



Self-Study Modules On Tuberculosis



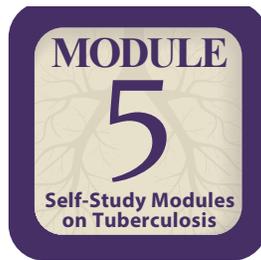
MODULE 5

Infectiousness and Infection Control



**Centers for Disease
Control and Prevention**
National Center for HIV/AIDS,
Viral Hepatitis, STD, and
TB Prevention

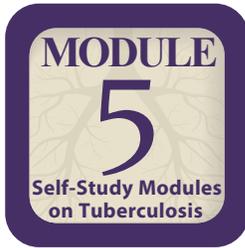




Infectiousness and Infection Control

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention
Division of Tuberculosis Elimination

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Infectiousness and Infection Control

CONTENTS

Background.....	1
Objectives.....	1
New Terms.....	2
Infectiousness.....	4
Infection Control.....	8
Additional Resources.....	35
Answers to Study Questions.....	36
Case Study Answers.....	42



Background

In this module, you will learn about the factors that determine the infectiousness of a person with TB disease. This will help you and others decide whether a particular patient should be considered infectious. You will also learn about the precautions that you should take to prevent the spread of TB in health care settings and communities. These precautions, or measures, are part of a TB infection-control program that each health care setting should develop to minimize the risk for transmission of *Mycobacterium tuberculosis*.

Note: The Self-Study Modules on Tuberculosis are a series of educational modules designed to provide information about TB in a self-study format. The target audiences include outreach workers, nurses, physicians, administrators, health educators, and students from a variety of settings. The Modules should not be used as a substitute for guidelines and should not be used for patient care decisions.

Objectives

After working through this module, you will be able to

1. Describe the factors that determine the infectiousness of a TB patient.
2. Describe the main goals of a TB infection-control program.
3. Describe the three levels of control measures that are the basis of an effective infection-control program.
4. Describe the purpose and the characteristics of a TB airborne infection isolation room.
5. Describe the circumstances when personal respirators should be used.

define

explain

list

describe



Doctor reviewing a chest x-ray.

New Terms

New terms introduced in this module are included below. These terms appear in bold in the module text.

administrative controls—the first level in the hierarchy of TB infection-control measures; managerial measures that reduce the risk for exposure to persons who have, or might have, TB disease

airborne infection isolation (All) room—formerly called “negative pressure isolation room.” A room with special characteristics to prevent the spread of droplet nuclei expelled by a TB patient, including negative-pressure ventilation.

cough-inducing procedures—procedures that make a patient cough, such as sputum induction and bronchoscopy

diagnostic evaluation—an evaluation used to diagnose TB disease; includes a medical history, a chest x-ray, the collection of specimens for bacteriologic examination, and possibly a tuberculin skin test or an interferon-gamma release assay (blood test)

environmental controls—the second level in the hierarchy of TB infection-control measures; engineering systems used to prevent the transmission of TB in health care settings, including ventilation, high-efficiency particulate air (HEPA) filtration, and ultraviolet germicidal irradiation

fit check—see **user seal check**

fit test—a method to evaluate the fit of a respirator on a person

health care personnel—individuals who work or volunteer in health care settings

health care setting—a place where health care is delivered; examples include inpatient settings, outpatient settings, laboratories, emergency medical services, medical settings in correctional facilities, home-based health care and outreach settings, long-term care facilities, and clinics in homeless shelters

high efficiency particulate air (HEPA) filters—special filters that can be used in ventilation systems to help remove droplet nuclei from the air

negative pressure—the difference in air-pressure between two areas. A room that is under negative pressure has a lower pressure than adjacent areas, which keeps air from flowing out of the room and into adjacent rooms or areas. Negative pressure is also used to describe a nonpowered respirator.

negative pressure isolation room—see **airborne infection isolation (AII) room**

personal respirator—special device designed to protect users from inhaling droplet nuclei; used in health care facilities and other settings where TB may be spread

respiratory-protection controls—the third level in the hierarchy of TB infection-control measures; used to minimize the risk for exposure to *M. tuberculosis*

surgical mask—device worn over the nose and mouth of a person who has, or might have, infectious TB disease to prevent infectious droplet nuclei from being spread (exhaled) into the air

TB risk assessment—an initial and ongoing evaluation of the risk for transmission of *M. tuberculosis* in a particular health care setting

TB screening—an administrative control measure in which health care personnel are evaluated for latent TB infection (LTBI) and TB disease. TB screening includes a baseline individual TB risk assessment, a TB symptom evaluation, a TB test (e.g., a TB blood test [interferon-gamma release assay] or a tuberculin skin test), and additional evaluation for TB disease as needed.

ultraviolet germicidal irradiation—the use of special lamps that give off ultraviolet light, which kills the tubercle bacilli contained in droplet nuclei

user seal check—formerly called “fit check”; procedure performed to check for the proper seal of a respirator each time a respirator is put on

ventilation systems—air systems designed to maintain negative pressure and to exhaust the air properly; designed to minimize the spread of TB in a health care facility

Infectiousness

Infectiousness is directly related to the number of tubercle bacilli the TB patient expels into the air. Patients who expel many tubercle bacilli are more infectious than patients who expel few or no bacilli.

Infectiousness is directly related to the number of tubercle bacilli that a TB patient expels into the air.

The number of tubercle bacilli expelled by a TB patient depends on the following factors (Table 5.1):

- **Presence of a cough**

TB patients expel more tubercle bacilli if they have a cough that produces a lot of sputum.

- **Cavity in the lung**

Because there are many tubercle bacilli in a cavity, TB patients who have a cavity in the lung may be expelling large amounts of tubercle bacilli if they are coughing.

- **Positive sputum smear result**

The presence of acid-fast bacilli on a sputum smear indicates that the patient may be expelling many tubercle bacilli.

- **Site of the disease**

Usually, only people with TB of the lungs, airway, or larynx are infectious. This is because these people may be coughing and expelling tubercle bacilli into the air. People with extrapulmonary TB other than the airway and larynx (with no pulmonary involvement) generally are not infectious. This is because tubercle bacilli usually cannot be expelled into the air from a non-respiratory extrapulmonary site.

Usually, only people with TB of the lungs, airway, or larynx are infectious.

- **Not covering mouth and nose when coughing**

Patients who do not cover their mouth and nose when they cough are more likely to expel tubercle bacilli.

- **Not receiving adequate treatment or having prolonged illness**

Patients who have not been receiving adequate TB treatment are much more likely to be infectious than patients who have been receiving adequate treatment for 2 weeks or longer. Patients who have been receiving adequate treatment usually respond to treatment; in other words, their symptoms improve and eventually go away.

Patients who have not been receiving adequate treatment are much more likely to be infectious than patients who have been receiving adequate treatment.

- **Cough-inducing procedures**

Patients may expel tubercle bacilli if they are undergoing medical procedures that cause them to cough (for example, bronchoscopy or sputum induction).

Table 5.1 – Factors Associated with Infectiousness and Less Infectiousness.*

Factors Associated with More Infectiousness	Factors Associated with Less Infectiousness
Presence of a cough	No cough
Cavity in the lung	No cavity in the lung
Acid-fast bacilli on sputum smear	No acid-fast bacilli on sputum smear
TB of the lungs, airway, or larynx	Most extrapulmonary (non-respiratory) TB
Patient not covering mouth and nose when coughing or sneezing	Patient covering mouth and nose when coughing
Not receiving adequate treatment or having prolonged illness	Receiving adequate treatment for 2 weeks or longer
Undergoing cough-inducing procedures	Not undergoing cough-inducing procedures
Positive sputum cultures	Negative sputum cultures

*Infectiousness depends on a variety of factors. Clinicians should consider all of these factors when determining whether a TB patient should be considered infectious.

Young children with pulmonary or laryngeal TB disease are less likely than adults to be infectious. This is because children are sometimes unable to produce sputum when they cough. However, it is still possible for children to transmit TB to others if they have characteristics that are associated with infectiousness, such as a positive AFB smear or a cavity on a chest x-ray.

Young children with TB disease are less likely than adults to be infectious.

Infectiousness appears to decline very rapidly after adequate treatment is started, but how quickly it declines varies from patient to patient. Some patients may remain infectious for weeks or even months. Patients with drug-resistant TB may not respond to the initial drug regimen; they will probably remain infectious until they receive an adequate treatment regimen.

Infectiousness appears to decline very rapidly after adequate treatment is started, but how quickly it declines varies from patient to patient.

Patients who have been diagnosed with TB disease can be considered noninfectious when they meet **all** of the following criteria:

- They have been receiving adequate treatment for 2 weeks or longer;
- Their symptoms have improved (for example, they are coughing less and they no longer have a fever); and
- They have 3 consecutive negative sputum smears from sputum collected in 8 to 24 hour intervals (at least one being an early morning specimen).



Study Questions 5.1 – 5.3

5.1 List seven factors that affect the infectiousness of a TB patient.

5.2 Why does the site of disease affect the infectiousness of a TB patient?

5.3 When can patients who have been diagnosed with TB disease be considered noninfectious? Select the correct answer(s).

- A.** After receiving adequate treatment for 2 weeks or longer
- B.** When symptoms have improved
- C.** When the patient has 3 consecutive negative sputum smears from sputum collected in 8 to 24 hour intervals (at least one being an early morning specimen)
- D.** When all of the above are met

Answers to study questions are on pages 36–41



Case Study 5.1

For each of the following situations, decide whether the patient should be considered infectious or noninfectious, and explain why.

- Two weeks ago, Mr. Lopez had a sputum smear that was positive; since then no sputum specimens have been tested. Mr. Lopez started self-administered TB treatment 7 days ago. He still has a cough.

- Ms. Nguyen, a patient with pulmonary TB, has been receiving directly observed therapy (DOT) for 6 weeks and no longer has symptoms of TB. She has had three sputum smears. The first one was positive, but the last two were negative.

- Mr. Martin started DOT treatment for pulmonary TB in April. His symptoms went away and his sputum smears were negative in May. However the outreach worker was unable to locate him on June 5th and has not been able to contact him since that time. Mr. Martin returned to the TB clinic on August 2nd and was still coughing.

Answers to case study questions are on pages 42–43

Infection Control

TB is a communicable disease. On average, 20% to 30% of contacts of someone who has infectious TB disease become infected with *M. tuberculosis*. However, TB patients vary in their infectiousness; some infect most or all of their contacts, whereas others infect few or none of their contacts. Contacts are defined as persons exposed to someone with infectious TB disease. This can include family members, roommates or housemates, close friends, coworkers, classmates, and others.

About 20% to 30% of contacts of someone who has infectious TB disease become infected with *M. tuberculosis*.

TB can be transmitted in just about any setting. It can be spread in places such as homes, worksites, or health care settings. In a health care setting, TB is most likely to be transmitted when **health care personnel** or patients come in contact with persons who have TB disease who are not receiving adequate treatment and who have not been isolated from others. Examples of **health care settings** include inpatient settings, outpatient settings, laboratories, emergency medical services, medical settings in correctional facilities, home-based health care and outreach settings, long-term care facilities, and clinics in homeless shelters. To prevent the spread of TB, all health care settings should implement infection-control measures. To ensure that infection-control measures are properly implemented, each health care setting should develop an **infection-control program**. Other non-traditional facility-based settings that should develop TB infection control programs include congregate settings such as nursing homes, correctional facilities, homeless shelters, drug treatment centers, and other places that serve clients who are at risk for being infected with *M. tuberculosis*.

In health care settings, TB is most likely to be transmitted when health care personnel or patients come in contact with persons who have TB disease who are not receiving adequate treatment and who have not been isolated from others.

Role of the Health Department in Infection Control

Health department TB control programs should not only ensure that each of their clinics develop a TB infection-control program; they should also be able to provide consultation about TB infection control to other health care and congregate settings in their communities.

Specifically, health departments should be able to assist health care settings with:

- Understanding the importance of infection control principles
- Reporting confirmed or presumptive TB cases as quickly as possible
- Conducting contact investigations
- Ensuring there is a plan for TB patients to receive follow-up care after they are discharged
- Conducting risk assessments, testing, surveillance, outbreak investigations, and other aspects of a TB infection-control program
- Planning and implementation of TB control activities

The health department should work closely with health care facilities to help them report confirmed or presumptive TB cases as quickly as possible. When the health department receives a report of a confirmed TB case or a presumptive TB case, it should begin a contact investigation. For more information on conducting contact investigations, refer to *Module 8, Contact Investigations for Tuberculosis*.

Moreover, health departments and health care settings should work together to make sure there is a plan for TB patients to receive follow-up care after they are discharged. Health departments should also ensure that health care personnel who visit TB patients at homes or other settings follow proper precautions to protect themselves from exposure to *M. tuberculosis*. The health department should also be able to help facilities with a TB risk assessment, testing, surveillance, outbreak investigations, and other aspects of a TB infection-control program.

The health department should work closely with health care facilities to help them report confirmed or presumptive TB cases as quickly as possible.

TB Infection-Control Program Fundamentals

The main goals of a TB infection-control program are to ensure early and prompt

- Detection of TB disease
- Airborne precautions (e.g., isolation of people with confirmed or presumptive TB disease)
- Treatment of people with confirmed or presumptive TB disease

The main goals of a TB infection-control program are to detect TB disease early and to promptly isolate and treat people who have TB disease.

Detection of TB Disease

In areas where TB is common, staff of health care facilities should be alert for TB. Staff at public health and community clinics should be especially aware of TB signs and symptoms, as patients who are at high risk for TB often receive care at these settings prior to diagnosis or treatment. Personnel who admit patients to facilities should be trained to ask appropriate questions to help detect patients who have signs or symptoms of TB. Staff at homeless shelters, nursing homes, and correctional facilities should also be aware of TB signs and symptoms to detect TB among their clients or workers.

To detect persons who have TB disease as soon as possible, clinicians and other health care personnel should consider the possibility of TB disease in anyone who has any of these signs or symptoms:

- Persistent cough (3 weeks or longer)
- Chest pain
- Bloody sputum
- Weight loss or loss of appetite
- Fever
- Chills
- Night sweats
- Malaise
- Fatigue

Persons who have any of these symptoms should be given a diagnostic evaluation as soon as possible (for more information on diagnosing TB disease, refer to *Module 3, Targeted Testing and the Diagnosis of Latent Tuberculosis Infection and Tuberculosis Disease*). People with confirmed or presumptive TB disease should be asked to cover their nose and mouth when coughing or sneezing, even when in an area away from others. These persons should also be given a **surgical mask** (Figure 5.2) and instructed to keep it on, or they should be supplied with tissues to cover their cough or sneeze.

Airborne Precautions

Airborne precautions should be taken for any persons who have signs or symptoms of TB disease. Persons who have confirmed or presumptive TB disease should be placed in an area away from other patients. If a facility has an **airborne infection isolation (All) room**, persons with confirmed or presumptive TB disease should preferably be placed there. For more information on All rooms, see the Environmental Controls Section of this module. If a facility does not have All rooms, persons who have confirmed or presumptive TB disease should be placed in a room that has been designated for isolation of persons with confirmed or presumptive infectious TB disease. Patients should be instructed to observe strict respiratory hygiene and cough etiquette procedures (e.g., covering their cough or sneeze).

Airborne precautions should be taken for any person who has signs or symptoms of TB disease.

Clinics should take special care to separate patients with confirmed or presumptive infectious TB disease from those with HIV infection and other immunocompromising conditions that increase the likelihood of developing TB disease if infected with *M. tuberculosis*. Immunosuppressed patients with confirmed or presumptive infectious TB disease need to be physically separated from others to protect both the patient and others they may infect. One strategy to avoid exposing HIV-infected and other immunocompromised persons to *M. tuberculosis* at clinics is to designate certain times of the day to schedule appointments for patients with infectious TB disease. Another strategy is to treat patients with infectious TB disease in areas at a facility where immunocompromised persons are not treated.

Clinics should take special care to separate patients with confirmed or presumptive infectious TB disease from those with HIV infection and other immunocompromising conditions that increase the likelihood of developing TB disease if infected with M. tuberculosis.

Health care settings, such as TB clinics, in which patients with confirmed or presumptive TB disease are expected to be encountered, should also implement a respiratory protection program. In these settings, health care personnel who enter All rooms, visit areas in which persons with confirmed or presumptive TB disease are located, or transport patients with confirmed or presumptive TB disease in vehicles should be included in the respiratory protection program. When persons with confirmed or presumptive infectious TB disease are in the TB clinic and not in an All room, they should wear a surgical mask, if possible.

For settings other than clinics, patients with presumptive TB disease should be promptly referred so that they can receive a medical evaluation. These patients should not stay in the setting any longer than the time it takes to arrange a referral or transfer to an All room. The patient should be given a surgical mask, if possible, and instructed to follow proper cough etiquette procedures.

All cough-inducing and aerosol-generating procedures should be performed using environmental controls (e.g., in a sputum induction booth or an All room). Patients should be left in the booth or All room until coughing subsides. Another patient or health care personnel should not be allowed to enter the booth or the All room until enough time has passed for adequate removal of *M. tuberculosis*-contaminated air.

Discontinuation of Airborne Isolation for Patients with Presumptive TB Disease

For patients with presumptive TB disease, airborne precautions may be discontinued when infectious TB disease is considered unlikely and either another diagnosis is made or the patient has three consecutive, negative sputum smear results. Each of the three sputum specimens should be collected in 8 to 24-hour intervals (at least one being an early morning specimen).

Results from the Xpert MTB/RIF assay may also aid in making decisions regarding the discontinuation of airborne isolation. Patients with one or two negative Xpert MTB/RIF assay test results, in consideration with AFB smear results, may be able to be released from airborne isolation. However, Xpert MTB/RIF assay results should not be the sole basis for infection control practices. Decisions regarding whether to remove a patient from isolation should always be based on all the information available about the patient. The Xpert MTB/RIF assay does not replace the need for AFB smear microscopy, culture for mycobacteria, molecular or growth-based drug susceptibility testing, and genotyping. Providers and laboratories need to ensure that patient specimens are available for all recommended mycobacterial testing. For more information on the Xpert MTB/RIF assay, refer to the CDC guidelines, *Availability of an Assay for Detecting Mycobacterium tuberculosis, Including Rifampin-Resistant Strains, and Considerations for Its Use — United States, 2013*, available from the CDC website (www.cdc.gov/tb).

Treatment

Patients diagnosed with TB disease should start appropriate treatment immediately, preferably by DOT to ensure adherence. For more information on TB treatment, please refer to *Module 4, Treatment of Latent Tuberculosis Infection and Tuberculosis Disease*.



Study Questions 5.4 – 5.6

- 5.4 Under what circumstances is TB most likely to be transmitted in health care facilities?**
- 5.5 How can the health department help health care facilities in preventing the spread of TB?**
- 5.6 What are the main goals of a TB infection-control program? Select the correct answer(s).**
- A.** Detection of TB disease
 - B.** Airborne precautions (e.g., isolation of people with confirmed or presumptive TB disease)
 - C.** Treatment of people with confirmed or presumptive TB disease
 - D.** All of the above

Answers to study questions are on pages 36–41



Study Questions 5.7 – 5.8

5.7 What would make health care personnel think that a patient has TB disease?

5.8 What should be done when health care personnel think that a patient has TB disease? Select the correct answer(s).

- A. The patient should be isolated and placed in an All room right away, if available
- B. The patient should be given a surgical mask and instructed to keep it on
- C. The patient should be given a diagnostic evaluation
- D. The patient should be tested for lung capacity

Answers to study questions are on pages 36–41



Case Study 5.2

You are checking patients into the TB clinic. An elderly man comes to the desk and says someone told him to come and get checked because one of his friends has TB. You notice that he looks sick and is coughing frequently. The waiting room is full of patients, and you know it will probably be more than an hour before the physician can see him.

- What should you do?

Answers to case study questions are on pages 42–43

Developing an Infection-Control Program

A health care or congregate setting's TB infection-control program should be based on a three-level hierarchy of control measures (Table 5.2).

The three levels of control include

- Administrative controls
- Environmental controls
- Respiratory-protection controls

Administrative controls, the first and most important level of the infection-control program, are management measures that are intended to reduce the risk for exposure to persons with infectious TB. The second level of the hierarchy, **environmental controls**, aims to reduce the concentration of infectious *M. tuberculosis* droplet nuclei in the air.

Administrative controls are the first and most important level of a TB infection-control program.

Environmental controls aim to reduce the concentration of infectious *M. tuberculosis* droplet nuclei in the air.

These two measures reduce, but do not eliminate, the risk of TB in areas where exposure can still occur (for example, All rooms and rooms where cough-inducing or aerosol-generating procedures are performed). Because persons entering these areas may be exposed to airborne *M. tuberculosis*, the third level of the infection-control program is the use of **respiratory-protection controls**. Respiratory-protection control procedures also need to be in place for persons in other settings in which administrative and environmental controls may not protect them from inhaling infectious droplet nuclei. These persons may include those who transport patients with confirmed or presumptive infectious TB disease in ambulances, or persons who provide home-based health care to TB patients.

Respiratory-protection controls are used in settings where persons may be exposed to airborne *M. tuberculosis*.

The specifics of each TB infection-control program for health care or congregate settings may differ depending on whether a setting will provide health care or will transfer patients with confirmed or presumptive TB disease. The specifics of each TB infection-control program will also differ based on the setting's TB risk assessment.

Administrative Controls

The first and most important level of a TB infection-control program is the use of administrative measures to reduce the risk of exposure to persons who might have TB disease. Administrative controls consist of the following activities:

- **Assigning someone the responsibility for TB infection control in the setting**

At each health care setting, a person or group with expertise in TB and infection control should be assigned supervisory responsibility for implementing the TB infection-control program. The supervisor should be in charge of conducting a TB risk assessment and ensuring appropriate training and education of health care personnel.

Each health care setting should assign someone the responsibility for implementing the TB infection-control program.

- **Developing and implementing a written TB-infection control plan**

Each health care setting should develop and implement a written TB infection control plan. The plan should specify policies and work practices to ensure prompt detection, isolation, and treatment or transfer of persons who have confirmed or presumptive TB disease.

Each health care setting should develop and implement a written TB infection control plan.

- **Conducting a TB Risk Assessment**

A TB risk assessment consists of evaluating the risk of TB transmission in the health care setting. A TB risk assessment examines a number of factors, including:

- Number of patients with TB disease in the setting;
- Promptness of the detection, isolation, and evaluation of patients with confirmed or presumptive TB;
- Evidence of transmission of *M. tuberculosis* in the setting; and
- Community rate of TB disease.

All health care settings should conduct initial and ongoing TB risk assessments to monitor and evaluate the quality of TB infection control. For more information on assessing the risk of TB transmission in your health care setting, please refer to the TB Risk Assessment and TB Screening Program section of this module.

All settings should conduct initial and ongoing TB risk assessments to monitor and evaluate the quality of TB infection control.

- **Ensuring the availability of prompt laboratory processing, testing, and reporting of results**

In hospital and clinic health care settings, workers should have access to a laboratory that will process, test, and report results back to them and the infection-control team in a prompt manner. This will help determine if patients are still infectious and if they need to remain in an All room.

- **Implementing effective work practices for managing patients who may have TB**

The primary TB risk to health care personnel is when they come in contact with patients who have undiagnosed TB disease. Once a patient with TB disease is identified, the appropriate measures should be taken to decrease the risk of TB transmission to other patients and health care personnel.

- **Ensuring proper cleaning and sterilization or disinfection of equipment that might be contaminated**

Medical instruments and equipment used on patients who have TB disease are usually not involved in the transmission of TB. However, there have been some cases where the transmission of TB has been linked to bronchoscopes that were contaminated with *M. tuberculosis*. Equipment should be cleaned, disinfected, or sterilized to decrease the risk for TB transmission.

- **Educating, training, and counseling health care personnel about TB**

Training and education for health care personnel is an important part of administrative controls. All health care personnel should receive TB education annually. TB education should include information on TB risk factors, the signs and symptoms of TB disease, and TB infection control policies and procedures. Health care personnel training and education can help ensure that TB infection-control measures are properly followed.

All health care personnel should receive TB education annually.

- **Screening and testing health care personnel for TB**

TB screening programs can protect both health care personnel and patients. Screening can help prevent future TB transmission by identifying gaps in infection control, as well as the prompt treatment of health care personnel who have TB disease or LTBI. All U.S. health care personnel should be screened for TB upon hire/preplacement. This screening should include a baseline individual TB risk assessment, a TB symptom evaluation, a TB test (e.g., a TB blood test [interferon-gamma release assay [IGRA]] or a tuberculin skin test [TST]), and additional evaluation for TB disease as needed. Annual TB testing of health care personnel is not recommended unless there is a known exposure or ongoing transmission. For more information on screening health care personnel for TB, please refer to the TB Screening Program section of this module.

All U.S. health care personnel should be screened for TB upon hire/preplacement.

- Applying epidemiology-based prevention principles, including the use of setting-related TB infection control data
- Using posters and signs to remind patients of proper cough etiquette and respiratory hygiene
Posters and signs reminding patients of the importance of covering their nose and mouth when coughing or sneezing should be placed in highly visible areas.

Use posters and signs to remind patients of proper cough etiquette and respiratory hygiene.

- Coordinating efforts between local health department and high-risk health care and congregate settings

State or local health department TB control programs and high-risk health care and congregate settings should establish regular communication. The TB control program can help with planning and implementing TB control activities in these settings. TB control programs should also work together with health care and congregate settings when conducting contact investigations for patients or health care personnel who have TB disease. For more information about contact investigations, refer to *Module 8, Contact Investigations for Tuberculosis*.

State and local TB control programs should communicate with high risk health care settings.

Environmental Controls

The second level of an infection-control program is the use of environmental controls. Environmental controls consist of engineering technologies that are designed to prevent the spread and reduce the concentration of infectious TB droplet nuclei in the air. The technologies include:

- Ventilation
- High efficiency particulate air filtration (HEPA)
- Ultraviolet germicidal irradiation (UVGI)

The specifics of the environmental controls will differ for each health care setting. Health care and congregate settings should seek the advice of experts for designing, implementing, and maintaining an effective ventilation system and using other environmental technologies for infection control purposes. (For more information on environmental technologies, please refer to the CDC's *Guidelines for Preventing the Transmission of Mycobacterium tuberculosis in Health-Care Settings, 2005* and the Curry International TB Center's *Tuberculosis Infection Control: A Practical Manual for Preventing TB*.)

Environmental controls consist of technologies that are designed to prevent the spread and reduce the concentration of droplet nuclei in the air.

Ventilation

Ventilation is the movement of air in a building and the replacement of air in a building with air from outside. When fresh air enters a room, it dilutes the concentration of particles in room air, such as droplet nuclei containing *M. tuberculosis*. There are two general types of ventilation:

- Natural Ventilation
- Mechanical Ventilation

Natural ventilation relies on open doors and windows to bring in air from the outside. Natural ventilation can be useful for non-traditional facility-based and congregate settings that do not have a central ventilation system. In these settings, waiting rooms, shelter dormitories, or other rooms in which people congregate should have an operable window, door, or skylight that is kept open as often as possible. Fans can be used to help distribute the air. When using natural ventilation, facility staff should be aware of the direction of airflow. If the air direction is known, staff should sit near the fresh air source and clients should sit near the exhaust location. This can help protect staff from *M. tuberculosis* expelled by persons with TB.

When using natural ventilation, facility staff should sit near the fresh air source and clients should sit near exhaust location.

Mechanical ventilation refers to the use of technological equipment to circulate and move air in a building. Mechanical ventilation technologies should be used by hospitals, TB clinics, and other health care and congregate settings in which it is expected to see TB patients. Mechanical ventilation can consist of two types of technologies:

- Local Exhaust Ventilation
- General Ventilation

Local Exhaust Ventilation

Local exhaust ventilation is used to control the source of infection by stopping airborne contaminants before they spread into the general environment. Local exhaust ventilation, which includes the use of external hoods, booths, and tents, should be used for cough-inducing and aerosol-generating procedures. If local exhaust ventilation cannot be used, cough-inducing and aerosol-generating procedures should be performed preferably in an **airborne infection isolation (All) room** or a sputum induction booth. If an All room or a sputum induction booth is not available, the procedures should be performed outdoors or somewhere away from people, windows, and air intakes.

Cough-inducing procedures should be done in All rooms or sputum induction booths.

General Ventilation

General ventilation systems maintain air quality in health care settings by the:

- Dilution of contaminated air
- Removal of contaminated air
- Control of airflow patterns in patient/procedure room or setting (for example, negative pressure in All rooms)

Air dilution occurs when an uncontaminated air supply mixes with contaminated air in a room. Removal occurs when the exhaust system removes the air from the room and places it outside, away from people, air intakes, or windows. This process reduces the concentration of TB droplet nuclei in the room.

In TB clinics, hospitals, and other inpatient settings, patients with confirmed or presumptive TB disease should be placed in an All room right away, if available. TB All rooms are designed to prevent the spread of droplet nuclei expelled by a TB patient. Health care facilities that provide care for patients with confirmed or presumptive infectious TB disease should have at least one All room. Medical facilities in correctional settings should also have at least one All room. The need for additional All rooms should be based on the TB risk assessment for the setting.

Patients with confirmed or presumptive TB disease should be placed in a TB All room right away.

One characteristic of TB All rooms is that they are at **negative pressure** relative to other parts of the facility. Negative pressure allows the uncontaminated air to flow from the corridors into the All room. The air from the All room cannot escape to other parts of the health care setting. Air from the All room can be exhausted directly to the outdoors, where any infectious droplet nuclei will be diluted in the outdoor air and killed by the sunlight. Alternatively, the air can be passed through a special HEPA filter that removes all of the droplet nuclei before the air is returned to the general circulation. The door must be kept closed in order to maintain negative pressure, and the room must be checked periodically to make sure that it remains at negative pressure.

High Efficiency Particulate Air (HEPA) filters

HEPA filters are special filters that can be used in ventilation systems to help remove droplet nuclei from the air. HEPA filters must be used when releasing air from local exhaust ventilation booths into surrounding areas and when releasing air from an All room to the general ventilation system.

HEPA filters can be used in ventilation systems to help remove droplet nuclei from the air.

Ultraviolet Germicidal Irradiation (UVGI)

UVGI is an air-cleaning technology that consists of special lamps that give off ultraviolet light. The lamps are used to kill the tubercle bacilli contained in droplet nuclei. However, exposure to ultraviolet light can be harmful to the skin and eyes of humans, so the lamps must be installed in the upper part of rooms or corridors or placed in exhaust ducts. HEPA filters and UVGI should be used in conjunction with other infection control measures.

Respiratory-Protection Controls

The third level of infection-control is the use of respiratory protection equipment. Respiratory-protection controls include:

- Implementing a respiratory-protection program
- Training health care personnel on respiratory protection
- Educating patients on respiratory hygiene and the importance of covering their cough

All health care settings that use respiratory-protection controls are required by the Occupational Safety and Health Administration (OSHA) to develop, implement, and maintain a respiratory-protection program.

Respiratory-protection controls reduce the risk of TB transmission in settings where administrative and environmental controls may not fully protect persons against droplet nuclei.

In these settings, personal respiratory protection should be used by all persons, including health care personnel and visitors. These settings include:

- TB All rooms
- Rooms where cough-inducing or aerosol generating procedures are done
- Ambulances and other vehicles transporting infectious TB patients
- The homes of infectious TB patients

In these settings, health care personnel should use **personal respirators** that are designed to filter out droplet nuclei (Figures 5.1 and 5.2). Health care personnel should be taught how and when to use personal respirators.

Health care personnel should use personal respirators in TB All rooms, rooms where cough-inducing procedures are done, ambulances transporting infectious TB patients, and homes of infectious TB patients.

Laboratorians who conduct aerosol-producing procedures may require respiratory protection. The decision to use respiratory protection in this setting should be made on an individual basis, depending upon ventilation and the lab procedure.

Selection and Fit Testing of Respirators

Personal respirators that can be used to protect against *M. tuberculosis* include:

- Nonpowered respirators with N95, N99, N100, R95, R99, R100, P95, P99, and P100 filters (including disposable respirators);
- Powered air-purifying respirators (PAPRs) with high-efficiency filters; and
- Supplied-air respirators.

When selecting respirators for use in a health care setting, the most important factor to consider is whether or not the respirator can fit the varying facial sizes and characteristics of health care personnel. A **fit test** is a method used to determine which respirator fits the user. A **user seal check** is a procedure done each time a respirator is put on to ensure that the respirator is properly sealed.

Respirators and Surgical Masks

It is very important to understand the difference between a respirator and a surgical mask. Respirators are designed to protect health care personnel and other individuals from breathing in (inhaling) droplet nuclei (Figures 5.1 and 5.2). This can protect these individuals from becoming infected with *M. tuberculosis* when in contact with a person with infectious TB disease.

Surgical masks (Figure 5.2) are designed to stop droplet nuclei from being spread (exhaled) into the air by the person wearing them when he or she breathes, talks, coughs, or sneezes. Persons with confirmed or presumptive infectious TB disease should be given a surgical mask to wear to prevent them from expelling infectious droplet nuclei.



Figure 5.1 The personal respirators in this photograph are specially designed to filter out droplet nuclei.



Figure 5.2 The TB patient (on the left) is wearing a surgical mask. This mask is designed to stop droplet nuclei from being spread (exhaled) by the patient. The health care personnel (on the right) is wearing a personal respirator.

Table 5.2 – TB Infection-Control Program: Level of Controls.

Administrative Controls	Environmental Controls	Respiratory-Protection Controls
<ul style="list-style-type: none"> • Assign someone the responsibility for TB infection control • Develop and implement a written TB infection-control plan • Conduct a TB risk assessment • Ensure the availability of prompt laboratory processing, testing, and reporting of results • Implement effective work practices for managing patients who may have TB • Ensure proper cleaning and sterilization or disinfection of potentially contaminated equipment • Train and educate health care personnel • Screen health care personnel for TB infection and disease • Apply epidemiologic-based prevention principles • Use posters and signs to remind patients of proper cough etiquette and respiratory hygiene • Coordinate efforts between the local health department and high-risk health care and congregate settings 	<ul style="list-style-type: none"> • Reduce concentration of infectious droplet nuclei through the following technologies: <ul style="list-style-type: none"> • Ventilation <ul style="list-style-type: none"> • Natural ventilation • Mechanical ventilation • High efficiency particulate air filtration (HEPA) • Ultraviolet germicidal irradiation (UVGI) 	<ul style="list-style-type: none"> • Implement a respiratory-protection program • Train health care personnel on respiratory protection • Educate patients on respiratory hygiene and the importance of covering their cough • Test health care personnel for mask fit and functionality



Study Questions 5.9 – 5.12

- 5.9** What are the three levels of control that form the basis of a TB infection-control program?
- 5.10** List five administrative control measures that should be taken in health care settings to reduce the risk of exposure to persons who may have TB disease.
- 5.11** Where should health care personnel conduct sputum induction, bronchoscopy, or other cough-inducing procedures? Select the correct answer(s).
- A.** The clinic waiting room
 - B.** Special All rooms
 - C.** Sputum induction booths
 - D.** General radiology rooms
- 5.12** What is a TB airborne infection isolation (All) room? What are the important characteristics of an All room?

Answers to study questions are on pages 36–41



Study Questions 5.13 – 5.15

5.13 How do ventilation systems help prevent the spread of TB?

5.14 Give four examples of settings where personal respirators should be used.

5.15 What is the difference in use between a respirator and a surgical mask?

Answers to study questions are on pages 36–41

TB Risk Assessment and TB Screening Program

TB Risk Assessment

Every health care and congregate setting should conduct initial and ongoing evaluations of the risk for transmission of *M. tuberculosis*. The TB risk assessment determines the types of administrative, environmental, and respiratory-protection controls needed for a setting. It also serves as an ongoing monitoring and evaluation tool of the infection-control program. The TB risk assessment examines a number of factors, including:

- Number of patients with TB disease in the setting
- Promptness of the detection, isolation, and evaluation of patients with confirmed or presumptive TB
- Evidence of transmission of *M. tuberculosis* in the setting
- Community rate of TB disease

For more detailed information on how to conduct a TB risk assessment, please refer to the CDC *Guidelines for Preventing the Transmission of Mycobacterium tuberculosis in Health-Care Settings, 2005*.

Risk Classification

The risk level, or risk classification, will vary from setting to setting. There are three TB risk classifications:

- Low risk
- Medium risk
- Potential ongoing transmission

The **low risk classification** should be used for settings in which persons with TB disease are not expected to be encountered. Exposure to *M. tuberculosis* in these settings is unlikely.

The **medium risk classification** should be used for settings in which the risk assessment has determined that health care personnel will possibly be exposed to persons with TB disease. Medium risk classification can also be used for settings in which health care personnel will be exposed to clinical specimens that may contain *M. tuberculosis*.

The **potential ongoing transmission classification** should be temporarily assigned to any setting where there is evidence of person-to-person transmission of *M. tuberculosis* in the past year.

TB Screening Program

Health care settings should have a TB screening program as part of their TB infection control plan.

Baseline TB Screening and Testing

All health care personnel should be screened for TB upon hire/preplacement. This screening should include

- A baseline individual TB risk assessment (Figure 5.3);
- TB symptom evaluation;
- A TB test (e.g., a TB blood test [IGRA] or a TST); and
- Additional evaluation for TB disease as needed.

Information from the baseline individual TB risk assessment should be used to help interpret the results of an IGRA or a TST given upon hire/preplacement. Health care personnel with a newly positive TB test result should receive a symptom evaluation and a chest x-ray to rule out TB disease. Additional evaluation may be needed based on those results.

Health care personnel who have a documented history of a prior positive TB test should receive a baseline individual TB risk assessment and a TB symptom screen upon hire/preplacement. They do not require a repeat TB test. Health care personnel with a prior positive TB test and a documented normal chest x-ray do not require a repeat x-ray unless they are symptomatic or starting LTBI treatment.

Annual TB Screening and Testing

Annual TB testing is **not** recommended for health care personnel unless they have been exposed to TB or there is ongoing TB transmission. Health care personnel with untreated LTBI should receive a yearly TB symptom screen to detect early signs of TB disease and to evaluate the risks and benefits of LTBI treatment. Health care personnel with LTBI are strongly encouraged to take treatment for LTBI.

Annual TB testing is not recommended for health care personnel unless they have been exposed to TB or there is ongoing TB transmission.

Health care facilities might consider using serial TB screening for certain groups at increased occupational risk for TB exposure (e.g., pulmonologists or respiratory therapists) or in certain settings if transmission has occurred in the past (e.g., emergency departments). Facilities should work with their state and local health departments to help make these decisions.

Post-Exposure Screening and Testing

All health care personnel with a known exposure to TB disease should receive a TB symptom screen and timely testing, if indicated.

Health care personnel with a previous negative TB test result should be tested immediately if they have been exposed to TB disease. Those with an initial negative test result should be retested 8 to 10 weeks after their last known exposure to TB disease. This is because it can take 2 to 8 weeks after being infected with *M. tuberculosis* for the body's immune system to mount a response detectable by the tests. For consistency, the same type of test (e.g., IGRA or TST) should be used upon hire and for any follow-up testing.

Health care personnel with a documented history of a positive TB test do NOT need to be re-tested after exposure to TB. They should receive a TB symptom screen and if they have symptoms of TB they should receive further evaluation for TB disease.

For more information, please refer to the *Tuberculosis Screening, Testing, and Treatment of U.S. Health Care Personnel: Recommendations from the National Tuberculosis Controllers Association and CDC*, available from the CDC website (www.cdc.gov/tb).



Health Care Personnel (HCP) Baseline Individual TB Risk Assessment

HCP should be considered at increased risk for TB if any of the following statements are marked “Yes”:

	<p>Temporary or permanent residence of ≥ 1 month in a country with a high TB rate</p> <p>Any country other than the United States, Canada, Australia, New Zealand, and those in Northern Europe or Western Europe</p>	YES <input type="checkbox"/>
OR		
	<p>Current or planned immunosuppression, including human immunodeficiency virus (HIV) infection, organ transplant recipient, treatment with a TNF-alpha antagonist (e.g., infliximab, etanercept, or other), chronic steroids (equivalent of prednisone ≥ 15 mg/day for ≥ 1 month) or other immunosuppressive medication</p>	YES <input type="checkbox"/>
OR		
	<p>Close contact with someone who has had infectious TB disease since the last TB test</p>	YES <input type="checkbox"/>
NO <input type="checkbox"/>		

Figure 5.3 Sample baseline individual TB risk assessment for health care personnel.

All health care personnel should be screened for TB upon hire/preplacement. This screening should include a baseline individual TB risk assessment. This image is a sample baseline individual TB risk assessment for health care personnel.

Special Considerations for Infection Control in Nontraditional Facility–Based Settings

Congregate settings such as nursing homes, correctional facilities, homeless shelters, drug treatment centers, and other nontraditional facility-based settings should establish and follow an infection-control program. As in other health care settings, the main goal of the infection-control program should be to detect TB disease early and arrange for the isolation and treatment of patients who might have TB disease. Local health departments and congregate settings should collaborate to provide training and education to clients and employees about TB, as well as conduct contact investigations when necessary. Other nontraditional facility-based settings that should establish an infection-control program include emergency medical services, home-based health care, and outreach settings. (For more detailed information on developing an infection control plan for these settings, please refer to CDC's *Guidelines for Preventing the Transmission of Mycobacterium tuberculosis in Health-Care Settings, 2005* and the Curry International TB Center's *Tuberculosis Infection Control: A Practical Manual for Preventing TB*.)

Congregate settings such as nursing homes, correctional facilities, homeless shelters, drug treatment centers, and other nontraditional facility-based settings should establish and follow an infection-control program.

Medical Settings in Correctional Facilities

TB is also a major health concern in correctional facilities. All correctional facilities should have a written infection-control plan for both employees and inmates. Medical settings in correctional facilities should be classified as at least medium risk based on the possibility of exposure to persons with TB disease. Furthermore, a respiratory-protection program should be implemented with at least one All room available in the correctional facility. Inmates with confirmed or presumptive infectious TB disease who must be transported outside an All room should wear a surgical mask during transport.

Medical settings in correctional facilities should be classified as medium risk given the possibility that staff may be exposed to persons with TB disease.

Correctional facilities should maintain a tracking system for inmate TB testing and treatment and establish a mechanism for sharing this information with state and local health departments and other correctional facilities. Confidentiality of inmate information should be ensured during testing for signs and symptoms of TB.

Homeless Shelters

TB is more common in the homeless population than in the general population. Homeless shelters should have a TB infection-control plan. This plan should include procedures for evaluating clients, staff, and volunteers for TB disease and TB infection. Evaluations for TB disease should include regular queries to staff and clients as to whether they have TB symptoms.

Clients with TB symptoms should be separated from others until they have received a medical evaluation. They should remain separated until TB disease has been excluded or they are not infectious. Other administrative controls for homeless shelters include requiring TB diagnostic evaluations for clients who stay longer than a defined period, maintaining bed maps and tracking bed assignments, and maintaining as much space as possible between beds to reduce the possibility of TB transmission. For more information on administrative controls in homeless shelters, please refer to the *TB Control in Overnight Homeless Facilities Quick Reference Guide*, available on the CDC website (www.cdc.gov/tb).

Several factors can influence the likelihood of TB transmission in homeless shelters. Factors include how crowded the shelter is, and the ventilation system of the shelter.

Homeless shelters should have a TB infection control plan.

Emergency Medical Services

Although the overall risk of TB transmission is low, there is documented transmission of *M. tuberculosis* in emergency medical services (EMS) occupational settings. Thus, EMS workers should be included in a comprehensive TB screening program. Persons with confirmed or presumptive infectious TB who are transported in an ambulance should wear a surgical mask, if possible. The drivers, health care personnel, and other staff who are transporting the patient should consider wearing an N95 respirator.

The ambulance ventilation system should be operated in the nonrecirculating mode with the maximum amount of outdoor air provided. If the vehicle has a rear exhaust fan, it should be used during transport. If the vehicle is equipped with HEPA filters they should be used. If an ambulance is not used, the ventilation system for the vehicle should bring in as much outdoor air as possible, and the system should be set to nonrecirculating.

If transporting a patient with confirmed or presumptive infectious TB disease, the ambulance should allow for the maximum amount of outdoor air to be circulated in the vehicle.

Long Term-Care Facilities

Long term-care facilities (LTCFs) include hospices and nursing homes. Infection with *M. tuberculosis* poses a health risk to patients, health care personnel, visitors, and volunteers. New employees, volunteers, and residents to these settings should receive a symptom screen and possibly a test for *M. tuberculosis* infection.

LTCFs must have adequate administrative and environmental controls, including airborne precaution capabilities and respiratory-protection programs if they accept patients with confirmed or presumptive infectious TB disease.

Patients with confirmed or presumptive infectious TB disease should not stay in the LTCF unless adequate administrative and environmental controls are in place. Persons with TB disease who are determined to be noninfectious can remain in the LTCF, and do not need to be in an All room.

Infection Control in the Home

Patients with confirmed or presumptive TB disease are frequently sent home after starting treatment, even though they may still be infectious. Patients with TB disease can be sent home even if they do not have three negative sputum smears, if the following criteria are met:

- A follow-up plan has been made with the local TB program;
- The patient is on standard TB treatment and DOT has been arranged;
- No infants or children younger than 5 years of age or persons with immunocompromising conditions are present in the household;
- All household members, who are not immunocompromised, have been previously exposed to the person with TB; and
- The patient is willing to not travel outside his or her home until he or she has negative sputum smear results.

If all of the above criteria are met, patients with TB disease are allowed to go back home. Additionally, they are more likely to have already transmitted TB to members of their household **before** their TB was diagnosed and treatment was started. However, TB patients and members of their household should still take steps to prevent the spread of TB in their home. For example, patients with TB disease should be instructed to cover their mouth and nose with a tissue when coughing or sneezing. Infectious TB patients should sleep alone, not in a room with other household members. Furthermore, TB patients should be advised to not have visitors until they are non-infectious.

People with TB disease are most likely to transmit TB to members of their household before TB has been diagnosed and treatment has started.

Patients with TB disease should be instructed to cover their mouth and nose with a tissue when coughing or sneezing.

Patients with infectious TB disease should not be allowed to return home where they may expose a person who is at high risk for progressing to TB disease if infected (for example, persons living with HIV, or infants and children younger than age 5).

Health care personnel in home-based health care or outreach settings should be trained on detecting the signs and symptoms of TB disease. Training should include the role of health care personnel in educating patients about the importance of reporting signs or symptoms. Health care personnel should also educate patients and other household members about the importance of taking medications as prescribed.

Health care personnel should not perform cough-inducing or aerosol-generating procedures on patients with confirmed or presumptive infectious TB disease inside a patient's home. Sputum collection should be performed outdoors, away from other persons, windows, or ventilation intakes.

Health care personnel who visit TB patients at their homes should take these precautions to protect themselves from exposure to *M. tuberculosis*:

- Instruct patients to cover their mouth and nose with a tissue when coughing or sneezing;
- Wear a personal respirator when visiting the home of an infectious TB patient or when transporting an infectious TB patient in a vehicle;
- When it is necessary to collect a sputum specimen in the home, collect the specimen in a well-ventilated area, away from other household members; if possible, the specimen should be collected outdoors; and
- Participate in a TB screening program.

Health care personnel who visit TB patients at home should take precautions to protect themselves from exposure to *M. tuberculosis*.



Study Questions 5.16 – 5.18

5.16 What are the different TB risk classifications that can be assigned to health care settings? Select the correct answer(s).

- A. High risk
- B. Low risk
- C. Medium risk
- D. Potential ongoing transmission

5.17 How often should health care personnel be screened for TB?

5.18 What precautions should health care personnel take when visiting the home of a TB patient who may be infectious?

Answers to study questions are on pages 36–41



Case Study 5.3

You are sent to deliver DOT to a woman who started treatment last week for presumptive pulmonary TB disease. Her sputum smear results are not back yet. You are asked to collect another sputum specimen while you are at the woman's home.

- What precautions should you take?

Answers to case study questions are on pages 42–43

Additional Resources

1. CDC. Availability of an Assay for Detecting *Mycobacterium tuberculosis*, Including Rifampin-Resistant Strains, and Considerations for its Use — United States, 2013. MMWR 2013; 62 (41). www.cdc.gov/mmwr/preview/mmwrhtml/mm6241a1.htm?s_cid=mm6241a1_e.
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3. CDC. Prevention and Control of Tuberculosis in Correctional and Detention Facilities: Recommendations from CDC, 2006. MMWR 2006; 55(RR-9). www.cdc.gov/mmwr/preview/mmwrhtml/rr5509a1.htm.
4. CDC. Prevention and Control of Tuberculosis in Facilities Providing Long-Term Care to the Elderly: Recommendations of the Advisory Committee for Elimination of Tuberculosis. The Americas, 1990. MMWR 1990; 39(RR-10). www.cdc.gov/mmwr/preview/mmwrhtml/00001711.htm.
5. CDC. TB Control in Overnight Homeless Facilities Quick Reference Guide. Atlanta, GA: U.S. Department of Health and Human Services, CDC; 2018. www.cdc.gov/tb/topic/populations/Homelessness/AdminControls.htm.
6. Curry International Tuberculosis Center. Tuberculosis Infection Control: A Practical Manual for Preventing TB; 2011. www.currytbcenter.ucsf.edu/products/view/tuberculosis-infection-control-practical-manual-preventing-tb.
7. Curry International Tuberculosis Center. Shelters and TB: What Staff Need to Know, Second Edition; 2013. www.currytbcenter.ucsf.edu/products/view/shelters-and-tb-what-staff-need-know-second-edition.
8. National Tuberculosis Controllers Association and the Association of Public Health Laboratories. Consensus Statement on the Use of Cepheid Xpert MTB/RIF Assay in Making Decisions to Discontinue Airborne Infection Isolation in Healthcare Settings; 2016. www.tbcontrollers.org/resources/airborne-infection-isolation/#.XJkcf8LV670.
9. Sosa, LE, Nije, GJ, Lobato, MN, Morris, SB, et al. Tuberculosis Screening, Testing, and Treatment of U.S. Health Care Personnel: Recommendations from the National Tuberculosis Controllers Association and CDC. MMWR 2019; 68(19); 439–443. www.cdc.gov/mmwr/volumes/68/wr/mm6819a3.htm?s_cid=mm6819a3_w.



Answers to Study Questions

5.1 List seven factors that affect the infectiousness of a TB patient.

- Presence of a cough
- Cavity in the lung
- Positive acid-fast bacilli sputum smear result
- TB of the lungs, airway, or larynx
- Patient not covering mouth and nose when coughing
- Patient not receiving adequate treatment or having prolonged illness
- Patient undergoing cough-inducing procedures

5.2 Why does the site of disease affect the infectiousness of a TB patient?

Usually, only people with pulmonary or laryngeal TB (TB of the larynx) are infectious. This is because these people may be coughing and expelling tubercle bacilli into the air. People with extrapulmonary TB only (with no laryngeal or pulmonary TB involvement) generally are not infectious.

5.3 When can patients who have been diagnosed with TB disease be considered noninfectious? Select the correct answer(s).

- A. After receiving adequate treatment for 2 weeks or longer
- B. When symptoms have improved
- C. When the patient has 3 consecutive negative sputum smears from sputum collected in 8 to 24 hour intervals (at least one being an early morning specimen)
- D. When all of the above are met

The correct answer is D. Patients who have been diagnosed with TB disease can be considered noninfectious when they meet all of the following criteria:

- They have been receiving adequate TB treatment for 2 weeks or longer
- Their symptoms have improved (for example, coughing less and no longer have a fever)
- They have 3 consecutive negative sputum smears from sputum collected in 8 to 24 hour intervals (one being an early morning specimen)

5.4 Under what circumstances is TB most likely to be transmitted in health care facilities?

TB is most likely to be transmitted in health care facilities when health care personnel and patients come in contact with persons who have TB disease who are not receiving adequate treatment and who have not been isolated from others.



Answers to Study Questions (Continued)

5.5 How can the health department help health care facilities in preventing the spread of TB?

The health department can help health care facilities with:

- Understanding the importance of infection control principles
- Reporting confirmed or presumptive TB cases as quickly as possible
- Conducting contact investigations
- Ensuring there is a plan for TB patients to receive follow-up care after they are discharged
- Risk assessments, testing, surveillance, outbreak investigations, and other aspects of a TB infection-control program
- Planning and implementation of TB control activities

5.6 What are the main goals of a TB infection-control program? Select the correct answer(s).

- A. Detection of TB disease
- B. Airborne precautions (e.g., isolation of people with confirmed or presumptive TB disease)
- C. Treatment of people with confirmed or presumptive TB disease
- D. All of the above

The correct answer is D. The main goals of a TB infection-control program are to detect TB disease early and to promptly isolate and treat people who have TB disease.

5.7 What would make health care personnel think that a patient has TB disease?

Clinicians and other health care personnel should consider TB disease in any patient who has a persistent cough, bloody sputum, weight loss or loss of appetite, fever, or night sweats. They should be especially alert for TB in areas where TB is common. Also, health care personnel who admit patients to a facility should be trained to ask appropriate questions to help detect patients who have signs or symptoms of TB.



Answers to Study Questions (Continued)

5.8 What should be done when health care personnel think that a patient has TB disease? Select the correct answer(s).

- A. The patient should be isolated and placed in an All room right away, if available
- B. The patient should be given a surgical mask and instructed to keep it on
- C. The patient should be given a diagnostic evaluation
- D. The patient should be tested for lung capacity

The correct answers are A, B, and C. The patient should be placed in an area away from other patients (preferably in a TB All room) and promptly given a diagnostic evaluation.

The patient should be given a surgical mask and instructed to keep it on. The patient should also be given tissues and asked to cover the nose and mouth when coughing or sneezing, even when in an area away from other patients. A patient diagnosed with TB should start appropriate treatment at once.

5.9 What are the three levels of controls that form the basis of a TB infection-control program?

An infection-control program should involve three types of controls:

- Administrative controls
- Environmental controls
- Respiratory-protection controls



Answers to Study Questions (Continued)

5.10 List five administrative control measures that should be taken in health care settings to reduce the risk of exposure to persons who may have TB disease.

- Assign responsibility for TB infection control
- Develop and implement a written TB infection-control plan
- Conduct a TB risk assessment
- Ensure the availability of prompt laboratory processing, testing, and reporting of results
- Implement effective work practices for managing patients who may have TB disease
- Ensure proper cleaning, sterilization, or disinfection of potentially contaminated equipment
- Train and educate health care personnel about TB
- Screen health care personnel for TB infection and TB disease
- Apply epidemiology-based prevention principles, including the use of setting-related TB infection control data
- Use posters and signs to remind patients of proper cough etiquette and respiratory hygiene
- Coordinate efforts between the local health department and high-risk health care and congregate settings

5.11 Where should sputum induction, bronchoscopy, or other cough-inducing procedures be done? Select the correct answer(s).

- A. The clinic waiting room
- B. Special All rooms
- C. Sputum induction booths
- D. General radiology rooms

The correct answers are B and C. These medical procedures should be done in special All rooms or sputum induction booths to prevent any droplet nuclei expelled during the procedure from reaching other parts of the facility.



Answers to Study Questions (Continued)

5.12 What is a TB airborne infection isolation (AII) room? What are the important characteristics of an AII room?

TB AII rooms are rooms in health care settings that have special characteristics to prevent the spread of droplet nuclei expelled by a TB patient. One characteristic is that they are at negative pressure relative to other parts of the facility. Another characteristic is that the air from the AII room is exhausted directly to the outdoors, or passed through a special filter that removes all of the droplet nuclei.

5.13 How do ventilation systems help prevent the spread of TB?

Ventilation systems are necessary to maintain negative pressure and to exhaust the air properly. These systems can also be designed to minimize the spread of TB in other areas of the health care facility.

5.14 Give four examples of settings where personal respirators should be used.

Personal respirators should be used in:

- TB AII rooms;
- Rooms where cough-inducing procedures are done;
- Ambulances or other vehicles transporting infectious TB patients; and
- Homes of infectious TB patients.

5.15 What is the difference in use between a respirator and a surgical mask?

Respirators are designed to protect health care workers and other individuals from breathing in (inhaling) droplet nuclei present in the air. This can protect these individuals from becoming infected with *M. tuberculosis* when in contact with a person with infectious TB disease.

Surgical masks are designed to stop droplet nuclei from being spread (exhaled) into the air by the person wearing them. Persons with confirmed or presumptive infectious TB disease may be given a surgical mask to wear to prevent them from expelling infectious droplet nuclei.



Answers to Study Questions (Continued)

5.16 What are the different TB risk classifications that can be assigned to health care settings? Select the correct answer(s).

- A. High risk
- B. Low risk
- C. Medium risk
- D. Potential ongoing transmission

The correct answers are B, C, and D. The three different TB risk classifications that can be assigned to health care settings are low risk, medium risk, and potential ongoing transmission.

5.17 How often should health care personnel be screened for TB?

Health care personnel should be screened for TB upon hire/preplacement. Annual TB testing is **not** recommended unless there is a known exposure or ongoing transmission. Health care personnel with untreated LTBI should receive a yearly TB symptom screen to detect early signs of TB disease and to evaluate the risks and benefits of LTBI treatment.

Health care facilities might consider using serial TB screening for certain groups at increased occupational risk for TB exposure (e.g., pulmonologists or respiratory therapists) or in certain settings if transmission has occurred in the past (e.g., emergency departments). Facilities should work with their state and local health departments to help make these decisions.

5.18 What precautions should health care personnel take when visiting the home of a TB patient who may be infectious?

Health care personnel who visit TB patients at home should take these precautions to protect themselves from the spread of TB:

- Instruct patients to cover their mouth and nose with a tissue when coughing or sneezing;
- Wear a personal respirator when visiting the home of an infectious TB patient or when transporting an infectious TB patient in a vehicle;
- When it is necessary to collect a sputum specimen in the home, collect the specimen in a well-ventilated area, away from other household members; if possible, the specimen should be collected outdoors; and
- Participate in a TB screening program.



Case Study Answers

5.1 For each of the following situations, decide whether the patient should be considered infectious or noninfectious, and explain why.

- **Two weeks ago, Mr. Lopez had a sputum smear that was positive; since then no sputum specimens have been tested. Mr. Lopez started self-administered TB treatment 7 days ago. He still has a cough.**

Mr. Lopez should be considered infectious. He does not meet the criteria for noninfectiousness because

1. he has been receiving treatment for only 7 days, not 2 weeks,
2. his symptoms have not improved, and
3. he does not have three consecutive negative sputum smears.

Mr. Lopez should be given his treatment by DOT to ensure he receives adequate treatment.

- **Ms. Nguyen, a patient with pulmonary TB, has been receiving DOT treatment for 6 weeks and no longer has symptoms of TB. She has had three sputum smears. The first one was positive, but the last two were negative.**

Ms. Nguyen meets the first two criteria for noninfectiousness: she has been receiving treatment for at least 2 weeks; and her symptoms have improved. However, she should be considered infectious until she has three consecutive negative sputum smears.

- **Mr. Martin started DOT treatment for pulmonary TB in April. His symptoms went away and his sputum smears were negative in May. However the outreach worker was unable to locate him on June 5th and has not been able to contact him since that time. Mr. Martin returned to the TB clinic on August 2nd and was still coughing.**

Mr. Martin may have been noninfectious in May, but it appears that he may be infectious again. He is coughing and has not been receiving adequate treatment since June 4th. At this point, Mr. Martin should be considered infectious. He should be evaluated for infectiousness and nonadherence to treatment.



Case Study Answers (Continued)

5.2 You are checking patients into the TB clinic. An elderly man comes to the desk and says he was told to come and get checked because one of his friends has TB. You notice that he looks sick and is coughing frequently. The waiting room is full of patients, and you know it will probably be more than an hour before the physician can see him.

■ **What should you do?**

You should work with the clinical staff to ensure that he is evaluated for TB disease quickly. In the meantime, the man should be given a surgical mask, instructed to keep it on, and asked to cover his mouth and nose when coughing or sneezing. He should be placed in an area away from other patients right away.

5.3 You are sent to deliver DOT to a woman who started treatment last week for presumptive pulmonary TB disease. Her sputum smear results are not back yet. You are asked to collect another sputum specimen while you are at the woman's home.

■ **What precautions should you take?**

First, you should instruct the patient to cover her mouth and nose when she coughs or sneezes. Second, because the patient may be infectious, you should wear a personal respirator when visiting her home. Third, you should collect the sputum specimen in a well-ventilated area (preferably outdoors), away from other household members. (Ideally, sputum specimens should be collected in a special All room or sputum induction booth.) Fourth, because you visit TB patients at home as part of your job, you should participate in a TB screening program through your employer.



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