for such disposal.
8. Blood spills should be cleaned up promptly with a solution of 5.25% sodium hypochlorite diluted 1:10 with water.

Diseases Requiring Blood/Body Fluid Precautions

Acquired immunodeficiency syndrome (AIDS)
 Arthropodborne viral fevers (for example, dengue, yellow fever, and Colorado tick fever)
 Babesiosis
 Creutzfeldt-Jakob disease
 Hepatitis B (including HBsAg antigen carrier)
 Hepatitis, non-A, non-B
 Leptospirosis
 Malaria
 Rat-bite fever
 Relapsing fever
 Syphilis, primary and secondary with skin and mucous membrane lesions

TABLE A. Category-Specific Isolation Precautions

Table A, Category-Specific Isolation Precautions, lists most of the common infectious agents and diseases that are likely to be found in U.S. hospitals and the category of isolation indicated for each. Diseases are listed alphabetically in several ways: by anatomical site or syndrome (abscess, burn wound, cellulitis, etc.), by etiologic agent (*Chlamydia trachomatis*, *Clostridium perfringens*, *Escherichia coli*, etc.), and sometimes by a combination of syndrome and etiologic agent (endometritis, group A *Streptococcus*, pneumonia, *Staphylococcus aureus*, etc.). In an attempt to make the table useful to all hospital personnel, including those from nonclinical areas (admitting, dietary, housekeeping, laundry, etc.), we have also included common terminology and jargon (such as gangrene

and "TORCH" syndrome) in the alphabetical listing of diseases.

For some diseases or conditions listed in Table A, we recommend more stringent isolation precautions for infants and young children than for adults since the risk of spread and the consequences of infection are greater in infants and young children. We use the term "young children" rather than an age breakpoint because children mature at such different rates. Thus, the interpretation of the term "young children" will differ in various pediatric settings according to patient population.

In addition to showing the category of isolation for each disease, Table A, Category-Specific Isolation Precautions,

identifies which secretions, excretions, discharges, body fluids, and tissues are infective or might be infective. Again, common terms such as feces and pus are used to describe infective material. In the table the term "pus" refers to grossly purulent as well as serous drainage that is likely to be infective. In the table we also tell how long to apply the category-specific precautions for each disease and, in the comments column, list other considerations that personnel should be aware of when taking care of an infected or colonized patient for whom isolation precautions are indicated. Additional information essential to understanding and properly using category-specific isolation precautions is contained in the first part of this section in Techniques for Isolation Precautions (page 9).

Table A. Category-Specific Isolation Precautions

DISEASE	CATEGORY	INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
Abscess, etiology unknown				
Draining, major	Contact Isolation	Pus	Duration of illness	Major = no dressing or dressing does not adequately contain the pus.
Draining, minor or limited	Drainage/ Secretion Precautions	Pus	Duration of illness	Minor or limited = dressing covers and adequately contains the pus, or infected area is very small, such as a stitch abscess.
Not draining	None			
Acquired immunodeficiency syndrome (AIDS)	Blood/Body Fluid Precautions	Blood and body fluids	Duration of illness	Use caution when handling blood and blood-soiled articles. Take special care to avoid needle-stick injuries. If gastrointestinal bleeding is likely, wear gloves if touching feces. (Acquired immune deficiency syndrome [AIDS]: precautions for clinical and laboratory staffs. MMWR 1982; 31:577-80.)
Actinomycosis, all lesions	None			
Adenovirus infection, respiratory in infants and young children	Contact Isolation	Respiratory secretions and feces	Duration of hospitalization	During epidemics patients believed to have adenovirus infection may be placed in the same room (cohorting).
Amebiasis				
Dysentery	Enteric Precautions	Feces	Duration of illness	
Liver abscess	None			
Anthrax				
Cutaneous	Drainage/ Secretion Precautions	Pus	Duration of illness	
Inhalation	Drainage/ Secretion Precautions	Respiratory secretions may be	Duration of illness	

Table A. Category-Specific Isolation Precautions

DISEASE	CATEGORY	INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
Arthropodborne viral encephalitides (eastern equine, western equine, and Venezuelan equine encephalomyelitis, St. Louis and California encephalitis)	None			
Arthropodborne viral fevers (dengue, yellow fever, and Colorado tick fever)	Blood/Body Fluid Precautions	Blood	Duration of hospitalization	
Ascariasis	None			
Aspergillosis	None			
Babesiosis	Blood/Body Fluid Precautions	Blood	Duration of illness	
Blastomycosis, North American, cutaneous or pulmonary	None			
Botulism				
Infant	None			
Other	None			
Bronchiolitis, etiology unknown in infants and young children	Contact Isolation	Respiratory secretions	Duration of illness	Various etiologic agents, such as respiratory syncytial virus, parainfluenza viruses, adenoviruses, and influenza viruses, have been associated with this syndrome (Committee on Infectious Diseases, American Academy of Pediatrics, 1982 Red Book); therefore, precautions to prevent their spread are generally indicated.
Bronchitis, infective, etiology unknown				
Adults	None	Respiratory secretions may be		
Infants and young children	Contact Isolation	Respiratory secretions	Duration of illness	
Brucellosis (undulant fever, Malta fever, Mediterranean fever)				
Draining lesions, limited or minor	Drainage/Secretion Precautions	Pus	Duration of illness	Limited or minor = dressing covers and adequately contains the pus, or infected area is very small.
Other	None			
Burn wound (see separate section on Care of Patients with Burns)				
<i>Campylobacter</i> gastroenteritis	Enteric Precautions	Feces	Duration of illness	
Candidiasis, all forms, including mucocutaneous (moniliasis, thrush)	None			
Cat-scratch fever (benign inoculation lymphoreticulosis)	None			

Table A. Category-Specific Isolation Precautions

DISEASE	CATEGORY	INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
Cellulitis				
Draining, limited or minor	Drainage/ Secretion Precautions	Pus	Duration of illness	Limited or minor = dressing covers and adequately contains the pus, or infected area is very small.
Intact skin	None			
Chancroid (soft chancre)	None			
Chickenpox (varicella)	Strict Isolation	Respiratory secretions and lesion secretions	Until all lesions are crusted	Persons who are not susceptible do not need to wear a mask. Susceptible persons should, if possible, stay out of room. Special ventilation for the room, if available, may be advantageous, especially for outbreak control. Neonates born to mothers with active varicella should be placed in Strict Isolation at birth. Exposed susceptible patients should be placed in Strict Isolation beginning 10 days after exposure and continuing until 21 days after last exposure. See CDC Guideline for Infection Control in Hospital Personnel for recommendations for exposed susceptible personnel.
<i>Chlamydia trachomatis</i> infection				
Conjunctivitis	Drainage/ Secretion Precautions	Purulent exudate	Duration of illness	
Genital	Drainage/ Secretion Precautions	Genital discharge	Duration of illness	
Respiratory	Drainage/ Secretion Precautions	Respiratory secretions	Duration of illness	
Cholera	Enteric Precautions	Feces	Duration of illness	
Closed-cavity infection				
Draining, limited or minor	Drainage/ Secretion Precautions	Pus	Duration of illness	Limited or minor = dressing covers and adequately contains the pus, or infected area is very small.
Not draining	None			
<i>Clostridium perfringens</i>				
Food poisoning	None			
Gas gangrene	Drainage/ Secretion Precautions	Pus	Duration of illness	
Other	Drainage/ Secretion Precautions	Pus	Duration of illness	

Table A. Category-Specific Isolation Precautions

DISEASE	CATEGORY	INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
Coccidioidomycosis (valley fever)				
Draining lesions	None	Drainage may be if spores form		
Pneumonia	None			
Colorado tick fever	Blood/Body Fluid Precautions	Blood	Duration of hospitalization	
Common cold				
Adults	None	Respiratory secretions may be		
Infants and young children	Contact Isolation	Respiratory secretions	Duration of illness	Although rhinoviruses are most frequently associated with the common cold and are mild in adults, severe infections may occur in infants and young children. Other etiologic agents, such as respiratory syncytial virus and parainfluenza viruses, may also cause this syndrome (Committee on Infectious Diseases, American Academy of Pediatrics, 1982 Red Book); therefore, precautions to prevent their spread are generally indicated.
Congenital rubella	Contact Isolation	Urine and respiratory secretions	During any admission for the 1st year after birth unless nasopharyngeal and urine cultures after 3 months of age are negative for rubella virus.	Susceptible persons should, if possible, stay out of room. Pregnant personnel may need special counseling (see CDC Guideline for Infection Control in Hospital Personnel).
Conjunctivitis, acute bacterial (sore eye, pink eye)	Drainage/ Secretion Precautions	Purulent exudate	Duration of illness	
Conjunctivitis, <i>Chlamydia</i>	Drainage/ Secretion Precautions	Purulent exudate	Duration of illness	
Conjunctivitis, gonococcal				
Adults	Drainage/ Secretion Precautions	Purulent exudate	For 24 hours after start of effective therapy	
Newborns	Contact Isolation	Purulent exudate	For 24 hours after start of effective therapy	

Table A. Category-Specific Isolation Precautions

DISEASE	CATEGORY	INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
Conjunctivitis, viral and etiology unknown (acute hemorrhagic and swimming pool conjunctivitis)	Drainage/ Secretion Precautions	Purulent exudate	Duration of illness	If patient hygiene is poor, a private room may be indicated.
Coronavirus infection, respiratory				
Adults	None	Respiratory secretions may be		
Infants and young children	Contact Isolation	Respiratory secretions	Duration of illness	
Coxsackievirus disease	Enteric Precautions	Feces and respiratory secretions	For 7 days after onset	
Creutzfeldt-Jakob disease	Blood/Body Fluid Precautions	Blood, brain tissue, and spinal fluid	Duration of hospitalization	Use caution when handling blood, brain tissue, or spinal fluid. (Jarvis WR. Precautions for Creutzfeldt-Jakob disease. Infect Control 1982; 3:238-9.)
Croup	Contact Isolation	Respiratory secretions	Duration of illness	Because viral agents, such as parainfluenza viruses and influenza A virus, have been associated with this syndrome (Committee on Infectious Diseases, American Academy of Pediatrics, 1982 Red Book), precautions to prevent their spread are generally indicated.
Cryptococcosis	None			
Cysticercosis	None			
Cytomegalovirus infection, neonatal or immunosuppressed	None	Urine and respiratory secretions may be		Pregnant personnel may need special counseling (see CDC Guideline for Infection Control in Hospital Personnel).
Decubitus ulcer, infected				
Major	Contact Isolation	Pus	Duration of illness	Major = draining and not covered by dressing or dressing does not adequately contain the pus.
Minor or limited	Drainage/ Secretion Precautions	Pus	Duration of illness	Minor or limited = dressing covers and adequately contains the pus, or infected area is very small.
Dengue	Blood/Body Fluid Precautions	Blood	Duration of hospitalization	
Diarrhea, acute—infective etiology suspected (see gastroenteritis)	Enteric Precautions	Feces	Duration of illness	

Table A. Category-Specific Isolation Precautions

DISEASE	CATEGORY	INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
Diphtheria				
Cutaneous	Contact Isolation	Lesion secretions	Until 2 cultures from skin lesions, taken at least 24 hours apart after cessation of antimicrobial therapy, are negative for <i>Corynebacterium diphtheriae</i>	
Pharyngeal	Strict Isolation	Respiratory secretions	Until 2 cultures from both nose and throat taken at least 24 hours apart after cessation of antimicrobial therapy are negative for <i>Corynebacterium diphtheriae</i>	
Echinococcosis (hydatidosis)	None			
Echovirus disease	Enteric Precautions	Feces and respiratory secretions	For 7 days after onset	
Eczema vaccinatum (vaccinia)	Contact Isolation	Lesion secretions	Duration of illness	
Encephalitis or encephalomyelitis, etiology unknown, but infection suspected (see also specific etiologic agents; likely causes include enterovirus and arthropodborne virus infections)	Enteric Precautions	Feces	Duration of illness or 7 days after onset, whichever is less	Although specific etiologic agents can include enteroviruses, arthropodborne viruses, and herpes simplex, precautions for enteroviruses are generally indicated until a definitive diagnosis can be made.
Endometritis				
Group A <i>Streptococcus</i>	Contact Isolation	Vaginal discharge	For 24 hours after start of effective therapy	
Other	Drainage/ Secretion Precautions	Vaginal discharge	Duration of illness	
Enterobiasis (pinworm disease, oxyuriasis)	None			

Table A. Category-Specific Isolation Precautions

DISEASE	CATEGORY	INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
Enterocolitis (see also necrotizing enterocolitis)				
<i>Clostridium difficile</i>	Enteric Precautions	Feces	Duration of illness	
<i>Staphylococcus</i>	Enteric Precautions	Feces	Duration of illness	
Enteroviral infection	Enteric Precautions	Feces	For 7 days after onset	
Epiglottitis, due to <i>Haemophilus influenzae</i>	Respiratory Isolation	Respiratory secretions	For 24 hours after start of effective therapy	
Epstein-Barr virus infection, any, including infectious mononucleosis	None	Respiratory secretions may be		
Erysipeloid	None			
Erythema infectiosum	Respiratory Isolation	Respiratory secretions	For 7 days after onset	
<i>Escherichia coli</i> gastroenteritis (enteropathogenic, enterotoxic, or enteroinvasive)	Enteric Precautions	Feces	Duration of hospitalization	
Fever of unknown origin (FUO)				Patients with FUO usually do not need isolation precautions; however, if a patient has signs and symptoms compatible with (and is likely to have) a disease that requires isolation precautions, use those isolation precautions for that patient.
Food poisoning				
Botulism	None			
<i>Clostridium perfringens</i> or <i>welchii</i> (food poisoning)	None			
Salmonellosis	Enteric Precautions	Feces	Duration of illness	
Staphylococcal food poisoning	None			
Furunculosis—staphylococcal				
Newborns	Contact Isolation	Pus	Duration of illness	During a nursery outbreak, cohorting of ill and colonized infants and use of gowns and gloves is recommended.
Others	Drainage/Secretion Precautions	Pus	Duration of illness	
Gangrene				
Gas gangrene (due to any bacteria)	Drainage/Secretion Precautions	Pus	Duration of illness	

Table A. Category-Specific Isolation Precautions

DISEASE	CATEGORY	INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
Gastroenteritis				
<i>Campylobacter</i> species	Enteric Precautions	Feces	Duration of illness	
<i>Clostridium difficile</i>	Enteric Precautions	Feces	Duration of illness	
<i>Cryptosporidium</i> species	Enteric Precautions	Feces	Duration of illness	
<i>Dientamoeba fragilis</i>	Enteric Precautions	Feces	Duration of illness	
<i>Escherichia coli</i> (enteropathogenic, enterotoxigenic, or enteroinvasive)	Enteric Precautions	Feces	Duration of illness	
<i>Giardia lamblia</i>	Enteric Precautions	Feces	Duration of illness	
<i>Rotavirus</i>	Enteric Precautions	Feces	Duration of illness or 7 days after onset, whichever is less	
<i>Salmonella</i> species	Enteric Precautions	Feces	Duration of illness	
<i>Shigella</i> species	Enteric Precautions	Feces	Until 3 consecutive cultures of feces taken after ending antimicrobial therapy are negative for infecting strain	
Unknown etiology	Enteric Precautions	Feces	Duration of illness	
<i>Vibrio parahaemolyticus</i>	Enteric Precautions	Feces	Duration of illness	
Viral	Enteric Precautions	Feces	Duration of illness	
<i>Yersinia enterocolitica</i>	Enteric Precautions	Feces	Duration of illness	
German measles (rubella) (see also congenital rubella)	Contact Isolation	Respiratory secretions	For 7 days after onset of rash	Persons who are not susceptible do not need to wear a mask. Susceptible persons should, if possible, stay out of room. Pregnant personnel may need special counseling (see CDC Guideline for Infection Control in Hospital Personnel).
Giardiasis	Enteric Precautions	Feces	Duration of illness	

Table A. Category-Specific Isolation Precautions

DISEASE	CATEGORY	INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
Gonococcal ophthalmia neonatorum (gonorrheal ophthalmia, acute conjunctivitis of the newborn)	Contact Isolation	Purulent exudate	For 24 hours after start of effective therapy	
Gonorrhea	None	Discharge may be		
Granulocytopenia	None			Wash hands well <i>before</i> taking care of patient (see separate section on Care of Severely Compromised Patients).
Granuloma inguinale (donovaniasis, granuloma venereum)	None	Drainage may be		
Guillain-Barré syndrome	None			
Hand, foot, and mouth disease	Enteric Precautions	Feces	For 7 days after onset	
Hemorrhagic fevers (for example, Lassa fever)	Strict Isolation	Blood, body fluids, and respiratory secretions	Duration of illness	Call the State Health Department and Centers for Disease Control for advice about management of a suspected case.
Hepatitis, viral				
Type A (infectious)	Enteric Precautions	Feces may be	For 7 days after onset of jaundice	Hepatitis A is most contagious before symptoms and jaundice appear; once these appear, small, inapparent amounts of feces, which may contaminate the hands of personnel during patient care, do not appear to be infective. Thus, gowns and gloves are most useful when gross soiling with feces is anticipated or possible.
Type B ("serum hepatitis"), including hepatitis B antigen (HBsAg) carrier	Blood/Body Fluid Precautions	Blood and body fluids	Until patient is HBsAg-negative	Use caution when handling blood and blood-soiled articles. Take special care to avoid needle-stick injuries. Pregnant personnel may need special counseling (see CDC Guideline for Infection Control in Hospital Personnel). Gowns are indicated when clothing may become contaminated with body fluids or blood (for example, when blood splattering is anticipated). If gastrointestinal bleeding is likely, wear gloves if touching feces. A private room may be indicated if profuse bleeding is likely to cause environmental contamination.
Non-A, Non-B	Blood/Body Fluid Precautions	Blood and body fluids	Duration of illness	Currently, the period of infectivity cannot be determined.
Unspecified type, consistent with viral etiology				Maintain precautions indicated for the infections that are most likely.

Table A. Category-Specific Isolation Precautions

DISEASE	CATEGORY	INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
Herpangina	Enteric Precautions	Feces	For 7 days after onset	
Herpes simplex (<i>Herpesvirus hominis</i>)				
Encephalitis	None			
Mucocutaneous, disseminated or primary, severe (skin, oral, and genital)	Contact Isolation	Lesion secretions from infected site	Duration of illness	
Mucocutaneous, recurrent (skin, oral, and genital)	Drainage/ Secretion Precautions	Lesion secretions from infected site	Until all lesions are crusted	
Neonatal (see comments for newborn with perinatal exposure)	Contact Isolation	Lesion secretions	Duration of illness	The same isolation precautions are indicated for infants delivered (either vaginally or by cesarean section if membranes have been ruptured for more than 4-6 hours) to women with active genital herpes simplex infections. Infants delivered by cesarean section to women with active genital herpes simplex infections before and probably within 4-6 hours after membrane rupture are at minimal risk of developing herpes simplex infection; the same isolation precautions may still be indicated, however. (American Academy of Pediatrics Committee on Fetus and Newborn. Perinatal herpes simplex virus infections. <i>Pediatrics</i> 1980; 66:147-9. Also: Kibrick S, Herpes simplex infection at term. <i>JAMA</i> 1980; 243:157-60.)
Herpes zoster (varicella-zoster)				
Localized in immunocompromised patient, or disseminated	Strict Isolation	Lesion secretions and possibly respiratory secretions	Duration of illness	Localized lesions in immunocompromised patients frequently become disseminated. Because such dissemination is unpredictable, use the same isolation precautions as for disseminated disease. Persons who are not susceptible do not need to wear a mask. Persons susceptible to varicella-zoster (chickenpox) should, if possible, stay out of room. Special ventilation for the room, if available, may be advantageous, especially for outbreak control. Exposed susceptible patients should be placed in Strict Isolation beginning 10 days after exposure and continuing until 21 days after last exposure. See CDC Guideline for Infection Control in Hospital Personnel for recommendations for exposed susceptible personnel.

Table A. Category-Specific Isolation Precautions

DISEASE	CATEGORY	INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
Herpes-zoster (cont.) Localized in normal patient	Drainage/ Secretion Precautions	Lesion secretions	Until all lesions are crusted	Persons susceptible to varicella-zoster (chickenpox) should, if possible, stay out of room. Roommates should not be susceptible to chickenpox. If patient hygiene is poor, a private room may be indicated.
Histoplasmosis at any site	None			
Hookworm disease (ancylostomiasis, uncinariasis)	None			
Immunocompromised status	None			Wash hands well <i>before</i> taking care of patients (see separate section on Care of Severely Compromised Patients).
Impetigo	Contact Isolation	Lesions	For 24 hours after start of effective therapy	
Infectious mononucleosis	None	Respiratory secretions may be		
Influenza Adults	None	Respiratory secretions may be		In the absence of an epidemic, influenza may be difficult to diagnose on clinical grounds. Most patients will have fully recovered by the time laboratory diagnosis is established; therefore, placing patients with suspect influenza on isolation precautions, although theoretically desirable, is simply not practical in most hospitals. During epidemics, the accuracy of clinical diagnosis increases, and patients believed to have influenza may be placed in the same room (cohorting). Amantadine prophylaxis may be useful to prevent symptomatic influenza A infections in high-risk patients during epidemics.
Infants and young children	Contact Isolation	Respiratory secretions	Duration of illness	In the absence of an epidemic, influenza may be difficult to diagnose. During epidemics, patients believed to have influenza may be placed in the same room (cohorting).
Jakob-Creutzfeldt disease	Blood/Body Fluid Precautions	Blood, brain tissue, and spinal fluid	Duration of hospitalization	Use caution when handling blood, brain tissue, or spinal fluid. (Jarvis WR, Precautions for Creutzfeldt-Jakob disease. Infect Control 1982; 3:238-9.)
Kawasaki syndrome	None			
Keratoconjunctivitis, infective	Drainage/ Secretion Precautions	Purulent exudate	Duration of illness	If patient hygiene is poor, a private room may be indicated.

Table A. Category-Specific Isolation Precautions

DISEASE	CATEGORY	INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
Lassa fever	Strict Isolation	Blood, body fluids, and respiratory secretions	Duration of illness	Call the State Health Department and Centers for Disease Control for advice about management of a suspected case.
Legionnaires disease	None	Respiratory secretions may be		
Leprosy	None			
Leptospirosis	Blood/Body Fluid Precautions	Blood and urine	Duration of hospitalization	
Listeriosis	None			
Lyme disease	None			
Lymphocytic choriomeningitis	None			
Lymphogranuloma venereum	None	Drainage may be		
Malaria	Blood/Body Fluid Precautions	Blood	Duration of illness	
Marburg virus disease	Strict Isolation	Blood, body fluids, and respiratory secretions	Duration of illness	Call the State Health Department and Centers for Disease Control for advice about management of a suspected case.
Measles (rubeola), all presentations	Respiratory Isolation	Respiratory secretions	For 4 days after start of rash, except in immunocompromised patients, with whom precautions should be maintained for duration of illness	Persons who are not susceptible do not need to wear a mask. Susceptible persons should, if possible, stay out of room.
Melioidosis, all forms	None	Respiratory secretions may be, and, if a sinus is draining, drainage may be		
Meningitis				
Aseptic (nonbacterial or viral meningitis) (also see specific etiologies)	Enteric Precautions	Feces	For 7 days after onset	Enteroviruses are the most common cause of aseptic meningitis.
Bacterial, gram-negative enteric, in neonates	None	Feces may be		During a nursery outbreak, cohort ill and colonized infants, and use gowns if soiling is likely and gloves if touching feces.

Table A. Category-Specific Isolation Precautions

DISEASE	CATEGORY	INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
Meningitis (cont.)				
Fungal	None			
<i>Haemophilus influenzae</i> , known or suspected	Respiratory Isolation	Respiratory secretions	For 24 hours after start of effective therapy	
<i>Listeria monocytogenes</i>	None			
<i>Neisseria meningitidis</i> (meningococcal), known or suspected	Respiratory Isolation	Respiratory secretions	For 24 hours after start of effective therapy	See CDC Guideline for Infection Control in Hospital Personnel for recommendations for prophylaxis after exposure.
Pneumococcal	None			
Tuberculous	None			Patient should be examined for evidence of current (active) pulmonary tuberculosis. If present, precautions are necessary (see tuberculosis).
Other diagnosed bacterial	None			
Meningococcal pneumonia	Respiratory Isolation	Respiratory secretions	For 24 hours after start of effective therapy	See CDC Guideline for Infection Control in Hospital Personnel for recommendations for prophylaxis after exposure.
Meningococemia (meningococcal sepsis)	Respiratory Isolation	Respiratory secretions	For 24 hours after start of effective therapy	See CDC Guideline for Infection Control in Hospital Personnel for recommendations for prophylaxis after exposure.
<i>Molluscum contagiosum</i>	None			
Mucormycosis	None			
Multiply-resistant organisms,* infection or colonization†				
Gastrointestinal	Contact Isolation	Feces	Until off antimicrobials and culture-negative	In outbreaks, cohorting of infected and colonized patients may be indicated if private rooms are not available.
Respiratory	Contact Isolation	Respiratory secretions and possibly feces	Until off antimicrobials and culture-negative	In outbreaks, cohorting of infected and colonized patients may be indicated if private rooms are not available.
Skin, Wound, or Burn	Contact Isolation	Pus and possibly feces	Until off antimicrobials and culture-negative	In outbreaks, cohorting of infected and colonized patients may be indicated if private rooms are not available.

*The following multiply-resistant organisms are included:

- 1) Gram-negative bacilli resistant to all aminoglycosides that are tested. (In general, such organisms should be resistant to gentamicin, tobramycin, and amikacin for these special precautions to be indicated.)
- 2) *Staphylococcus aureus* resistant to methicillin (or nafcillin or oxacillin if they are used instead of methicillin for testing).
- 3) *Pneumococcus* resistant to penicillin.
- 4) *Haemophilus influenzae* resistant to ampicillin (beta-lactamase positive) and chloramphenicol.
- 5) Other resistant bacteria may be included if they are judged by the infection control team to be of special clinical and epidemiologic significance.

†Colonization may involve more than 1 site.

Table A. Category-Specific Isolation Precautions

DISEASE	CATEGORY	INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
Multiply-resistant organisms (cont.) Urinary	Contact Isolation	Urine and possibly feces	Until off antimicrobials and culture-negative	Urine and urine-measuring devices are sources of infection, especially if the patient (or any nearby patients) has indwelling urinary catheter. In outbreaks, cohorting of infected and colonized patients may be indicated if private rooms are not available.
Mumps (infectious parotitis)	Respiratory Isolation	Respiratory secretions	For 9 days after onset of swelling	Persons who are not susceptible do not need to wear a mask.
Mycobacteria, nontuberculous (atypical)				
Pulmonary	None			
Wound	Drainage/ Secretion Precautions	Drainage may be	Duration of drainage	
<i>Mycoplasma pneumoniae</i>	None	Respiratory secretions may be		A private room may be indicated for children.
Necrotizing enterocolitis	Enteric Precautions	Feces may be	Duration of illness	In nurseries, cohorting of ill infants is recommended. It is not known whether or how this disease is transmitted; nevertheless, gowns are recommended if soiling is likely, and gloves are recommended for touching feces.
Neutropenia	None			Wash hands well <i>before</i> taking care of patient (see separate section on Care of Severely Compromised Patients).
Nocardiosis				
Draining lesions	None	Drainage may be		
Other	None			
Norwalk agent gastroenteritis	Enteric Precautions	Feces	Duration of illness	
Orf	None	Drainage may be		
Parainfluenza virus infection, respiratory in infants and young children	Contact Isolation	Respiratory secretions	Duration of illness	During epidemics, patients believed to have parainfluenza virus infection may be placed in the same room (cohorting).
Pediculosis	Contact Isolation	Infested area	For 24 hours after start of effective therapy	Masks are not needed.
Pertussis ("whooping cough")	Respiratory Isolation	Respiratory secretions	For 7 days after start of effective therapy	See CDC Guideline for Infection Control in Hospital Personnel for recommendations for prophylaxis after exposure.

Table A. Category-Specific Isolation Precautions

DISEASE	CATEGORY	INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
Pharyngitis, infective, etiology unknown				
Adults	None	Respiratory secretions may be		
Infants and young children	Contact Isolation	Respiratory secretions	Duration of illness	Because adenoviruses, influenza viruses, and parainfluenza viruses have been associated with this syndrome (Committee on Infectious Diseases, American Academy of Pediatrics, 1982 Red Book), precautions to prevent their spread are generally indicated.
Pinworm infection	None			
Plague				
Bubonic	Drainage/ Secretion Precautions	Pus	For 3 days after start of effective therapy	
Pneumonic	Strict Isolation	Respiratory secretions	For 3 days after start of effective therapy	
Pleurodynia	Enteric Precautions	Feces	For 7 days after onset	Enteroviruses frequently cause infection.
Pneumonia				
Bacterial not listed elsewhere (including gram-negative bacterial)	None	Respiratory secretions may be		
<i>Chlamydia</i>	Drainage/ Secretion Precautions	Respiratory secretions	Duration of illness	
Etiology unknown				Maintain precautions indicated for the etiology that is most likely.
Fungal				
<i>Haemophilus influenzae</i>				
Adults	None	Respiratory secretions may be		
Infants and children (any age)	Respiratory Isolation	Respiratory secretions	For 24 hours after start of effective therapy	
<i>Legionella</i>	None	Respiratory secretions may be		

Table A. Category-Specific Isolation Precautions

DISEASE	CATEGORY	INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
Pneumonia (cont.)				
Meningococcal	Respiratory Isolation	Respiratory secretions	For 24 hours after start of effective therapy	See CDC Guideline for Infection Control in Hospital Personnel for recommendations for prophylaxis after exposure.
Multiply-resistant bacterial	Contact Isolation	Respiratory secretions and possibly feces	Until off antimicrobials and culture-negative	In outbreaks, cohorting of infected and colonized patients may be necessary if private rooms are not available.
<i>Mycoplasma</i> (primary atypical pneumonia, Eaton agent pneumonia)	None	Respiratory secretions may be		A private room may be useful for children.
Pneumococcal	None	Respiratory secretions may be for 24 hours after start of effective therapy		
<i>Pneumocystis carinii</i>	None			
<i>Staphylococcus aureus</i>	Contact Isolation	Respiratory secretions	For 48 hours after start of effective therapy	
<i>Streptococcus</i> , group A	Contact Isolation	Respiratory secretions	For 24 hours after start of effective therapy	
Viral (see also specific etiologic agents)				
Adults	None	Respiratory secretions may be		
Infants and young children	Contact Isolation	Respiratory secretions	Duration of illness	Viral pneumonia may be caused by various etiologic agents, such as parainfluenza viruses, influenza viruses, and particularly, respiratory syncytial virus, in children less than 5 years old (Committee on Infectious Diseases, American Academy of Pediatrics, 1982 Red Book); therefore, precautions to prevent their spread are generally indicated.
Poliomyelitis	Enteric Precautions	Feces	For 7 days after onset	
Psittacosis (ornithosis)	None	Respiratory secretions may be		
Q fever	None	Respiratory secretions may be		

Table A. Category-Specific Isolation Precautions

DISEASE	CATEGORY	INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
Rabies	Contact Isolation	Respiratory secretions	Duration of illness	See CDC Guideline for Infection Control in Hospital Personnel for recommendations for prophylaxis after exposure.
Rat-bite fever (<i>Streptobacillus moniliformis</i> disease, <i>Spirillum minus</i> disease)	Blood/Body Fluid Precautions	Blood	For 24 hours after start of effective therapy	
Relapsing fever	Blood/Body Fluid Precautions	Blood	Duration of illness	
Resistant bacterial (see multiply-resistant bacteria)				
Respiratory infectious disease, acute (if not covered elsewhere)				
Adults	None	Respiratory secretions may be		
Infants and young children				Maintain precautions for the bacterial or viral infections that are most likely.
Respiratory syncytial virus (RSV) infection, in infants and young children	Contact Isolation	Respiratory secretions	Duration of illness	During epidemics, patients believed to have RSV infection may be placed in the same room (cohorting).
Reye syndrome	None			
Rheumatic fever	None			
Rhinovirus infection, respiratory				
Adults	None	Respiratory secretions may be		
Infants and young children	Contact Isolation	Respiratory secretions	Duration of illness	
Rickettsial fevers, tickborne (Rocky Mountain spotted fever, tickborne typhus fever)	None	Blood may be		
Rickettsialpox (vesicular rickettsiosis)	None			
Ringworm (dermatophytosis, dermatomycosis, tinea)	None			
Ritter's disease (staphylococcal scalded skin syndrome)	Contact Isolation	Lesion drainage	Duration of illness	
Rocky Mountain spotted fever	None	Blood may be		
Roseola infantum (exanthem subitum)	None			
Rotavirus infection (viral gastroenteritis)	Enteric Precautions	Feces	Duration of illness or 7 days after onset, whichever is less	

Table A. Category-Specific Isolation Precautions

DISEASE	CATEGORY	INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
Rubella ("German measles") (see also congenital rubella)	Contact Isolation	Respiratory secretions	For 7 days after onset of rash	Persons who are not susceptible do not need to wear a mask. Susceptible persons should, if possible, stay out of room. Pregnant personnel may need special counseling (see CDC Guideline for Infection Control in Hospital Personnel).
Salmonellosis	Enteric Precautions	Feces	Duration of illness	
Scabies	Contact Isolation	Infested area	For 24 hours after start of effective therapy	Masks are not needed.
Scalded skin syndrome, staphylococcal (Ritter's disease)	Contact Isolation	Lesion drainage	Duration of illness	
Schistosomiasis (bilharziasis)	None			
Shigellosis (including bacillary dysentery)	Enteric Precautions	Feces	Until 3 consecutive cultures of feces, taken after ending antimicrobial therapy, are negative for infecting strain	
Smallpox (variola)	Strict Isolation	Respiratory secretions and lesion secretions	Duration of illness	As long as smallpox virus is kept stocked in laboratories, the potential exists for cases to occur. Call the State Health Department and Centers for Disease Control for advice about management of a suspected case.
<i>Spirillum minus</i> disease (rat-bite fever)	Blood/Body Fluid Precautions	Blood	For 24 hours after start of effective therapy	
Sporotrichosis	None			
Staphylococcal disease (<i>S. aureus</i>)				
Skin, wound, or burn infection				
Major	Contact Isolation	Pus	Duration of illness	Major = draining and not covered by dressing or dressing does not adequately contain the pus.
Minor or limited	Drainage/ Secretion Precautions	Pus	Duration of illness	Minor or limited = dressing covers and adequately contains the pus, or infected area is very small.
Enterocolitis	Enteric Precautions	Feces	Duration of illness	

Table A. Category-Specific Isolation Precautions

DISEASE	CATEGORY	INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
Staphylococcal disease (cont.)				
Pneumonia or draining lung abscess	Contact Isolation	Respiratory secretions	For 48 hours after start of effective therapy	
Scalded skin syndrome	Contact Isolation	Lesion drainage	Duration of illness	
Toxic shock syndrome	Drainage/ Secretion Precautions	Vaginal discharge or pus	Duration of illness	
<i>Streptobacillus moniliformis</i> disease (rat-bite fever)	Blood/Body Fluid Precautions	Blood	For 24 hours after start of effective therapy	
Streptococcal disease (group A <i>Streptococcus</i>)				
Skin, wound, or burn infection				
Major	Contact Isolation	Pus	For 24 hours after start of effective therapy	Major = draining and not covered by dressing or dressing does not adequately contain the pus.
Minor or limited	Drainage/ Secretion Precautions	Pus	For 24 hours after start of effective therapy	Minor or limited = dressing covers and adequately contains the pus. or infected area is very small.
Endometritis (puerperal sepsis)	Contact Isolation	Vaginal discharge	For 24 hours after start of effective therapy	
Pharyngitis	Drainage/ Secretion Precautions	Respiratory secretions	For 24 hours after start of effective therapy	
Pneumonia	Contact Isolation	Respiratory secretions	For 24 hours after start of effective therapy	
Scarlet fever	Drainage/ Secretion Precautions	Respiratory secretions	For 24 hours after start of effective therapy	
Streptococcal disease (group B <i>Streptococcus</i>), neonatal	None	Feces may be		During a nursery outbreak, cohorting of ill and colonized infants and use of gowns and gloves is recommended.
Streptococcal disease (not group A or B) unless covered elsewhere	None			

Table A. Category-Specific Isolation Precautions

DISEASE	CATEGORY	INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
Strongyloidiasis	None	Feces may be		If patient is immunocompromised and has pneumonia or has disseminated disease, respiratory secretions may be infective.
Syphilis				
Skin and mucous membrane, including congenital, primary, and secondary	Drainage/ Secretion Precautions, Blood/Body Fluid Precautions	Lesion secretions and blood	For 24 hours after start of effective therapy	Skin lesions of primary and secondary syphilis may be highly infective.
Latent (tertiary) and seropositivity without lesions	None			
Tapeworm disease				
<i>Hymenolepis nana</i>	None	Feces may be		
<i>Taenia solium</i> (pork)	None	Feces may be		
Other	None			
Tetanus	None			
Tinea (fungus infection, dermatophytosis, dermatomycosis, ringworm)	None			
“TORCH” syndrome (If congenital forms of the following diseases are seriously being considered, see separate listing for these diseases: toxoplasmosis, rubella, cytomegalovirus, herpes, and syphilis.)				
Toxic shock syndrome (staphylococcal disease)	Drainage/ Secretion Precautions	Vaginal discharge and pus	Duration of illness	
Toxoplasmosis	None			
Trachoma, acute	Drainage/ Secretion Precautions	Purulent exudate	Duration of illness	
Trench mouth (Vincent’s angina)	None			
Trichinosis	None			
Trichomoniasis	None			
Trichuriasis (whipworm disease)	None			
Tuberculosis				
Extrapulmonary, draining lesion (including scrofula)	Drainage/ Secretion Precautions	Pus	Duration of drainage	A private room is especially important for children.
Extrapulmonary, meningitis	None			

Table A. Category-Specific Isolation Precautions

DISEASE	CATEGORY	INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
Tuberculosis (cont.)				
Pulmonary, confirmed or suspected (sputum smear is positive or chest X-ray appearance strongly suggests current [active] TB, for example, a cavitory lesion is found), or laryngeal disease.	Tuberculosis Isolation (AFB Isolation)	Airborne droplet nuclei	In most instances the duration of isolation precautions can be guided by clinical response and a reduction in numbers of TB organisms on sputum smear. Usually this occurs within 2-3 weeks after chemotherapy is begun. When the patient is likely to be infected with isoniazid-resistant organisms, apply precautions until patient is improving and sputum smear is negative for TB organisms.	Prompt use of effective antituberculous drugs is the most effective means of limiting transmission. Gowns are not important because TB is rarely spread by fomites, although gowns are indicated to prevent gross contamination of clothing. For more detailed guidelines refer to "Guidelines for Prevention of TB Transmission in Hospitals" (1982), Tuberculosis Control Division, Center for Prevention Services, Centers for Disease Control, Atlanta, GA (HHS Publication No. [CDC] 82-8371) and CDC Guideline for Infection Control in Hospital Personnel. In general, infants and young children do not require isolation precautions because they rarely cough and their bronchial secretions contain few TB organisms compared to adults with pulmonary TB.
Skin-test positive with no evidence of current pulmonary disease (sputum smear is negative, X-ray not suggestive of current [active] disease)	None			
Tularemia				
Draining lesion	Drainage/ Secretion Precautions	Pus may be	Duration of illness	
Pulmonary	None	Respiratory secretions may be		
Typhoid fever				
	Enteric Precautions	Feces	Duration of illness	
Typhus, endemic and epidemic				
	None	Blood may be		
Urinary tract infection (including pyelonephritis), with or without urinary catheter				
	None			See multiply-resistant bacteria if infection is with these bacteria. Spatially separate infected and uninfected patients who have indwelling catheters (see CDC Guideline for Prevention of Catheter-associated Urinary Tract Infection).

Table A. Category-Specific Isolation Precautions

DISEASE	CATEGORY	INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
Vaccinia				
At vaccination site	Drainage/ Secretion Precautions	Lesion secretions	Duration of illness	
Generalized and progressive, eczema vaccinatum	Contact Isolation	Lesion secretions	Duration of illness	
Varicella (chickenpox)	Strict Isolation	Respiratory secretions and lesion secretions	Until all lesions are crusted	Persons who are not susceptible do not need to wear a mask. Susceptible persons should, if possible, stay out of the room. Special ventilation for the room, if available, may be advantageous, especially for outbreak control. Neonates born to mothers with active varicella should be placed in Strict Isolation at birth. Exposed susceptible patients should be placed in Strict Isolation beginning 10 days after exposure and continuing until 21 days after last exposure. See CDC Guideline for Infection Control in Hospital Personnel for recommendations for exposed susceptible personnel.
Variola (smallpox)	Strict Isolation	Respiratory secretions and lesion secretions	Duration of illness	Call the State Health Department and Centers for Disease Control for advice about management of a suspected case.
<i>Vibrio parahaemolyticus</i> gastroenteritis	Enteric Precautions	Feces	Duration of illness	
Vincent's angina (trench mouth)	None			
Viral diseases				
Pericarditis, myocarditis, or meningitis	Enteric Precautions	Feces and possibly respiratory secretions	For 7 days after onset	Enteroviruses frequently cause these infections.
Respiratory (if not covered elsewhere)				
Adults	None	Respiratory secretions may be		
Infants and young children	Contact Isolation	Respiratory secretions	Duration of illness	Various etiologic agents, such as respiratory syncytial virus, parainfluenza viruses, adenoviruses, and, influenza viruses, can cause viral respiratory infections (Committee on Infectious Diseases, American Academy of Pediatrics, 1982 Red Book); therefore, precautions to prevent their spread are generally indicated.

Table A. Category-Specific Isolation Precautions

DISEASE	CATEGORY	INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
Whooping cough (pertussis)	Respiratory Isolation	Respiratory secretions	For 7 days after start of effective therapy	See CDC Guideline for Infection Control in Hospital Personnel for recommendations for prophylaxis after exposure.
Wound infections				
Major	Contact Isolation	Pus	Duration of illness	Major = draining and not covered by dressing or dressing does not adequately contain the pus.
Minor or limited	Drainage/ Secretion Precautions	Pus	Duration of illness	Minor or limited = dressing covers and adequately contains the pus, or infected area is very small, such as a stitch abscess.
<i>Yersinia enterocolitica</i> gastroenteritis	Enteric Precautions	Feces	Duration of illness	
Zoster (varicella-zoster)				
Localized in immunocompromised patient, or disseminated	Strict Isolation	Lesion secretions	Duration of illness	Localized lesions in immunocompromised patients frequently become disseminated. Because such dissemination is unpredictable, use the same isolation precautions as with disseminated disease. Persons who are not susceptible do not need to wear a mask. Persons susceptible to varicella-zoster (chickenpox) should, if possible, stay out of the room. Special ventilation for room, if available, may be advantageous, especially for outbreak control. Exposed susceptible patients should be placed in Strict Isolation beginning 10 days after exposure and continuing until 21 days after last exposure. See CDC Guideline for Infection Control in Hospital Personnel for recommendations for exposed susceptible personnel.
Localized in normal patient	Drainage/ Secretion Precautions	Lesion secretions	Until all lesions are crusted	Persons susceptible to varicella-zoster (chickenpox) should, if possible, stay out of room. Roommates should not be susceptible to chickenpox.
Zygomycosis (phycomycosis, mucormycosis)	None			

Instruction Cards for Category-Specific Isolation Precautions

Instruction cards have been designed to give concise information about category-specific isolation precautions, and samples are shown on the following pages. The specific isolation

precautions indicated for each category of isolation are listed on the front and back of a color-coded card. Cards should be displayed conspicuously in the immediate vicinity of the patient on isolation precautions (on the door, foot or head of bed, etc.). A duplicate card may also be attached to the front of the patient's chart.

(Front of Card)

Strict Isolation

Visitors—Report to Nurses' Station Before Entering Room

1. Masks are indicated for all persons entering room.
2. Gowns are indicated for all persons entering room.
3. Gloves are indicated for all persons entering room.
4. **HANDS MUST BE WASHED AFTER TOUCHING THE PATIENT OR POTENTIALLY CONTAMINATED ARTICLES AND BEFORE TAKING CARE OF ANOTHER PATIENT.**
5. Articles contaminated with infective material should be discarded or bagged and labeled before being sent for decontamination and reprocessing.

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Diseases Requiring Strict Isolation*

Diphtheria, pharyngeal

Lassa fever and other viral hemorrhagic fevers, such as Marburg virus disease§

Plague, pneumonic

Smallpox§

Varicella (chickenpox)

Zoster, localized in immunocompromised patient, or disseminated

*A private room is indicated for Strict Isolation; in general, however, patients infected with the same organism may share a room. See Guideline for Isolation Precautions in Hospitals for details and for how long to apply precautions.

§A private room with special ventilation is indicated.

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Contact Isolation

Visitors—Report to Nurses' Station Before Entering Room

1. Masks are indicated for those who come close to patient.
2. Gowns are indicated if soiling is likely.
3. Gloves are indicated for touching infective material.
4. **HANDS MUST BE WASHED AFTER TOUCHING THE PATIENT OR POTENTIALLY CONTAMINATED ARTICLES AND BEFORE TAKING CARE OF ANOTHER PATIENT.**
5. Articles contaminated with infective material should be discarded or bagged and labeled before being sent for decontamination and reprocessing.

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Diseases or Conditions Requiring Contact Isolation*

Acute respiratory infections in infants and young children, including croup, colds, bronchitis, and bronchiolitis caused by respiratory syncytial virus, adenovirus, coronavirus, influenza viruses, parainfluenza viruses, and rhinovirus

Conjunctivitis, gonococcal, in newborns

Diphtheria, cutaneous

Endometritis, group A *Streptococcus*

Furunculosis, staphylococcal, in newborns

Herpes simplex, disseminated, severe primary or neonatal

Impetigo

Influenza, in infants and young children

Multiply-resistant bacteria, infection or colonization (any site) with any of the following:

1. Gram-negative bacilli resistant to all aminoglycosides that are tested. (In general, such organisms should be resistant to gentamicin, tobramycin, and amikacin for these special precautions to be indicated.)
2. *Staphylococcus aureus* resistant to methicillin (or nafcillin or oxacillin if they are used instead of methicillin for testing)

3. *Pneumococcus* resistant to penicillin

4. *Haemophilus influenzae* resistant to ampicillin (beta-lactamase positive) and chloramphenicol

5. Other resistant bacteria may be included in this isolation category if they are judged by the infection control team to be of special clinical and epidemiologic significance.

Pediculosis

Pharyngitis, infectious, in infants and young children

Pneumonia, viral, in infants and young children

Pneumonia, *Staphylococcus aureus* or group A *Streptococcus*

Rabies

Rubella, congenital and other

Scabies

Scalded skin syndrome (Ritter's disease)

Skin, wound, or burn infection, major (draining and not covered by a dressing or dressing does not adequately contain the purulent material), including those infected with

Staphylococcus aureus or group A *Streptococcus*

Vaccinia (generalized and progressive eczema vaccinatum)

*A private room is indicated for Contact Isolation; in general, however, patients infected with the same organism may share a room. During outbreaks, infants and young children with the same respiratory clinical syndrome may share a room. See Guideline for Isolation Precautions in Hospitals for details and for how long to apply precautions.

(Front of Card)

Respiratory Isolation

Visitors—Report to Nurses' Station Before Entering Room

1. Masks are indicated for those who come close to patient.
2. Gowns are not indicated.
3. Gloves are not indicated.
4. **HANDS MUST BE WASHED AFTER TOUCHING THE PATIENT OR POTENTIALLY CONTAMINATED ARTICLES AND BEFORE TAKING CARE OF ANOTHER PATIENT.**
5. Articles contaminated with infective material should be discarded or bagged and labeled before being sent for decontamination and reprocessing.

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Diseases Requiring Respiratory Isolation*

Epiglottitis, *Haemophilus influenzae*
Erythema infectiosum
Measles
Meningitis
 Haemophilus influenzae, known or suspected
 Meningococcal, known or suspected
Meningococcal pneumonia
Meningococemia
Mumps
Pertussis (whooping cough)
Pneumonia, *Haemophilus influenzae*, in children (any age)

*A private room is indicated for Respiratory Isolation; in general, however, patients infected with the same organism may share a room. See Guideline for Isolation Precautions in Hospitals for details and for how long to apply precautions.

(Front of Card)

AFB Isolation

Visitors—Report to Nurses' Station Before Entering Room

1. Masks are indicated only when patient is coughing and does not reliably cover mouth.
2. Gowns are indicated only if needed to prevent gross contamination of clothing.
3. Gloves are not indicated.
4. **HANDS MUST BE WASHED AFTER TOUCHING THE PATIENT OR POTENTIALLY CONTAMINATED ARTICLES AND BEFORE TAKING CARE OF ANOTHER PATIENT.**
5. Articles should be discarded, cleaned, or sent for decontamination and reprocessing.

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Diseases Requiring AFB Isolation*

This isolation category is for patients with current pulmonary TB who have a positive sputum smear or a chest X-ray appearance that strongly suggests current (active) TB. Laryngeal TB is also included in this category. In general, infants and young children with pulmonary TB do not require isolation precautions because they rarely cough and their bronchial secretions contain few AFB compared with adults with pulmonary TB. To protect the patient's privacy, this instruction card is labeled AFB (acid-fast bacilli) Isolation rather than Tuberculosis Isolation.

*A private room with special ventilation is indicated for AFB isolation. In general, patients infected with the same organism may share a room. See Guideline for Isolation Precautions in Hospitals for details and for how long to apply precautions.

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Enteric Precautions

Visitors—Report to Nurses' Station Before Entering Room

1. Masks are not indicated.
2. Gowns are indicated if soiling is likely.
3. Gloves are indicated for touching infective material.
4. **HANDS MUST BE WASHED AFTER TOUCHING THE PATIENT OR POTENTIALLY CONTAMINATED ARTICLES AND BEFORE TAKING CARE OF ANOTHER PATIENT.**
5. Articles contaminated with infective material should be discarded or bagged and labeled before being sent for decontamination and reprocessing.

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Diseases Requiring Enteric Precautions*

Amebic dysentery
Cholera
Coxsackievirus disease
Diarrhea, acute illness with suspected infectious etiology
Echovirus disease
Encephalitis (unless known not to be caused by enteroviruses)
Enterocolitis caused by *Clostridium difficile* or *Staphylococcus aureus*
Enteroviral infection
Gastroenteritis caused by
 Campylobacter species
 Cryptosporidium species
 Dientamoeba fragilis
 Escherichia coli (enterotoxigenic, enteropathogenic, or enteroinvasive)
 Giardia lamblia
 Salmonella species

Shigella species
Vibrio parahaemolyticus
Viruses—including Norwalk agent and rotavirus
Yersinia enterocolitica
Unknown etiology but presumed to be an infectious agent
Hand, foot, and mouth disease
Hepatitis, viral, type A
Herpangina
Meningitis, viral (unless known not to be caused by enteroviruses)
Necrotizing enterocolitis
Pleurodynia
Poliomyelitis
Typhoid fever (*Salmonella typhi*)
Viral pericarditis, myocarditis, or meningitis (unless known not to be caused by enteroviruses)

*A private room is indicated for Enteric Precautions if patient hygiene is poor. A patient with poor hygiene does not wash hands after touching infective material, contaminates the environment with infective material, or shares contaminated articles with other patients. In general, patients infected with the same organism may share a room. See Guideline for Isolation Precautions in Hospitals for details and for how long to apply precautions.

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Drainage/Secretion Precautions

Visitors—Report to Nurses' Station Before Entering Room

1. Masks are not indicated.
2. Gowns are indicated if soiling is likely.
3. Gloves are indicated for touching infective material.
4. **HANDS MUST BE WASHED AFTER TOUCHING THE PATIENT OR POTENTIALLY CONTAMINATED ARTICLES AND BEFORE TAKING CARE OF ANOTHER PATIENT.**
5. Articles contaminated with infective material should be discarded or bagged and labeled before being sent for decontamination and reprocessing.

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Diseases Requiring Drainage/Secretion Precautions*

Infectious diseases included in this category are those that result in production of infective purulent material, drainage, or secretions, unless the disease is included in another isolation category that requires more rigorous precautions. (If you have questions about a specific disease, see the listing of infectious diseases in Guideline for Isolation Precautions in Hospitals, Table A, Disease-Specific Isolation Precautions.)

The following infections are examples of those included in this category provided they are *not* a) caused by multiply-resistant microorganisms, b) major (draining and not covered by a dressing or dressing does not adequately contain the drainage) skin, wound, or burn infections, including those caused by *Staphylococcus aureus* or group A *Streptococcus*, or c) gonococcal eye infections in newborns. See Contact Isolation if the infection is one of these 3.

Abscess, minor or limited

Burn infection, minor or limited

Conjunctivitis

Decubitus ulcer, infected, minor or limited

Skin infection, minor or limited

Wound infection, minor or limited

*A private room is usually not indicated for Drainage/Secretion Precautions. See Guideline for Isolation Precautions in Hospitals for details and for how long to apply precautions.

(Front of Card)

Blood/Body Fluid Precautions

Visitors—Report to Nurses' Station Before Entering Room

1. Masks are not indicated.
2. Gowns are indicated if soiling with blood or body fluids is likely.
3. Gloves are indicated for touching blood or body fluids.
4. **HANDS SHOULD BE WASHED IMMEDIATELY IF THEY ARE POTENTIALLY CONTAMINATED WITH BLOOD OR BODY FLUIDS AND BEFORE TAKING CARE OF ANOTHER PATIENT.**
5. Articles contaminated with blood or body fluids should be discarded or bagged and labeled before being sent for decontamination and reprocessing.
6. Care should be taken to avoid needle-stick injuries. Used needles should not be recapped or bent; they should be placed in a prominently labeled, puncture-resistant container designated specifically for such disposal.
7. Blood spills should be cleaned up promptly with a solution of 5.25% sodium hypochlorite diluted 1:10 with water.

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Diseases Requiring Blood/Body Fluid Precautions*

Acquired immunodeficiency syndrome (AIDS)
Arthropodborne viral fevers (for example, dengue, yellow fever, and Colorado tick fever)
Babesiosis
Creutzfeldt-Jakob disease
Hepatitis B (including HBsAg antigen carrier)
Hepatitis, non-A, non-B
Leptospirosis
Malaria
Rat-bite fever
Relapsing fever
Syphilis, primary and secondary with skin and mucous membrane lesions

*A private room is indicated for Blood/Body Fluid Precautions if patient hygiene is poor. A patient with poor hygiene does not wash hands after touching infective material, contaminates the environment with infective material, or shares contaminated articles with other patients. In general, patients infected with the same organism may share a room. See Guideline for Isolation Precautions in Hospitals for details and for how long to apply precautions.

SYSTEM B. DISEASE-SPECIFIC ISOLATION PRECAUTIONS

Disease-specific isolation precautions are 1 of 2 isolation systems recommended by CDC. Again, we emphasize that hospitals should choose either disease-specific or category-specific isolation recommendations: elements of both cannot easily be combined. With disease-specific isolation precautions, each infectious disease is considered individually so that only those precautions (private room, masks, gowns, and gloves) that are indicated to interrupt transmission for that disease are recommended. The theoretical advantage of using disease-specific isolation precautions rather than the alternative isolation system (category-specific isolation precautions) is saving of supplies and expense. Moreover, the excessive donning of masks, gowns, and gloves, when unnecessary, wastes time, is inconvenient, and may discourage hospital personnel from properly taking care of such patients. Furthermore, personnel may comply more fully with the disease-specific isolation precautions than with the category-specific precautions, especially physicians who are knowledgeable about modes of disease transmission. On the other hand, isolation precautions are often most important early in a patient's stay, before specific therapy has been begun, and before a diagnosis is confirmed. In such situations, category-specific precautions, which are more general, may be more practical and easier to implement.

The particular isolation precautions indicated for each disease are listed in Table B, Disease-Specific Isolation Precautions.

TABLE B. Disease-Specific Isolation Precautions

Table B, Disease-Specific Isolation Precautions lists most of the common infectious agents and diseases that are likely to be found in U.S. hospitals and the specific isolation precautions indicated for each. Diseases are listed alphabetically in several ways: by anatomical site or syndrome (abscess, burn wound, cellulitis, etc.), by etiologic agent (*Chlamydia trachomatis*, *Clostridium perfringens*, *Escherichia coli*, etc.) and sometimes by a combination of syndrome and etiologic agent (endometritis, group A *Streptococcus*; pneumonia, *Staphylococcus aureus*, etc.). In an attempt to make the table useful

to all hospital personnel, including those from nonclinical areas (admitting, dietary, housekeeping, laundry, etc.), common terminology and jargon (such as gangrene and "TORCH" syndrome) are also used in the alphabetical listing of diseases.

For some diseases or conditions listed in Table B, we recommend more stringent isolation precautions for infants and young children than for adults since the risk of spread and the consequences of infection are greater in infants and young children. We use the term "young children" rather than an age breakpoint because children mature at such different rates. Thus, the interpretation of the term "young children" will differ in various pediatric settings according to the patient population.

Table B, Disease-Specific Isolation Precautions specifies by use of "no," "yes," or a qualified "yes" whether a private room, masks, gowns, or gloves is indicated for each disease. In general, patients infected with the same organism may share a room. For some diseases or conditions a private room is indicated if patient hygiene is poor. A patient with poor hygiene does not wash hands after touching infective material (feces, purulent drainage, or secretions), contaminates the environment with infective material, or shares contaminated articles with other patients. Likewise, for some diseases a mask is indicated only for those who get close (about 3 feet) to the patient. Handwashing is not listed in the table because it is important for all patient care, whether or not the patient is infected, and is always necessary to prevent transmission of infection.

In addition to including the specific precautions indicated for each disease, Table B, Disease-Specific Isolation Precautions, identifies which secretions, excretions, discharges, body fluids, and tissues are infective or might be infective. Again, common terms such as feces and pus are used to describe infective material. In the table the term "pus" refers to grossly purulent as well as serous drainage that is likely to be infective. In the table, we also tell how long to apply the precautions and other considerations that personnel should be aware of when taking care of an infected or colonized patient for whom isolation precautions are indicated. Additional information essential to understanding and properly using disease-specific isolation precautions is contained in the first part of this section in Techniques for Isolation Precautions (page 9).

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Abscess, etiology unknown							
Draining, major	Yes	No	Yes if soiling is likely	Yes for touching infective material	Pus	Duration of illness	Major = no dressing or dressing does not adequately contain the pus.

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Abscess, etiology unknown (cont.)							
Draining, minor or limited	No	No	Yes if soiling is likely	Yes for touching infective material	Pus	Duration of illness	Minor or limited = dressing covers and adequately contains the pus, or infected area is small, such as a stitch abscess.
Not draining	No	No	No	No			
Acquired immunodeficiency syndrome (AIDS)	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Blood and body fluids	Duration of illness	Use caution when handling blood and blood-soiled articles. Take special care to avoid needle-stick injuries. If gastrointestinal bleeding is likely, wear gloves if touching feces. (Acquired immune deficiency syndrome [AIDS]: precautions for clinical and laboratory staffs. MMWR 1982; 31:577-80.)
Actinomycosis, all lesions	No	No	No	No			
Adenovirus infection, respiratory in infants and young children	Yes	No	Yes if soiling is likely	No	Respiratory secretions and feces	Duration of hospitalization	During epidemics patients believed to have adenovirus infection may be placed in the same room (cohorting).
Amebiasis							
Dysentery	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	
Liver abscess	No	No	No	No			
Anthrax							
Cutaneous	No	No	No	Yes for touching infective material	Pus	Duration of illness	
Inhalation	No	No	Yes if soiling is likely	Yes for touching infective material	Respiratory secretions may be	Duration of illness	

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Arthropodborne viral encephalitides (eastern equine, western equine, and Venezuelan equine encephalomyelitis, St. Louis and California encephalitis.)	No	No	No	No			
Arthropodborne viral fevers (dengue, yellow fever, and Colorado tick fever)	No	No	No	Yes for touching infective material	Blood	Duration of hospitalization	
Ascariasis	No	No	No	No			
Aspergillosis	No	No	No	No			
Babesiosis	No	No	No	Yes for touching infective material	Blood	Duration of illness	
Blastomycosis, North American, cutaneous or pulmonary	No	No	No	No			
Botulism							
Infant	No	No	No	No			
Other	No	No	No	No			
Bronchiolitis, etiology unknown in infants and young children	Yes	No	Yes if soiling is likely	No	Respiratory secretions	Duration of illness	Various etiologic agents, such as respiratory syncytial virus, parainfluenza viruses, adenoviruses, and influenza viruses, have been associated with this syndrome (Committee on Infectious Diseases, American Academy of Pediatrics, 1982 Red Book); therefore, precautions to prevent their spread are generally indicated.
Bronchitis, infective etiology unknown							
Adults	No	No	No	No	Respiratory secretions may be		

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRECAUTIONS		COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?		HOW LONG?		
Bronchitis, infection etiology unknown (cont.)								
Infants and young children	Yes	No	Yes if soiling is likely	No	Respiratory secretions	Duration of illness		
Brucellosis (undulant fever, Malta fever, Mediterranean fever)								
Draining lesions, limited or minor	No	No	Yes if soiling is likely	Yes for touching infective material	Pus	Duration of illness	Limited or minor = dressing covers and adequately contains the pus or infected area is very small.	
Other	No	No	No	No				
Burn wound (see separate section on Care of Patients with Burns)								
<i>Campylobacter</i> gastroenteritis	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness		
Candidiasis, all forms, including mucocutaneous (moniliasis, thrush)	No	No	No	No				
Cat-scratch fever (benign inoculation lymphoreticulosis)	No	No	No	No				
Cellulitis,								
Draining, limited or minor	No	No	Yes if soiling is likely	Yes for touching infective material	Pus	Duration of illness	Limited or minor = dressing covers and adequately contains the pus, or infected area is very small.	
Intact skin	No	No	No	No				
Chancroid (soft chancre)	No	No	No	No				
Chickenpox (varicella)	Yes	Yes	Yes	Yes	Respiratory secretions and lesion secretions	Until all lesions are crusted	Persons who are not susceptible do not need to wear a mask. Susceptible persons should, if possible, stay out of room. Special ventilation for the room, if available, may be advantageous, especially for outbreak control. Neonates born to mothers with active vari-	

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRE-	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?		CAUTIONS HOW LONG?	
Chickenpox (cont.)							cells should be placed on isolation precautions at birth. Exposed susceptible patients should be placed on isolation precautions beginning 10 days after exposure and continuing until 21 days after last exposure. See CDC Guideline for Infection Control in Hospital Personnel for recommendations for exposed susceptible personnel.
<i>Chlamydia trachomatis</i> infection							
Conjunctivitis	No	No	No	Yes for touching infective material	Purulent exudate	Duration of illness	
Genital	No	No	No	Yes for touching infective material	Genital discharge	Duration of illness	
Respiratory	No	No	No	Yes for touching infective material	Respiratory secretions	Duration of illness	
Cholera	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	
Closed-cavity infection							
Draining, limited or minor	No	No	Yes if soiling is likely	Yes for touching infective material	Pus	Duration of illness	Limited or minor = dressing covers and adequately contains the pus or infected area is very small.
Not draining	No	No	No	No			
<i>Clostridium perfringens</i>							
Food poisoning	No	No	No	No			
Gas gangrene	No	No	Yes if soiling is likely	Yes for touching infective material	Pus	Duration of illness	
Other	No	No	Yes if soiling is likely	Yes for touching infective material	Pus	Duration	

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Coccidioidomycosis (valley fever)							
Draining lesions	No	No	No	No	Draining may be if spores form		
Pneumonia	No	No	No	No			
Colorado tick fever	No	No	No	Yes for touching infective material	Blood	Duration of hospitalization	
Common cold							
Adults	No	No	No	No	Respiratory secretions may be		
Infants and young children	Yes	No	Yes if soiling is likely	No	Respiratory secretions	Duration of illness	Although rhinoviruses are most frequently associated with the common cold and are mild in adults, severe infections may occur in infants and young children. Other etiologic agents, such as respiratory syncytial virus and parainfluenza viruses, may also cause this syndrome (Committee on Infectious Diseases, American Academy of Pediatrics, 1982 Red Book); therefore, precautions to prevent their spread are generally indicated.
Congenital rubella	Yes	No	Yes if soiling is likely	Yes for touching infective material	Urine and respiratory secretions	During any admission for the 1st year after birth unless nasopharyngeal and urine cultures after 3 months of age are negative for rubella virus.	Susceptible persons should, if possible, stay out of room. Pregnant personnel may need special counseling (see CDC Guideline for Infection Control in Hospital Personnel).
Conjunctivitis, acute bacterial (sore eye, pink eye)	No	No	No	Yes for touching infective material	Purulent exudate	Duration of illness	

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Conjunctivitis, <i>Chlamydia</i>	No	No	No	Yes for touching infective material	Purulent exudate	Duration of illness	
Conjunctivitis, gonococcal							
Adults	No	No	No	Yes for touching infective material	Purulent exudate	For 24 hours after start of effective therapy	
Newborns	Yes	No	No	Yes for touching infective material	Purulent exudate	For 24 hours after start of effective therapy	
Conjunctivitis, viral and etiology unknown (acute hemorrhagic and swimming pool conjunctivitis)	Yes if patient hygiene is poor	No	No	Yes for touching infective material	Purulent exudate	Duration of illness	
Coronavirus infection, respiratory							
Adults	No	No	No	No	Respiratory secretions may be		
Infants and young children	Yes	No	Yes if soiling is likely	No	Respiratory secretions	Duration of illness	
Coxsackievirus disease	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces and respiratory secretions	For 7 days after onset	
Creutzfeldt-Jakob disease	No	No	No	Yes for touching infective material	Blood, brain tissue, and spinal fluid	Duration of hospitalization	Use caution when handling blood, brain tissue or spinal fluid. (Jarvis WR. Precautions for Creutzfeldt-Jakob disease. <i>Infect Control</i> 1982; 3:238-9.)
Croup	Yes	No	Yes if soiling is likely	No	Respiratory secretions	Duration of illness	Because viral agents, such as parainfluenza viruses and influenza A virus, have been associated with this syndrome (Committee on Infectious Diseases, American Academy of Pediatrics, 1982 Red Book), precautions to prevent their spread are generally indicated.

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Cryptococcosis	No	No	No	No			
Cysticercosis	No	No	No	No			
Cytomegalovirus infection, neonatal or immunosuppressed	No	No	No	No	Urine and respiratory secretions may be		Pregnant personnel may need special counseling (see CDC Guideline for Infection Control in Hospital Personnel).
Decubitus ulcer, infected							
Draining, major	Yes	No	Yes if soiling is likely	Yes for touching infective material	Pus	Duration of illness	Major = draining and not covered by dressing or dressing does not adequately contain the pus.
Draining, minor	No	No	Yes if soiling is likely	Yes for touching infective material	Pus	Duration of illness	Minor or limited = dressing covers and adequately contains the pus, or infected area is very small.
Dengue	No	No	No	Yes for touching infective material	Blood	Duration of hospitalization	
Diarrhea, acute— infective etiology suspected (see gastroenteritis)	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	
Diphtheria							
Cutaneous	Yes	No	Yes if soiling is likely	Yes for touching infective material	Lesion secretions	Until 2 cultures from skin lesions, taken at least 24 hours apart after cessation of antimicrobial therapy, are negative for <i>Corynebacterium diphtheriae</i>	
Pharyngeal	Yes	Yes	Yes if soiling is likely	Yes for touching infective material	Respiratory secretions	Until 2 cultures from both nose and throat taken at least 24 hours apart after cessation of antimicrobial therapy	

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Diphtheria Pharyngeal (cont.)						are negative for <i>Corynebacterium diphtheriae</i>	
Echinococcosis (hydatidosis)	No	No	No	No			
Echovirus disease	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces and respiratory secretions	For 7 days after onset	
Eczema vaccination (vaccinia)	Yes	No	Yes if soiling is likely	Yes for touching infective material	Lesion secretions	Duration of illness	
Encephalitis or encephalomyelitis, etiology unknown, but infection suspected (see also specific etiologic agents; likely causes include enterovirus and arthropodborne virus infections)	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness or 7 days after onset, whichever is less	Although specific etiologic agents can include enteroviruses, arthropodborne viruses, and herpes simplex, precautions for enteroviruses are generally indicated until a definitive diagnosis can be made.
Endometritis							
Group A <i>Streptococcus</i>	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Vaginal discharge	For 24 hours after start of effective therapy	
Other	No	No	Yes if soiling is likely	Yes for touching infective material	Vaginal discharge	Duration of illness	
Enterobiasis (pinworm disease, oxyuriasis)	No	No	No	No			
Enterocolitis (see also necrotizing enterocolitis)							
<i>Clostridium difficile</i>	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	
<i>Staphylococcus</i>	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Enteroviral infection	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	For 7 days after onset	
Epiglottitis, due to <i>Haemophilus influenzae</i>	Yes	Yes for those close to patient	No	No	Respiratory secretions	For 24 hours after start of effective therapy	
Epstein-Barr virus infection, any, including infectious mononucleosis	No	No	No	No	Respiratory secretions may be		
Erysipeloid	No	No	No	No			
Erythema infectiosum	Yes	Yes for those close to patient	No	No	Respiratory secretions	For 7 days after onset	
<i>Escherichia coli</i> gastroenteritis (enteropathogenic, enterotoxigenic, or enteroinvasive)	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of hospitalization	
Fever of unknown origin (FUO)							Patients with FUO usually do not need isolation precautions; however, if a patient has signs and symptoms compatible with (and is likely to have) a disease that requires isolation precautions, use those isolation precautions for that patient.
Food poisoning							
Botulism	No	No	No	No			
<i>Clostridium perfringens</i> or <i>welchii</i> food poisoning)	No	No	No	No			
Salmonellosis	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	
Staphylococcal food poisoning	No	No	No	No			

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED			INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS	
	PRIVATE ROOM?	MASKS?	GOWNS? GLOVES?				
Furunculosis—staphylococcal							
Newborns	Yes	No	Yes if soiling is likely	Yes for touching infective material	Pus	Duration of illness	During a nursery outbreak, cohorting of ill and colonized infants and use of gowns and gloves are recommended.
Others	No	No	Yes if soiling is likely	Yes for touching infective material	Pus	Duration of illness	
Gangrene							
Gas gangrene (due to any bacteria)	No	No	Yes if soiling is likely	Yes for touching infective material	Pus	Duration of illness	
Gastroenteritis							
<i>Campylobacter</i> species	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	
<i>Clostridium difficile</i>	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	
<i>Cryptosporidium</i> species	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	
<i>Dientamoeba fragilis</i>	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	
<i>Escherichia coli</i> (enteropathogenic, enterotoxic, or enteroinvasive)	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	
<i>Giardia lamblia</i>	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	
<i>Rotavirus</i>	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness or 7 days after onset, whichever is less	

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Gastroenteritis (cont.)							
<i>Salmonella</i> species	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	
<i>Shigella</i> species	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Until 3 consecutive cultures of feces taken after ending antimicrobial therapy are negative for infecting strain	
Unknown etiology	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	
<i>Vibrio parahaemolyticus</i>	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	
Viral	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	
<i>Yersinia enterocolitica</i>	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	
German measles (rubella) (see also congenital rubella)	Yes	Yes for those close to patient	No	No	Respiratory secretions	For 7 days after onset of rash	Persons who are not susceptible do not need to wear a mask. Susceptible persons should, if possible, stay out of room. Pregnant personnel may need special counseling (see CDC Guideline for Infection Control in Hospital Personnel).
Giardiasis	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	
Gonococcal ophthalmia neonatorum (gonorrheal ophthalmia, acute conjunctivitis of the newborn)	Yes	No	No	Yes for touching infective material	Purulent exudate	For 24 hours after start of effective therapy	

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Gonorrhea	No	No	No	No	Discharge may be		
Granulocytopenia	No	No	No	No			Wash hands well <i>before</i> taking care of patient (see separate section on Care of Severely Compromised Patients).
Granuloma inguinale (donovaniasis, granuloma venereum)	No	No	No	No	Drainage may be		
Guillain-Barré syndrome	No	No	No	No			
Hand, foot, and mouth disease	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	For 7 days after onset	
Hemorrhagic fevers (for example, Lassa fever)	Yes with special ventilation	Yes	Yes	Yes	Blood, body fluids, and respiratory secretions	Duration of illness	Call the State Health Department and Centers for Disease Control for advice about management of a suspected case.
Hepatitis, viral							
Type A (infectious)	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces may be	For 7 days after onset of jaundice	Hepatitis A is most contagious before symptoms and jaundice appear; once these appear, small, inapparent amounts of feces, which may contaminate the hands of personnel during patient care, do not appear to be infective. Thus, gowns and gloves are most useful when gross soiling with feces is anticipated or possible.
Type B ("serum hepatitis"), including hepatitis B antigen (HBsAg) carrier	No	No	Yes if soiling is likely	Yes for touching infective material	Blood and body fluids	Until patient is HBsAg-negative	Use caution when handling blood and blood-soiled articles. Take special care to avoid needle-stick injuries. Pregnant personnel may need special counseling (see CDC Guideline for Infection Control in Hospital Personnel). Gowns are indicated when clothing may become contaminated with body fluids or blood

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Hepatitis, viral Type B (cont.)							(for example, when blood splattering is anticipated). If gastrointestinal bleeding is likely, wear gloves if touching feces. A private room may be indicated if profuse bleeding is likely to cause environmental contamination.
Non-A, Non-B	No	No	Yes if soiling is likely	Yes for touching infective material	Blood and body fluids	Duration of illness	Currently, the period of infectivity cannot be determined.
Unspecified type, consistent with viral etiology							Maintain precautions indicated for the infections that are most likely.
Herpangina	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	For 7 days after onset	
Herpes simplex (<i>Herpesvirus hominis</i>)							
Encephalitis	No	No	No	No			
Mucocutaneous, disseminated or primary, severe (skin, oral, and genital)	Yes	No	Yes if soiling is likely	Yes for touching infective material	Lesion secretions from infected site	Duration of illness	
Mucocutaneous, recurrent (skin, oral, and genital)	No	No	No	Yes for touching infective material	Lesion secretions from infected site	Until all lesions are crusted	
Neonatal (see comments for newborn with perinatal exposure)	Yes	No	Yes if soiling is likely	Yes for touching infective material	Lesion secretions	Duration of illness	The same isolation precautions are indicated for infants delivered (either vaginally or by cesarean section if membranes have been ruptured for more than 4–6 hours) to women with active genital herpes simplex infections. Infants delivered by cesarean section to women with active genital herpes simplex infections before and probably within 4–6 hours after membrane rupture are at minimal risk of develop-

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Herpes simplex Neonatal (cont.)							ing herpes simplex infection; the same isolation precautions may still be indicated, however. (American Academy of Pediatrics Committee on Fetus and Newborn. Perinatal herpes simplex virus infections. Pediatrics 1980; 66:147-9. Also: Kibrick S. Herpes simplex infection at term. JAMA 1980; 243:157-60.)
Herpes zoster (varicella-zoster), Localized in immunocompromised patient, or disseminated	Yes	Yes	Yes	Yes for touching infective material	Lesion secretions and possibly respiratory secretions	Duration of illness	Localized lesions in immunocompromised patients frequently become disseminated. Because such dissemination is unpredictable, use the same isolation precautions as for disseminated disease. Persons who are not susceptible do not need to wear a mask. Persons susceptible to varicella-zoster (chickenpox) should, if possible, stay out of room. Special ventilation for the room, if available, may be advantageous, especially for outbreak control. Exposed susceptible patients should be placed on isolation precautions beginning at 10 days after exposure and continuing until 21 days after last exposure. See CDC Guideline for Infection Control in Hospital Personnel for recommendations for exposed susceptible personnel.
Localized in normal patient	Yes if patient hygiene is poor	No	No	Yes for touching infective material	Lesion secretions	Until all lesions are crusted	Persons susceptible to varicella-zoster (chickenpox) should, if possible, stay out of room. Roommates should not be susceptible to chickenpox.

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Histoplasmosis at any site	No	No	No	No			
Hookworm disease (ancylostomiasis, uncinariasis)	No	No	No	No			
Immunocompromised status	No	No	No	No			Wash hands well <i>before</i> taking care of patients (see separate section on Care of Severely Compromised Patients).
Impetigo	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Lesions	For 24 hours after start of effective therapy	
Infectious mononucleosis	No	No	No	No	Respiratory secretions may be		
Influenza Adults	No	No	No	No	Respiratory secretions may be		In the absence of an epidemic, influenza may be difficult to diagnose on clinical grounds. Most patients will have fully recovered by the time laboratory diagnosis is established; therefore, placing patients with suspect influenza on isolation precautions, although theoretically desirable, is simply not practical in most hospitals. During epidemics, the accuracy of clinical diagnosis increases, and patients believed to have influenza may be placed in the same room (cohorting). Amantadine prophylaxis may be useful to prevent symptomatic influenza A infections in high-risk patients during epidemics.
Infants and young children	Yes	No	Yes if soiling is likely	No	Respiratory secretions	Duration of illness	In the absence of an epidemic, influenza may be difficult to diagnose. During epidemics, patients believed to have influenza may be placed in the same room (cohorting).

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Jakob-Creutzfeldt disease	No	No	No	Yes for touching infective material	Blood, brain tissue, and spinal fluid	Duration of hospitalization	Use caution when handling blood, brain tissue or spinal fluid. (Jarvis WR. Precautions for Creutzfeldt-Jakob disease. Infect Control 1982; 3:238-9.)
Kawasaki syndrome	No	No	No	No			
Keratoconjunctivitis, infective	Yes if patient hygiene is poor	No	No	Yes for touching infective material	Purulent exudate	Duration of illness	
Lassa fever	Yes with special ventilation	Yes	Yes	Yes	Blood, body fluids, and respiratory secretions	Duration of illness	Call the State Health Department and Centers for Disease Control for advice about management of a suspected case.
Legionnaires' disease	No	No	No	No	Respiratory secretions may be		
Leprosy	No	No	No	No			
Leptospirosis	No	No	No	Yes for touching infective material	Blood and urine	Duration of hospitalization	
Listeriosis	No	No	No	No			
Lyme disease	No	No	No	No			
Lymphocytic choriomeningitis	No	No	No	No			
Lymphogranuloma venereum	No	No	No	No	Drainage may be		
Malaria	No	No	No	Yes for touching infective material	Blood	Duration of illness	
Marburg virus disease	Yes with special ventilation	Yes	Yes	Yes	Blood, body fluids, and respiratory secretions	Duration of illness	Call the State Health Department and Centers for Disease Control for advice about management of a suspected case.
Measles (rubella) atypical presentations	Yes	Yes for those close to patient	No	No	Respiratory secretions	For 4 days after start of rash, except in immunocompromised patients with whom precautions should be maintained for duration of illness	Persons who are not susceptible do not need to wear mask. Susceptible persons should, if possible, stay out of room.

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Melioidosis, all forms	No	No	No	No	Respiratory secretions may be, and, if a sinus is draining, drainage may be		
Meningitis							
Aseptic (nonbacterial or viral meningitis) (also see specific etiologies)	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	For 7 days after onset	Enteroviruses are the most common cause of aseptic meningitis.
Bacterial, gram-negative enteric, in neonates	No	No	No	No	Feces may be		During a nursery outbreak, cohort ill and colonized infants, and use gowns if soiling is likely and gloves if touching feces.
Fungal	No	No	No	No			
<i>Haemophilus influenzae</i> , known or suspected	Yes	Yes for those close to patient	No	No	Respiratory secretions	For 24 hours after start of effective therapy	
<i>Listeria monocytogenes</i>	No	No	No	No			
<i>Neisseria meningitidis</i> (meningococcal), known or suspected	Yes	Yes for those close to patient	No	No	Respiratory secretions	For 24 hours after start of effective therapy	See CDC Guideline for Infection Control in Hospital Personnel for recommendations for prophylaxis after exposure.
Pneumococcal	No	No	No	No			
Tuberculous	No	No	No	No			Patient should be examined for evidence of current (active) pulmonary tuberculosis. If present, precautions are necessary (see tuberculosis).
Other diagnosed bacterial	No	No	No	No			
Meningococcal pneumonia	Yes	Yes for those close to patient	No	No	Respiratory secretions	For 24 hours after start of effective therapy	See CDC Guideline for Infection Control in Hospital Personnel for recommendations for prophylaxis after exposure.

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Meningococemia (meningococcal sepsis)	Yes	Yes for those close to patient	No	No	Respiratory secretions	For 24 hours after start of effective therapy	See CDC Guideline for Infection Control in Hospital Personnel for recommendations for prophylaxis after exposure.
<i>Molluscum contagiosum</i>	No	No	No	No			
Mucormycosis	No	No	No	No			
Multiply-resistant organisms,* infection or colonization.†							
Gastrointestinal	Yes	No	Yes if soiling is likely	Yes for touching infective material	Feces	Until off antimicrobials and culture-negative	In outbreaks, cohorting of infected and colonized patients may be indicated if private rooms are not available.
Respiratory	Yes	Yes for those close to patient	Yes if soiling is likely	Yes for touching infective material	Respiratory secretions and possibly feces	Until off antimicrobials and culture-negative	In outbreaks, cohorting of infected and colonized patients may be indicated if private rooms are not available.
Skin, Wound, or Burn	Yes	No	Yes if soiling is likely	Yes for touching infective material	Pus and possibly feces	Until off antimicrobials and culture-negative	In outbreaks, cohorting of infected and colonized patients may be indicated if private rooms are not available.
Urinary	Yes	No	No	Yes for touching infective material	Urine and possibly feces	Until off antimicrobials and culture-negative	Urine and urine-measuring devices are sources of infection, especially if the patient (or any nearby patients) has indwelling urinary catheter. In outbreaks, cohorting of infected and colonized patients may be indicated if private rooms are not available.
Mumps (infectious parotitis)	Yes	Yes for those close to patient	No	No	Respiratory secretions	For 9 days after onset of swelling	Persons who are not susceptible do not need to wear mask.

*The following multiply-resistant organisms are included:

- 1) Gram-negative bacilli resistant to all aminoglycosides that are tested. (In general, such organisms should be resistant to gentamicin, tobramycin, and amikacin for these special precautions to be indicated.)
- 2) *Staphylococcus aureus* resistant to methicillin (or nafcillin or oxacillin if they are used instead of methicillin for testing).
- 3) *Pneumococcus* resistant to penicillin.
- 4) *Haemophilus influenzae* resistant to ampicillin (beta-lactamase positive) and chloramphenicol.
- 5) Other resistant bacteria may be included if they are judged by the infection control team to be of special clinical and epidemiologic significance.

†Colonization may involve more than 1 site.

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				APPLY PRE-CAUTIONS		COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?	INFECTIVE MATERIAL	HOW LONG?	
Mycobacteria, nontuberculous (atypical)							
Pulmonary	No	No	No	No			
Wound	No	No	Yes if soiling is likely	Yes for touching infective material	Drainage may be	Duration of drainage	
Mycoplasma pneumonia	No	No	No	No	Respiratory secretions may be		A private room may be indicated for children.
Necrotizing enterocolitis	No	No	Yes if soiling is likely	Yes for touching infective material	Feces may be	Duration of illness	In nurseries, cohorting of ill infants is recommended. It is not known whether or how this disease is transmitted; nevertheless, gowns are recommended if soiling is likely, and gloves are recommended for touching feces.
Neutropenia	No	No	No	No			Wash hands well <i>before</i> taking care of patient (see separate section on Care of Severely Compromised Patients).
Nocardiosis							
Draining lesions	No	No	No	No	Drainage may be		
Other	No	No	No	No			
Norwalk agent gastroenteritis	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	
Orf	No	No	No	No	Drainage may be		
Parainfluenza virus infection, respiratory in infants and young children	Yes	No	Yes if soiling is likely	No	Respiratory secretions	Duration of illness	During epidemics, patients believed to have parainfluenza virus infection may be placed in the same room (cohorting).
Pediculosis	Yes if patient hygiene is poor	No	Yes for close contact	Yes for close contact	Infested area	For 24 hours after start of effective therapy	

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Pertussis ("whooping cough")	Yes	Yes for those close to patient	No	No	Respiratory secretions	For 7 days after start of effective therapy	See CDC Guideline for Infection Control in Hospital Personnel for recommendations for prophylaxis after exposure.
Pharyngitis, infective, etiology unknown							
Adults	No	No	No	No	Respiratory secretions may be		
Infants and young children	Yes if patient hygiene is poor	No	Yes if soiling is likely	No	Respiratory secretions	Duration of illness	Because adenoviruses, influenza viruses, and parainfluenza viruses have been associated with this syndrome (Committee on Infectious Diseases, American Academy of Pediatrics, 1982 Red Book), precautions to prevent their spread are generally indicated.
Pinworm infection	No	No	No	No			
Plague							
Bubonic	No	No	Yes if soiling is likely	Yes for touching infective material	Pus	For 3 days after start of effective therapy	
Pneumonic	Yes	Yes	Yes if soiling is likely	Yes for touching infective material	Respiratory secretions	For 3 days after start of effective therapy	
Pleurodynia	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	For 7 days after onset	Enteroviruses frequently cause infection.
Pneumonia							
Bacterial not listed elsewhere (including gram-negative bacterial)	No	No	No	No	Respiratory secretions may be		
<i>Chlamydia</i>	No	No	No	Yes for touching infective material	Respiratory secretions	Duration of illness	

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Pneumonia (cont.) Etiology unknown							Maintain precautions indicated for the etiology that is most likely.
Fungal	No	No	No	No			
<i>Haemophilus influenzae</i>							
Adults	No	No	No	No	Respiratory secretions may be		
Infants and children (any age)	Yes	Yes for those close to patient	No	No	Respiratory secretions	For 24 hours after start of effective therapy	
<i>Legionella</i>	No	No	No	No	Respiratory secretions may be		
Meningococcal	Yes	Yes for those close to patient	No	No	Respiratory secretions	For 24 hours after start of effective therapy	See CDC Guideline for Infection Control in Hospital Personnel for recommendations for prophylaxis after exposure.
Multiply-resistant bacterial	Yes	Yes for those close to patient	Yes if soiling is likely	Yes for touching infective material	Respiratory secretions and possibly feces	Until off antimicrobials and culture-negative	In outbreaks, cohorting of infected and colonized patients may be necessary if private rooms are not available.
<i>Mycoplasma</i> (primary atypical pneumonia, Eaton agent pneumonia)	No	No	No	No	Respiratory secretions may be		A private room may be useful for children
Pneumococcal	No	No	No	No	Respiratory secretions may be for 24 hours after start of effective therapy		
<i>Pneumocystis carinii</i>	No	No	No	No			
<i>Staphylococcus aureus</i>	Yes	Yes for those close to patient	Yes if soiling is likely	Yes for touching infective material	Respiratory secretions	For 48 hours after start of effective therapy	
<i>Streptococcus</i> , group A	Yes	Yes for those close to patient	Yes if soiling is likely	Yes for touching infective material	Respiratory secretions	For 24 hours after start of effective therapy	

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Pneumonia (cont.)							
Viral (see also specific etiologic agents)							
Adults	No	No	No	No	Respiratory secretions may be		
Viral Infants and young children	Yes	No	Yes if soiling is likely	No	Respiratory secretions	Duration of illness	Viral pneumonia may be caused by various etiologic agents, such as parainfluenza viruses, influenza viruses, and, particularly, respiratory syncytial virus, in children less than 5 years old (Committee on Infectious Diseases, American Academy of Pediatrics, 1982 Red Book); therefore, precautions to prevent their spread are generally indicated.
Poliomyelitis	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	For 7 days after onset	
Psittacosis (ornithosis)	No	No	No	No	Respiratory secretions may be		
Q fever	No	No	No	No	Respiratory secretions may be		
Rabies	Yes	Yes for those close to patient	Yes if soiling is likely	Yes for touching infective material	Respiratory secretions	Duration of illness	See CDC Guideline for Infection Control in Hospital Personnel for recommendations for prophylaxis after exposure.
Rat-bite fever (<i>Streptobacillus moniliformis</i> disease, <i>Spirillum minus</i> disease)	No	No	No	Yes for touching infective material	Blood	For 24 hours after start of effective therapy	
Relapsing fever	No	No	No	Yes for touching infective material	Blood	Duration of illness	
Resistant bacterial (see multiply-resistant bacteria)							

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Respiratory infectious disease, acute (if not covered elsewhere)							
Adults	No	No	No	No	Respiratory secretions may be		
Infants and young children							Maintain precautions indicated for the bacterial or viral infections that are most likely.
Respiratory syncytial virus (RSV) infection, in infants and young children	Yes	No	Yes if soiling is likely	No	Respiratory secretions	Duration of illness	During epidemics, patients believed to have RSV infection may be placed in the same room (cohorting). The use of masks has not been recommended since they have proven ineffective in controlled studies.
Reye syndrome	No	No	No	No			
Rheumatic fever	No	No	No	No			
Rhinovirus infection, respiratory							
Adults	No	No	No	No	Respiratory secretions may be		
Infants and young children	Yes	No	Yes if soiling is likely	No	Respiratory secretions	Duration of illness	
Rickettsial fevers, tickborne (Rocky Mountain spotted fever, tickborne typhus fever)	No	No	No	No	Blood may be		
Rickettsialpox (vesicular rickettsiosis)	No	No	No	No			
Ringworm (dermatophytosis, dermatomycosis, tinea)	No	No	No	No			
Ritter's disease (staphylococcal scalded skin syndrome)	Yes	No	Yes if soiling is likely	Yes for touching infective material	Lesion drainage	Duration of illness	
Rocky Mountain spotted fever	No	No	No	No	Blood may be		

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Roseola infantum (exanthem subitum)	No	No	No	No			
Rotavirus infection (viral gastroenteritis)	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness or 7 days after onset, whichever is less	
Rubella ("German measles") (see also congenital rubella)	Yes	Yes for those close to patient	No	No	Respiratory secretions	For 7 days after onset of rash	Persons who are not susceptible do not need to wear a mask. Susceptible persons should, if possible, stay out of room. Pregnant personnel may need special counseling (see CDC Guideline for Infection Control in Hospital Personnel).
Salmonellosis	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	
Scabies	Yes if patient hygiene is poor	No	Yes for close contact	Yes for close contact	Infested area	For 24 hours after start of effective therapy	
Scalded skin syndrome, staphylococcal (Ritter's disease)	Yes	No	Yes if soiling is likely	Yes for touching infective material	Lesion drainage	Duration of illness	
Schistosomiasis (bilharziasis)	No	No	No	No			
Shigellosis (including bacillary dysentery)	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Until 3 consecutive cultures of feces, taken after ending antimicrobial therapy, are negative for infecting strain	
Smallpox (variola)	Yes with special ventilation	Yes	Yes	Yes	Respiratory secretions and lesion secretions	Duration of illness	As long as smallpox virus is kept stocked in laboratories, the potential exists for cases to occur. Call the State Health Department and Centers for Disease Control for advice about management of a suspected case.

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Sporotrichosis	No	No	No	No			
<i>Spirillum minus</i> disease (rat-bite fever)	No	No	No	Yes for touching infective material	Blood	For 24 hours after start of effective therapy	
Staphylococcal disease (<i>S. aureus</i>)							
Skin, wound, or burn infection							
Major	Yes	No	Yes if soiling is likely	Yes for touching infective material	Pus	Duration of illness	Major = draining and not covered by dressing or dressing does not adequately contain the pus.
Minor or limited	No	No	Yes if soiling is likely	Yes for touching infective material	Pus	Duration of illness	Minor or limited = dressing covers and adequately contains the pus, or infected area is very small.
Enterocolitis	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	
Pneumonia or draining lung abscess	Yes	Yes for those close to patient	Yes if soiling is likely	Yes for touching infective material	Respiratory secretions	For 48 hours after start of effective therapy	
Scalded skin syndrome	Yes	No	Yes if soiling is likely	Yes for touching infective material	Lesion drainage	Duration of illness	
Toxic shock syndrome	No	No	Yes if soiling is likely	Yes for touching infective material	Vaginal discharge or pus	Duration of illness	
<i>Streptobacillus moniliformis</i> disease (rat-bite fever)	No	No	No	Yes for touching infective material	Blood	For 24 hours after start of effective therapy	
Streptococcal disease (group A <i>Streptococcus</i>)							
Skin, wound, or burn infection							
Major	Yes	No	Yes if soiling is likely	Yes for touching infective material	Pus	For 24 hours after start of effective therapy	Major = draining and not covered by dressing or dressing does not adequately contain the pus.

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Streptococcal disease (group A—cont.) Minor or limited	No	No	Yes if soiling is likely	Yes for touching infective material	Pus	For 24 hours after start of effective therapy	Minor or limited = dressing covers and adequately contains the pus, or infected area is very small.
Endometritis (puerperal sepsis)	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Vaginal discharge	For 24 hours after start of effective therapy	
Pharyngitis	Yes if patient hygiene is poor	No	No	No	Respiratory secretions	For 24 hours after start of effective therapy	
Pneumonia	Yes	Yes for those close to patient	Yes if soiling is likely	Yes for touching infective material	Respiratory secretions	For 24 hours after start of effective therapy	
Scarlet fever	Yes if patient hygiene is poor	No	No	No	Respiratory secretions	For 24 hours after start of effective therapy	
Streptococcal disease (group B <i>Streptococcus</i>), neonatal	No	No	No	No	Feces may be		During a nursery outbreak, cohorting of ill and colonized infants and use of gowns and gloves is recommended.
Streptococcal disease (not group A or B) unless covered elsewhere	No	No	No	No			
Strongyloidiasis	No	No	No	No	Feces may be		If the patient is immunocompromised and has pneumonia or has disseminated disease, respiratory secretions may be infective.
Syphilis							
Skin and mucous membrane, including congenital, primary, and secondary	No	No	No	Yes for touching infective material	Lesion secretions and blood	For 24 hours after start of effective therapy	Skin lesions of primary and secondary syphilis may be highly infective.
Latent (tertiary) and seropositivity without lesions	No	No	No	No			

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Tapeworm disease							
<i>Hymenolepis nana</i>	No	No	No	No	Feces may be		
<i>Taenia solium</i> (pork)	No	No	No	No	Feces may be		
Other	No	No	No	No			
Tetanus	No	No	No	No			
Tinea (fungus infection dermatophytosis, dermatomycosis, ringworm)	No	No	No	No			
"TORCH" syndrome (If congenital forms of the following diseases are seriously being considered, see separate listing for these diseases: toxoplasmosis, rubella, cytomegalovirus, herpes, and syphilis.)							
Toxoplasmosis	No	No	No	No			
Toxic shock syndrome (staphylococcal disease)	No	No	Yes if soiling is likely	Yes for touching infective material	Vaginal discharge and pus	Duration of illness	
Trachoma, acute	No	No	No	Yes for touching infective material	Purulent exudate	Duration of illness	
Trench mouth (Vincent's angina)	No	No	No	No			
Trichinosis	No	No	No	No			
Trichomoniasis	No	No	No	No			
Trichuriasis (whipworm disease)	No	No	No	No			
Tuberculosis							
Extrapulmonary, draining lesion (including scrofula)	No	No	Yes if soiling is likely	Yes for touching infective material	Pus	Duration of drainage	A private room is especially important for children.
Extrapulmonary, meningitis	No	No	No	No			

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRE-CAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Tuberculosis (cont.)							
Pulmonary, confirmed or suspected (sputum smear is positive or chest X-ray appearance strongly suggests current [active] TB, for example, a cavitory lesion is found), or laryngeal disease.	Yes with special ventilation	Yes if patient is coughing and does not reliably cover mouth	Yes if gross contamination of clothing is likely	No	Airborne droplet nuclei	In most instances the duration of isolation precautions can be guided by clinical response and a reduction in numbers of TB organisms on sputum smear. Usually this occurs within 2-3 weeks after chemotherapy is begun. When the patient is likely to be infected with isoniazid-resistant organisms, apply precautions until patient is improving and sputum smear is negative for TB organisms.	Prompt use of effective antituberculous drugs is the most effective means of limiting transmission. Gowns are not important because TB is rarely spread by fomites, although gowns are indicated to prevent gross contamination of clothing. For more detailed guidelines refer to "Guidelines for Prevention of TB Transmission in Hospitals" (1982), Tuberculosis Control Division, Center for Prevention Services, Centers for Disease Control, Atlanta, GA, (HHS Publication No. [CDC] 82-8371) and CDC Guideline for Infection Control in Hospital Personnel. In general, infants and young children do not require isolation precautions because they rarely cough and their bronchial secretions contain few TB organisms compared to adults with pulmonary TB.
Skin-test positive with no evidence of current pulmonary disease (sputum smear is negative, X-ray not suggestive of current [active] disease)	No	No	No	No			
Tularemia							
Draining lesion	No	No	Yes if soiling is likely	Yes for touching infective material	Pus may be	Duration of illness	
Pulmonary	No	No	No	No	Respiratory secretions may be		

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Typhoid fever	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	
Typhus, endemic and epidemic	No	No	No	No	Blood may be		
Urinary tract infection (including pyelonephritis), with or without urinary catheter	No	No	No	No			See multiply-resistant bacteria if infection is with these bacteria. Spatially separate infected and uninfected patients who have indwelling catheters (see CDC Guideline for Prevention of Catheter-associated Urinary Tract Infection).
Vaccinia							
At vaccination site	No	No	Yes if soiling is likely	Yes for touching infective material	Lesion secretions	Duration of illness	
Generalized and progressive, eczema vaccinatum	Yes	No	Yes if soiling is likely	Yes for touching infective material	Lesion secretions	Duration of illness	
Varicella (chickenpox)	Yes	Yes	Yes	Yes	Respiratory secretions and lesion secretions	Until all lesions are crusted	Persons who are not susceptible do not need to wear a mask. Susceptible persons should, if possible, stay out of the room. Special ventilation for the room, if available, may be advantageous, especially for outbreak control. Neonates born to mothers with active varicella should be placed on isolation precautions at birth. Exposed susceptible patients should be placed on isolation precautions beginning 10 days after exposure and continuing until 21 days after last exposure. See CDC Guideline for Infection Control in Hospital Personnel for recommendations for exposed susceptible personnel.

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Variola (smallpox)	Yes with special ventilation	Yes	Yes	Yes	Respiratory secretions and lesion secretions	Duration of illness	Call the State Health Department and Centers for Disease Control for advice about management of a suspected case.
<i>Vibrio parahaemolyticus</i> gastroenteritis	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	
Vincent's angina (trench mouth)	No	No	No	No			
Viral diseases							
Pericarditis, myocarditis, or meningitis	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces and possibly respiratory secretions	For 7 days after onset	Enteroviruses frequently cause these infections.
Respiratory (if not covered elsewhere)							
Adults	No	No	No	No	Respiratory secretions may be		
Infants and young children	Yes	No	Yes if soiling is likely	No	Respiratory secretions	Duration of illness	Various etiologic agents, such as respiratory syncytial virus, parainfluenza viruses, adenoviruses, and influenza viruses, can cause viral respiratory infections (Committee on Infectious Diseases, American Academy of Pediatrics, 1982 Red Book); therefore, precautions to prevent their spread are generally indicated.
Whooping cough (pertussis)	Yes	Yes for those close to patient	No	No	Respiratory secretions	For 7 days after start of effective therapy	See CDC Guideline for Infection Control in Hospital Personnel for recommendations for prophylaxis after exposure.
Wound infections							
Major	Yes	No	Yes if soiling is likely	Yes for touching infective material	Pus	Duration of illness	Major = draining and not covered by dressing or dressing does not adequately contain the pus.

Table B. Disease-specific Isolation Precautions

DISEASE	PRECAUTIONS INDICATED				INFECTIVE MATERIAL	APPLY PRECAUTIONS HOW LONG?	COMMENTS
	PRIVATE ROOM?	MASKS?	GOWNS?	GLOVES?			
Wound infections (cont.) Minor or limited	No	No	Yes if soiling is likely	Yes for touching infective material	Pus	Duration of illness	Minor or limited = dressing covers and adequately contains the pus, or infected area is very small, such as a stitch abscess.
<i>Yersinia enterocolitica</i> gastroenteritis	Yes if patient hygiene is poor	No	Yes if soiling is likely	Yes for touching infective material	Feces	Duration of illness	
Zoster (varicella-zoster).							
Localized in immunocompromised patient or disseminated	Yes	Yes	Yes	Yes for touching infective material	Lesion secretions	Duration of illness	Localized lesions in immunocompromised patients frequently become disseminated. Because such dissemination is unpredictable, use the same isolation precautions as with disseminated disease. Persons who are not susceptible do not need to wear a mask. Persons susceptible to varicella-zoster (chickenpox) should, if possible, stay out of the room. Special ventilation for room, if available, may be advantageous, especially for outbreak control. Exposed susceptible patients should be placed on isolation precautions beginning 10 days after exposure and continuing until 21 days after last exposure. See CDC Guideline for Infection Control in Hospital Personnel for recommendations for exposed susceptible personnel.
Localized in normal patient	Yes if patient hygiene is poor	No	No	Yes for touching infective material	Lesion secretions	Until all lesions are crusted	Persons susceptible to varicella-zoster (chickenpox) should, if possible, stay out of room. Roommates should not be susceptible to chickenpox.
Zygomycosis (phycomycosis, mucormycosis)	No	No	No	No			

Instruction Card for Disease-Specific Isolation Precautions

An instruction card has been designed to give concise information about disease-specific isolation precautions, and a sample is shown below. The specific isolation precautions indicated for each disease or syndrome are listed in Table B.

Disease-Specific Isolation Precautions. The instruction card can be prepared by checking items and filling in blanks. After the card has been prepared, it should be displayed conspicuously near the patient who is on isolation precautions (on the door, foot or head of bed, etc.). A duplicate card may also be attached to the front of the patient's chart.

Sample Instruction Card for Disease-Specific Isolation Precautions

(Front of Card)

Visitors—Report to Nurses' Station Before Entering Room

1. Private room indicated? No
 Yes
 2. Masks indicated? No
 Yes for those close to patient
 Yes for all persons entering room
 3. Gowns indicated? No
 Yes if soiling is likely
 Yes for all persons entering room
 4. Gloves indicated? No
 Yes for touching infective material
 Yes for all persons entering room
 5. Special precautions indicated for handling blood? No
 Yes
 6. Hands must be washed after touching the patient or potentially contaminated articles and before taking care of another patient.
 7. Articles contaminated with _____ should be discarded or bagged and labeled before being sent for decontamination and reprocessing.
infective material(s)
-

(Back of Card)

Instructions

1. On Table B, Disease-Specific Precautions, locate the disease for which isolation precautions are indicated.
 2. Write disease in blank space here: _____
 3. Determine if a private room is indicated. In general, patients infected with the same organism may share a room. For some diseases or conditions, a private room is indicated if patient hygiene is poor. A patient with poor hygiene does not wash hands after touching infective material (feces, purulent drainage, or secretions), contaminates the environment with infective material, or shares contaminated articles with other patients.
 4. Place a check mark beside the indicated precautions on front of card.
 5. Cross through precautions that are *not* indicated.
 6. Write infective material in blank space in item 7 on front of card.
-

SECTION 4: MODIFICATION OF ISOLATION PRECAUTIONS

MODIFICATION OF ISOLATION PRECAUTIONS IN INTENSIVE CARE UNITS

Patients requiring intensive care are usually at higher risk than other patients of becoming colonized or infected with organisms of special clinical or epidemiologic significance. Three reasons are that contacts between these patients and personnel are frequent, the patients are clustered in a confined area, and many of them are unusually susceptible to infection. Moreover, critically ill patients are more likely to have multiple invasive procedures performed on them. Because there is ample opportunity for cross-infection in the Intensive Care Unit (ICU), infection control precautions must be done scrupulously. Frequent in-service training and close supervision to ensure adequate application of infection control and isolation precautions are particularly important for ICU personnel. (See Guideline for Hospital Environmental Control: Intensive Care Units.)

Most ICUs pose special problems for applying isolation precautions, hence some modifications that will neither compromise patient care nor increase the risk of infection to other patients or personnel may be necessary. The isolation precaution that will most often have to be modified is the use of a private room. Ideally, private rooms should be available in ICUs, but some ICUs do not have them or do not use them for patients who are critically ill if frequent and easy accessibility by personnel is crucial. When a private room is not available or is not desirable because of the patient's critical condition, and if airborne transmission is *not* likely, an isolation area can be defined within the ICU by curtains, partitions, or an area marked off on the floor with tape. Instructional cards can be posted to inform personnel and visitors about the isolation precautions in use.

Patients with infections that can cause serious illness (for example, chickenpox) if transmitted in hospitals, should be put in a private room even when the ICU does not have one. Because the risk of these highly contagious or virulent infections to patients and personnel is great, the inconvenience and expense associated with intensive care in a private room outside the ICU must be accepted.

One isolation precaution that should never be modified in intensive care units is frequent and appropriate handwashing. Hands should be washed between patients and may need to be washed several times during the care of a patient so that microorganisms are not transmitted from 1 site to another on the same patient; for example, from urinary tract to wound. Antiseptics, rather than soap, should be considered for handwashing in intensive care units. (See Guideline for Hospital Environmental Control: Antiseptics, Handwashing, and Handwashing Facilities.)

MODIFICATION OF ISOLATION PRECAUTIONS FOR NEWBORNS AND INFANTS

Isolation precautions for newborns and infants may have to be modified from those recommended for adults because 1) usually only a small number of private rooms are available for newborns and infants, and 2) during outbreaks, it is frequently necessary to establish cohorts of newborns and infants. Moreover, a newborn may need to be placed on isolation precautions at delivery because its mother has an infection.

It has often been recommended that infected newborns or those suspected of being infected (regardless of the pathogen and clinical manifestations) should be put in a private room. This recommendation was based on the assumptions that a geographically isolated room was necessary to protect uninfected newborns and that infected newborns would receive closer scrutiny and better care in such a room. Neither of these assumptions is completely correct.

Separate isolation rooms are seldom indicated for newborns with many kinds of infection if the following conditions are met: 1) an adequate number of nursing and medical personnel are on duty and have sufficient time for appropriate handwashing, 2) sufficient space is available for a 4- to 6-foot aisle or area between newborn stations, 3) an adequate number of sinks for handwashing are available in each nursery room or area, and 4) continuing instruction is given to personnel about the mode of transmission of infections. When these criteria are not met, a separate room with handwashing facilities may be indicated.

Another incorrect assumption regarding isolation precautions for newborns and infants is that forced-air incubators can be substituted for private rooms. These incubators may filter the incoming air but not the air discharged into the nursery. Moreover, the surfaces of incubators housing newborns or infants can easily become contaminated with organisms infecting or colonizing the patient, so personnel working with the patient through portholes may have their hands and forearms colonized. Forced-air incubators, therefore, are satisfactory for limited "protective" isolation of newborns and infants but should not be relied on as a major means of preventing transmission from infected patients to others.

Isolation precautions for an infected or colonized newborn or infant, or for a newborn of a mother suspected of having an infectious disease can be determined by the specific viral or bacterial pathogen, the clinical manifestations, the source and possible modes of transmission, and the number of colonized or infected newborns or infants. Other factors to be considered include the overall condition of the newborn or infant and the kind of care required, the available space and facilities, the nurse-to-patient ratio, and the size and type of nursery services for newborns and infants.

In addition to applying isolation precautions, cohorts may be established to keep to a minimum the transmission of organisms or infectious diseases among different groups of newborns and infants in large nurseries. A cohort usually consists of all well newborns from the same 24- or 48-hour birth period; these newborns are admitted to and kept in a single nursery room and, ideally, are taken care of by a single group of personnel who do not take care of any other cohort during the same shift. After the newborns in a cohort have been discharged, the room is thoroughly cleaned and prepared to accept the next cohort.

Cohorting is not practical as a routine for small nurseries or in neonatal intensive care units or graded care nurseries. It is useful in these nurseries, however, as a control measure during outbreaks or for managing a group of infants or newborns colonized or infected with an epidemiologically important pathogen. Under these circumstances, having separate rooms for each cohort is ideal, but not mandatory for many kinds of infections if cohorts can be kept separate within a single large room and if personnel are assigned to take care of only those in the cohort.

During outbreaks, newborns or infants with overt infection or colonization and personnel who are carriers, if indicated, should be identified rapidly and placed in cohorts; if rapid identification is not possible, exposed newborns or infants should be placed in a cohort separate from those with disease and from unexposed infants and newborns and new admissions. The success of cohorting depends largely on the willingness and ability of nursing and ancillary personnel to adhere strictly to the cohort system and to meticulously follow patient-care practices.

CARE OF SEVERELY COMPROMISED PATIENTS

Patients with certain diseases (for example, leukemia, cancer, and extensive skin conditions, such as severe burns or dermatitis) and patients who are receiving certain therapeutic regimens (for example, total body irradiation, steroid or antimetabolite therapy) are highly susceptible to infection. These compromised patients are often on special "protective" patient-care regimens intended to reduce the risk of infection. One such regimen, Protective Isolation (as outlined in the previous editions of *Isolation Techniques for Use in Hospitals*), does not appear to reduce this risk any more than strong emphasis on appropriate handwashing during patient care.

Protective isolation, as previously outlined, may fail to reduce the risk of infection because compromised patients are often infected by their own (endogenous) microorganisms or are colonized and infected by microorganisms transmitted by the inadequately washed hands of personnel or by nonsterile items used in routine protective isolation. Such items may include patient-care equipment, food, water, and air. Some

studies suggest that vigorous efforts to exclude all microorganisms by using patient-isolator units, eradicating endogenous flora, and sterilizing food, water, and fomites may prevent or delay onset of some infections; thus, these procedures have been recommended by some for use with very-high-risk patients who have a predictable temporary period of high susceptibility. However, these extraordinary and expensive precautions do not appear warranted for most compromised patients.

In general, compromised patients should be taken care of by using precautions that are no different from routine good patient-care techniques, but for these patients, routine techniques must be emphasized and enforced. All personnel must frequently and appropriately wash their hands before, during, and after patient care. Compromised patients should be kept separate from patients who are infected or have conditions that make infection transmission likely. They should be put in private rooms whenever possible.

CARE OF PATIENTS WITH BURNS

Burn wounds have been classified as major or minor by various investigators according to several risk factors for burn-associated complications. We have considered only the infectious complications of burns. Therefore, we have classified major burn wounds as those that cannot effectively be covered or whose drainage cannot effectively be contained by use of dressings. The drainage from a minor burn can be covered and contained by dressings.

Most major burn wounds and many minor ones have become infected by the second or third day after the burn occurs. Care of burn patients, therefore, involves efforts to prevent colonization and infection of the wound, and isolation precautions to prevent transmission to other patients. Other important methods of care include use of topical and systemic antimicrobials, vaccines, and general supportive measures.

It is beyond the scope of this guideline to present comprehensive infection control recommendations for taking care of patients with burns. We have, however, made recommendations for isolation precautions for both major and minor burns infected with various pathogens. Rather than listing burn wounds separately, we have grouped them under the subheading "skin, wound, or burn infection."

Isolation precautions and infection control techniques for major burn wounds vary among burn centers. These precautions may involve the use of strictly enforced, frequent handwashing, sterile gowns, sterile gloves, and masks. Since it is not possible to "isolate" a major wound by use of dressings, a private room or a special burn center is indicated for such patients. (American College of Surgeons. Total care for burn patients: a guide to hospital resources. *Bull Am Coll Surgeons* 1977; 62:6-14.)

Guideline for Infection Control in Hospital Personnel

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CDC GUIDELINES ON INFECTION CONTROL

The Guideline for Infection Control in Hospital Personnel is part of the *Guidelines for Prevention and Control of Nosocomial Infections*. The CDC guidelines were developed to provide a central reference for professionals involved in infection control that contains CDC recommendations and is easily accessible to the infection control personnel in hospitals. It should be emphasized that these guidelines represent the advice of CDC on questions commonly asked of the Hospital Infections Program, but are not intended to have the force of law or regulation. These guidelines can be expected to change in response to the acquisition of new knowledge.

Each guideline begins with a preamble that describes the approaches that have been used or advocated to deal with infection control issues and evaluate, where data exist, their efficacy. The preamble is followed by a group of succinct recommendations. The guidelines are assembled in a loose-leaf notebook to allow for the addition of new guidelines as they are developed and revisions as necessary.

Optimally, recommendations should be based on rigorously controlled scientific studies because recommendations of this type have the highest probability of value. There are some recommended practices that have not been adequately evaluated by controlled scientific trials, but are based on such inherent logic and broad experience that experts generally agree that they are useful. At the other extreme are recommendations that are of uncertain benefit and may be quite controversial. To address these last 2 types of practices, realizing that hospitals must make decisions in the absence of definitive data, we have sought the advice of working groups composed of non-CDC experts with broad experience in infection control. CDC has endorsed such recommendations if members of the working group have determined that the recommended practices are likely to be effective.

To assist infection control staff in critically assessing the value of these recommendations, we developed a ranking scheme that takes into account considerations of scientific validity, applicability, and practicality (Table 1). The last 2 considerations are clearly important since scientifically valid infection control practices that are applicable in one setting (e.g., debilitated patients in tertiary referral centers) might not necessarily be applicable or practical in another (e.g., acutely ill patients in community hospitals). Cost effectiveness, another important consideration, is taken into account in the ranking process when possible, although adequate data are generally lacking. We have ranked each recommendation according to the degree to which it has been substantiated by

scientific data or the strength of the working group's opinion on the effectiveness and practical value of the particular practice. The rankings thus provide additional useful information for hospital officials who must decide on the recommendations (e.g., those in Category II and, especially, Category III) that best suit their hospital's needs and resources.

Finally, the adoption of these recommendations by hospitals does not guarantee that hospital personnel will adhere to them. The reduction of nosocomial infection risks depends largely on the actual performance of correct patient-care practices. Personnel may be motivated to follow those practices if they are given adequate training, followed by periodic in-service education. Continuous or periodic evaluation of patient-care practices, preferably under the supervision of the infection control staff, might assure continued performance of correct practices.

Table 1. RANKING SCHEME FOR RECOMMENDATIONS*

Category I. Strongly Recommended for Adoption:

Measures in Category I are strongly supported by well-designed and controlled clinical studies that show effectiveness in reducing the risk of nosocomial infections or are viewed as useful by the majority of experts in the field. Measures in this category are judged to be applicable to the majority of hospitals—regardless of size, patient population, or endemic nosocomial infection rate—and are considered practical to implement.

Category II. Moderately Recommended for Adoption:

Measures in Category II are supported by highly suggestive clinical studies or by definitive studies in institutions that might not be representative of other hospitals. Measures that have not been adequately studied, but have a strong theoretical rationale indicating that they might be very effective are included in this category. Category II measures are judged to be practical to implement. They are *not* to be considered a standard of practice for every hospital.

Category III. Weakly Recommended for Adoption:

Measures in Category III have been proposed by some investigators, authorities, or organizations, but, to date, they lack both supporting data and a strong theoretical rationale. Thus, they might be considered as important issues that require further evaluation; they might be considered by some hospitals for implementation, especially if such hospitals have specific nosocomial infection problems or sufficient resources.

*Recommendations that advise against the adoption of certain measures can be found in the guidelines. These negative recommendations are also ranked into 1 of the 3 categories depending on the strength of the scientific backing or opinions of the members of the working group. A negative recommendation in Category I means that scientific data or prevailing opinion strongly indicate that the measure not be adopted. A negative recommendation in Category III means that, given the available information, the measure under consideration should probably not be adopted; such a measure, however, requires further evaluation.

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Guideline for Infection Control in Hospital Personnel

INTRODUCTION

In the United States, about 5 million persons work in more than 7,000 hospitals. These personnel may become infected through exposure to infected patients if proper precautions are not used, or acquire infection outside the hospital. They may then transmit the infection to susceptible patients or other hospital personnel, members of their households, or other community contacts. In this guideline, we focus on diseases that are of particular concern to hospital personnel because of the possibility of transmission. In some instances we focus our discussion on transmission of infectious disease from patient-care personnel to patients. In other instances we focus on transmission of disease from patients to patient-care personnel. Recommendations for prevention and control are limited to these areas. We frequently refer to the Guideline for Isolation Precautions in Hospitals, where suggestions can be found on precautions that personnel may use when taking care of patients to prevent the spread of infection to themselves, other personnel or patients, and visitors.

Personnel who have direct contact with patients include nursing personnel, medical house staff, clinical faculty, attending physicians, paramedical staff, and nursing and medical students. Since other hospital personnel may have exposure to patients that is comparable in quality, intensity, and duration to that of patient-care personnel, hospitals may also consider them in applying these recommendations. Risk to patients from personnel with whom patients have only brief casual contact, or risk to these personnel, is generally felt to be low.

In the glossary key words or phrases used in this guideline are defined. Issues related to management of outbreaks, exposure to agents in microbiologic and biomedical laboratories, and risks from exposure to noninfectious hazards are not discussed in this guideline.

OBJECTIVES OF A PERSONNEL HEALTH SERVICE FOR INFECTION CONTROL

The infection control objectives of a personnel health service should be part of the hospital's general programs for infection control. The objectives can include 1) stressing maintenance of sound habits in personal hygiene and individual responsibility in infection control; 2) monitoring and investigating infectious diseases, potentially harmful infectious exposures, and outbreaks of infections among personnel; 3) providing care to personnel for work-related illnesses or exposures; 4) identifying infection risks related to employment and instituting appropriate preventive measures; and 5) containing costs by eliminating unnecessary procedures and by preventing infectious disease that results in absenteeism and disability. For these objectives to be met, the support of the administration, medical staff, and other hospital staff is essential.

Whether programs or services other than those for infection control are offered will depend on whether the hospital's personnel health service is devoted mainly to controlling infectious diseases or to providing a comprehensive health program for personnel.

ELEMENTS OF A PERSONNEL HEALTH SERVICE FOR INFECTION CONTROL

The organization of a health service for hospital personnel will depend on many factors, for example, the size of the institution, the number of personnel, and the services offered. These factors will determine the size, location, and staffing of the service. Regardless of how the service is provided, certain elements will assist in effectively attaining infection control goals. These elements are as follows:

1. Placement evaluations
2. Personnel health and safety education
3. Immunization programs
4. Protocols for surveillance and management of job-related illnesses and exposures to infectious diseases
5. Counseling services for personnel regarding infection risks related to employment or special conditions
6. Guidelines for work restriction because of infectious disease
7. Maintenance of health records

Placement Evaluations

When personnel are initially appointed or are reassigned to different jobs or areas, a placement evaluation can be used to ensure that persons are not placed in jobs that would pose undue risk of infection to them, other personnel, patients, or visitors. A health inventory is an important part of this evaluation. This inventory can include determining a health worker's immunization status, and obtaining a history of any conditions that may predispose the health worker to acquiring or transmitting infectious diseases, for example, a history of such childhood diseases as chickenpox and measles, history of exposure to or treatment for tuberculosis, history of hepatitis, dermatologic conditions, chronic draining infections or open wounds, and immunodeficient conditions. Physical examinations may be useful to detect conditions that may increase the likelihood of transmitting disease to patients, or unusual susceptibility to infection, and to serve as a baseline for determining whether any future problems are work-related. There are no data, however, to suggest that routine complete physical examinations are needed for infection control purposes. Neither are there data to suggest that routine laboratory testing (such as complete blood counts, serologic tests for syphilis, urinalysis, chest roentgenograms) or preemployment screening for enteric or other pathogens are cost-beneficial. The health inventory can be used to determine whether physical examinations or laboratory tests are needed. In some areas, however, local public health ordinances may still mandate that certain screening procedures be used.

It is important that initial placement evaluations be done when personnel are hired or as soon after as possible. After the placement evaluation, later appraisals may be done as needed for ongoing programs or evaluation of work-related problems.

Personnel Health and Safety Education

Personnel are more likely to comply with an infection control program if they understand its rationale. Thus, staff education should be a central focus of the infection control

program. Clearly written policies, guidelines, and procedures are needed in many instances for uniformity, efficiency, and effective coordination of activities. Since job categories vary, not all personnel need the same degree of instruction in infection control. Educational programs should be matched to the needs of each group.

Immunization Programs

Since hospital personnel are at risk of exposure to and possible transmission of vaccine-preventable diseases because of their contact with patients or material from patients with infections, maintenance of immunity is an essential part of a hospital's personnel health and infection control program. Optimal use of immunizing agents will not only safeguard the health of personnel but also protect patients from becoming infected by personnel. Following a consistent program of immunizations could eliminate the problem of susceptible personnel and avoid unnecessary work restrictions.

Immunization recommendations are made by the U.S. Public Health Service Immunization Practices Advisory Committee (ACIP) and are published periodically in the *Morbidity and Mortality Weekly Report* (MMWR). Indications for use of licensed vaccines are generally the same for hospital personnel as for the general population; however, immunity to some diseases, such as rubella, may be more important for persons who work in hospitals. Decisions about which vaccines to include in immunization programs can be made by considering 1) the risk of exposure to an agent in a given area, 2) the nature of employment, and 3) the size and kind of institution. The suggestions included in this guideline summarize ACIP recommendations as they apply to hospital personnel. The categories reflect the views of the Working Group for this guideline. The ACIP guidelines should be consulted for a detailed discussion of the rationale for active or passive immunization of hospital personnel and the general population. The ACIP guidelines can be requested from Public Inquiries, Building 1, Room B63, Centers for Disease Control, Atlanta, Georgia 30333.

• Screening for Susceptibility to Hepatitis B or Rubella.

The decision to screen potential vaccine recipients for susceptibility to hepatitis B virus (HBV) is an economic one, because vaccinating HBV carriers or persons already immune does not appear to present a hazard.^{1,2} In the United States the prevalence of previous infection in any targeted group, the cost of screening, and the cost of immunizing personnel determine whether screening would be cost-effective.^{3,4}

Routinely performing serologic tests to determine susceptibility to rubella to be sure vaccine is given only to proven susceptibles may be very expensive. The ACIP believes that rubella immunization of men and women not known to be pregnant is justifiable without serologic testing.⁵

• Vaccine Administration

The most efficient use of vaccines with high-risk groups is to immunize personnel before they enter high-risk situations. It is crucial that persons administering immunizing agents be well-informed about indications, storage, dosage, preparation, and contraindications for each of the vaccines, toxoids, and immune globulins they may use. Product information should be available at all times, and pertinent health history should be obtained from each health worker before an agent is given.

How immunizations are provided to personnel and who pays for vaccines are topics not addressed in this guideline.

Work Restrictions and Management of Job-related Illnesses and Exposures

Major functions of the personnel health service include arranging for prompt diagnosis and management of job-related illnesses and providing prophylaxis for certain preventable diseases to which personnel may be exposed. If susceptible personnel contract a serious infection that is potentially transmissible or are exposed to an illness that leads to a period during which infection may be spread, the hospital's responsibility to prevent the spread of infection to patients and other personnel may sometimes require that these persons be excluded from direct patient contact. For any exclusion policy to be enforceable and effective, all personnel—especially department heads, area supervisors, and head nurses—must know when an illness must be reported. Any policy for work restriction should be designed to encourage personnel to report their illnesses or exposures and not penalize them with loss of wages, benefits, or job status.

Health Counseling

Access to health counseling about illnesses they may acquire from or transmit to patients is especially important for all hospital personnel, but particularly for women of child-bearing age and persons with special clinical conditions. All personnel should know about infection risks related to employment. Female personnel who may be pregnant or who might become pregnant should know about potential risks to the fetus due to work assignments and preventive measures that will reduce those risks. Among the diseases with potential for risk to a fetus if contracted by the mother are cytomegalovirus infection, hepatitis B, and rubella.

Coordinated Planning With Other Departments

For infection control objectives to be achieved, the activities of the personnel health service must be coordinated with the infection control program and with various hospital departments. This coordination will help assure adequate surveillance of infections in personnel and maintenance of effective infection control programs. During case investigations, outbreaks, and other epidemiologic studies that involve hospital personnel, coordinating activities will help to assure that investigations can be conducted efficiently and control measures implemented promptly.

Epidemiology and Control of Selected Infections Transmitted Among Hospital Personnel and Patients

Almost any transmissible infection may occur in the community at large or within the hospital and can affect both personnel and patients. However, only those infectious diseases that occur frequently in the hospital setting or are most important to personnel are discussed below. These diseases have been divided into 2 groups, according to what we know about the epidemiology and whether the primary concern is 1) preventing transmission of infection both to and from personnel and patients or 2) preventing transmission of infection primarily from infected patients to personnel. Within each sec-

tion, diseases are listed alphabetically. Relevant epidemiology, microbiology, and preventive measures are reviewed for each disease. Infections that are unusual or are not major nosocomial problems in this country receive only a brief comment or none at all.

In all patient-care activities, personnel can decrease the risk of acquiring or transmitting infection by careful handwashing and by taking care of patients with potentially transmissible infections according to the CDC Guideline for Isolation Precautions in Hospitals.

Group I Infections: Transmission to and from Personnel

ACQUIRED IMMUNODEFICIENCY SYNDROME (AIDS)

Personnel have been exposed to patients with AIDS and to their clinical specimens; however, there is currently no evidence of AIDS transmission to hospital personnel or from hospital personnel to patients. The etiology of the underlying immune deficiencies of patients with AIDS is unknown. One current hypothesis is that a transmissible agent is involved. If so, the agent appears to be transmitted most commonly through intimate, direct contact with mucosal surfaces or through parenteral spread. Airborne spread and interpersonal spread through casual contact do not seem likely. These patterns resemble the distribution of disease and modes of spread of hepatitis B virus.

With our present knowledge, it appears prudent for hospital personnel to use similar precautions when taking care of patients with AIDS as those used for patients with hepatitis B virus infection⁶ (see Guideline for Isolation Precautions in Hospitals). It also appears prudent for hospital personnel who have AIDS to use similar precautions as those suggested for known carriers of HBsAg to minimize their infectious risk to others (see hepatitis discussion below). Precautions have been advised for persons and specimens from persons in certain patient categories considered to be part of the AIDS spectrum. These categories include persons with the following illnesses: opportunistic infections that are not associated with underlying immunosuppressive disease or therapy; Kaposi's sarcoma (patients under 60 years of age); chronic generalized lymphadenopathy, unexplained weight loss, and/or prolonged unexplained fever in persons who belong to groups with apparently increased risk of AIDS (homosexual men, intravenous-drug abusers, Haitian immigrants, hemophiliacs).⁶ However, since AIDS

has been diagnosed in persons not in identified high-risk groups, personnel may also use precautions when taking care of patients whose clinical condition and epidemiologic history suggest a risk for developing AIDS. Any new information on the cause and transmission of AIDS should be considered when precautions are designed or changed.

Extraordinary care must be taken to avoid accidental wounds from sharp instruments contaminated with potentially infective material and to avoid contact of mucous membranes and open skin lesions with materials from AIDS patients. Because of the lack of pertinent information, no particular course of action can be recommended in the event of accidental percutaneous or mucosal exposure to potentially infective material from patients with AIDS. Since these patients are often in high-risk groups for hepatitis B, following the suggestions for handling exposures to blood at high risk of being positive for hepatitis B surface antigen (HBsAg) may be considered (Table 1). Currently, no information is available on the potential benefits or problems associated with administering passive or active immunizing agents or therapy in this situation.

ACUTE DIARRHEA

Various agents may cause diarrhea in patients and hospital personnel. *Salmonella*, *Shigella*, and *Campylobacter* species are among the common bacterial enteric pathogens. Infection with these agents may produce mild symptoms but is often accompanied by other symptoms, such as abdominal cramps, fever, or bloody diarrhea. Diarrheal illness accompanied by such symptoms suggests a bacterial cause. Rotavirus and the 27-nanometer (Norwalk and Norwalk-like) agents are among the chief causes of sporadic and epidemic viral gastroenteritis. *Giardia lamblia* and other protozoa are also frequent causes

Table 1. Summary of Postexposure Prophylaxis for Acute Percutaneous (Needle-stick) Exposures to HBV*

Status of the patient's blood the health worker was exposed to	HBsAg testing recommended	Recommended prophylaxis
HBsAg-positive		HBIG (0.06 ml/kg) immediately and 1 month after needle-stick
HBsAg status unknown		
Source known:		
Blood is at High Risk (β) of being HBsAg-positive	Yes§	IG (0.06 ml/kg) immediately and if test positive HBIG (0.06 ml/kg) immediately and 1 month after needle-stick or if test negative nothing
Blood is at Low Risk (¶) of being HBsAg-positive	No	Nothing or IG (0.06 ml/kg)
HBsAg status unknown		
Source unknown	No	Nothing or IG (0.06 ml/kg)

*Consult current ACIP recommendations for important details.

(β) High risk that the source is HBsAg-positive—such as patients with acute, unconfirmed viral hepatitis; patients institutionalized with Down's syndrome; patients on hemodialysis; persons of Asian origin; homosexual men; users of illicit, intravenous drugs.

§ If results can be known within 7 days after exposure. Although prophylaxis may be given up to 7 days after exposure, it is most effective when given as soon after exposure as possible, preferably within 24-48 hours. Screening of exposed personnel to determine susceptibility may also be considered, but the decision to screen should not delay the administration of globulin.

(¶) Low risk that the source is HBsAg-positive—such as the average hospital patient.

HBIG = Hepatitis B immune globulin

IG = Immune globulin (formerly called "immune serum globulin," ISG, or "gamma globulin")

of diarrhea. Any of these agents may be nosocomially transmitted via the hands of personnel who are infected.

If personnel contract an acute diarrheal illness accompanied by fever, cramps, or bloody stools, they are likely to be excreting potentially infective organisms in high titer in their feces. The specific cause of acute diarrhea, however, cannot be determined solely on the basis of clinical symptoms; thus, appropriate laboratory tests are important. Not allowing these persons to take care of patients pending evaluation will prevent transmission. Evaluation of personnel may usually be limited to an initial culture for bacterial pathogens and stool examination for intestinal protozoa; repeat studies may be indicated if the results of the first tests are negative and the illness persists.

Carriage of Enteric Pathogens by Personnel

Carriage of enteric pathogens may persist after resolution of the acute illness. Once the person has clinically recovered and is having formed stools, however, there should be little hazard to patients, provided normal hygienic practices are observed. Existing data suggest that appropriate antibiotic therapy may eradicate fecal excretion of *Shigella* or *Campylobacter*. If persons take antibiotics, any follow-up cultures are best taken 48 hours after the last dose. Carriage of *Salmonella*, however, calls for special concern, because carriage may be prolonged and because the clinical sequelae of acute salmonellosis are often severe in high-risk patients, such as newborns, the elderly, immunocompromised patients, and the severely ill, such as those in intensive care units. Antibiotic therapy may prolong *Salmonella* excretion or lead to emergence of resistant strains and is not generally indicated. Thus, special precautions regarding contact with high-risk patients may be needed for personnel who are convalescent carriers of *Salmonella*.

Generally, personal hygiene, particularly handwashing by personnel before and after all patient contacts, will minimize the risk of transmitting enteric pathogens to patients. Maintaining good hygiene when away from the work setting will minimize the risk of transmission to family contacts.

Food-service personnel are not discussed in this guideline. Precautions for personnel taking care of patients who have gastroenteritis are discussed in the Guideline for Isolation Precautions in Hospitals.

HEPATITIS

Viral hepatitis has long been recognized as a nosocomial hazard. The agents that most commonly cause viral hepatitis are hepatitis A virus (HAV), hepatitis B virus (HBV), and 1 or more viruses currently designated non-A, non-B (NANB).

Hepatitis A

Nosocomial hepatitis A occurs infrequently and is associated with 2 unusual circumstances: 1) the source of infection is a patient hospitalized for other reasons whose hepatitis is not apparent, and 2) the patient is fecally incontinent. These circumstances may occur in adult and pediatric patients.

Hepatitis A is transmitted primarily by the fecal-oral route. It has not been reported to occur after inadvertent needle sticks or other contact with blood. Personnel who have frequent contact with blood, such as those who work in dialysis units, do not have evidence of increased infections with HAV.⁷ Hepatitis A has, however, been reported to be transmitted by blood transfusion.⁸

Fecal excretion of HAV is greatest during the incubation period of disease before the onset of jaundice. Once disease is clinically obvious, the risk of transmitting infection is decreased. However, some patients admitted to the hospital with hepatitis A may still be shedding virus^{9,10} and are potentially infective. Fecal shedding of HAV can continue for up to 2 to 3 weeks after onset of dark urine; however, in most persons, viral shedding is complete about 7 days after dark urine appears.⁹ Anicteric infection may also occur, especially in young children. There is no evidence supporting the existence of a chronic HAV carrier state.

Personnel can help protect themselves and others from infection with HAV by always maintaining good personal hygiene, practicing thorough handwashing at all times, and taking care of patients known to be infected with HAV according to published recommendations (see Guideline for Isolation Precautions in Hospitals). If personnel become infected with HAV, the risk of transmitting infection is very low or negligible after about 7 days after onset of jaundice. Foodborne transmission of hepatitis A is not discussed in this guideline.

Hepatitis B

Most nosocomial cases of hepatitis B unrelated to the transfusion of blood or blood products occur in hospital personnel rather than patients. Transmission occurs by parenteral or mucosal exposure to HBsAg-positive blood from persons who are carriers or have acute HBV infection. Often carriers of HBsAg and persons with acute infections are unrecognized and are therefore not known to be infective. The infectivity of blood is best correlated with the presence of hepatitis B "e" antigen (HBeAg); however, any blood that is HBsAg-positive is potentially infective. Presence of HBeAg correlates strongly with the number of infective HBV in the serum.

The principal modes of HBV transmission are given below in order of decreasing efficiency:

1. **Overt parenteral transmission.**
Direct percutaneous inoculation by needle or instrument contaminated with serum or plasma (for example, accidental needle-sticks, transfusion of contaminated blood or blood products, and acupuncture).
2. **Inapparent parenteral transmission.**
 - a. Percutaneous inoculation with infective serum or plasma without overt needle puncture (for example, contamination of fresh cutaneous scratches, abrasions, burns, or other lesions).
 - b. Contamination of mucosal surfaces with infective serum or plasma (for example, mouth pipetting accidents, accidental eye splash, and other direct contact with mucous membranes of the eyes or mouth, such as hand to mouth or eye when contaminated with infective blood or serum).
 - c. Transfer of infective material to skin lesions or mucous membranes via inanimate environmental surfaces (for example, surfaces of various types of hospital equipment, devices, and rubber gloves).
 - d. Contamination of mucosal surfaces with infective secretions other than serum or plasma (for example, contact involving saliva or semen).

Fecal-oral transmission of HBV does not appear to occur; however, transmission among homosexual men has been described, possibly via contamination from asymp-

omatic rectal mucosal lesions at sites of sexual contact.¹¹ Airborne spread of HBV by droplet nuclei does not appear to be epidemiologically important.^{12,13} Transmission of HBV in dental operatories, however, by large droplets that may strike mucous membranes or contaminate environmental surfaces has not been ruled out.¹³

Within the hospital setting certain work locations and occupational categories have been identified as showing increased risk for hepatitis B infection.^{7,14-20} Generally, the highest risk of HBV infection is associated with locations and occupations in which contact with blood from infected patients is frequent. The locations and occupations are as follows:^{*}

<i>Work locations</i>	<i>Occupational categories</i>
Blood banks	Dentists and dental surgeons
Clinical laboratories	Dialysis technicians
Dental clinics	Laboratory technicians
Dialysis wards	Nurses
Emergency rooms	Physicians (especially surgeons and pathologists)
Hematology/oncology wards	
Operating and recovery rooms	
Pathology laboratories	

Hospital personnel who do not have physical exposure to blood are at no greater risk than the general population. Patient contact without physical exposure to blood has not been documented to be a risk factor.

To prevent transmission of hepatitis B, hospital staff must be aware of the modes of transmission and the appropriate precautions in taking care of infected patients or handling their clinical specimens (see Guideline for Isolation Precautions in Hospitals). In general, the major emphasis is on applying blood precautions, practicing proper handwashing, having minimal contact with blood or blood-contaminated excretions, and handling the blood of all patients as potentially infective material.²¹

Since droplets from the patient's mouth reach the face of the dentist during certain procedures, dentists might consider protecting their eyes, nose, and mouth from such exposure by using masks and protective eyewear. They can prevent direct contact with infective material in the mouth by routinely wearing gloves during dental procedures.

● **Acute HBV Infection in Personnel and HBsAg Carriers**

A carrier is defined as a person who is HBsAg-positive on at least 2 occasions at least 6 months apart. After acute infection with HBV, the likelihood of developing the carrier state lessens as the person gets older and depends on the host's immune responsiveness. Carriers and persons with acute cases have the highest concentrations of HBV in the blood and serous fluids. The risk of transmission of HBV by HBsAg-positive health professionals has been examined in recent reports.²²⁻²⁸ Transmission has been documented in a few instances from oral surgeons, gynecologists performing complex pelvic surgery, and a general practitioner. HBsAg-positive personnel with exudative dermatitis on body areas that may contact patients may also pose a risk to patients.²⁸

*Adapted from Maynard, JE. Nosocomial viral hepatitis. *Am J Med* 1981; 70:440.

Among dental practitioners who do not routinely wear gloves, a greater risk of transmitting infection appears to be associated with highly traumatic dental work, such as tooth extractions and surgery, than with less traumatic work such as examinations and restorations. Transmission by surgeons has been related to type of surgery, in particular, major operative procedures, such as laparotomy, hysterectomy, and major repairs, during which the chance of accidental puncture wounds is presumably greater. In 1 instance, transmission by a hospital worker with a severe exudative dermatitis on both hands appeared to be related to contamination of indwelling arterial catheters.²⁸

The asymptomatic carrier of HBsAg and the person with an acute case do not appear to endanger susceptible persons except through direct inoculation of his or her blood or contaminated secretions. Thus, these persons need not be restricted from patient-care responsibilities, unless there is epidemiologic evidence that the worker is transmitting infection.

Personnel who are HBsAg-positive may be able to reduce or eliminate their risk of infecting patients by wearing gloves during high-risk procedures in which their blood or body fluids may contact patients.^{22,23} Double-gloving during complex surgery might also help interrupt transmission.²⁶ Furthermore, it is crucial to counsel known carriers of HBsAg about practicing good personal hygiene, preventing their blood and potentially infective body fluids from contacting other persons, and not donating blood.

● **Hemodialysis Centers**

Infection with HBV has represented a great hazard to both patients and personnel in hemodialysis centers. If adequate infection control strategies are not practiced, hepatitis B infection, once introduced, can become endemic, with patients and environmental surfaces acting as reservoirs. Isolating or segregating patients who are HBV carriers, combined with assigning seropositive personnel to take care of these patients, has greatly decreased transmission of HBV in this environment. A complete discussion of the modes of transmission and control measures for hepatitis B in dialysis centers has been published.²⁹

● **Pregnant Personnel**

Pregnant personnel are at no greater risk of contracting hepatitis than other personnel; however, if a woman develops hepatitis B during pregnancy and is HBsAg-positive at the time of delivery, the infant is at high risk of developing neonatal hepatitis and becoming an HBsAg carrier.^{30,31} Because of this risk, it is important that pregnant personnel know the dangers of working in high-risk departments and be familiar with precautions that should be used.²⁹ Female personnel of childbearing age may also consider immunization with hepatitis B virus vaccine (see below).

● **Hepatitis B Virus (HBV) Vaccine**

An inactivated vaccine of high immunogenicity and efficacy is commercially available. The application of the vaccine in acute-care hospitals will depend on the risk of HBV infection for hospital personnel and the cost of vaccine.

Present estimates of risk have been based primarily on studies of the prevalence of hepatitis serum markers in selected groups.^{14-17,19,20} Incidence studies of HBV infection among hospital personnel have been few,^{18,32,33} and have not included all groups of hospital personnel and appropriate

community controls. Thus, data that can be used to analyze the cost-effectiveness of administering vaccine to hospital personnel are not complete.

Because the risk that hospital personnel will acquire hepatitis B varies among hospitals and among different occupational groups within hospitals, each hospital should formulate its own specific immunization strategy. In developing specific immunization strategies, hospitals may use available published data^{14-20,32,33} about the risk of infection. Some institutions may instead choose to serologically screen personnel in various occupational categories or work locations to determine the prevalence of seropositivity in these groups.

The decision to screen potential vaccine recipients for susceptibility to hepatitis B is an economic decision; immunizing HBV carriers and persons already immune does not appear to present a hazard.^{1,2} In the United States, the prevalence of previous infection in any targeted group, the cost of screening, and the cost of immunizing personnel determine whether screening would be cost-effective.^{3,4}

HBV vaccine is reported to be safe.³⁴⁻³⁸ The Immunization Practices Advisory Committee (ACIP) has published a discussion of this vaccine and its use.³

Non-A, Non-B Hepatitis

The epidemiology of NANB hepatitis in the United States more closely resembles that of hepatitis B than that of hepatitis A. Important aspects of NANB infections are as follows: 1) the NANB agent(s) circulates in the blood in acute cases, 2) there appears to be a chronic blood carrier state during which blood may remain infective, and 3) transmission of NANB infection is usually associated with percutaneous needle exposure or other exposure to blood, or with inapparent parenteral transmission. Since blood containing HBsAg is not used for transfusion, most post-transfusion hepatitis in the United States is NANB. Thus, emphasis on blood precautions, as with hepatitis B, seems the most reasonable current approach to preventing transmission from patients to personnel. For personnel who contract this illness, precautions suggested for hepatitis B should be adequate to prevent transmission to patients. Techniques are not yet available to detect specific antigens and antibodies or to determine the period of infectivity after acute infection.

Needle-stick Injuries

Needle-stick injuries account for a large number of the work-related accidents reported in hospitals.³⁹ Most injuries happen on patient-care units when personnel are 1) disposing of used needles, 2) administering parenteral injections or infusion therapy (especially to uncooperative patients), 3) drawing blood, 4) recapping needles after use, 5) handling linens or trash containing uncapped needles, or 6) cleaning up after patient-care procedures in which needles are used. Although other infections have been reported to be transmitted by accidental needle sticks, hepatitis B and probably NANB pose the greatest risks to hospital personnel. In the absence of immunoprophylaxis, the risk of acquiring overt hepatitis B through an accidental puncture wound from a needle used on an HBsAg-positive patient is about 6%.⁴⁰

The risk of needle-stick injuries can be reduced by discarding used needles in puncture-resistant disposal units without first recapping them or purposely bending or break-

ing them by hand. Risk of injury may also be reduced if personnel obtain assistance when administering injections or infusion therapy to uncooperative patients and if personnel use caution when cleaning up after procedures that include the use of needles. Additionally, the incidence of needle-stick injuries may be reduced by providing needle-disposal units throughout the hospital in locations that facilitate their immediate use, for example, in nursing stations, patient rooms, laboratories, and utility rooms.⁴¹ When some needle-cutting devices are used, blood may spatter onto environmental surfaces. Currently, no data are available from controlled studies examining the effect, if any, of needle-cutting devices on the incidence of needle-stick injuries.

After some needle-stick injuries, immunoprophylaxis for hepatitis B or NANB may be advisable.⁴² Immune globulins for protection against viral hepatitis are most effective when given soon after exposure.

HERPES SIMPLEX VIRUSES

Herpes simplex viruses (HSV) can be transmitted among personnel and patients through either primary or recurrent lesions or through secretions (such as saliva, vaginal secretions, infected amniotic fluid) that can contain the virus when no lesions are obvious. Although many sites can become infected, exposed areas of skin are most likely to be involved, particularly when minor cuts, abrasions, or other skin lesions are present. Direct contact with lesions or infected secretions is the principal mode of spread.

Transmission of HSV From Patients to Personnel

Personnel may develop an infection of the fingers (herpetic whitlow or paronychia) from exposure to contaminated oral secretions. Such exposure is a distinct hazard for nurses, anesthesiologists, dentists, respiratory care personnel, and other personnel who may have direct (usually hand) contact with either oral lesions or respiratory secretions from patients. Less frequently, personnel may develop infection of the fingers from exposure to contaminated genital secretions or lesions on skin or mucous membranes. Personnel can protect themselves from such infections by 1) avoiding direct contact with lesions, 2) wearing gloves on both hands or using "no-touch" technique for all contact with oral or vaginal secretions, and 3) thorough handwashing after patient contact (see Guideline for Isolation Precautions in Hospitals).

Transmission of HSV From Personnel to Patients

Currently, there is no evidence that personnel with genital infections pose a high risk to patients if personnel follow good patient-care practices. The risk posed by personnel with orofacial herpes to patients is unknown. Personnel with oral infections, however, can reduce the risk of infecting patients by 1) wearing an appropriate barrier—such as a mask or gauze dressing—to prevent hand contact with the lesion, 2) washing hands well before all patient care, and 3) whenever possible, not taking care of patients at high risk of severe infection such as neonates, patients with severe malnutrition, severely burned patients, and patients in immunodeficient states. The potential risk of infecting high-risk patients must be weighed against the possibility of compromising patient care by excluding personnel with orofacial herpes.

Personnel with herpetic whitlow may be more likely to transmit infection by contact. Personnel can prevent trans-

mission of HSV to patients by not working when they have active infections of the hands. Although some have suggested that personnel with herpetic whitlow may have patient contact if they wear gloves,^{43,44} the adequacy of this method of preventing transmission of infection is unknown.

STAPHYLOCOCCUS AUREUS AND STREPTOCOCCUS, GROUP A AND GROUP B

Carriage of potential pathogens by hospital personnel has been a traditional concern of infection control practitioners. Management of personnel who are infected with *Staphylococcus aureus* or carriers of *Staphylococcus aureus* or group A or group B *Streptococcus* is discussed here. Carriage of enteric pathogens and meningococci by hospital personnel are covered elsewhere; carriage of other organisms, such as gram-negative bacteria, has rarely been implicated as a source of nosocomial infection and is not discussed.

Staphylococcus aureus Infection and Carriage

Staphylococcal carriage or infection occurs frequently in humans. In nosocomial transmission, there are 2 sources: a person with a lesion or an asymptomatic carrier. Persons with skin lesions due to *S. aureus* are most likely to disseminate these organisms. Direct contact is the major route of transmission. Even a single boil in an occult body site (for example, the axilla) caused by *S. aureus* may increase the likelihood of dissemination. One way to decrease the possibility of dissemination is to not allow patient-care personnel to work until skin infection caused by this organism is resolved.

The anterior nares is one of the most commonly colonized sites, but carriage of *S. aureus* may occur at other sites, such as the axilla or perineum. The epidemiology of methicillin-resistant staphylococci does not appear to be different, except that nasal carriage may be less frequent, and outbreaks tend to occur more frequently in intensive care and burn units.

Culture surveys of personnel can detect carriers of *S. aureus* but do not indicate whether carriers are likely to disseminate their organisms. Thus, such data are difficult to interpret. A more reasonable approach is to emphasize effective surveillance that permits prompt recognition of staphylococcal infections in both personnel and patients. If certain personnel are linked epidemiologically to an increased number of infections, these persons can be cultured and, if positive, removed from patient contact until carriage is eradicated. Treatment regimens, followup of implicated personnel, and management of outbreaks are not discussed in this guideline.

Group A Streptococcus Carriage

For nosocomial transmission, the main reservoirs for group A *Streptococcus* appear to be the pharynx, the skin, the rectum, and the female genital tract. Direct contact and large droplets are the major modes of transmitting this organism; however, airborne spread has been suggested.^{45,46}

Although pharyngeal and skin infections are the most common group A streptococcal infections, outbreaks of surgical wound infections caused by this organism have been more important in the hospital. Since group A streptococcal surgical wound infections occur infrequently, the occurrence of cases should prompt a search for a carrier. If personnel are linked epidemiologically to the occurrence of disease, they should be cultured, and if positive, removed

from patient contact until carriage is eradicated. Treatment regimens, followup of implicated personnel, and management of outbreaks are not discussed here.

Group B Streptococcus Carriage

Carriage of group B *Streptococcus* by personnel does not appear to be important in nosocomial transmission. The epidemiology of group B streptococcal infections in neonates suggests that maternal colonization with group B *Streptococcus*, followed by the infant's acquisition during passage through the birth canal, accounts for most infections that have onset soon after birth. Spread of the organism from colonized to uncolonized infants via the hands of personnel, however, may play a role in late onset neonatal infections. Careful handwashing by personnel will minimize the risk of spread from colonized to uncolonized infants.

TUBERCULOSIS

Even though the risk of nosocomial infection with *Mycobacterium tuberculosis* is low, tuberculosis (TB) continues to pose a problem for health-care personnel. In the hospital, infection is most likely to occur when a patient has unsuspected pulmonary or laryngeal TB, has bacilli-laden sputum or respiratory secretions, and is coughing or sneezing into air that remains in circulation. The best ways to protect others from a patient with TB are to maintain a high index of suspicion for TB and to institute appropriate precautions (see Guideline for Isolation Precautions in Hospitals). A complete discussion of the transmission of tuberculosis in hospitals has been published elsewhere.⁴⁷

Screening Programs

A tuberculosis screening and prevention program for personnel is important in protecting personnel and patients.^{48,49} It is important that all institutions have a screening program; however, the program should be based on local epidemiologic data, because risk of transmission varies broadly among different segments of the population and in different localities. It is important to identify hospital personnel with tuberculous infection without evidence of current (active) disease, because preventive treatment with isoniazid may be indicated.⁵⁰ Persons with tuberculous infection are those with a significant skin-test reaction, usually defined as 10 mm or more of induration to 5 Tuberculin Units (TU) of Purified Protein Derivative-Standard (PPD-S) administered via the Mantoux technique.

The tuberculin skin test is the method of choice for TB screening. The Mantoux technique (intracutaneous injection of 0.1 ml of PPD-tuberculin containing 5 TU) is preferred for screening persons for TB infection,⁵¹ because it is the most accurate test available. A 2-step procedure⁵² can be used to minimize the likelihood of misinterpreting a boosted reaction as a true conversion due to recent infection.^{52,53} In the 2-step procedure, an initial tuberculin skin test (Mantoux, 5 TU PPD) is given. If this test result is 0-9 mm of induration, a second test is given at least 1 week and no more than 3 weeks after the first. The results of the second test should be used as the baseline test in determining treatment and follow-up of these personnel. A skin test result of 10 mm of induration or more is considered to be significant.

The 2-step procedure, however, may not always be necessary. Personnel in the second or third decade of life may be less likely to have had remote infection with *M. tuberculosis*. Thus, the age of personnel in an institution and the

epidemiology of nontuberculous mycobacterial infection in the geographic location may determine the frequency of the booster phenomenon.⁵³ Depending on these factors, the 2-step method may not detect any more reactors than a single test. A pilot study may be useful to assess the frequency of the booster phenomenon in a given hospital and, thus, the need for the 2-step test.⁵⁴

Multipuncture skin-test methods deliver an unknown quantity of antigen and may produce both false-positive and false-negative results. When repeated tuberculin testing is required or in postexposure testing, multipuncture methods do not allow precise interpretation of test results and proper counseling.

After the initial TB screening test, policies for repeat testing can be established by considering factors that contribute to the risk that a person will acquire new infection.⁴⁹ These factors include the location and prevalence of untreated TB in the community, in the institution, and among personnel.⁴⁹ For personnel considered to be at significant risk, repeat skin tests may be necessary on a routine basis (for example, every 3–6 months or yearly). If the risk of exposure to TB is small, it is not necessary to repeat skin tests routinely.

During TB screening, it is important to obtain an initial chest roentgenogram on those persons with significant skin-test reactions, those who convert their skin tests, or those who have pulmonary symptoms that may be due to TB. There is no need to obtain routine chest films of asymptomatic, tuberculin-negative personnel.

After initial chest films of persons with significant reactions, repeated chest X-ray examinations have not been found to be of sufficient clinical value or to be cost-effective in monitoring persons for development of disease.⁵⁵ Thus, personnel known to have a significant reaction and significant reactors who have completed adequate preventive treatment do not need repeat chest films unless they have pulmonary symptoms that may be due to TB.^{55,56}

Management of Personnel After Exposure

If personnel are exposed to an infective patient with TB and do not use proper precautions, it is important to skin-test these personnel 10 weeks after the exposure. Ten weeks is the upper limit of the time required for an infected person to develop hypersensitivity to tuberculin. Unless a recent skin test was given, for example, during the 3 months before the exposure, a baseline test may be needed as soon as possible after the exposure, to help in deciding whether a significant reaction at 10 weeks represents a recent conversion related to the exposure.

Because the size of the skin-test reaction can be so important, the Mantoux technique is preferred for postexposure evaluations. Those already known to have significant reactions need not be skin-tested. Those who have significant reactions upon testing need chest roentgenograms to exclude the possibility of tuberculous pulmonary disease. If chest films are normal, these persons can be advised to receive preventive treatment, unless such treatment is contraindicated. If the chest film has abnormalities compatible with pulmonary TB, these personnel need evaluation to rule out the possibility of current disease.

BCG Vaccination

Many bacille Calmette-Guérin (BCG) vaccines are avail-

able today, and they vary in immunogenicity, efficacy, and reactogenicity. Controlled trials of previous vaccines conducted before 1955 showed protection ranging from 0 to 80%; however, the efficacy of vaccines currently available in the United States has not been demonstrated directly and can only be inferred. Thus, the skin-test reaction after BCG vaccination may be quite variable, and it cannot be distinguished from that due to virulent tuberculous infection. Caution is necessary in attributing a significant skin test to prior BCG vaccination, especially if the vaccinee has recently been exposed to infective tuberculosis. A history of BCG vaccination, then, should not preclude an initial screening test, and it is important to manage a significant reaction in BCG-vaccinated persons as a possible tuberculous infection.

Skin testing after BCG vaccination or natural infection with mycobacteria may be associated with adverse reactions, including severe or prolonged ulceration at the test site. Initial use of 1 TU PPD or a partial dose of 5 TU PPD may be useful in avoiding untoward reactions in persons who might be expected to have a severe reaction, such as those with an undocumented history of a large reaction in the past. A full 5 TU dose may be used safely if the initial skin test is negative. The efficacy of this method, however, has not been examined in controlled trials.

Generally in the United States, adequate surveillance and control measures rather than BCG vaccination are all that is necessary to protect hospital personnel and patients.

Preventive Treatment and Work Restrictions

Preventive treatment of persons with significant tuberculin reactions may decrease the risk that their subclinical infections will progress to clinical disease. In determining priorities for preventive therapy the decision-maker must weigh the risk of the person's developing current tuberculosis against the risk of isoniazid toxicity, the ease of identifying and supervising those to whom preventive therapy is offered, and the likelihood of their infecting others. About 5% of persons who are recent converters will develop current disease in the first 1–2 years after infection; the risk of developing current disease gradually declines thereafter. Persons for whom preventive treatment is recommended include newly infected persons, significant reactors with abnormal chest roentgenograms and negative bacteriologic findings, persons with special clinical conditions, significant reactors less than 35 years old, even in the absence of additional risk factors, and household members of persons with newly discovered TB.⁵⁰ Contraindications to treatment include 1) previous isoniazid-associated hepatic injury or other severe adverse reactions (for example, drug fever, chills, and arthritis), and 2) acute liver disease of any etiology. Persons of age 35 years or more may need preventive treatment, if the potential exists for transmitting disease if it develops.⁵⁰ Since the risk of developing current disease is low, work restrictions may not be necessary for otherwise healthy persons who do not accept preventive therapy. However, it is essential that they be instructed to seek evaluation promptly if symptoms develop that may be caused by TB, especially if they have contact with high-risk patients.

Personnel with current pulmonary or laryngeal TB pose a risk to patients and other personnel while they are infective. Stringent requirements regarding work restrictions for hospital personnel are necessary because of this special sit-

uation. Objective measures of lack of infectivity are negative cultures and sputum smears that are free of bacilli. Criteria for removing from or returning to work should always be tailored to the individual. Multiple factors should be considered, including those that influence the expulsion of infective particles in the work air space, mainly coughing, and the characteristics of potential contacts in the work environment and possible consequences, if they become infected.⁵⁷

VARICELLA ZOSTER

Varicella-zoster virus (VZV) is the etiologic agent of varicella (chickenpox) and zoster (shingles). Nosocomial transmission of varicella-zoster infection among personnel and patients is well recognized. Appropriate isolation of hospitalized patients with known or suspected varicella or zoster can reduce the risk of transmission to personnel (see Guideline for Isolation Precautions in Hospitals). It is advisable to allow only personnel who have had varicella or those with serologic evidence of immunity to take care of these patients.

Varicella

Varicella is transmitted primarily via airborne spread by small particle aerosols (droplet nuclei) and by large particles (droplets). The virus may also be spread by direct contact but is not likely to be spread by inanimate objects because the virus is extremely labile. The incubation period for varicella in the normal host ranges from 10 to 21 days.

Even though personnel who are susceptible to varicella may be few, it is useful to identify such persons at the time of the placement evaluation. Most persons with a clearly positive history of previous varicella are probably immune. Many with negative or unknown histories may be immune, but some may also be susceptible.⁵⁸ When available, serologic screening may be used to define susceptibility more precisely. In institutions where varicella is prevalent or where there are many high-risk patients, it may be useful to screen those personnel who have a negative or equivocal history of varicella for the presence of serum antibodies to VZV to document susceptibility or immunity. This knowledge will help in assigning personnel to areas where VZV infection is present, avoiding unnecessary work restrictions and disruption of patient service if exposure occurs, and reducing the chance of nosocomial transmission.⁵⁹ Sensitive screening techniques exist, for example, fluorescent antibody to membrane antigen (FAMA), immune adherence hemagglutination (IAH), or enzyme-linked immunosorbent assay (ELISA), but they may not be readily available. The complement fixation (CF) test is not considered to be reliable because of the false-negative results obtained by this method.

If susceptible personnel are exposed to persons with varicella, these personnel are potentially infective during the incubation period (10 to 21 days after exposure). If varicella occurs, transmission is possible until all lesions are dry and crusted.

Zoster

Zoster appears to occur as a result of activation of latent VZV. There is scant evidence to support the view that zoster can be contracted by exposure to persons with varicella or zoster. However, varicella-zoster virus can be transmitted by direct contact with a person with zoster. If susceptible

personnel are exposed to zoster, varicella may occur; thus, these persons may transmit VZV during the incubation period of varicella.

Because of the possibility of transmission and development of severe illness in high-risk patients, it may be advisable to exclude personnel with zoster from taking care of high-risk patients until all lesions are crusted. Personnel with zoster may not pose a special risk to other patients if the lesions can be covered.

VIRAL RESPIRATORY INFECTIONS

Viral respiratory infections are common problems for infection control programs. The role of viruses in nosocomial infections has been recently discussed⁶⁰⁻⁶² (also, see Guideline for Prevention of Nosocomial Pneumonia). Hospital personnel, visitors, and patients are important sources of viruses.

The 3 chief mechanisms of transmission of respiratory viruses are 1) small-particle aerosols (droplet nuclei), 2) large particles (droplets), and 3) inoculation of viruses after direct contact with infective areas or materials. Different respiratory viruses may vary in the way in which they are transmitted.

Small-particle aerosols are produced by talking, sneezing, or coughing and may transmit infection over a considerable distance (more than 3 feet). Large particles (droplets) are produced by sneezing and coughing and require close person-to-person contact for transmission. Person-to-person transmission can also occur by contaminating the hands by direct contact with infective areas or materials, then transferral of infective virus to mucous membranes of a susceptible person. Self-inoculation can also occur in this way. The nose and eyes, rather than the mouth, appear to be important portals of entry.

Pediatric patients appear to be at particular risk for complications from nosocomial respiratory tract infections. Infection in the elderly, patients with chronic underlying illness, and immunocompromised patients may also be associated with significant morbidity. Thus, it may be prudent to exclude personnel with viral respiratory infections from the care of these high-risk patients. Because large numbers of personnel may have viral respiratory illnesses during the winter, it may not be possible to restrict all such personnel from taking care of patients not in high-risk groups. In all instances, careful handwashing before patient contact is essential in preventing transmission. If handwashing is done appropriately, gloves and routine use of gowns may have no additional benefit in preventing transmission to patients.^{63,64} Masks might be beneficial in preventing transmission by large droplets from personnel to patients upon close contact. However, masks probably will not completely protect personnel from patients with respiratory illnesses because large particles and aerosols may still reach the eyes, and self-inoculation from contaminated hands can still occur by touching the eyes.

Influenza epidemics may require other measures. Because influenza epidemics are unpredictable, hospitals may want to determine their policy on influenza immunization each year, taking note of the recommendations from the Immunization Practices Advisory Committee (ACIP), which are revised annually. Nosocomial spread of influenza might be reduced by immunizing personnel and high-risk patients several weeks or longer before the influenza season. An antiviral drug, amantadine, may be useful to limit spread to and from patients and unimmunized personnel during an epidemic of influenza A.

Group II Infections: Transmission from Patients to Personnel

CYTOMEGALOVIRUS

Personnel may be exposed to patients with cytomegalovirus (CMV) infection, but the risk of acquiring CMV infection from patients appears to be small. There are 2 principal reservoirs of CMV in the hospital: 1) infants infected with CMV and 2) immunocompromised patients, such as oncology patients and those undergoing kidney or bone marrow transplant. Available data have shown no evidence of an excess risk of transmission of CMV to personnel working in dialysis units,⁶⁵ oncology wards,⁶⁶ or pediatric areas, when compared with personnel with no patient contact.^{67,68} However, evidence is accumulating to suggest sexual contact as a significant mode of transmission of CMV outside the hospital environment.^{69,70} Large, well-controlled studies are needed to document the validity of these observations.

The precise mechanism of transmission is unknown; however, infection appears to be acquired only through intimate, direct contact with an excreter of CMV or contact with contaminated secretions. Virus can be shed in the urine, saliva, respiratory secretions, tears, feces, breast milk, semen, and cervical secretions.

Screening Programs for CMV Infection

Because infection with CMV during pregnancy may damage the fetus, protecting women of childbearing age from persons who are excreting the virus is of primary concern. Most infants who are infected with CMV are asymptomatic. Screening programs to detect such patients, however, are not practical, because the tests are time-consuming and costly and would entail screening all newborns. Mass screening of personnel is not likely to provide useful information because the available complement fixation (CF) tests are not reliable indicators of immunity, since these tests lack sensitivity and since the antigen most commonly used for serologic testing (the AD 169 strain) may not cross-react with all other known CMV strains. Furthermore, identifying seropositive women would not necessarily provide a group who, if they become pregnant, are at no risk of transmitting infection to the fetus, because congenital infection may result from reactivation of latent infection^{71,72} and, theoretically, from exogenous reinfection. In addition, since there are no studies to indicate clearly that personnel may be protected by transfer to areas with less contact with infants and children,^{67,68} identifying seronegative women in order to institute such measures may not reduce the number of primary infections.

Preventing Transmission of CMV

When hygienic precautions (appropriate handwashing, not kissing infants, etc.) are satisfactory, the risk of acquiring infection through patient contact is low.⁶⁸ Therefore, a practical approach to reducing the risk of infection with CMV is to stress careful handwashing after all patient contacts and avoiding contact with areas or materials that are potentially infective (see Guideline for Isolation Precautions in Hospitals). Patients known to be infected with CMV can be identified, and this information can be used in counseling pregnant personnel and determining their work assignments.

Personnel who contract illnesses thought to be due to CMV need not be restricted from work. They can reduce

the risk of transmission to patients or other personnel by careful handwashing and exercising care to prevent their body fluids from contacting other persons.

MENINGOCOCCAL DISEASE

Nosocomial transmission of *Neisseria meningitidis* to hospital personnel taking care of patients with meningococcemia, meningococcal meningitis, or lower respiratory infections is uncommon. In rare instances transmission to personnel from patients with meningococcemia or meningococcal meningitis has occurred through intensive direct contact with the infected person and direct contact with respiratory secretions without use of proper precautions. The most likely mode of spread from a person with infections at these sites is by large droplet secretions. Risk to personnel from casual contact (for example, as usually occurs with housekeepers and with laboratory contact with clinical specimens) appears to be negligible.

Meningococcal lower respiratory infections, however, may present a greater risk of transmission than meningococcemia or meningitis alone,^{73,74} especially if the patient has an active, productive cough.⁷³ Possible airborne transmission to other persons who did not have close contact with the infected patient has been suggested;⁷³ however, droplet spread could not be excluded.

When taking care of patients with suspected *N. meningitidis* infection at any site, personnel can decrease the risk of infection by using proper precautions (see Guideline for Isolation Precautions in Hospitals).

Prophylaxis After Unprotected Exposure

Antimicrobial prophylaxis can eradicate carriage of *N. meningitidis* and prevent infections in personnel who have unprotected exposure to patients with meningococcal infections. Prophylaxis is indicated for persons who have intensive direct contact with infected patients and who do not use proper precautions. Personnel who have close contact with patients who have unrecognized meningococcal lower respiratory infection and therefore do not use proper precautions might also need prophylaxis.⁷³ Further studies will be important to define the need for prophylaxis in this situation.

When prophylaxis is deemed necessary, it is important to begin treatment immediately. Often prophylaxis must be started before results of antimicrobial testing are available. Rifampin is now the drug of choice for prophylaxis. Because sulfonamide-resistant meningococci are prevalent, sulfonamides should be used only if the organism has been found to be sulfonamide sensitive.

Carriage of *N. meningitidis* by Personnel

Carriage of *N. meningitidis* in the nasopharynx of healthy persons has been recognized for many years, but the prevalence is quite variable. Carriage may be transient, intermittent, or chronic. Surveillance of hospital personnel to determine carriage is useful only during special epidemiologic studies. Generally, in non-outbreak situations, asymptomatic carriers among personnel need not be identified, treated, or removed from patient-care activities. Management of carriers identified during special studies is not within the scope of this guideline.

PERTUSSIS

Pertussis, caused by *Bordetella pertussis*, is highly communicable. The secondary attack rate is determined primarily by the immune status of those exposed; age may also be a factor. Unless infected persons are treated with an effective antibiotic, the period of communicability extends from the beginning of the catarrhal stage to approximately 3 weeks after onset of paroxysms.

Nosocomial transmission of pertussis has been reported infrequently. Although infection occurs less commonly in adults and may be limited to mild respiratory illness, personnel with pediatric patient contact may be involved in transmission of pertussis to patients.^{75,76} However, the risk of pertussis infection and dissemination is probably not serious enough to warrant routine immunization of hospital personnel with current vaccines. Immunizing persons over age 6 is not recommended, because of the increased frequency of adverse reactions. In addition, current vaccines do not confer complete immunity, and protection against pertussis may decrease as the interval between immunization and reexposure increases. Natural immunity appears to be long-lasting, although infection in persons who reportedly had pertussis in the past has been reported.⁷⁶

During an outbreak, removal of personnel with cough or upper respiratory tract symptoms from the care of patients may be important in preventing further spread.⁷⁵ Erythromycin prophylaxis of exposed susceptibles who are infected may abort or attenuate illness if administered in the early pre-paroxysmal cough stage of the illness. Prophylaxis for less than 14 days is frequently followed by bacteriologic relapse. Infected contacts may be identified rapidly by the fluorescent antibody (FA) technique; however, culture techniques identify infection more reliably than FA examination, because of both false-positive

and false-negative results with the FA method. "Carriers" of pertussis are very unusual, because persons with positive cultures generally develop symptoms.

SCABIES

Scabies is a disease caused by infestation with the mite *Sarcoptes scabiei*. It is transmitted in hospitals primarily through intimate direct contact with an infested person, even when high levels of personal hygiene are maintained.⁷⁷⁻⁷⁹ Transmission to personnel has occurred during activities such as sponge-bathing patients or applying body lotions. Transmission between patients may also be possible when patients are ambulatory. Transmission by casual contact, such as holding hands, has been infrequently reported.⁸⁰ Transmission via inanimate objects, such as infested bedding, clothes, or other fomites has not been implicated as a major mode of transferring mites.^{77,81}

Treatment is recommended for persons with active infestation. A single, correct application^{77,81} of agents used to treat scabies is curative in most cases and appears to eliminate the risk of transmission immediately after the first treatment.^{77,78,81} Treatment destroys both eggs and the active forms of the mites; however, ovacidal activity has not been fully substantiated for all available agents. Repeating the treatment 7-10 days after the initial therapy will kill any newly hatched mites. Between treatments the risk of transmission is felt to be negligible.

Using appropriate precautions when taking care of infested patients will decrease the risk of transmission to personnel (see Guideline for Isolation Precautions in Hospitals). If personnel are infested with the mite, transmission can be prevented by excluding them from work until they are treated.

GLOSSARY

Exposure. An important exposure is one in which a person is subjected to an infectious agent in a way considered likely to lead to acquisition of disease. Whether an exposure to an infectious agent is important depends on various factors, including 1) the mechanism of transmission of the agent involved and the person's infective potential; for example, a non-coughing patient with pulmonary tuberculosis poses little threat; 2) the type and duration of contact; 3) host susceptibility; and 4) whether or not suggested precautions are used. The persons in each hospital who have been given the responsibility, in consultation with others who may be involved, will have to determine whether an important exposure has occurred and if some intervention after the exposure is needed.

Transmission. Microorganisms are transmitted by various routes, and the same microorganism may be transmitted by more than 1 route. For example, varicella-zoster virus can spread either by the airborne route (droplet nuclei) or by direct contact. The differences in infectivity and in the mode of transmission of the various agents form the basis for the differences in precautions that are recommended in this guideline.

There are 4 main routes of transmission—contact, vehicle, airborne, and vectorborne.

- A. Contact transmission, the most important and frequent means of transmission of nosocomial infections, can be divided into 3 subgroups: direct contact, indirect contact, and droplet contact.
 1. Direct contact—This involves direct physical transfer between a susceptible host and an infected or colonized person, such as occurs between patient and hospital personnel when personnel are turning patients, giving baths, changing dressings, or performing other procedures requiring direct personal contact. Taking care of patients generally involves some direct contact. Direct contact can also occur between 2 patients, 1 serving as the source of infection and the other as a susceptible host.
 2. Indirect contact—This involves personal contact of the susceptible host with a contaminated intermediate object, usually inanimate, such as instruments, dressings, or other infective material. If proper care is not taken, personnel can contaminate objects when assembling or handling critical equipment (such as respiratory therapy equipment, pressure-monitoring devices, cardiac bypass pumps) or during other procedures that involve inanimate objects.
 3. Droplet contact—Infectious agents may come in contact with the conjunctivae, nose, or mouth of a susceptible person as a result of coughing, sneezing, or talking by an infected person. This occurrence is considered "contact" transmission rather than airborne since droplets usually travel no more than about 3 feet. "Close contact" is used to mean within 3 feet of an infected person.
- B. The vehicle route applies in diseases transmitted through contaminated items, such as transmission of hepatitis non-A, non-B by contaminated blood.
- C. Airborne transmission occurs by dissemination of either droplet nuclei (residue of evaporated droplets that may

remain suspended in the air for long periods of time) or dust particles in the air containing the infectious agent. Organisms carried in this manner are then inhaled by or deposited on the susceptible host.

- D. Vectorborne transmission is of greater concern in developing countries, for example, mosquito-transmitted malaria.

Since agent and host factors are more difficult to control, interruption of the chain of infection in the hospital is directed primarily at transmission. The precautions recommended in this guideline are based on this concept.

RECOMMENDATIONS*

1. Elements of a Personnel Health Service for Infection Control

- a. Placement Evaluation
 - 1) A health inventory should be obtained from personnel who will have patient contact. *Category I*
 - 2) For infection control, complete physical and laboratory examinations should not be routinely required for all personnel but should be done when indicated; for example, the need for an examination or laboratory test may be determined from results of the health inventory. *Category I*
 - 3) Health assessments of personnel other than placement evaluations should be done depending only on need; for example, as required to evaluate work-related illness or exposures to infectious diseases. *Category I*
 - 4) Routine culturing of personnel, such as taking cultures of the nose, throat, or stool, should *not* be done as part of the placement evaluation or thereafter. *Category I* (See Guideline for Hospital Environmental Control: Microbiologic Surveillance of the Environment and of Personnel in the Hospital)
- b. Personnel Health and Safety Education
 - 1) Initial job orientation and ongoing in-service education should include the infection control aspects of personnel health and the proper use of the personnel health service. *Category I*
 - 2) Specific written policies and procedures for control of infections in hospital personnel should be readily available. *Category I*
- c. Job-related Illnesses and Exposures
 - 1) A record should be maintained on hospital personnel that includes information obtained during the placement evaluation, immunization records, results of tests obtained in any screening or con-

*The recommendations in this guideline are limited to prevention and control of infectious disease transmission among patient-care personnel and patients (see Introduction). These suggestions, however, can include other personnel. This guideline and other guidelines in the manual include all of the current recommendations of the Hospital Infections Program, CDC, on personnel health. Hospitals may choose to establish additional policies for personnel.

trol programs, and reports of work-related illnesses or exposures. *Category I*

- 2) A readily available mechanism should be established for personnel to obtain advice about illnesses they may acquire from or transmit to patients. *Category I*
- 3) Evaluation of job-related illnesses or important exposures and postexposure prophylaxis, when indicated, should be provided. *Category I*
- 4) Written protocols should be established for handling job-related infectious diseases or important exposures. These occurrences should be recorded in the person's record and, when applicable, the appropriate member of the infection control committee and personnel health service should be notified. *Category I*

d. Coordinated Planning and Administration

- 1) Each hospital should have ways to coordinate policy-making and planning among the administration, personnel health service, infection control program, and various departments. *Category I*
- 2) A system should be established for notifying the infection control program of 1) infections in personnel that require work restrictions or exclusion from work, 2) clearance for work after an infectious illness that required work restrictions or exclusion, 3) other work-related infections and exposures, and 4) when appropriate, results of epidemiologic investigations. *Category I*
- 3) A representative of the personnel health program should be on the infection control committee. *Category I*

2. Immunization of Hospital Personnel*

- a. Hospitals should formulate a written comprehensive policy on immunizing hospital personnel. *Category I*
- b. The following recommendations should be considered by the hospital in formulating its policies:
 - 1) *Rubella*
 - a) All personnel (male or female) who are considered to be at increased risk of contact with patients with rubella or who are likely to have direct contact with pregnant patients should be immune to rubella.† *Category I*
 - b) Before immunizing, serologic screening for rubella need not be done unless the hospital considers it cost-effective or the potential vaccinee requests it. *Category I* (Persons can be considered susceptible unless they have laboratory evidence of immunity or documented immunization with live virus vaccine on or after their first birthday. Consideration should be given to giving rubella vaccine in combination with measles and mumps vaccines [measles-mumps-rubella (MMR) trivalent vaccine].)

*Consult current ACIP recommendations for a detailed discussion of the rationale for each recommendation. See page 5 for information on obtaining the full ACIP guidelines.

†Pregnancy is a contraindication. Vaccine should not be given to pregnant women or those who may become pregnant within 3 months.

2) *Hepatitis B*

- a) Persons at substantial risk of HBV infection who are demonstrated or judged likely to be susceptible should be actively immunized (see text). *Category II*
- b) Before immunizing, serologic screening for hepatitis B need not be done unless the hospital considers it cost-effective or the potential vaccinee requests it. *Category I*
- c) Prophylaxis with an immune globulin (passive immunization) should be used when indicated, such as following needle-stick exposure to blood that is at high-risk of being HBsAg-positive. *Category I*
- d) Immune globulins should not be used as a substitute for active immunization. *Category I*

3) *Measles*

All persons susceptible by history or serology who are considered to be at increased risk of contact with patients infected with measles should be protected.* *Category I* (Most persons born before 1957 have probably been infected naturally and generally need not be considered susceptible. Younger persons can be considered immune only if they have documentation of 1) physician-diagnosed measles, 2) laboratory evidence of measles immunity, or 3) adequate immunization with live measles vaccine on or after the first birthday. Consideration should be given to administering measles vaccine in combination with rubella and mumps vaccines [measles-mumps-rubella (MMR) trivalent vaccine].)

4) *Poliomyelitis*

- a) Routine primary immunization for adults in the United States is not recommended. Personnel who may have direct contact with patients who may be excreting polioviruses should complete a primary series. Primary immunization with inactivated polio vaccine (IPV) instead of oral polio vaccine (OPV) is recommended for these persons whenever feasible. *Category I* (IPV is preferred because the risk of vaccine-associated paralysis following OPV is slightly higher in adults than in children and because personnel may shed virus after OPV and inadvertently expose susceptible or immunocompromised patients to live virus.)
- b) In an outbreak, OPV should be provided to anyone who has not been completely immunized or whose immunization status is unknown.† *Category I*

5) *Influenza*

To avoid problems with staffing during the influenza season and to prevent spread of influenza

*Pregnancy is a contraindication. Vaccine should not be given to pregnant women or those who may become pregnant within 3 months.

†Exceptions to this recommendation are discussed in the current ACIP recommendations under the heading *Precautions and Contraindications: Immunodeficiency.*

from personnel to patients, efforts should be made to immunize hospital personnel against influenza in the fall of each year. *Category II*

- c. Hospital personnel are not at substantially higher risk than the general adult population of acquiring diphtheria, pneumococcal disease, mumps, or tetanus. Therefore, hospital personnel should seek these immunizations from their primary care provider, according to the recommendations of ACIP. *Category I*
- d. Hospitals should not assume responsibility for routine immunization of hospital personnel against pertussis, tuberculosis, cholera, meningococcal disease, plague, rabies, typhoid, typhus, or yellow fever. *Category I* (Smallpox vaccine is no longer recommended for general use.*)

3. Protection of Personnel and Other Patients from Patients with Infections

- a. Patients with potentially transmissible infections should be placed on isolation precautions using recommendations in the current Guideline for Isolation Precautions in Hospitals. (This recommendation is not categorized. The working group for the Guideline for Isolation Precautions in Hospitals did not rank the isolation recommendations into categories. Although the isolation recommendations are based on well-documented modes of transmission identified in epidemiologic studies or on a reasonable theoretical rationale, there have been few studies to test the efficacy of isolation recommendations.)

4. Prevention of Needle-Stick Injuries

- a. Training or instruction of personnel should include discussions of methods to prevent needle-stick injuries. *Category I*
- b. Used needles should be placed in a prominently labeled, puncture-resistant container designated specifically for their disposal. *Category I*
- c. Used needles should not be recapped, purposely bent, or broken by hand. *Category II*

5. Prophylaxis After Exposure

- a. When prophylactic treatment with drugs, vaccines, or immune globulins is deemed necessary and is offered, personnel should be informed of alternative means of prophylaxis, the risk (if this is known) of infection if treatment is not accepted, the degree of protection provided by the therapy, and the potential side effects. *Category I*
- b. Hepatitis A
 - 1) Personnel who have had direct fecal-oral exposure to excretions from a patient found to have been incubating hepatitis A should be given immune globulin (IG) (0.02 ml/kg). *Category I*
 - 2) Prophylaxis with immune globulin (IG) for all personnel who take care of patients with hepatitis A (other than as suggested in recommendation 5.b.1 above) should not be given. *Category I*
- c. Hepatitis B
 - For prophylaxis against hepatitis B after percuta-

neous (needle-stick) or mucous membrane exposure to blood that might be infective, the recommendations in Table 1 should be followed. *Category I*

- d. Hepatitis Non-A, Non-B
 - If needle-stick exposures occur involving patients known to have hepatitis non-A, non-B, IG (0.06 ml/kg) should be given. *Category II*
- e. Meningococcal disease
 - Antimicrobial prophylaxis against meningococcal disease should be offered immediately to personnel who have had intensive direct contact with an infected patient without using proper precautions. If prophylaxis is deemed necessary, treatment should not await results of antimicrobial sensitivity testing. *Category I*
- f. Pertussis
 - Antimicrobial prophylaxis against pertussis should be offered immediately to personnel who have had intensive contact with an infected patient without using proper precautions. *Category II*
- g. Rabies
 - Hospital personnel who either have been bitten by a human with rabies or have scratches, abrasions, open wounds, or mucous membranes contaminated with saliva or other potentially infective material from a human with rabies should receive a full course of anti-rabies treatment. *Category I*

6. Personnel Restriction Because of Illnesses or Special Conditions

- a. 1) Hospitals should have well-defined policies concerning contact of personnel with patients when personnel have potentially transmissible conditions. Policies should govern personnel responsibility in using the health service and reporting illness, removal of personnel from direct contact with patients, and clearance for work after an infectious disease that required work restriction. *Category I*
- 2) Hospitals should identify those with authority to relieve personnel of duties. *Category I*
- 3) Policies for exclusion from work should be designed to encourage personnel to report their illnesses or exposures and not penalize them with loss of wages, benefits, or job status. *Category I*
- b. Personnel who have responsibilities for patient care and have signs and symptoms of a transmissible infectious disease should report promptly to their supervisor. *Category I*
- c. Acute Diarrhea
 - 1) Personnel with an acute diarrheal illness that is severe, is accompanied by other symptoms (such as fever, abdominal cramps, or bloody stools) or lasts longer than 24 hours should be excluded from direct patient contact pending evaluation. *Category II*
 - 2) Whenever appropriate, specific treatment for documented infection with enteric pathogens should be made available to infected personnel. *Category I*
 - 3) Personnel with non-typhoidal *Salmonella* enteric infections should be excluded from the direct care

*Consult current ACIP recommendations for a detailed discussion of the rationale for each recommendation. See page 5 for information on obtaining the full ACIP guidelines.

- of high-risk patients until stool cultures are *Salmonella*-free on 2 consecutive specimens collected not less than 24 hours apart. *Category II*
- 4) a) Personnel infected by enteric pathogens other than *Salmonella* may return to work after symptoms resolve. *Category II*
 - b) These persons should be individually counseled before they return to work about the importance of handwashing. *Category I*
 - 5) Follow-up cultures or examinations of stool for pathogens other than *Salmonella* may be done to determine when the stool is free of the infecting organism. *Category III*
- d. Herpes Simplex Infections
- 1) Personnel with primary or recurrent orofacial herpes simplex infections should not take care of high-risk patients, for example, newborns, patients with burns, or severely immunocompromised patients, until the lesions are healed. *Category II*
 - 2) Personnel with herpes simplex infections of the fingers or hands (herpetic whitlow) should not have direct contact with patients until lesions are healed. *Category I*
- e. Respiratory Infections
- 1) Personnel with respiratory infections should not be assigned to the direct care of high-risk patients, for example, neonates, young infants, patients with chronic obstructive lung disease, or immunocompromised patients. *Category II*
 - 2) If an influenza epidemic is anticipated, a prevention program should be started for all patient-care personnel and high-risk patients. This program could include use of influenza vaccine and antiviral chemoprophylaxis. *Category II*
- f. Streptococcal Disease
- If group A streptococcal disease is suspected, appropriate cultures should be taken, and the health worker should be excluded from work until she or he has received adequate therapy for 24 hours or until streptococcal infection has been ruled out. *Category I*
- g. Management of Personnel Who Are Linked to Outbreaks
- Personnel who are linked epidemiologically to an increase in bacterial infections caused by a pathogen associated with a carrier state should be cultured and, if positive, excluded from patient contact until carriage is eradicated or the risk of disease transmission is eliminated. *Category I*
- ## 7. Detection and Control of Tuberculosis
- a. Skin Tests
- 1) During the placement evaluation a tuberculin skin test should be given to all personnel, unless a previously significant reaction (10 mm or more of induration by Mantoux or vesiculation by a multiple puncture test) can be documented. The results should be used as the baseline test in determining treatment and follow-up of these personnel. *Category I*
 - 2) The Mantoux technique using 5 TU PPD should be used. *Category II*
 - 3) The 2-step test should be used to minimize the likelihood of interpreting a boosted reaction as a true conversion due to recent infection. *Category II* (Evaluation of the efficacy of the 2-step method in a given area may be necessary.)
 - 4) If there is a likelihood of a severe reaction to skin testing, an initial test using a 2-step method with 1 TU PPD or a partial dose of 5 TU PPD should be considered. *Category II*
 - 5) After the initial skin test, the need for repeat testing should be determined in each hospital by the risk of acquiring new infection; for example, personnel need not have repeat testing if the incidence of tuberculosis in the community and in personnel is very low and personnel have not been exposed to an infective case. *Category II*
 - 6) All personnel with significant reactions should be informed about risks of developing disease, risks they may pose to their contacts, and preventive treatment (see also recommendation 7.c.). *Category I*
- b. Skin Tests After BCG Vaccination
- 1) Persons who have had prior BCG vaccination should be skin-tested using the Mantoux method, unless a previously significant reaction can be documented. *Category I*
 - 2) The results of skin tests in persons who have had prior BCG vaccination should be interpreted and acted on in the same manner as those in personnel who have not been vaccinated with BCG (see Preventive Treatment and Work Restrictions below). *Category I*
- c. Chest Roentgenograms
- 1) Chest roentgenograms should be taken on those persons with significant tuberculin skin test results a) who have never been evaluated, b) who have had recent conversions, c) who have never received adequate treatment for tuberculosis, or d) who have pulmonary symptoms that may be due to tuberculosis. If the chest film suggests pulmonary TB, these persons should be evaluated to rule out the possibility of current disease. *Category I*
 - 2) Routine follow-up roentgenograms should not be taken. *Category I*
- d. Preventive Treatment and Work Restrictions
- 1) Personnel with current pulmonary or laryngeal tuberculosis whose sputum smear shows bacilli should be excluded from work until adequate treatment has begun and the sputum is free of bacilli on 3 consecutive smears obtained on separate days or until sputum cultures show no growth. *Category I*
 - 2) Personnel who have current TB at a site other than the lung or larynx should be allowed to continue their usual activities. *Category I*
 - 3) Personnel who discontinue medications for current pulmonary or laryngeal disease before the rec-

ommended course of therapy has been completed should not be allowed to work. *Category I*

- 4) a) All personnel with significant skin-test reactions who do not have current tuberculosis and who have not had previous adequate therapy should be advised to receive preventive treatment, unless such therapy is specifically contraindicated. *Category I*
- b) These personnel, if otherwise healthy and receiving preventive treatment, should be allowed to continue usual activities. *Category I*
- 5) a) Personnel who cannot take or do not accept or complete preventive treatment should have their work situations evaluated and may require reassignment. A change in assignment should be considered, if these persons work with high-risk patients. *Category III*
- b) These persons should be counseled about the risk of developing disease and risks they may pose to their contacts and should be instructed to seek evaluation of any signs or symptoms that may be due to TB. *Category I*
- 6) All persons with a history of TB and all personnel with significant reactions are at risk for developing current disease. These persons should be instructed to report promptly for evaluation if symptoms that may be due to TB develop. *Category I*
- 7) Personnel who have completed preventive treatment or adequate therapy for current disease should be exempt from further screening unless symptomatic. *Category I*
- e. Postexposure Prophylaxis
 - 1) After exposure to an infective case of tuberculosis during which proper precautions were not used, all personnel, except those already known to have significant skin-test reactions, should be skin-tested 10 weeks after the exposure. Personnel whose skin test converts should have a chest roentgenogram taken and, unless specifically contraindicated, be advised to receive preventive treatment, provided current disease has been ruled out. If the chest film suggests pulmonary TB, these persons should be evaluated to rule out current disease. *Category I*
 - 2) Unless a skin test was given during the 3 months before exposure, a baseline skin test should be done as soon as possible after the exposure to assist in interpreting the 10-week postexposure skin test. *Category II*
 - 3) Personnel already known to have significant reactions should not have a chest roentgenogram taken unless they have pulmonary symptoms that may be due to tuberculosis. *Category I*

8. Personnel Exposed to Varicella or Zoster

- a. After exposure to varicella (chickenpox) or zoster (shingles) personnel not known to be immune to varicella (by history or serology) should be excluded from work beginning on the tenth day after exposure

and remain away from work for the maximum incubation period of varicella (21 days). *Category I*

- b. Personnel who have onset of varicella should be excluded from work at least until all lesions have dried and crusted. *Category I*

9. Control of Hepatitis Infections

- a. Personnel who are suspected of being infected with hepatitis A virus (HAV) should not take care of patients until 7 days after the onset of jaundice. *Category III*
- b. Screening for evidence of prior infection with hepatitis B virus (HBV) in personnel who work in dialysis centers or other high-risk areas should be done only when needed to institute appropriate control measures. *Category I*
- c. Personnel who are known carriers of HBsAg should be counseled about precautions to minimize their risk of infecting others. *Category I*
- d.
 - 1) Personnel who have no exudative lesions on the hands and who are acutely infected with HBV, are known to be carriers of HBsAg, or have hepatitis non A/non B (NANB) should not be restricted from patient-care responsibilities, unless there is evidence of disease transmission. *Category I*
 - 2) Personnel who have no exudative lesions on the hands and who are acutely infected with HBV, are known to be carriers of HBsAg, or have hepatitis NANB should wear gloves for procedures that involve trauma to tissues or direct contact with mucous membranes or non-intact skin. *Category II*
- e. Personnel with exudative lesions on the hands who are HBsAg-positive should either wear gloves for all direct patient contact and when handling equipment that will touch mucous membranes or non-intact skin or abstain from all direct patient care. *Category I*
- f. Dental personnel should consider routine use of gloves, masks, and protective eyewear when performing dental procedures. *Category III*

10. Precautions for AIDS*

- a. Personnel considered to have any of the clinical features described in the AIDS spectrum should be counseled about precautions to minimize their risk of infecting others (see discussion of AIDS and HBsAg carriers in text). *Category I*
- b. Personnel considered to have any of the clinical features described in the AIDS spectrum who have no exudative lesions on the hands should wear gloves for procedures that involve trauma to tissues or direct contact with mucous membranes or non-intact skin. *Category II*
- c. Personnel considered to have any of the clinical features described in the AIDS spectrum and who have exudative lesions on the hands should either wear gloves for all direct patient contact and when handling equipment that will touch mucous membranes or non-intact skin or abstain from all direct patient care. *Category II*

*These suggestions are not meant to restrict hospitals from using additional precautions.

- d. Dental personnel taking care of patients considered to have any of the clinical features in the AIDS spectrum should consider routine use of gloves, masks, and protective eyewear when performing dental procedures. *Category II*

11. Personnel with Other Infectious Diseases

Table 2 is a summary of the important recommendations above and work restrictions for personnel with other infectious diseases not mentioned previously.

Table 2. Summary of Important Recommendations and Work Restriction for Personnel With Other Infectious Diseases

Disease/Problem	Relieve from direct patient contact	Partial work restriction	Duration	Category
Conjunctivitis, infectious	Yes		Until discharge ceases	II
Cytomegalovirus infections	No			II
Diarrhea (see 6.c.)				
Acute stage (diarrhea with other symptoms)	Yes		Until symptoms resolve and infection with <i>Salmonella</i> is ruled out	II
Convalescent stage <i>Salmonella</i> (non-typhoidal)	No	Personnel should not take care of high-risk patients	Until stool is free of the infecting organism on 2 consecutive cultures not less than 24 hours apart	II
Other enteric pathogens	No	(See text & recommendation 6.c.)		II
Enteroviral infections	No	Personnel should not take care of infants and newborns	Until symptoms resolve	II
Group A streptococcal disease	Yes		Until 24 hours after adequate treatment is started	I
Hepatitis, viral				
Hepatitis A	Yes		Until 7 days after onset of jaundice	III
Hepatitis B				
Acute	No	Personnel should wear gloves for procedures that involve trauma to tissues or contact with mucous membranes or non-intact skin	Until antigenemia resolves	II
Chronic antigenemia	No	Same as acute illness	Until antigenemia resolves	II
Hepatitis NANB	No	Same as acute hepatitis B	Period of infectivity has not been determined	II
Herpes simplex				
Genital	No			II
Hands (herpetic whitlow)	Yes	(Note: It is not known whether gloves prevent transmission)	Until lesions heal	I
Orofacial	No	Personnel should not take care of high-risk patients	Until lesions heal	II
Measles				
Active	Yes		Until 7 days after the rash appears	I
Postexposure (Susceptible personnel)	Yes		From the 5th through the 21st day after exposure and/or 7 days after the rash appears	II

*Mumps vaccine may be offered to susceptible personnel. When given after exposure, mumps vaccine may not provide protection. However, if exposure did not result in infection, immunizing exposed personnel should protect against subsequent infection. Neither mumps immune globulin nor immune serum globulin (ISG) is of established value in postexposure prophylaxis. Transmission of mumps among personnel and patients has not been a major problem in hospitals in the United States, probably due to multiple factors, including high levels of natural and vaccine-induced immunity.

Disease/Problem	Relieve from direct patient contact	Partial work restriction	Duration	Category
Mumps				
Active	Yes		Until 9 days after onset of parotitis	I
Postexposure	Yes*		From the 12th through the 26th day after exposure or until 9 days after onset of parotitis	III
Pertussis				
Active	Yes		From the beginning of the catarrhal stage through the 3rd week after onset of paroxysms or until 7 days after start of effective therapy	I
Postexposure (asymptomatic personnel)	No			II
Postexposure (symptomatic personnel)	Yes		Same as active pertussis	I
Rubella				
Active	Yes		Until 5 days after the rash appears	I
Postexposure (susceptible personnel)	Yes		From the 7th through the 21st day after exposure and/or 5 days after rash appears	II
Scabies	Yes		Until treated	I
<i>Staphylococcus aureus</i> (skin lesions)	Yes		Until lesions have resolved	II
Upper respiratory infections (high-risk patients)	Yes	Personnel with upper respiratory infections should not take care of high-risk patients (See 6.e.)	Until acute symptoms resolve	II
Zoster (Shingles)				
Active	No	Appropriate barrier desirable; personnel should not take care of high-risk patients	Until lesions dry and crust	II
Postexposure (susceptible personnel)	Yes		From the 10th through the 21st day after exposure or if varicella occurs until all lesions dry and crust	I
Varicella (Chickenpox)				
Active	Yes		Until all lesions dry and crust	I
Postexposure	Yes		From the 10th through the 21st day after exposure or if varicella occurs until all lesions dry and crust	I

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GUIDELINE FOR HANDWASHING AND HOSPITAL ENVIRONMENTAL CONTROL, 1985

**Supersedes Guideline for Hospital Environmental Control
Published in 1981**

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RANKING SCHEME FOR RECOMMENDATIONS

CATEGORY I

Measures in Category I are strongly supported by well-designed and controlled clinical studies that show their effectiveness in reducing the risk of nosocomial infections, or are viewed as effective by a majority of expert reviewers. Measures in this category are viewed as applicable for most hospitals—regardless of size, patient population, or endemic nosocomial infection rates.

CATEGORY II

Measures in Category II are supported by highly suggestive clinical studies in general hospitals or by definitive studies in specialty hospitals that might not be representative of general hospitals. Measures that have not been adequately studied but have a logical or strong theoretical rationale indicating probable effectiveness are included in this category. Category II recommendations are viewed as practical to implement in most hospitals.

CATEGORY III

Measures in Category III have been proposed by some investigators, authorities, or organizations, but, to date, lack supporting data, a strong theoretical rationale, or an indication that the benefits expected from them are cost effective. Thus, they are considered important issues to be studied. They might be considered by some hospitals for implementation, especially if the hospitals have specific nosocomial infection problems, but they are *not* generally recommended for widespread adoption.

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Preface

In 1980, the Centers for Disease Control (CDC) began developing a series of guidelines entitled *Guidelines for the Prevention and Control of Nosocomial Infections*. The purpose of the *Guidelines* was twofold: 1) to disseminate advice on how to prevent or control specific nosocomial infection problems and 2) to cover the questions most frequently asked of the Hospital Infections Program staff on different aspects of the hospital's inanimate environment (1). One of the first *Guidelines* to be published was the *Guideline for Hospital Environmental Control*. It was written by Bryan P. Simmons, M.D. in consultation with Thomas M. Hooton, M.D., and George F. Mallison, M.P.H., and in collaboration with a working group consisting of Edward J. Bertz; Mary K. Bruch; Sue Crow, R.N., M.S.N.; William E. Scheckler, M.D.; Harold Laufman, M.D., Ph.D.; Janet K. Schultz, R.N., M.S.N.; Earle H. Spaulding, Ph.D.; and Richard P. Wenzel, M.D.

In February 1981, CDC mailed to each U. S. acute-care hospital Part I of the *Guideline for Hospital Environmental Control*, which contained sections entitled "Antiseptics, Handwashing, and Handwashing Facilities," "Cleaning, Disinfection, and Sterilization of Hospital Equipment," and "Microbiologic Surveillance of the Environment and of Personnel in the Hospital." In October 1981, Part II of the *Guideline for Hospital Environmental Control*, which contained the sections "Housekeeping Services and Waste Disposal," "Laundry Services," "Intensive Care Units," and "Pharmacy," was published. In July 1982, the section on "Cleaning, Disinfection, and Sterilization of Hospital Equipment" was revised. In November 1982, the two parts of the *Guideline* were combined into a single document entitled *Guideline for Hospital Environmental Control*, and copies were mailed to all U.S. acute-care hospitals.

In October 1983, CDC issued a statement entitled "Clarification of Guideline Recommendations on Generic Antiseptic, Disinfectant, and Other Products," which was mailed to all U.S. acute-care hospitals. The statement emphasized that CDC recommendations are not intended to endorse any particular commercial product or to exclude the use of other commercial products containing generic ingredients not mentioned in the *Guideline for Hospital Environmental Control*.

In November 1983, a follow-up statement requested that users delete the portion of the *Guideline for Hospital Environmental Control* that recommended specific generic antimicrobial ingredients for use in health care personnel handwashes and announced that the entire *Guideline* would be comprehensively revised. In June 1984, a draft of the proposed revision was mailed to 150 scientists and infection control professionals for review and comment. Rather than using an expert working group to finalize the content of this *Guideline*, we used the written comments and suggestions which we received from the reviewers to determine the final content of the *Guideline* and the ranking of the recommendations.

This *Guideline* incorporates the above revisions, as well as newly available information; the title has been

changed to *Guideline for Handwashing and Hospital Environmental Control*. It replaces all previous handwashing and environmental control statements issued or published by the Hospital Infections Program, Center for Infectious Diseases, CDC.

MAJOR CHANGES IN THE GUIDELINE

Since this *Guideline* contains many important changes from the original *Guideline for Hospital Environmental Control*, it is important that users read the entire *Guideline* carefully. The major changes in the titles and content of sections are listed below:

1. The section "Handwashing," which replaces the old section entitled "Antiseptics, Handwashing, and Handwashing Facilities," contains updated recommendations for handwashing with plain soaps or detergents and with antimicrobial-containing products. Rather than recommending specific generic ingredients for handwashing with antimicrobial-containing products, the *Guideline* indicates that hospitals may choose from appropriate products in categories defined by the U.S. Food and Drug Administration (FDA), since preparations used to inhibit or kill microorganisms on skin are categorized by an FDA advisory review panel for nonprescription (over-the-counter [OTC]) antimicrobial drug products (2). Manufacturers of antimicrobial-containing products voluntarily submit data to the review panel, which categorizes the products according to their intended use, i.e., antimicrobial soaps, health-care personnel handwashes, patient preoperative skin preparations, skin antiseptics, skin wound cleansers, skin wound protectants, and surgical hand scrubs. Generic antimicrobials for each use category are further divided: Category I (safe and efficacious); Category II (not safe and/or efficacious); and Category III (insufficient data to categorize). Consequently, chemical germicides formulated as antiseptics are categorized by the FDA into groupings by use and efficacy, but they are not regulated or registered in the same fashion as chemical germicides are by the U.S. Environmental Protection Agency (EPA).
Persons responsible for selecting commercially marketed health-care-personnel handwashes can obtain information about categorization of products from the Center for Drugs and Biologics, Division of OTC Drug Evaluation, FDA, 5600 Fishers Lane, Rockville, MD 20857. In addition, information published in the scientific literature, presented at scientific meetings, documented by manufacturers, and obtained from other sources deemed important may be considered.
2. The section "Cleaning, Disinfecting, and Sterilizing of Patient-Care Equipment" has been rewritten. Medical devices, equipment, and materials are divided into three categories (critical, semicritical,

and noncritical) based on the risk of infection involved in their use. Revised recommendations for sterilizing and disinfecting items in these categories are included in this section. Rather than listing specific chemical germicides, the *Guideline* indicates that hospitals may choose from sterilant and disinfectant formulations registered with the EPA, since chemical germicides are regulated and registered by the EPA (3). Manufacturers of chemical germicides formulated as general disinfectants, hospital disinfectants, and disinfectants used in other environments, such as the food industry, are required by EPA to test their formulations using specific protocols for microbicidal efficiency, stability, and toxicity to humans. In past years, the EPA has reserved the right to test and verify formulations of chemical germicides for their specified efficacy; however, in practice only those formulations to be registered as sterilants or sporicides were actually tested. In 1982, the EPA discontinued this testing. Currently, formulations of chemical germicides are registered by the EPA based on data obtained from the manufacturer.

Persons responsible for selecting chemical germicides should keep in mind that the field is highly competitive, and exaggerated claims are often made about the germicidal efficiency of specific formulations. When questions regarding specific claims or use arise, the Disinfectants Branch, Registration Division, Office of Pesticides, EPA, 401 M Street, S.W., Washington, D.C. 20460, can be consulted. As with handwashing products, information in the scientific literature, presented at scientific meetings, documented by manufacturers, and obtained from other sources deemed important may be considered.

The recommendation against reprocessing and reusing single-use items has been removed. Since there is lack of evidence indicating increased risk of nosocomial infections associated with the reuse of all single-use items, a categorical recommendation against all types of reuse was not considered justifiable. Rather than recommending for or against reprocessing and reusing single-use items, the *Guideline* indicates that items or devices that cannot be cleaned and sterilized or disinfected without altering their physical integrity and function should not be reprocessed. In addition, reprocessing procedures that result in residual toxicity or compromise the overall safety or effectiveness of the items or devices should be avoided. Arguments for and against reprocessing and reusing single-use items have been summarized in a report from the International Conference on the Reuse of Disposable Medical Devices in the 1980's (4).

3. The section "Microbiologic Sampling" replaces the old section entitled "Microbiologic Surveillance of the Environment and of Personnel in the Hospital." The recommendation for microbiologic sampling of infant formulas prepared in the hospital has been removed, since there is no epidemiologic evidence to show that such sampling reduces the infection rate in hospitals. Information and recommendations for

microbiologic surveillance of personnel have been deleted, since this topic is addressed in the *Guideline for Infection Control in Hospital Personnel* (5).

4. A new section, "Infective Waste," has been added. It contains information about identifying infective waste and recommendations for its handling and disposal.
5. The section "Housekeeping" replaces the old section "Housekeeping Services and Waste Disposal." Recommendations against use of carpets in patient-care areas have been removed, since there is no epidemiologic evidence to show that carpets influence the nosocomial infection rate in hospitals (6); whether to use carpets, therefore, is not considered an infection control issue.
6. The section "Laundry" contains a discussion of and recommendations for both hot-water and reduced-temperature washing.
7. The section "Intensive Care Units" has been deleted, since it primarily dealt with information and recommendations that are covered elsewhere in this *Guideline* and in the *Guideline for Isolation Precautions in Hospitals* (7).
8. The section "Pharmacy" has been deleted from this *Guideline*, since it primarily dealt with recommendations for admixture of parenteral fluids that are contained in the *Guideline for Prevention of Intravascular Infections*.

The recommendations presented in this *Guideline* were chosen primarily for their acknowledged importance to infection control, but other factors, such as the feasibility of implementing them and their potential costs to hospitals, were also considered. Many recommendations are intended to reduce or eliminate expensive practices that are not likely to prevent infections. Some of the recommendations are based on well-documented epidemiologic studies; others are based on a reasonable theoretical rationale, since for many of these practices little or no scientifically valid evidence is available to permit evaluation of their effect on the incidence of infection. Because new studies are constantly revealing pertinent information in this field, users of this *Guideline* should keep informed of other sources. The recommendations presented in this *Guideline* may be modified as necessary for an individual hospital and are not meant to restrict a hospital from developing recommendations that may be more appropriate to its own unique needs. The recommendations have no force of law or regulation.

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Section 1: Handwashing

INTRODUCTION

Handwashing is the single most important procedure for preventing nosocomial infections. Handwashing is defined as a vigorous, brief rubbing together of all surfaces of lathered hands, followed by rinsing under a stream of water. Although various products are available, handwashing can be classified simply by whether plain soap or detergents or antimicrobial-containing products are used (1). Handwashing with plain soaps or detergents (in bar, granule, leaflet, or liquid form) suspends microorganisms and allows them to be rinsed off; this process is often referred to as mechanical removal of microorganisms. In addition, handwashing with antimicrobial-containing products kills or inhibits the growth of microorganisms; this process is often referred to as chemical removal of microorganisms. Routine handwashing is discussed in this *Guideline*; the surgical hand scrub is discussed in the *Guideline for Prevention of Surgical Wound Infections*.

EPIDEMIOLOGY

The microbial flora of the skin consists of resident and transient microorganisms; the resident microorganisms survive and multiply on the skin and can be repeatedly cultured, while the transient microbial flora represent recent contaminants that can survive only a limited period of time. Most resident microorganisms are found in superficial skin layers, but about 10%-20% can inhabit deep epidermal layers (2,3). Handwashing with plain soaps and detergents is effective in removing many transient microbial flora (4-6). Resident microorganisms in the deep layers may not be removed by handwashing with plain soaps and detergents, but usually can be killed or inhibited by handwashing with products that contain antimicrobial ingredients.

Many resident skin microorganisms are not highly virulent and are not implicated in infections other than skin infections. However, some of these microorganisms can cause infections in patients when surgery or other invasive procedures allow them to enter deep tissues or when a patient is severely immunocompromised or has an implanted device, such as a heart valve. In contrast, the transient microorganisms often found on the hands of hospital personnel can be pathogens acquired from colonized or infected patients and may cause nosocomial infections. Several recent studies have shown that transient and resident hand carriage of aerobic gram-negative microorganisms by hospital personnel may be more frequent than previously thought (7-10). More study on the bacteriology of hands is needed to fully understand the factors that contribute to persistent hand carriage of such microorganisms (11).

CONTROL MEASURES

The absolute indications for and the ideal frequency of handwashing are generally not known because of the lack of well-controlled studies. Listing all circumstances that

may require handwashing would be a lengthy and arbitrary task. The indications for handwashing probably depend on the type, intensity, duration, and sequence of activity. Generally, superficial contact with a source not suspected of being contaminated, such as touching an object not visibly soiled or taking a blood pressure, does not require handwashing. In contrast, prolonged and intense contact with any patient should probably be followed by handwashing. In addition, handwashing is indicated *before* performing invasive procedures, *before* taking care of particularly susceptible patients, such as those who are severely immunocompromised or newborn infants, and *before* and *after* touching wounds. Moreover, handwashing is indicated, even when gloves are used, *after* situations during which microbial contamination of the hands is likely to occur, especially those involving contact with mucous membranes, blood and body fluids, and secretions or excretions, and *after* touching inanimate sources that are likely to be contaminated, such as urine-measuring devices. In addition, handwashing is an important component of the personal hygiene of all hospital personnel, and *handwashing should be encouraged when personnel are in doubt about the necessity for doing so*.

The circumstances that require handwashing are frequently found in high-risk units, because patients in these units are often infected or colonized with virulent or multiply-resistant microorganisms, and are highly susceptible to infection because of wounds, invasive procedures, or diminished immune function. Handwashing in these units is indicated between direct contact with different patients and often is indicated more than once in the care of one patient, for example, after touching excretions or secretions, before going on to another care activity for the same patient.

The recommended handwashing technique depends on the purpose of the handwashing. The ideal duration of handwashing is not known, but washing times of 15 seconds (6) or less (5) have been reported as effective in removing most transient contaminants from the skin. Therefore, for most activities, a vigorous, brief (at least 10 seconds) rubbing together of all surfaces of lathered hands followed by rinsing under a stream of water is recommended. If hands are visibly soiled, more time may be required for handwashing.

The absolute indications for handwashing with plain soaps and detergents versus handwashing with antimicrobial-containing products are not known because of the lack of well-controlled studies comparing infection rates when such products are used. For most routine activities, handwashing with plain soap appears to be sufficient, since soap will allow most transient microorganisms to be washed off (4-6).

Handwashing products for use in hospitals are available in several forms. It is important, however, that the product selected for use be acceptable to the personnel who will use it (6). When plain soap is selected for handwashing, the bar, liquid, granule, or soap-impregnated tissue

form may be used. It is preferable that bar soaps be placed on racks that allow water to drain. Since liquid-soap containers can become contaminated and might serve as reservoirs of microorganisms, reusable liquid containers need to be cleaned when empty and refilled with fresh soap. Completely disposable containers obviate the need to empty and clean dispensers but may be more expensive. Most antimicrobial-containing handwashing products are available as liquids. Antimicrobial-containing foams and rinses are also available for use in areas without easy access to sinks.

In addition to handwashing, personnel may often wear gloves as an extra margin of safety. As with handwashing, the absolute indications for wearing gloves are not known. There is general agreement that wearing sterile gloves is indicated when certain invasive procedures are performed or when open wounds are touched. Nonsterile gloves can be worn when hands are likely to become contaminated with potentially infective material such as blood, body fluids, or secretions, since it is often not known which patients' blood, body fluids, or secretions contain hepatitis B virus or other pathogens. Further, gloves can be worn to prevent gross microbial contamination of hands, such as when objects soiled with feces are handled. When gloves are worn, handwashing is also recommended because gloves may become perforated during use and because bacteria can multiply rapidly on gloved hands.

The convenient placement of sinks, handwashing products, and paper towels is often suggested as a means of encouraging frequent and appropriate handwashing. Sinks with faucets that can be turned off by means other than the hands (e.g., foot pedals) and sinks that minimize splash can help personnel avoid immediate recontamination of washed hands.

Although handwashing is considered the most important single procedure for preventing nosocomial infections, two reports showed poor compliance with handwashing protocols by personnel in medical intensive care units, especially by physicians (12) and personnel taking care of patients on isolation precautions (13). Failure to wash hands is a complex problem that may be caused by lack of motivation or lack of knowledge about the importance of handwashing. It may also be caused by obstacles such as understaffing, inconveniently located sinks, absence of paper towels, an unacceptable handwashing product, or the presence of dermatitis caused by previous handwashing. More study is needed to identify which of these factors, alone or in combination, contribute significantly to the problem of poor compliance with handwashing recommendations.

RECOMMENDATIONS

1. Handwashing Indications

a. In the absence of a true emergency, personnel should *always* wash their hands

1) before performing invasive procedures;
Category I

2) before taking care of particularly susceptible patients, such as those who are severely immunocompromised and newborns; *Category I*

3) before and after touching wounds, whether surgical, traumatic, or associated with an invasive device; *Category I*

4) after situations during which microbial contamination of hands is likely to occur, especially those involving contact with mucous membranes, blood or body fluids, secretions, or excretions;
Category I

5) after touching inanimate sources that are likely to be contaminated with virulent or epidemiologically important microorganisms; these sources include urine-measuring devices or secretion-collection apparatuses; *Category I*

6) after taking care of an infected patient or one who is likely to be colonized with microorganisms of special clinical or epidemiologic significance, for example, multiply-resistant bacteria;
Category I

7) between contacts with different patients in high-risk units. *Category I*

b. Most routine, brief patient-care activities involving *direct* patient contact other than that discussed in 1.a. above, e.g., taking a blood pressure, do not require handwashing. *Category II*.

c. Most routine hospital activities involving *indirect* patient contact, e.g., handing a patient medications, food, or other objects, do not require handwashing.
Category I.

2. Handwashing Technique

For routine handwashing, a vigorous rubbing together of all surfaces of lathered hands for at least 10 seconds, followed by thorough rinsing under a stream of water, is recommended. *Category I*

3. Handwashing with Plain Soap

a. Plain soap should be used for handwashing unless otherwise indicated. *Category II*

b. If bar soap is used, it should be kept on racks that allow drainage of water. *Category II*

c. If liquid soap is used, the dispenser should be replaced or cleaned and filled with fresh product when empty; liquids should not be added to a partially full dispenser. *Category II*

4. Handwashing with Antimicrobial-Containing Products (Health-Care Personnel Handwashes)

a. Antimicrobial handwashing products should be used for handwashing before personnel care for newborns and when otherwise indicated during their care, between patients in high-risk units, and before personnel take care of severely immunocompromised patients. *Category III* (Hospitals may choose from products in the product category defined by the FDA as health-care personnel handwashes. Persons responsible for selecting commercially marketed antimicrobial health-care personnel handwashes can obtain information about categorization of products from the Center for Drugs and Biologics, Division of OTC Drug Evaluation, FDA, 5600 Fishers Lane, Rockville, MD 20857. In addition, information published in the scientific literature, presented at scientific meetings, documented by manufacturers, and obtained from other sources deemed important may be considered.)

- b. Antimicrobial-containing products that do not require water for use, such as foams or rinses, can be used in areas where no sinks are available.

Category III

5. Handwashing Facilities

- a. Handwashing facilities should be conveniently located throughout the hospital. *Category I*
- b. A sink should be located in or just outside every patient room. More than one sink per room may be necessary if a large room is used for several patients. *Category II*
- c. Handwashing facilities should be located in or adjacent to rooms where diagnostic or invasive procedures that require handwashing are performed (e.g., cardiac catheterization, bronchoscopy, sigmoidoscopy, etc.). *Category I*

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Section 2: Cleaning, Disinfecting, and Sterilizing Patient-Care Equipment

INTRODUCTION

Cleaning, the physical removal of organic material or soil from objects, is usually done by using water with or without detergents. Generally, cleaning is designed to remove rather than to kill microorganisms. Sterilization, on the other hand, is the destruction of all forms of microbial life; it is carried out in the hospital with steam under pressure, liquid or gaseous chemicals, or dry heat. Disinfection, defined as the intermediate measures between physical cleaning and sterilization, is carried out with pasteurization or chemical germicides.

Chemical germicides can be classified by several systems. We have used the system originally proposed by Spaulding (1) in which three levels of disinfection are defined: high, intermediate, and low (Table 1). In contrast, EPA uses a system that classifies chemical germicides as sporicides, general disinfectants, hospital disinfectants, sanitizers, and others. Formulations registered by the EPA as sporicides are considered sterilants if the contact time is long enough to destroy all forms of microbial life, or high-level disinfectants if contact times are shorter. Chemical germicides registered by the EPA as sanitizers probably fall into the category of low-level disinfectants. Numerous formulations of chemical germicides can be classified as either low- or intermediate-level disinfectants, depending on the specific label claims. For example, some chemical germicide formulations are claimed to be efficacious against *Mycobacterium tuberculosis*; by Spaulding's system, these formulations would be classified at least as intermediate-level disinfectants. However, chemical germicide formulations with specific label claims for effectiveness against *Salmonella choleraesuis*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa* (the challenge microorganisms required for EPA classification as a "hospital disinfectant") could fall into intermediate- or low-level disinfectant categories.

The rationale for cleaning, disinfecting, or sterilizing patient-care equipment can be understood more readily if medical devices, equipment, and surgical materials are divided into three general categories (critical items, semicritical items, and noncritical items) based on the potential risk of infection involved in their use. This categorization of medical devices also is based on the original suggestions by Spaulding (1).

Critical items are instruments or objects that are introduced directly into the bloodstream or into other normally sterile areas of the body. Examples of critical items are surgical instruments, cardiac catheters, implants, pertinent components of the heart-lung oxygenator, and the blood compartment of a hemodialyzer. Sterility at the time of use is required for these items; consequently, one of several accepted sterilization procedures is generally recommended.

Items in the second category are classified as semicritical in terms of the degree of risk of infection. Examples are noninvasive flexible and rigid fiberoptic endoscopes,

endotracheal tubes, anesthesia breathing circuits, and cystoscopes. Although these items come in contact with intact mucous membranes, they do not ordinarily penetrate body surfaces. If steam sterilization can be used, it is often cheaper to sterilize many of these items, but sterilization is not absolutely essential; at a minimum, a high-level disinfection procedure that can be expected to destroy vegetative microorganisms, most fungal spores, tubercle bacilli, and small nonlipid viruses is recommended. In most cases, meticulous physical cleaning followed by an appropriate high-level disinfection treatment gives the user a reasonable degree of assurance that the items are free of pathogens.

Noncritical items are those that either do not ordinarily touch the patient or touch only intact skin. Such items include crutches, bedboards, blood pressure cuffs, and a variety of other medical accessories. These items rarely, if ever, transmit disease. Consequently, depending on the particular piece of equipment or item, washing with a detergent may be sufficient.

The level of disinfection achieved depends on several factors, principally contact time, temperature, type and concentration of the active ingredients of the chemical germicide, and the nature of the microbial contamination. Some disinfection procedures are capable of producing sterility if the contact times used are sufficiently long; when these procedures are continued long enough to kill all but resistant bacterial spores, the result is high-level disinfection. Other disinfection procedures that can kill many types of viruses and most vegetative microorganisms (but cannot be relied upon to kill resistant microorganisms such as tubercle bacilli, bacterial spores, or certain viruses) are considered to be intermediate- or low-level disinfection (Table 1).

The tubercle bacillus, lipid and nonlipid viruses, and other groups of microorganisms in Table 1 are used in the context of indicator microorganisms that have varying degrees of resistance to chemical germicides and not necessarily because of their importance in causing nosocomial infections. For example, cells of *M. tuberculosis* or *M. bovis*, which are used in routine efficacy tests, are among the most resistant vegetative microorganisms known and, after bacterial endospores, constitute the most severe challenge to a chemical germicide. Thus, a tuberculocidal chemical germicide may be used as a high or intermediate-level disinfectant targeted to many types of nosocomial pathogens but not specifically to control respiratory tuberculosis.

CONTROL MEASURES

Since it is neither necessary nor possible to sterilize all patient-care items, hospital policies can identify whether cleaning, disinfecting, or sterilizing of an item is indicated to decrease the risk of infection. The process indicated for an item will depend on its intended use. Any microorganism, including bacterial spores, that come in contact with

normally sterile tissue can cause infection. Thus, it is important that all items that will touch normally sterile tissues be sterilized. It is less important that objects touching mucous membranes be sterile. Intact mucous membranes are generally resistant to infection by common bacterial spores but are not resistant to many other microorganisms, such as viruses and tubercle bacilli; therefore, items that touch mucous membranes require a disinfection process that kills all but resistant bacterial spores. In general, intact skin acts as an effective barrier to most microorganisms; thus, items that touch only intact skin need only be clean.

Items must be thoroughly cleaned before processing, because organic material (e.g., blood and proteins) may contain high concentrations of microorganisms. Also, such organic material may inactivate chemical germicides and protect microorganisms from the disinfection or sterilization process. For many noncritical items, such as blood pressure cuffs or crutches, cleaning can consist only of 1) washing with a detergent or a disinfectant-detergent, 2) rinsing, and 3) thorough drying.

Steam sterilization is the most inexpensive and effective method for sterilization. Steam sterilization is unsuitable, however, for processing plastics with low melting points, powders, or anhydrous oils. Items that are to be sterilized but not used immediately need to be wrapped for storage. Sterility can be maintained in storage for various lengths of time, depending on the type of wrapping material, the conditions of storage, and the integrity of the package.

Several methods have been developed to monitor steam sterilization processes. One method is to check the highest temperature that is reached during sterilization and the length of time that this temperature is maintained. In addition, heat- and steam-sensitive chemical indicators can be used on the outside of each pack. These indicators do not reliably document sterility, but they do show that an item has not accidentally bypassed a sterilization process. As an additional precaution, a large pack might have a chemical indicator both on the outside and the inside to verify that steam has penetrated the pack.

Microbiological monitoring of steam sterilizers is recommended at least once a week with commercial preparations of spores of *Bacillus stearothermophilus* (a microorganism having spores that are particularly resistant to moist heat, thus assuring a wide margin of safety). If a sterilizer is working properly and used appropriately, the spores are usually killed. One positive spore test (spores not killed) does not necessarily indicate that items processed in the sterilizer are not sterile, but it does suggest that the sterilizer should be rechecked for proper temperature, length of cycle, loading, and use and that the test be repeated. Spore testing of steam sterilization is just one of several methods for assuring adequate processing of patient-care items (Table 2).

Implantable items, such as orthopedic devices, require special handling before and during sterilization; thus, packs containing implantable objects need to be clearly labeled so they will be appropriately processed. To guarantee a wide margin of safety, it is recommended that each load of such items be tested with a spore test and that the sterilized item not be released for use until the

spore test is negative at 48 hours. If it is not possible to process an implantable object with a confirmed 48-hour spore test before use, it is recommended that the unwrapped object receive the equivalent of full-cycle steam sterilization and *not* flash sterilization. Flash sterilization [270°F (132°C) for 3 minutes in a gravity displacement steam sterilizer] is *not* recommended for implantable items because spore tests cannot be used reliably and the margin of safety is lower.

Because ethylene oxide gas sterilization is a more complex and expensive process than steam sterilization, it is usually restricted to objects that might be damaged by heat or excessive moisture. Before sterilization, objects also need to be cleaned thoroughly and wrapped in a material that allows the gas to penetrate. Chemical indicators need to be used with each package to show that it has been exposed to the gas sterilization process. Moreover, it is recommended that gas sterilizers be checked at least once a week with commercial preparations of spores, usually *Bacillus subtilis* var. *niger*. Because ethylene oxide gas is toxic, precautions (e.g., local exhaust ventilation) should be taken to protect personnel (2). All objects processed by gas sterilization also need special aeration according to manufacturer's recommendations before use to remove toxic residues of ethylene oxide.

Powders and anhydrous oils can be sterilized by dry heat. Microbiological monitoring of dry heat sterilizers and following manufacturers' recommendations for their use and maintenance usually provides a wide margin of safety for dry heat sterilization.

Liquid chemicals can be used for sterilization and disinfection when steam, gas, or dry heat sterilization is not indicated or available. With some formulations, high-level disinfection can be accomplished in 10-30 minutes, and sterilization can be achieved if exposure is for significantly longer times. Nevertheless, not all formulations are equally applicable to all items that need to be sterilized or disinfected. No formulation can be considered as an "all purpose" chemical germicide. In each case, more detailed information can be obtained from the EPA, descriptive brochures from the manufacturers, peer-review journal articles, and books. The most appropriate chemical germicide for a particular situation can be selected by responsible personnel in each hospital based on the object to be disinfected, the level of disinfection needed, and the scope of services, physical facilities, and personnel available in the hospital. It is also important that the manufacturer's instructions for use be consulted.

Gloves may be indicated to prevent skin reactions when some chemical disinfectants are used. Items subjected to high-level disinfection with liquid chemicals need to be rinsed in *sterile* water to remove toxic or irritating residues and then thoroughly dried. Subsequently, the objects need to be handled aseptically with sterile gloves and towels and stored in protective wrappers to prevent recontamination.

Hot-water disinfection (pasteurization) is a high-level, nontoxic disinfection process that can be used for certain items, e.g., respiratory therapy breathing circuits.

In recent years, some hospitals have considered reusing medical devices labeled disposable or single use only. In general, the primary, if not the sole, motivation for

such reuse is to save money. For example, the disposable hollow-fiber hemodialyzer has been reprocessed and reused on the same patient in hemodialysis centers since the early 1970s. By 1984, 51% of the 1,200 U.S. dialysis centers were using dialyzer reprocessing programs. It has been estimated that this practice saves more than 100 million dollars per year (3). When standard protocols for cleaning and disinfecting hemodialyzers are used, there does not appear to be any significant infection risk to dialysis patients (4). Moreover, the safety and efficacy of dialyzer reuse programs are supported by several major studies (5-7). Few, if any, other medical devices that might be considered candidates for reprocessing have been evaluated in this manner.

Arguments for and against reprocessing and reusing single-use items in the 1980's have been summarized (4). Since there is lack of evidence indicating increased risk of nosocomial infections associated with reusing *all* single-use items, a categorical recommendation against all types of reuse is not considered justifiable. Rather than recommending for or against reprocessing and reuse of all single-use items, it appears more prudent to recommend that hospitals consider the safety and efficacy of the reprocessing procedure of each item or device separately and the likelihood that the device will function as intended after reprocessing. In many instances it may be difficult if not impossible to document that the device can be reprocessed without residual toxicity and still function safely and effectively. Few, if any, manufacturers of disposable or single-use medical devices provide reprocessing information on the product label.

Hydrotherapy pools and immersion tanks present unique disinfection problems in hospitals. It is generally not economically feasible to drain large hydrotherapy pools that contain thousands of gallons of water after each patient use. Typically, these pools are used by a large number of patients and are drained and cleaned every one to two weeks. The water temperature is typically maintained near 37°C. Between cleanings, water can be contaminated by organic material from patients, and high levels of microbial contamination are possible. One method to maintain safe pool water is to install a water filter of sufficient size to filter all the water at least three times per day and to chlorinate the water so that a free chlorine residual of approximately 0.5 mg/l is maintained at a pH of 7.2 to 7.6. Local public health authorities can provide consultation regarding chlorination, alternate halogen disinfectants, and hydrotherapy pool sanitation.

Hubbard and immersion tanks present entirely different problems than large pools, since they are drained after each patient use. All inside surfaces need to be cleaned with a disinfectant-detergent, then rinsed with tap water. After the last patient each day, an additional disinfection step is performed. One general procedure is to circulate a chlorine solution (200-300 mg/l) through the agitator of the tank for 15 minutes and then rinse it out. It is also recommended that the tank be thoroughly cleaned with a disinfectant-detergent, rinsed, wiped dry with clean cloths, and not filled until ready for use.

An alternative approach to control of contamination in hydrotherapy tanks is to use plastic liners and create the "whirlpool effect" without agitators. Such liners make it

possible to minimize contact of contaminated water with the interior surface of the tank and also obviate the need for agitators that may be very difficult to clean and decontaminate.

RECOMMENDATIONS

1. Cleaning

All objects to be disinfected or sterilized should first be thoroughly cleaned to remove all organic matter (blood and tissue) and other residue. *Category I*

2. Indications for Sterilization and High-Level Disinfection

a. Critical medical devices or patient-care equipment that enter normally sterile tissue or the vascular system or through which blood flows should be subjected to a sterilization procedure before each use. *Category I*

b. Laparoscopes, arthroscopes, and other scopes that enter normally sterile tissue should be subjected to a sterilization procedure before each use; if this is not feasible, they should receive at least high-level disinfection. *Category I*

c. Equipment that touches mucous membranes, e.g., endoscopes, endotracheal tubes, anesthesia breathing circuits, and respiratory therapy equipment, should receive high-level disinfection. *Category I*

3. Methods of Sterilization

a. Whenever sterilization is indicated, a steam sterilizer should be used unless the object to be sterilized will be damaged by heat, pressure, or moisture or is otherwise inappropriate for steam sterilization. In this case, another acceptable method of sterilization should be used. *Category II*

b. Flash sterilization [270°F (132°C) for 3 minutes in a gravity displacement steam sterilizer] is not recommended for implantable items. *Category II*

4. Biological Monitoring of Sterilizers

a. All sterilizers should be monitored at least once a week with commercial preparations of spores intended specifically for that type of sterilizer (i.e., *Bacillus stearothermophilus* for steam sterilizers and *Bacillus subtilis* for ethylene oxide and dry heat sterilizers). *Category II*

b. Every load that contains implantable objects should be monitored. These implantable objects should not be used until the spore test is found to be negative at 48 hours. *Category II*

c. If spores are not killed in routine spore tests, the sterilizer should immediately be checked for proper use and function and the spore test repeated. Objects, other than implantable objects, do not need to be recalled because of a single positive spore test unless the sterilizer or the sterilization procedure is defective. *Category II*

d. If spore tests remain positive, use of the sterilizer should be discontinued until it is serviced. *Category I*

5. Use and Preventive Maintenance

Manufacturers' instructions should be followed for use and maintenance of sterilizers. *Category II*

6. Chemical Indicators

Chemical indicators that will show a package has been through a sterilization cycle should be visible on the outside of each package sterilized. *Category II*

7. Use of Sterile Items

An item should not be used if its sterility is questionable, e.g., its package is punctured, torn, or wet. *Category I*

8. Reprocessing Single-Use or Disposable Items

a. Items or devices that cannot be cleaned and sterilized or disinfected without altering their physical integrity and function should not be reprocessed. *Category I*

b. Reprocessing procedures that result in residual toxicity or compromise the overall safety or effectiveness of the items or devices should be avoided. *Category I*

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Section 3: Microbiologic Sampling

INTRODUCTION

Before 1970, regularly scheduled culturing of the air and environmental surfaces such as floors, walls, and table tops was widely practiced in U.S. hospitals. By 1970, CDC and the American Hospital Association were advocating that hospitals discontinue routine environmental culturing, since rates of nosocomial infection had not been related to levels of general microbial contamination of air or environmental surfaces, and meaningful standards for permissible levels of microbial contamination of environmental surfaces did not exist (1,2). Between 1970 and 1975, 25% of U.S. hospitals reduced the extent of such routine environmental culturing (3), and this trend has continued.

In the last several years, there has also been a trend toward reducing routine microbiologic sampling for quality control purposes. In 1982, CDC recommended that the disinfection process for respiratory therapy equipment should not be monitored by routine microbiologic sampling (4). Moreover, the recommendation for microbiologic sampling of infant formulas prepared in the hospital has been removed from this *Guideline*, since there is no epidemiologic evidence to show that such quality control testing influences the infection rate in hospitals.

CONTROL MEASURES

The only routine or periodic microbiologic sampling that is recommended is of the water and dialysis fluids used with artificial kidney machines in hospital-based or free standing chronic hemodialysis centers. Microbiologic sampling of dialysis fluids and water used to prepare dialysis fluids is recommended because gram-negative bacteria are able to grow rapidly in water and other fluids associated with the hemodialysis system; high levels of these microorganisms place dialysis patients at risk of pyrogenic reactions, bacteremia, or both (5). It is suggested that the water that is used to prepare dialysis fluid also be sampled periodically, because high levels of bacteria in water often become amplified downstream in a hemodialysis system and are sometimes predictive of bacterial contamination in dialysis fluids. Although it is difficult to determine the exact frequency of such a sampling program in the absence of pyrogenic reactions and bacteremia, sampling water and dialysis fluid monthly appears to be reasonable.

Routine microbiologic sampling of patient-care items purchased as sterile is not recommended because of the difficulty and expense of performing adequate sterility testing with low-frequency contamination.

Microbiologic sampling is indicated during investigation of infection problems if environmental reservoirs are

implicated epidemiologically in disease transmission. It is important, however, that such culturing be based on epidemiologic data and follow a written plan that specifies the objects to be sampled and the actions to be taken based on culture results.

RECOMMENDATIONS

1. Routine Environmental Culturing of Air and Environmental Surfaces

Routine microbiologic sampling of the air and environmental surfaces should not be done. *Category I*

2. Microbiologic Sampling of Dialysis Fluids

Water used to prepare dialysis fluid should be sampled once a month; it should not contain a total viable microbial count greater than 200 colony-forming units (CFU)/ml. The dialysis fluid should be sampled once a month at the end of a dialysis treatment and should contain less than 2,000 CFU/ml. *Category II*

3. Microbiologic Sampling for Specific Problems

Microbiologic sampling, when indicated, should be an integral part of an epidemiologic investigation.

Category I

4. Sampling for Manufacturer-Associated Contamination

a. Routine microbiologic sampling of patient-care objects purchased as sterile is not recommended.

Category I

b. If contamination of a commercial product sold as sterile is suspected, infection control personnel should be notified, suspect lot numbers should be recorded, and items from suspected lots should be segregated and quarantined. Appropriate microbiologic assays may be considered; however, the nearest district office of the FDA, local and state health departments, and CDC should be notified promptly.

Category I

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Section 4: Infective Waste

INTRODUCTION

There is no epidemiologic evidence to suggest that most hospital waste is any more infective than residential waste. Moreover, there is no epidemiologic evidence that hospital waste disposal practices have caused disease in the community. Therefore, identifying wastes for which special precautions are indicated is largely a matter of judgment about the relative risk of disease transmission. Aesthetic and emotional considerations may override the actual risk of disease transmission, particularly for pathology wastes.

Since a precise definition of infective waste that is based on the quantity and type of etiologic agents present is virtually impossible, the most practical approach to infective waste management is to identify those wastes that represent a sufficient potential risk of causing infection during handling and disposal and for which some special precautions appear prudent. Hospital wastes for which special precautions appear prudent include microbiology laboratory waste, pathology waste, and blood specimens or blood products. Moreover, the risk of either injury or infection from certain sharp items (e.g., needles and scalpel blades) contaminated with blood also needs to be considered when such items are disposed of. While any item that has had contact with blood, exudates, or secretions may be potentially infective, it is not normally considered practical or necessary to treat all such waste as infective. CDC has published general recommendations for handling infective waste from patients on isolation precautions (1). Additional special precautions may be necessary for certain rare diseases or conditions such as Lassa fever (2). The EPA has published a draft manual (Environmental Protection Agency, Office of Solid Waste and Emergency Response. Draft Manual for Infectious Waste Management, SW-957, 1982. Washington: 1982) that identifies and categorizes other specific types of waste that may be generated in some research-oriented hospitals. In addition to the above guidelines, local and state environmental regulations may also exist.

CONTROL MEASURES

Solid waste from the microbiology laboratory can be placed in steam-sterilizable bags or pans and steam-sterilized in the laboratory. Alternatively, it can be transported in sealed, impervious plastic bags to be burned in a hospital incinerator. A single bag is probably adequate if the bag is sturdy (not easily penetrated) and if the waste can be put in the bag without contaminating the outside of the bag; otherwise, double-bagging is indicated. All slides or tubes with small amounts of blood can be packed in sealed, impervious containers and sent for incineration or steam sterilization in the hospital. Exposure for up to 90 minutes at 250°F (121°C) in a steam sterilizer, depending on the size of the load and type container, may be necessary to assure an adequate sterilization cycle (3,4). After steam sterilization, the residue can be safely handled and discarded with all other nonhazardous hospital solid waste. All containers with more than a few milliliters of blood remaining after laboratory procedures

and/or bulk blood may be steam sterilized, or the contents may be carefully poured down a utility sink drain or toilet.

Waste from the pathology laboratory is customarily incinerated at the hospital. Although no national data are available, in one state 96% of the hospitals surveyed reported that they incinerate pathology waste (5). Any hospital incinerator should be capable of burning, within applicable air pollution regulations, the actual waste materials to be destroyed. Improper incineration of waste with high moisture and low energy content, such as pathology waste, can lead to emission problems.

Disposables that can cause injury, such as scalpel blades and syringes with needles, should be placed in puncture-resistant containers. Ideally, such containers are located where these items are used. Syringes and needles can be placed intact directly into the rigid containers for safe storage until terminal treatment. To prevent needle-stick injuries, needles should not be recapped, purposely bent, or broken by hand. When some needle-cutting devices are used, blood may be aerosolized or splattered onto environmental surfaces; however, currently no data are available from controlled studies examining the effect, if any, of the use of these devices on the incidence of needle-transmissible infections.

It is often necessary to transport or store infective waste within the hospital prior to terminal treatment. This can be done safely if proper and common-sense procedures are used. The EPA draft manual mentioned above contains guidelines for the storage and transport, both on-site and off-site, of infective waste. For unique and specialized problems, this manual can be consulted.

RECOMMENDATIONS

1. Identification of Infective Waste

- a. Microbiology laboratory wastes, blood and blood products, pathology waste, and sharp items (especially needles) should be considered as potentially infective and handled and disposed of with special precautions. *Category II*
- b. Infective waste from patients on isolation precautions should be handled and disposed of according to the current edition of the *Guideline for Isolation Precautions in Hospitals*. (This recommendation is not categorized since the recommendations for isolation precautions are not categorized.)

2. Handling, Transport, and Storage of Infective Waste

- a. Personnel involved in the handling and disposal of infective waste should be informed of the potential health and safety hazards and trained in the appropriate handling and disposal methods. *Category II*
- b. If processing and/or disposal facilities are not available at the site of infective waste generation (i.e., laboratory, etc.) the waste may be safely transported in sealed impervious containers to another hospital area for appropriate treatment. *Category II*
- c. To minimize the potential risk for accidental transmission of disease or injury, infective waste awaiting

terminal processing should be stored in an area accessible only to personnel involved in the disposal process. *Category III*

3. Processing and Disposal of Infective Waste

- a. Infective waste, in general, should either be incinerated or should be autoclaved prior to disposal in a sanitary landfill. *Category III*
- b. Disposable syringes with needles, scalpel blades, and other sharp items capable of causing injury should be placed intact into puncture-resistant containers located as close to the area in which they were used as is practical. To prevent needle-stick injuries, needles should not be recapped, purposely bent, broken, or otherwise manipulated by hand. *Category I*
- c. Bulk blood, suctioned fluids, excretions, and secretions may be carefully poured down a drain connected to a sanitary sewer. Sanitary sewers may also be used for the disposal of other infectious wastes capable of being ground and flushed into the sewer.

Category II (Special precautions may be necessary for certain rare diseases or conditions such as Lassa fever (2).)

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Section 5: Housekeeping

INTRODUCTION

Although microorganisms are a normal contaminant of walls, floors, and other surfaces, these environmental surfaces rarely are associated with transmission of infections to patients or personnel. Therefore, extraordinary attempts to disinfect or sterilize these environmental surfaces are rarely indicated. However, routine cleaning and removal of soil are recommended. Recommendations for cleaning in the rooms of patients on isolation precautions have been published (1).

CONTROL MEASURES

Cleaning schedules and methods vary according to the area of the hospital, type of surface to be cleaned, and the amount and type of soil present. Horizontal surfaces (for example, bedside tables and hard-surfaced flooring) in patient-care areas are usually cleaned on a regular basis, when soiling or spills occur, and when a patient is discharged. Cleaning of walls, blinds, and curtains is recommended only if they are visibly soiled. Disinfectant fogging is an unsatisfactory method of decontaminating air and surfaces and is not recommended.

Recommendations against use of carpets in patient-care areas have been removed from this *Guideline*, since there is no epidemiologic evidence to show that carpets influence the nosocomial infection rate in hospitals (2). Carpets, however, may contain much higher levels of microbial contamination than hard-surfaced flooring and can be difficult to keep clean in areas of heavy soiling or spillage; therefore, appropriate cleaning and maintenance procedures are indicated.

Disinfectant-detergent formulations registered by the EPA can be used for environmental surface cleaning, but the actual physical removal of microorganisms by scrubbing is probably as important, if not more so, than any antimicrobial effect of the cleaning agent used. Therefore, cost, safety, and acceptability by housekeepers can be the main criteria for selecting any such registered agent. The manufacturers' instructions for appropriate use should be followed.

Special precautions for cleaning incubators, mattresses, and other nursery surfaces with which neonates

have contact have been recommended (3), since inadequately diluted solutions of phenolics used for such cleaning and poor ventilation have been associated with hyperbilirubinemia in newborns (4).

RECOMMENDATIONS

1. **Choice of Cleaning Agent for Environmental Surfaces in Patient-Care Areas**
Any hospital-grade disinfectant-detergent registered by the EPA may be used for cleaning environmental surfaces. Manufacturers' instructions for use of such products should be followed. *Category II*
2. **Cleaning of Horizontal Surfaces in Patient-care Areas**
 - a. Uncarpeted floors and other horizontal surfaces, e.g., bedside tables, should be cleaned regularly and if spills occur. *Category II*
 - b. Carpeting should be vacuumed regularly with units designed to efficiently filter discharged air, cleaned if spills occur, and shampooed whenever a thorough cleaning is indicated. *Category II*
3. **Cleaning Walls, Blinds, and Curtains**
Terminal cleaning of walls, blinds, and curtains is not recommended unless they are visibly soiled. *Category II*
4. **Disinfectant fogging**
Disinfectant fogging should not be done. *Category I*

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Section 6: Laundry

INTRODUCTION

Although soiled linen has been identified as a source of large numbers of pathogenic microorganisms, the risk of actual disease transmission appears negligible. Rather than rigid rules and regulations, hygienic and common-sense storage and processing of clean and soiled linen are recommended. Guidelines for laundry construction and operation for health care facilities have been published (1,2).

CONTROL MEASURES

Soiled linen can be transported in the hospital by cart or chute. Bagging linen is indicated if chutes are used, since improperly designed chutes can be a means of spreading microorganisms throughout the hospital (3). Recommendations for handling soiled linen from patients on isolation precautions have been published (4).

Soiled linen may or may not be sorted in the laundry before being loaded into washer/extractor units. Sorting before washing protects both machinery and linen from the effects of objects in the linen and reduces the potential for recontamination of clean linen that sorting after washing requires. Sorting after washing minimizes the direct exposure of laundry personnel to infective material in the soiled linen and reduces airborne microbial contamination in the laundry (5). Protective apparel and appropriate ventilation (2) can minimize these exposures.

The microbicidal action of the normal laundering process is affected by several physical and chemical factors (5). Although dilution is not a microbicidal mechanism, it is responsible for the removal of significant quantities of microorganisms. Soaps or detergents loosen soil and also have some microbicidal properties. Hot water provides an effective means of destroying microorganisms, and a temperature of at least 71°C (160°F) for a minimum of 25 minutes is commonly recommended for hot-water washing. Chlorine bleach provides an extra margin of safety. A total available chlorine residual of 50-150ppm is usually achieved during the bleach cycle. The last action performed during the washing process is the addition of a mild acid to neutralize any alkalinity in the water supply, soap, or detergent. The rapid shift in pH from approximately 12 to 5 also may tend to inactivate some microorganisms.

Recent studies have shown that a satisfactory reduction of microbial contamination can be achieved at lower water temperatures of 22-50°C when the cycling of the washer, the wash formula, and the amount of chlorine bleach are carefully monitored and controlled (6,7). Instead of the microbicidal action of hot water, low-temperature laundry cycles rely heavily on the presence of bleach to reduce levels of microbial contamination.

Regardless of whether hot or cold water is used for washing, the temperatures reached in drying and especially during ironing provide additional significant microbicidal action.

RECOMMENDATIONS

1. Routine Handling of Soiled Linen

- a. Soiled linen should be handled as little as possible and with minimum agitation to prevent gross microbial contamination of the air and of persons handling the linen. *Category II*
- b. 1) All soiled linen should be bagged or put into carts at the location where it was used; it should *not* be sorted or prerinsed in patient-care areas. *Category II*
2) Linen soiled with blood or body fluids should be deposited and transported in bags that prevent leakage. *Category II*
- c. If laundry chutes are used, linen should be bagged, and chutes should be properly designed. *Category II*

2. Hot-Water Washing

If hot water is used, linen should be washed with a detergent in water at least 71°C (160°F) for 25 minutes. *Category II*

3. Low-Temperature Water Washing

If low temperature (<70°C) laundry cycles are used, chemicals suitable for low-temperature washing at proper use concentration should be used. *Category II*

4. Transportation of Clean Linen

Clean linen should be transported and stored by methods that will ensure its cleanliness. *Category II*

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Table 1. Levels of Disinfection According to Type of Microorganism

Levels	Vegetative	Bacteria	Spores	Fungi ¹	Viruses	
		Tubercle Bacillus			Lipid & Medium size	Nonlipid & Small
High	+ ²	+	+ ³	+	+	+
Intermediate	+	+	± ⁴	+	+	±
Low	+	-	-	±	+	-

¹Includes asexual spores but not necessarily chlamydo spores or sexual spores.

²Plus sign indicates that a killing effect can be expected when the normal use-concentrations of chemical disinfectants or pasteurization are properly employed; a negative sign indicates little or no killing effect.

³Only with extended exposure times are high-level disinfectant chemicals capable of actual sterilization.

⁴Some intermediate-level disinfectants can be expected to exhibit some sporicidal action.

⁵Some intermediate-level disinfectants may have limited virucidal activity.

Table 2. Methods of Assuring Adequate Processing and Safe Use of Medical Devices

Object and Classification	Example	Method	Comment
PATIENT-CARE OBJECTS			
Critical			
Sterilized in the hospital	Surgical instruments and devices; trays and sets	<ol style="list-style-type: none"> 1. Thoroughly clean objects and wrap or package for sterilization. 2. Follow manufacturer's instructions for use of each sterilizer or use recommended protocol. 3. Monitor time-temperature charts. 4. Use commercial spore preparations to monitor sterilizers. 5. Inspect package for integrity and for exposure of sterility indicator before use. 6. Use before maximum safe storage time has expired if applicable. 	Sterilization processes are designed to have a wide margin of safety. If spores are not killed, the sterilizer should be checked for proper use and function; if spore tests remain positive, discontinue use of the sterilizer until properly serviced. Maximum safe storage time of items processed in the hospital varies according to type of package or wrapping material(s) used; follow manufacturer's instructions for use and storage times.
Purchased as sterile	Intravenous fluids; irrigation fluids; normal saline; trays and sets	<ol style="list-style-type: none"> 1. Store in safe, clean area. 2. Inspect package for integrity before use. 3. Use before expiration date if one is given. 4. Culture only if clinical circumstances suggest infection related to use of the item. 	Notify the Food and Drug Administration, local and state health departments, and CDC if intrinsic contamination is suspected.
Semicritical			
Should be free of vegetative bacteria. May be subjected to high-level disinfection rather than sterilization process	Respiratory therapy equipment and instruments that will touch mucous membranes	<ol style="list-style-type: none"> 1. Sterilize or follow a protocol for high-level disinfection. 2. Bag and store in safe, clean area. 3. Conduct quality control monitoring after any important changes in the disinfection process. 	Bacterial spores may survive after high-level disinfection, but these usually are not pathogenic. Microbiologic sampling can verify that a high-level disinfection process has resulted in destruction of vegetative bacteria; however, this sampling is not routinely recommended.
Non critical			
Usually contaminated with some bacteria	Bedpans; crutches; rails; EKG leads	<ol style="list-style-type: none"> 1. Follow a protocol for cleaning or, if necessary a low-level disinfection process. 	
Water-produced or treated	Water used for hemodialysis fluids	<ol style="list-style-type: none"> 1. Assay water and dialysis fluids monthly. 2. Water should not have more than 200 bacteria/ml and dialysis fluids not more than 2000 bacteria/ml. 	Gram-negative water bacteria can grow rapidly in water and dialysis fluids and can place dialysis patients at risk of pyrogenic reactions or septicemia. These water sources and pathways should be disinfected routinely.

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