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Review of Chapter

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Just a few thoughts inserted in to the document (attached), plus a few points of clarification. Some sections look a little "too verbatim" from Benenson's (!).

1. Be careful with the distinction between spatter (in direct contact, below) and true aerosols (in airborne diseases, below). I'm not sure it's true that spatter is produced simply from talking. Mumps is not spread by the airborne route.
2. Has transmission of fungal agents via clothing been reported?
3. I'm puzzled by the inclusion of giardiasis here. It doesn't seem to fit the categories or the definition of a "take-home" disease.

Hope this is at least somewhat helpful.

Bob Mullan

1. Incidences of Employee-Transported Home Contamination

k. infectious agents

In the Workers Family Protection Act of 1991 it is stipulated [Sec.3(a)(1)] that a study be conducted to evaluate the prevalence and potential for the contamination of workers' homes with hazardous chemicals and substances "including infectious agents." Infectious agents (i.e., organisms that cause communicable diseases) are similar to chemical toxins (e.g., lead, asbestos) since they may be brought home on the clothes of workers. The intent of the bill was to protect employees and their families from contaminants transferred from the workplace on workers' clothing. Therefore, the scope of the legislation limits the study to include infectious agents that are transported on a worker's person.

Microorganisms are ubiquitous in nature. In humans, they are found naturally in many locations of the body including the skin, hair, and even internally in several locations such as the GI tract. These normal microbial flora help protect the host from pathogens and do not constitute any problems for healthy individuals. In fact, only a few of the bacteria, viruses, fungi, mycoplasmas, chlamydiae, rickettsiae, or protozoa found in nature are capable of causing disease in humans. For those organisms that are effectively able to invade and cause disease, there are several ways that they may be transported from infected workers to other members of the household. These include [Benenson 1985, Davidson et al. 1980]:

- **Direct Contact:** essentially immediate transfer of infectious materials may occur between individuals through a receptive portal of entry by touching (e.g., scabies), biting (e.g., hepatitis B virus [HBV]), kissing (e.g., Epstein-Barr virus), or sexual intercourse (e.g., human immunodeficiency virus [HIV]). When individuals sneeze, cough, sing, or even talk they exhale a cloud of tiny droplets of saliva. Direct projection of this droplet spray (usually in close proximity to the source - 1 meter or less) onto the conjunctiva or mucous membranes of another individual can transfer disease (e.g., the common cold). Some diseases can also be transmitted transplacentally from mother to child (e.g., rubella, HIV).
- **Indirect Contact:** indirect transmission of infectious agents may occur by contact with intermediates such as contaminated inanimate materials (e.g., toys, clothing, eating utensils, bedding) as well as contaminated food, water, milk or biological products such as blood, tissues, or organs. Also, vector-borne diseases may be transmitted by contact with animals that serve as reservoirs for infectious agents such as rabies. In addition, arthropod vectors such as ticks may transfer rickettsiae (e.g., Lyme disease) or viruses through bites.
- **Airborne Disease:** as noted above, aerosols containing infectious agents may be generated when an individual coughs, sneezes, sings, or talks. Also, aerosols may be generated by other methods in normal work situations such as those found in slaughterhouses, rendering plants, or autopsy rooms as well as during accidents in microbiology laboratories. Droplet nuclei are aerosols that contain infectious particles that are made by the evaporation of fluid from the droplets formed during the production of aerosols. Unlike droplet spray that may remain airborne only for a

few feet that are associated with direct transmission of disease, droplet nuclei may remain suspended in the air for long periods of time and are associated with respiratory diseases (e.g., tuberculosis, influenza, mumps). Some infectious diseases that are normally spread via aerosols may also be spread via fomites (e.g., in dust from contaminated clothing or bedding, combs, floors, soil, etc.) such as the microorganisms that causes Q fever and anthrax. Droplet nuclei and dust particles in the 1-5µ micrometer size range may remain suspended in the air for long periods and, unlike larger particles, may easily be drawn into and retained in the alveoli of the lungs bypassing many of the defense mechanisms of the respiratory system.

Infectious diseases that most likely meet the criteria of being transported to workers' homes "on workers," their clothing, or other materials brought from the workplace include those (1) that are spread through direct skin-to-skin contact or direct contact with contaminated clothing (e.g., scabies, mites, lice), (2) via arthropod vectors (e.g., lyme disease) from arthropods brought home on clothing (?) or (3) or those that may be transmitted in aerosols contained in dust brought to the home from the workplace (e.g., Q fever, anthrax, and possibly? fungal diseases). Infectious diseases that are spread by other means were not intended to be covered by the legislation. For example, tuberculosis that may be spread by an infected infectious emergency medical respondent service worker to family members via aerosols is not included nor is HIV infection that may be transmitted to a spouse during intercourse. No documented cases have been noted by NIOSH, however, Although the potential exists for bloodborne diseases such as AIDS HIV or HBV to be transported home on a worker's clothing soiled with body fluids from an HIV or HBV infected person, there have been no case reports of transmission in this manner. Therefore, it appears to be relevant to consider this type of disease transmission. In addition, In occupations such as farming where the worksite and home are often located virtually together, infectious agents that are at the worksite may easily be transported directly or indirectly (e.g., via vectors) into the home and infect household members [this wouldn't seem to qualify as a take-home disease, to me].

It should be noted that virtually any infectious disease contracted by a worker at the workplace will be "brought home" and can potentially infect members of his or her household. However, since this legislation is intended to include agents that may be brought home on the worker's clothes or person, diseases that appear likely to be transmitted to the home on the worker include:

- Arthropod-borne diseases that occur in the United States include lyme disease; that is caused by a spirochete, *Borrelia burgorferi*. This Lyme disease was first recognized as a clinical disease in 1977 when a group of children in Lyme, Connecticut was infected. It is considered to be the most common vector-borne disease in the United States and is characterized by distinctive skin lesions, polyarthritis, and neurological and cardiac involvement [Infectious Diseases and the Fire and Emergency Services [are these references?]]. Additional vector-borne diseases that may be brought home by workers in the United States include rickettsial diseases where ticks are the vector such as rocky mountain spotted fever and murine typhus fever. In addition, approximately 90 arthropod-borne viral diseases have been identified. These include Colorado tick fever and encephalitis that are both tick-borne and occur in the United States. The mosquito is the vector for many arboviruses that infect humans; is the mosquitos which appear to be are less likely than ticks to be brought home on workers. Plague (*Yersinia pestis*) is a

disease of domestic and wild rodents that is transmitted to humans by flea bite. Tularemia (*Francisella tularensis*) may be spread via ticks but also may be transmitted via inhalation of contaminated or dust particles that are inhaled.

- Scabies and lice are parasitic diseases of the skin that are caused by mites and lice. Caused by a mite (*Sarcoptes scabiei*), scabies is a highly contagious infectious disease of the skin that causes severe itching. It is normally spread via skin-to-skin contact but in some cases may be spread through contact with mite-infected undergarments or bedclothes.

[new para] Lice are parasites that live entirely on humans. They feed on human blood and their bites are intensely irritating. Secondary infections from repeated scratching are common (Fire and Emergency Services).

- Respiratory diseases that may be spread by indirect contact are potential problems. For example, rickettsiae are small (300-600nm) obligatory parasitic bacteria. Most rickettsiae are transmitted to man through the bite of arthropod vectors such as ticks as indicated above. However, the rickettsia that causes Q fever (*Coxiella burnetii*) is found in animals as well as ticks and may be transmitted to humans by inhalation of infected dust, indirectly via the drinking of infected milk, or by direct contact with animals, particularly cattle, sheep, and goats. It is an acute febrile disease with pneumonitis occurring in many cases. The organisms are highly infectious and are often spread in dusts associated with parturition. Person-to-person transmission is uncommon while, although the disease may be contracted by direct contact with the laundry of exposed workers. Other respiratory diseases that may be spread via dusts include tularemia as noted above.
- Aspergillosis is a fungal disease that is caused primarily by *Aspergillus fumigatus*, *A. niger*, and *A. flavus*. Several clinical conditions can be produced by these fungi including [missing text here?] the formation of masses of hyphae within ectatic bronchi and pneumonic and disseminated infection. The organisms are often found in compost piles undergoing decay and fermentation, hay that has been stored damp, in decaying vegetation, and in cereal grains. *Aspergillus* species as well as many other fungi may cause allergic reactions such as asthma in sensitive individuals. Based on the potential proximity to large reservoirs (e.g., grain storage, compost piles) of fungus on farms, there is perhaps a greater potential for fungal exposures in farm households. A study in Finland of airborne fungal spore concentrations in farm houses during the winter months indicated that some fungal genera not normally found in the urban environment (e.g., *Alternaria*, *Botrytis*) were found in the farmhouses as well as the cow barns [Pasanen et al. 1989]. The results of the study indicated that airborne fungal spores may be carried from the cow barn into the farmers' homes.

[new para] Other diseases that may be directly associated with farmers include brucellosis and anthrax. Brucellosis is primarily an occupational disease of farm workers, slaughterhouse workers, and veterinarians working with infected animals or tissues. Approximately 150-250 cases per year are reported in the United States. Transmission is primarily by direct contact with infected animals (e.g., cattle and swine) but airborne transmission is possible. Anthrax (*Bacillus anthracis*) is an acute bacterial disease that usually initially affects the skin but may occasionally involve the

mediastinum or intestinal tract. It rarely occurs in industrial nations. It is primarily a disease of workers who process hides and veterinarians who come in contact with infected animals. It may remain viable as a spore in soil associated with infected animals for years. Inhalation anthrax may result if the spores are inhaled while intestinal anthrax may arise if the spores are ingested.

- Roundworm infection (*Ascaris lumbricoides*) from contaminated soil may be brought into houses and automobiles on the shoes of workers. The infection may then be transmitted to members of the household in dusts or via ingestion. Infection is usually highest in children aged 3-8 years.

The following are a number of examples from the literature that are indicative of the circumstances where infectious agents have been transmitted to the "homes" of workers:

- An HIV infected 28-year-old male with a disseminated *Mycobacterium avium* infection was admitted to an Italian hospital in 1991. He was also diagnosed as being infected with the mite *Sarcoptes scabiei*. The hospital staff were aware of this infection and used protective clothing, gloves, and booties. However, within one month, 29 staff members were infected with the mite. Six relatives of the staff were infected at home. [NIOSH 00215633]
- In 1984 an outbreak of Q fever in Idaho was associated with a sheep research station. Two of the 18 cases of Q fever that were associated with the research station were family members of workers employed at the station. One was a 14-month old child while the second was the wife of a worker. It is assumed that these family members were infected with fomites brought home on the clothes of the workers. It is also worth noting that a farmer who had no direct contact with the research station also contracted Q fever. It is thought that he was infected from a Q-fever infected guard dog he had received from the research station. [NIOSH 00167503]
- A case was reported in England where 10 people became ill with Q fever who were performers in an Easter play at their village church. One of the members of the play was a shepherd who came to rehearsals in his work clothes. *C. burnetti* was isolated from the dust collected from the shepherd's clothes. [Marmon, BP and Stoker, MPG [1956]. The varying epidemiology of Q fever in the South East region of Great Britain. II. In two rural areas, *J. Hyg.*, 54, p.547.]
- Giardiasis is a protozoan (*Giardia lamblia*) infection that primarily attacks the small intestine and is associated with symptoms that include diarrhea, cramps, and bloating. It is primarily contracted from fecally contaminated water or food but may be transmitted person-to-person. In 1979, the Minnesota Department of Health conducted an evaluation of an outbreak of giardiasis at a rural public school system. Nineteen of the 60 employees of the school system met the case definition for giardiasis. Three members of the employees' households also had persistent diarrhea consistent with giardiasis infection. The transmission of giardiasis to the employees was apparently initiated through the handling of food by an employee's family member. [NEJ 1/1/81 304, 1] [Does this fit the definitions?]