ACQUIRED IMMUNODEFICIENCY SYNDROME (AIDS)

Personnel have been exposed to patients with AIDS and to their clinical specimens; however, there is currently no evidence of AIDS transmission to hospital personnel or from hospital personnel to patients. The etiology of the underlying immune deficiencies of patients with AIDS is unknown. One current hypothesis is that a transmissible agent is involved. If so, the agent appears to be transmitted most commonly through intimate, direct contact with mucosal surfaces or through parenteral spread. Airborne spread and interpersonal spread through casual contact do not seem likely. These patterns resemble the distribution of disease and modes of spread of hepatitis B virus.

With our present knowledge, it appears prudent for hospital personnel to use similar precautions when taking care of patients with AIDS as those used for patients with hepatitis B virus infection[6] (see Guideline for Isolation Precautions in Hospitals). It also appears prudent for hospital personnel who have AIDS to use similar precautions as those suggested for known carriers of HBsAg to minimize their infectious risk to others (see hepatitis discussion below). Precautions have been advised for persons and specimens from persons in certain patient categories considered to be part of the AIDS spectrum. These categories include persons with the following illnesses: opportunistic infections that are not associated with underlying immunosuppressive disease or therapy; Kaposi's sarcoma (patients under 60 years of age); chronic generalized lymphadenopathy, unexplained weight loss, and/or prolonged unexplained fever in persons who belong to groups with apparently increased risk of AIDS (homosexual men, intravenous-drug abusers, Haitian immigrants, hemophiliacs).[6] However, since AIDS has been diagnosed in persons not in identified high-risk groups, personnel may also use precautions when taking care of patients whose clinical condition and epidemiologic history suggest a risk for developing AIDS. Any new information on the cause and transmission of AIDS should be considered when precautions are designed or changed.

Extraordinary care must be taken to avoid accidental wounds from sharp instruments contaminated with potentially infective material and to avoid contact of mucous membranes and open skin lesions with materials from AIDS patients. Because of the lack of pertinent information, no particular course of action can be recommended in the event of accidental percutaneous or mucosal exposure to potentially infective material from patients with AIDS. Since these patients are often in high-risk groups for hepatitis B, following the suggestions for handling exposures to blood at high risk of being positive for hepatitis B surface antigen (HBsAg) may be considered (Table 1). Currently, no information is available on the potential benefits or problems associated with administering passive or active immunizing agents or therapy in this situation.

ACUTE DIARRHEA

Various agents may cause diarrhea in patients and hospital personnel. *Salmonella*, *Shigella*, and *Campylobacter* species are among the common bacterial enteric pathogens. Infection with these agents may produce mild symptoms but is often accompanied by other symptoms, such as abdominal cramps, fever, or bloody diarrhea. Diarrheal illness accompanied by such symptoms suggests a bacterial cause. Rotavirus and the 27-nanometer (Norwalk and Norwalk-like) agents are among the chief causes of sporadic and epidemic viral gastroenteritis. *Giardia lamblia* and other protozoa are also frequent causes

Table 1. Summary of Postexposure Prophylaxis for Acute Percutaneous (Needle-stick) Exposures to HBV*

Status of the patient's blood the health worker was exposed to	HBsAg testing recommended	Recommended prophylaxis
HBsAg-positive		HBIG (0.06 ml/kg) immediately and 1 month after needle-stick
HBsAg status unknown Source known:		
Blood is at *High Risk* (β) of being HBsAg-positive	Yes§	IG (0.06 ml/kg) immediately and if *test positive* HBIG (0.06 ml/kg) immediately and 1 month after needle-stick or if *test negative* nothing
Blood is at *Low Risk* (¶) of being HBsAg-positive	No	Nothing or IG (0.06 ml/kg)
HBsAg status unknown Source unknown	No	Nothing or IG (0.06 ml/kg)

*Consult current ACIP recommendations for important details.

(β) *High risk that the source is HBsAG-positive*—such as patients with acute, unconfirmed viral hepatitis; patients institutionalized with Down's syndrome; patients on hemodialysis; persons of Asian origin; homosexual men; users of illicit, intravenous drugs.

§ If results can be known within 7 days after exposure. Although prophylaxis may be given up to 7 days after exposure, it is most effective when given as soon after exposure as possible, preferably within 24-48 hours. Screening of exposed personnel to determine susceptibility may also be considered, but the decision to screen should not delay the administration of globulin.

(¶) *Low risk that the source is HBsAG-positive*—such as the average hospital patient.

HBIG = Hepatitis B immune globulin
IG = Immune globulin (formerly called "immune serum globulin," ISG, or "gamma globulin")

of diarrhea. Any of these agents may be nosocomially transmitted via the hands of personnel who are infected.

If personnel contract an acute diarrheal illness accompanied by fever, cramps, or bloody stools, they are likely to be excreting potentially infective organisms in high titer in their feces. The specific cause of acute diarrhea, however, cannot be determined solely on the basis of clinical symptoms; thus, appropriate laboratory tests are important. Not allowing these persons to take care of patients pending evaluation will prevent transmission. Evaluation of personnel may usually be limited to an initial culture for bacterial pathogens and stool examination for intestinal protozoa; repeat studies may be indicated if the results of the first tests are negative and the illness persists.

Carriage of Enteric Pathogens by Personnel

Carriage of enteric pathogens may persist after resolution of the acute illness. Once the person has clinically recovered and is having formed stools, however, there should be little hazard to patients, provided normal hygienic practices are observed. Existing data suggest that appropriate antibiotic therapy may eradicate fecal excretion of *Shigella* or *Campylobacter*. If persons take antibiotics, any follow-up cultures are best taken 48 hours after the last dose. Carriage of *Salmonella*, however, calls for special concern, because carriage may be prolonged and because the clinical sequelae of acute salmonellosis are often severe in high-risk patients, such as newborns, the elderly, immunocompromised patients, and the severely ill, such as those in intensive care units. Antibiotic therapy may prolong *Salmonella* excretion or lead to emergence of resistant strains and is not generally indicated. Thus, special precautions regarding contact with high-risk patients may be needed for personnel who are convalescent carriers of *Salmonella*.

Generally, personal hygiene, particularly handwashing by personnel before and after all patient contacts, will minimize the risk of transmitting enteric pathogens to patients. Maintaining good hygiene when away from the work setting will minimize the risk of transmission to family contacts.

Food-service personnel are not discussed in this guideline. Precautions for personnel taking care of patients who have gastroenteritis are discussed in the Guideline for Isolation Precautions in Hospitals.

HEPATITIS

Viral hepatitis has long been recognized as a nosocomial hazard. The agents that most commonly cause viral hepatitis are hepatitis A virus (HAV), hepatitis B virus (HBV), and 1 or more viruses currently designated non-A, non-B (NANB).

Hepatitis A

Nosocomial hepatitis A occurs infrequently and is associated with 2 unusual circumstances: 1) the source of infection is a patient hospitalized for other reasons whose hepatitis is not apparent, and 2) the patient is fecally incontinent. These circumstances may occur in adult and pediatric patients.

Hepatitis A is transmitted primarily by the fecal-oral route. It has not been reported to occur after inadvertent needle sticks or other contact with blood. Personnel who have frequent contact with blood, such as those who work in dialysis units, do not have evidence of increased infections with HAV.[7] Hepatitis A has, however, been reported to be transmitted by blood transfusion.[8]

Fecal excretion of HAV is greatest during the incubation period of disease before the onset of jaundice. Once disease is clinically obvious, the risk of transmitting infection is decreased. However, some patients admitted to the hospital with hepatitis A may still be shedding virus[9,10] and are potentially infective. Fecal shedding of HAV can continue for up to 2 to 3 weeks after onset of dark urine; however, in most persons, viral shedding is complete about 7 days after dark urine appears.[9] Anicteric infection may also occur, especially in young children. There is no evidence supporting the existence of a chronic HAV carrier state.

Personnel can help protect themselves and others from infection with HAV by always maintaining good personal hygiene, practicing thorough handwashing at all times, and taking care of patients known to be infected with HAV according to published recommendations (see Guideline for Isolation Precautions in Hospitals). If personnel become infected with HAV, the risk of transmitting infection is very low or negligible after about 7 days after onset of jaundice. Foodborne transmission of hepatitis A is not discussed in this guideline.

Hepatitis B

Most nosocomial cases of hepatitis B unrelated to the transfusion of blood or blood products occur in hospital personnel rather than patients. Transmission occurs by parenteral or mucosal exposure to HBsAg-positive blood from persons who are carriers or have acute HBV infection. Often carriers of HBsAg and persons with acute infections are unrecognized and are therefore not known to be infective. The infectivity of blood is best correlated with the presence of hepatitis B "e" antigen (HBeAg); however, any blood that is HBsAg-positive is potentially infective. Presence of HBeAg correlates strongly with the number of infective HBV in the serum.

The principal modes of HBV transmission are given below in order of decreasing efficiency:

1. **Overt parenteral transmission.**
   Direct percutaneous inoculation by needle or instrument contaminated with serum or plasma (for example, accidental needle-sticks, transfusion of contaminated blood or blood products, and acupuncture).
2. **Inapparent parenteral transmission.**
   a. Percutaneous inoculation with infective serum or plasma without overt needle puncture (for example, contamination of fresh cutaneous scratches, abrasions, burns, or other lesions).
   b. Contamination of mucosal surfaces with infective serum or plasma (for example, mouth pipetting accidents, accidental eye splash, and other direct contact with mucous membranes of the eyes or mouth, such as hand to mouth or eye when contaminated with infective blood or serum).
   c. Transfer of infective material to skin lesions or mucous membranes via inanimate environmental surfaces (for example, surfaces of various types of hospital equipment, devices, and rubber gloves).
   d. Contamination of mucosal surfaces with infective secretions other than serum or plasma (for example, contact involving saliva or semen).

Fecal-oral transmission of HBV does not appear to occur; however, transmission among homosexual men has been described, possibly via contamination from asymp-

tomatic rectal mucosal lesions at sites of sexual contact.[11] Airborne spread of HBV by droplet nuclei does not appear to be epidemiologically important.[12,13] Transmission of HBV in dental operatories, however, by large droplets that may strike mucous membranes or contaminate environmental surfaces has not been ruled out.[13]

Within the hospital setting certain work locations and occupational categories have been identified as showing increased risk for hepatitis B infection.[7,14-20] Generally, the highest risk of HBV infection is associated with locations and occupations in which contact with blood from infected patients is frequent. The locations and occupations are as follows:*

Work locations	*Occupational categories*
Blood banks	Dentists and dental surgeons
Clinical laboratories	Dialysis technicians
Dental clinics	Laboratory technicians
Dialysis wards	Nurses
Emergency rooms	Physicians (especially surgeons and pathologists)
Hematology/oncology wards	
Operating and recovery rooms	
Pathology laboratories	

Hospital personnel who do not have physical exposure to blood are at no greater risk than the general population. Patient contact without physical exposure to blood has not been documented to be a risk factor.

To prevent transmission of hepatitis B, hospital staff must be aware of the modes of transmission and the appropriate precautions in taking care of infected patients or handling their clinical specimens (see Guideline for Isolation Precautions in Hospitals). In general, the major emphasis is on applying blood precautions, practicing proper handwashing, having minimal contact with blood or blood-contaminated excretions, and handling the blood of all patients as potentially infective material.[21]

Since droplets from the patient's mouth reach the face of the dentist during certain procedures, dentists might consider protecting their eyes, nose, and mouth from such exposure by using masks and protective eyewear. They can prevent direct contact with infective material in the mouth by routinely wearing gloves during dental procedures.

• *Acute HBV Infection in Personnel and HBsAg Carriers*

A carrier is defined as a person who is HBsAg-positive on at least 2 occasions at least 6 months apart. After acute infection with HBV, the likelihood of developing the carrier state lessens as the person gets older and depends on the host's immune responsiveness. Carriers and persons with acute cases have the highest concentrations of HBV in the blood and serous fluids. The risk of transmission of HBV by HBsAg-positive health professionals has been examined in recent reports.[22-28] Transmission has been documented in a few instances from oral surgeons, gynecologists performing complex pelvic surgery, and a general practitioner. HBsAg-positive personnel with exudative dermatitis on body areas that may contact patients may also pose a risk to patients.[28]

Among dental practitioners who do not routinely wear gloves, a greater risk of transmitting infection appears to be associated with highly traumatic dental work, such as tooth extractions and surgery, than with less traumatic work such as examinations and restorations. Transmission by surgeons has been related to type of surgery, in particular, major operative procedures, such as laparotomy, hysterectomy, and major repairs, during which the chance of accidental puncture wounds is presumably greater. In 1 instance, transmission by a hospital worker with a severe exudative dermatitis on both hands appeared to be related to contamination of indwelling arterial catheters.[28]

The asymptomatic carrier of HBsAg and the person with an acute case do not appear to endanger susceptible persons except through direct inoculation of his or her blood or contaminated secretions. Thus, these persons need not be restricted from patient-care responsibilities, unless there is epidemiologic evidence that the worker is transmitting infection.

Personnel who are HBsAg-positive may be able to reduce or eliminate their risk of infecting patients by wearing gloves during high-risk procedures in which their blood or body fluids may contact patients.[22,23] Double-gloving during complex surgery might also help interrupt transmission.[26] Furthermore, it is crucial to counsel known carriers of HBsAg about practicing good personal hygiene, preventing their blood and potentially infective body fluids from contacting other persons, and not donating blood.

• *Hemodialysis Centers*

Infection with HBV has represented a great hazard to both patients and personnel in hemodialysis centers. If adequate infection control strategies are not practiced, hepatitis B infection, once introduced, can become endemic, with patients and environmental surfaces acting as reservoirs. Isolating or segregating patients who are HBV carriers, combined with assigning seropositive personnel to take care of these patients, has greatly decreased transmission of HBV in this environment. A complete discussion of the modes of transmission and control measures for hepatitis B in dialysis centers has been published.[29]

• *Pregnant Personnel*

Pregnant personnel are at no greater risk of contracting hepatitis than other personnel; however, if a woman develops hepatitis B during pregnancy and is HBsAg-positive at the time of delivery, the infant is at high risk of developing neonatal hepatitis and becoming an HBsAg carrier.[30,31] Because of this risk, it is important that pregnant personnel know the dangers of working in high-risk departments and be familiar with precautions that should be used.[29] Female personnel of childbearing age may also consider immunization with hepatitis B virus vaccine (see below).

• *Hepatitis B Virus (HBV) Vaccine*

An inactivated vaccine of high immunogenicity and efficacy is commercially available. The application of the vaccine in acute-care hospitals will depend on the risk of HBV infection for hospital personnel and the cost of vaccine.

Present estimates of risk have been based primarily on studies of the prevalence of hepatitis serum markers in selected groups.[14-17,19,20] Incidence studies of HBV infection among hospital personnel have been few[18,32,33] and have not included all groups of hospital personnel and appropriate

*Adapted from Maynard, JE. Nosocomial viral hepatitis. Am J Med 1981; 70:440.

community controls. Thus, data that can be used to analyze the cost-effectiveness of administering vaccine to hospital personnel are not complete.

Because the risk that hospital personnel will acquire hepatitis B varies among hospitals and among different occupational groups within hospitals, each hospital should formulate its own specific immunization strategy. In developing specific immunization strategies, hospitals may use available published data[14–20,32,33] about the risk of infection. Some institutions may instead choose to serologically screen personnel in various occupational categories or work locations to determine the prevalence of seropositivity in these groups.

The decision to screen potential vaccine recipients for susceptibility to hepatitis B is an economic decision; immunizing HBV carriers and persons already immune does not appear to present a hazard.[1,2] In the United States, the prevalence of previous infection in any targeted group, the cost of screening, and the cost of immunizing personnel determine whether screening would be cost-effective.[3,4]

HBV vaccine is reported to be safe.[34–38] The Immunization Practices Advisory Committee (ACIP) has published a discussion of this vaccine and its use.[3]

Non-A, Non-B Hepatitis

The epidemiology of NANB hepatitis in the United States more closely resembles that of hepatitis B than that of hepatitis A. Important aspects of NANB infections are as follows: 1) the NANB agent(s) circulates in the blood in acute cases, 2) there appears to be a chronic blood carrier state during which blood may remain infective, and 3) transmission of NANB infection is usually associated with percutaneous needle exposure or other exposure to blood, or with inapparent parenteral transmission. Since blood containing HBsAg is not used for transfusion, most post-transfusion hepatitis in the United States is NANB. Thus, emphasis on blood precautions, as with hepatitis B, seems the most reasonable current approach to preventing transmission from patients to personnel. For personnel who contract this illness, precautions suggested for hepatitis B should be adequate to prevent transmission to patients. Techniques are not yet available to detect specific antigens and antibodies or to determine the period of infectivity after acute infection.

Needle-stick Injuries

Needle-stick injuries account for a large number of the work-related accidents reported in hospitals.[39] Most injuries happen on patient-care units when personnel are 1) disposing of used needles, 2) administering parenteral injections or infusion therapy (especially to uncooperative patients), 3) drawing blood, 4) recapping needles after use, 5) handling linens or trash containing uncapped needles, or 6) cleaning up after patient-care procedures in which needles are used. Although other infections have been reported to be transmitted by accidental needle sticks, hepatitis B and probably NANB pose the greatest risks to hospital personnel. In the absence of immunoprophylaxis, the risk of acquiring overt hepatitis B through an accidental puncture wound from a needle used on an HBsAg-positive patient is about 6%.[40]

The risk of needle-stick injuries can be reduced by discarding used needles in puncture-resistant disposal units without first recapping them or purposely bending or breaking them by hand. Risk of injury may also be reduced if personnel obtain assistance when administering injections or infusion therapy to uncooperative patients and if personnel use caution when cleaning up after procedures that include the use of needles. Additionally, the incidence of needle-stick injuries may be reduced by providing needle-disposal units throughout the hospital in locations that facilitate their immediate use, for example, in nursing stations, patient rooms, laboratories, and utility rooms.[41] When some needle-cutting devices are used, blood may spatter onto environmental surfaces. Currently, no data are available from controlled studies examining the effect, if any, of needle-cutting devices on the incidence of needle-stick injuries.

After some needle-stick injuries, immunoprophylaxis for hepatitis B or NANB may be advisable.[42] Immune globulins for protection against viral hepatitis are most effective when given soon after exposure.

HERPES SIMPLEX VIRUSES

Herpes simplex viruses (HSV) can be transmitted among personnel and patients through either primary or recurrent lesions or through secretions (such as saliva, vaginal secretions, infected amniotic fluid) that can contain the virus when no lesions are obvious. Although many sites can become infected, exposed areas of skin are most likely to be involved, particularly when minor cuts, abrasions, or other skin lesions are present. Direct contact with lesions or infected secretions is the principal mode of spread.

Transmission of HSV From Patients to Personnel

Personnel may develop an infection of the fingers (herpetic whitlow or paronychia) from exposure to contaminated oral secretions. Such exposure is a distinct hazard for nurses, anesthesiologists, dentists, respiratory care personnel, and other personnel who may have direct (usually hand) contact with either oral lesions or respiratory secretions from patients. Less frequently, personnel may develop infection of the fingers from exposure to contaminated genital secretions or lesions on skin or mucous membranes. Personnel can protect themselves from such infections by 1) avoiding direct contact with lesions, 2) wearing gloves on both hands or using "no-touch" technique for all contact with oral or vaginal secretions, and 3) thorough handwashing after patient contact (see Guideline for Isolation Precautions in Hospitals).

Transmission of HSV From Personnel to Patients

Currently, there is no evidence that personnel with genital infections pose a high risk to patients if personnel follow good patient-care practices. The risk posed by personnel with orofacial herpes to patients is unknown. Personnel with oral infections, however, can reduce the risk of infecting patients by 1) wearing an appropriate barrier—such as a mask or gauze dressing—to prevent hand contact with the lesion, 2) washing hands well before all patient care, and 3) whenever possible, not taking care of patients at high risk of severe infection such as neonates, patients with severe malnutrition, severely burned patients, and patients in immunodeficient states. The potential risk of infecting high-risk patients must be weighed against the possibility of compromising patient care by excluding personnel with orofacial herpes.

Personnel with herpetic whitlow may be more likely to transmit infection by contact. Personnel can prevent trans-

mission of HSV to patients by not working when they have active infections of the hands. Although some have suggested that personnel with herpetic whitlow may have patient contact if they wear gloves,[43,44] the adequacy of this method of preventing transmission of infection is unknown.

STAPHYLOCOCCUS AUREUS AND *STREPTOCOCCUS*, GROUP A AND GROUP B

Carriage of potential pathogens by hospital personnel has been a traditional concern of infection control practitioners. Management of personnel who are infected with *Staphylococcus aureus* or carriers of *Staphylococcus aureus* or group A or group B *Streptococcus* is discussed here. Carriage of enteric pathogens and meningococci by hospital personnel are covered elsewhere; carriage of other organisms, such as gram-negative bacteria, has rarely been implicated as a source of nosocomial infection and is not discussed.

Staphylococcus aureus *Infection and Carriage*

Staphylococcal carriage or infection occurs frequently in humans. In nosocomial transmission, there are 2 sources: a person with a lesion or an asymptomatic carrier. Persons with skin lesions due to *S. aureus* are most likely to disseminate these organisms. Direct contact is the major route of transmission. Even a single boil in an occult body site (for example, the axilla) caused by *S. aureus* may increase the likelihood of dissemination. One way to decrease the possibility of dissemination is to not allow patient-care personnel to work until skin infection caused by this organism is resolved.

The anterior nares is one of the most commonly colonized sites, but carriage of *S. aureus* may occur at other sites, such as the axilla or perineum. The epidemiology of methicillin-resistant staphylococci does not appear to be different, except that nasal carriage may be less frequent, and outbreaks tend to occur more frequently in intensive care and burn units.

Culture surveys of personnel can detect carriers of *S. aureus* but do not indicate whether carriers are likely to disseminate their organisms. Thus, such data are difficult to interpret. A more reasonable approach is to emphasize effective surveillance that permits prompt recognition of staphylococcal infections in both personnel and patients. If certain personnel are linked epidemiologically to an increased number of infections, these persons can be cultured and, if positive, removed from patient contact until carriage is eradicated. Treatment regimens, followup of implicated personnel, and management of outbreaks are not discussed in this guideline.

Group A Streptococcus *Carriage*

For nosocomial transmission, the main reservoirs for group A *Streptococcus* appear to be the pharynx, the skin, the rectum, and the female genital tract. Direct contact and large droplets are the major modes of transmitting this organism; however, airborne spread has been suggested.[45,46]

Although pharyngeal and skin infections are the most common group A streptococcal infections, outbreaks of surgical wound infections caused by this organism have been more important in the hospital. Since group A streptococcal surgical wound infections occur infrequently, the occurrence of cases should prompt a search for a carrier. If personnel are linked epidemiologically to the occurrence of disease, they should be cultured, and if positive, removed from patient contact until carriage is eradicated. Treatment regimens, followup of implicated personnel, and management of outbreaks are not discussed here.

Group B Streptococcus *Carriage*

Carriage of group B *Streptococcus* by personnel does not appear to be important in nosocomial transmission. The epidemiology of group B streptococcal infections in neonates suggests that maternal colonization with group B *Streptococcus*, followed by the infant's acquisition during passage through the birth canal, accounts for most infections that have onset soon after birth. Spread of the organism from colonized to uncolonized infants via the hands of personnel, however, may play a role in late onset neonatal infections. Careful handwashing by personnel will minimize the risk of spread from colonized to uncolonized infants.

TUBERCULOSIS

Even though the risk of nosocomial infection with *Mycobacterium tuberculosis* is low, tuberculosis (TB) continues to pose a problem for health-care personnel. In the hospital, infection is most likely to occur when a patient has unsuspected pulmonary or laryngeal TB, has bacilli-laden sputum or respiratory secretions, and is coughing or sneezing into air that remains in circulation. The best ways to protect others from a patient with TB are to maintain a high index of suspicion for TB and to institute appropriate precautions (see Guideline for Isolation Precautions in Hospitals). A complete discussion of the transmission of tuberculosis in hospitals has been published elsewhere.[47]

Screening Programs

A tuberculosis screening and prevention program for personnel is important in protecting personnel and patients.[48,49] It is important that all institutions have a screening program; however, the program should be based on local epidemiologic data, because risk of transmission varies broadly among different segments of the population and in different localities. It is important to identify hospital personnel with tuberculous infection without evidence of current (active) disease, because preventive treatment with isoniazid may be indicated.[50] Persons with tuberculous infection are those with a significant skin-test reaction, usually defined as 10 mm or more of induration to 5 Tuberculin Units (TU) of Purified Protein Derivative-Standard (PPD-S) administered via the Mantoux technique.

The tuberculin skin test is the method of choice for TB screening. The Mantoux technique (intracutaneous injection of 0.1 ml of PPD-tuberculin containing 5 TU) is preferred for screening persons for TB infection,[51] because it is the most accurate test available. A 2-step procedure[52] can be used to minimize the likelihood of misinterpreting a boosted reaction as a true conversion due to recent infection.[52,53] In the 2-step procedure, an initial tuberculin skin test (Mantoux, 5 TU PPD) is given. If this test result is 0–9 mm of induration, a second test is given at least 1 week and no more than 3 weeks after the first. The results of the second test should be used as the baseline test in determining treatment and follow-up of these personnel. A skin test result of 10 mm of induration or more is considered to be significant.

The 2-step procedure, however, may not always be necessary. Personnel in the second or third decade of life may be less likely to have had remote infection with *M. tuberculosis*. Thus, the age of personnel in an institution and the

epidemiology of nontuberculous mycobacterial infection in the geographic location may determine the frequency of the booster phenomenon.[53] Depending on these factors, the 2-step method may not detect any more reactors than a single test. A pilot study may be useful to assess the frequency of the booster phenomenon in a given hospital and, thus, the need for the 2-step test.[54]

Multipuncture skin-test methods deliver an unknown quantity of antigen and may produce both false-positive and false-negative results. When repeated tuberculin testing is required or in postexposure testing, multipuncture methods do not allow precise interpretation of test results and proper counseling.

After the initial TB screening test, policies for repeat testing can be established by considering factors that contribute to the risk that a person will acquire new infection.[49] These factors include the location and prevalence of untreated TB in the community, in the institution, and among personnel.[49] For personnel considered to be at significant risk, repeat skin tests may be necessary on a routine basis (for example, every 3–6 months or yearly). If the risk of exposure to TB is small, it is not necessary to repeat skin tests routinely.

During TB screening, it is important to obtain an initial chest roentgenogram on those persons with significant skin-test reactions, those who convert their skin tests, or those who have pulmonary symptoms that may be due to TB. There is no need to obtain routine chest films of asymptomatic, tuberculin-negative personnel.

After initial chest films of persons with significant reactions, repeated chest X-ray examinations have not been found to be of sufficient clinical value or to be cost-effective in monitoring persons for development of disease.[55] Thus, personnel known to have a significant reaction and significant reactors who have completed adequate preventive treatment do not need repeat chest films unless they have pulmonary symptoms that may be due to TB.[55,56]

Management of Personnel After Exposure

If personnel are exposed to an infective patient with TB and do not use proper precautions, it is important to skin-test these personnel 10 weeks after the exposure. Ten weeks is the upper limit of the time required for an infected person to develop hypersensitivity to tuberculin. Unless a recent skin test was given, for example, during the 3 months before the exposure, a baseline test may be needed as soon as possible after the exposure, to help in deciding whether a significant reaction at 10 weeks represents a recent conversion related to the exposure.

Because the size of the skin-test reaction can be so important, the Mantoux technique is preferred for postexposure evalutions. Those already known to have significant reactions need not be skin-tested. Those who have significant reactions upon testing need chest roentgenograms to exclude the possibility of tuberculous pulmonary disease. If chest films are normal, these persons can be advised to receive preventive treatment, unless such treatment is contraindicated. If the chest film has abnormalities compatible with pulmonary TB, these personnel need evaluation to rule out the possibility of current disease.

BCG Vaccination

Many bacille Calmette-Guérin (BCG) vaccines are available today, and they vary in immunogenicity, efficacy, and reactogenicity. Controlled trials of previous vaccines conducted before 1955 showed protection ranging from 0 to 80%; however, the efficacy of vaccines currently available in the United States has not been demonstrated directly and can only be inferred. Thus, the skin-test reaction after BCG vaccination may be quite variable, and it cannot be distinguished from that due to virulent tuberculous infection. Caution is necessary in attributing a significant skin test to prior BCG vaccination, especially if the vaccinee has recently been exposed to infective tuberculosis. A history of BCG vaccination, then, should not preclude an initial screening test, and it is important to manage a significant reaction in BCG-vaccinated persons as a possible tuberculous infection.

Skin testing after BCG vaccination or natural infection with mycobacteria may be associated with adverse reactions, including severe or prolonged ulceration at the test site. Initial use of 1 TU PPD or a partial dose of 5 TU PPD may be useful in avoiding untoward reactions in persons who might be expected to have a severe reaction, such as those with an undocumented history of a large reaction in the past. A full 5 TU dose may be used safely if the initial skin test is negative. The efficacy of this method, however, has not been examined in controlled trials.

Generally in the United States, adequate surveillance and control measures rather than BCG vaccination are all that is necessary to protect hospital personnel and patients.

Preventive Treatment and Work Restrictions

Preventive treatment of persons with significant tuberculin reactions may decrease the risk that their subclinical infections will progress to clinical disease. In determining priorities for preventive therapy the decision-maker must weigh the risk of the person's developing current tuberculosis against the risk of isoniazid toxicity, the ease of identifying and supervising those to whom preventive therapy is offered, and the likelihood of their infecting others. About 5% of persons who are recent converters will develop current disease in the first 1–2 years after infection; the risk of developing current disease gradually declines thereafter. Persons for whom preventive treatment is recommended include newly infected persons, significant reactors with abnormal chest roentgenograms and negative bacteriologic findings, persons with special clinical conditions, significant reactors less than 35 years old, even in the absence of additional risk factors, and household members of persons with newly discovered TB.[50] Contraindications to treatment include 1) previous isoniazid-associated hepatic injury or other severe adverse reactions (for example, drug fever, chills, and arthritis), and 2) acute liver disease of any etiology. Persons of age 35 years or more may need preventive treatment, if the potential exists for transmitting disease if it develops.[50] Since the risk of developing current disease is low, work restrictions may not be necessary for otherwise healthy persons who do not accept preventive therapy. However, it is essential that they be instructed to seek evaluation promptly if symptoms develop that may be caused by TB, especially if they have contact with high-risk patients.

Personnel with current pulmonary or laryngeal TB pose a risk to patients and other personnel while they are infective. Stringent requirements regarding work restrictions for hospital personnel are necessary because of this special sit-

uation. Objective measures of lack of infectivity are negative cultures and sputum smears that are free of bacilli. Criteria for removing from or returning to work should always be tailored to the individual. Multiple factors should be considered, including those that influence the expulsion of infective particles in the work air space, mainly coughing, and the characteristics of potential contacts in the work environment and possible consequences, if they become infected.[57]

VARICELLA ZOSTER

Varicella-zoster virus (VZV) is the etiologic agent of varicella (chickenpox) and zoster (shingles). Nosocomial transmission of varicella-zoster infection among personnel and patients is well recognized. Appropriate isolation of hospitalized patients with known or suspected varicella or zoster can reduce the risk of transmission to personnel (see Guideline for Isolation Precautions in Hospitals). It is advisable to allow only personnel who have had varicella or those with serologic evidence of immunity to take care of these patients.

Varicella

Varicella is transmitted primarily via airborne spread by small particle aerosols (droplet nuclei) and by large particles (droplets). The virus may also be spread by direct contact but is not likely to be spread by inanimate objects because the virus is extremely labile. The incubation period for varicella in the normal host ranges from 10 to 21 days.

Even though personnel who are susceptible to varicella may be few, it is useful to identify such persons at the time of the placement evaluation. Most persons with a clearly positive history of previous varicella are probably immune. Many with negative or unknown histories may be immune, but some may also be susceptible.[58] When available, serologic screening may be used to define susceptibility more precisely. In institutions where varicella is prevalent or where there are many high-risk patients, it may be useful to screen those personnel who have a negative or equivocal history of varicella for the presence of serum antibodies to VZV to document susceptibility or immunity. This knowledge will help in assigning personnel to areas where VZV infection is present, avoiding unnecessary work restrictions and disruption of patient service if exposure occurs, and reducing the chance of nosocomial transmission.[59] Sensitive screening techniques exist, for example, fluorescent antibody to membrane antigen (FAMA), immune adherence hemagglutination (IAH), or enzyme-linked immunosorbent assay (ELISA), but they may not be readily available. The complement fixation (CF) test is not considered to be reliable because of the false-negative results obtained by this method.

If susceptible personnel are exposed to persons with varicella, these personnel are potentially infective during the incubation period (10 to 21 days after exposure). If varicella occurs, transmission is possible until all lesions are dry and crusted.

Zoster

Zoster appears to occur as a result of activation of latent VZV. There is scant evidence to support the view that zoster can be contracted by exposure to persons with varicella or zoster. However, varicella-zoster virus can be transmitted by direct contact with a person with zoster. If susceptible personnel are exposed to zoster, varicella may occur; thus, these persons may transmit VZV during the incubation period of varicella.

Because of the possibility of transmission and development of severe illness in high-risk patients, it may be advisable to exclude personnel with zoster from taking care of high-risk patients until all lesions are crusted. Personnel with zoster may not pose a special risk to other patients if the lesions can be covered.

VIRAL RESPIRATORY INFECTIONS

Viral respiratory infections are common problems for infection control programs. The role of viruses in nosocomial infections has been recently discussed[60–62] (also, see Guideline for Prevention of Nosocomial Pneumonia). Hospital personnel, visitors, and patients are important sources of viruses.

The 3 chief mechanisms of transmission of respiratory viruses are 1) small-particle aerosols (droplet nuclei), 2) large particles (droplets), and 3) inoculation of viruses after direct contact with infective areas or materials. Different respiratory viruses may vary in the way in which they are transmitted.

Small-particle aerosols are produced by talking, sneezing, or coughing and may transmit infection over a considerable distance (more than 3 feet). Large particles (droplets) are produced by sneezing and coughing and require close person-to-person contact for transmission. Person-to-person transmission can also occur by contaminating the hands by direct contact with infective areas or materials, then transferral of infective virus to mucous membranes of a susceptible person. Self-inoculation can also occur in this way. The nose and eyes, rather than the mouth, appear to be important portals of entry.

Pediatric patients appear to be at particular risk for complications from nosocomial respiratory tract infections. Infection in the elderly, patients with chronic underlying illness, and immunocompromised patients may also be associated with significant morbidity. Thus, it may be prudent to exclude personnel with viral respiratory infections from the care of these high-risk patients. Because large numbers of personnel may have viral respiratory illnesses during the winter, it may not be possible to restrict all such personnel from taking care of patients not in high-risk groups. In all instances, careful handwashing before patient contact is essential in preventing transmission. If handwashing is done appropriately, gloves and routine use of gowns may have no additional benefit in preventing transmission to patients.[63,64] Masks might be beneficial in preventing transmission by large droplets from personnel to patients upon close contact. However, masks probably will not completely protect personnel from patients with respiratory illnesses because large particles and aerosols may still reach the eyes, and self-inoculation from contaminated hands can still occur by touching the eyes.

Influenza epidemics may require other measures. Because influenza epidemics are unpredictable, hospitals may want to determine their policy on influenza immunization each year, taking note of the recommendations from the Immunization Practices Advisory Committee (ACIP), which are revised annually. Nosocomial spread of influenza might be reduced by immunizing personnel and high-risk patients several weeks or longer before the influenza season. An antiviral drug, amantadine, may be useful to limit spread to and from patients and unimmunized personnel during an epidemic of influenza A.

CYTOMEGALOVIRUS

Personnel may be exposed to patients with cytomegalovirus (CMV) infection, but the risk of acquiring CMV infection from patients appears to be small. There are 2 principal reservoirs of CMV in the hospital: 1) infants infected with CMV and 2) immunocompromised patients, such as oncology patients and those undergoing kidney or bone marrow transplant. Available data have shown no evidence of an excess risk of transmission of CMV to personnel working in dialysis units,[65] oncology wards,[66] or pediatric areas, when compared with personnel with no patient contact.[67,68] However, evidence is accumulating to suggest sexual contact as a significant mode of transmission of CMV outside the hospital environment.[69,70] Large, well-controlled studies are needed to document the validity of these observations.

The precise mechanism of transmission is unknown; however, infection appears to be acquired only through intimate, direct contact with an excreter of CMV or contact with contaminated secretions. Virus can be shed in the urine, saliva, respiratory secretions, tears, feces, breast milk, semen, and cervical secretions.

Screening Programs for CMV Infection

Because infection with CMV during pregnancy may damage the fetus, protecting women of childbearing age from persons who are excreting the virus is of primary concern. Most infants who are infected with CMV are asymptomatic. Screening programs to detect such patients, however, are not practical, because the tests are time-consuming and costly and would entail screening all newborns. Mass screening of personnel is not likely to provide useful information because the available complement fixation (CF) tests are not reliable indicators of immunity, since these tests lack sensitivity and since the antigen most commonly used for serologic testing (the AD 169 strain) may not cross-react with all other known CMV strains. Furthermore, identifying seropositive women would not necessarily provide a group who, if they become pregnant, are at no risk of transmitting infection to the fetus, because congenital infection may result from reactivation of latent infection[71,72] and, theoretically, from exogenous reinfection. In addition, since there are no studies to indicate clearly that personnel may be protected by transfer to areas with less contact with infants and children,[67,68] identifying seronegative women in order to institute such measures may not reduce the number of primary infections.

Preventing Transmission of CMV

When hygienic precautions (appropriate handwashing, not kissing infants, etc.) are satisfactory, the risk of acquiring infection through patient contact is low.[68] Therefore, a practical approach to reducing the risk of infection with CMV is to stress careful handwashing after all patient contacts and avoiding contact with areas or materials that are potentially infective (see Guideline for Isolation Precautions in Hospitals). Patients known to be infected with CMV can be identified, and this information can be used in counseling pregnant personnel and determining their work assignments.

Personnel who contract illnesses thought to be due to CMV need not be restricted from work. They can reduce the risk of transmission to patients or other personnel by careful handwashing and exercising care to prevent their body fluids from contacting other persons.

MENINGOCOCCAL DISEASE

Nosocomial transmission of *Neisseria meningitidis* to hospital personnel taking care of patients with meningococcemia, meningococcal meningitis, or lower respiratory infections is uncommon. In rare instances transmission to personnel from patients with meningococcemia or meningococcal meningitis has occurred through intensive direct contact with the infected person and direct contact with respiratory secretions without use of proper precautions. The most likely mode of spread from a person with infections at these sites is by large droplet secretions. Risk to personnel from casual contact (for example, as usually occurs with housekeepers and with laboratory contact with clinical specimens) appears to be negligible.

Meningococcal lower respiratory infections, however, may present a greater risk of transmission than meningococcemia or meningitis alone,[73,74] especially if the patient has an active, productive cough.[73] Possible airborne transmission to other persons who did not have close contact with the infected patient has been suggested;[73] however, droplet spread could not be excluded.

When taking care of patients with suspected *N. meningitidis* infection at any site, personnel can decrease the risk of infection by using proper precautions (see Guideline for Isolation Precautions in Hospitals).

Prophylaxis After Unprotected Exposure

Antimicrobial prophylaxis can eradicate carriage of *N. meningitidis* and prevent infections in personnel who have unprotected exposure to patients with meningococcal infections. Prophylaxis is indicated for persons who have intensive direct contact with infected patients and who do not use proper precautions. Personnel who have close contact with patients who have unrecognized meningococcal lower respiratory infection and therefore do not use proper precautions might also need prophylaxis.[73] Further studies will be important to define the need for prophylaxis in this situation.

When prophylaxis is deemed necessary, it is important to begin treatment immediately. Often prophylaxis must be started before results of antimicrobial testing are available. Rifampin is now the drug of choice for prophylaxis. Because sulfonamide-resistant meningococci are prevalent, sulfonamides should be used only if the organism has been found to be sulfonamide sensitive.

Carriage of N. meningitidis *by Personnel*

Carriage of *N. meningitidis* in the nasopharynx of healthy persons has been recognized for many years, but the prevalence is quite variable. Carriage may be transient, intermittent, or chronic. Surveillance of hospital personnel to determine carriage is useful only during special epidemiologic studies. Generally, in non-outbreak situations, asymptomatic carriers among personnel need not be identified, treated, or removed from patient-care activities. Management of carriers identified during special studies is not within the scope of this guideline.

PERTUSSIS

Pertussis, caused by *Bordetella pertussis*, is highly communicable. The secondary attack rate is determined primarily by the immune status of those exposed; age may also be a factor. Unless infected persons are treated with an effective antibiotic, the period of communicability extends from the beginning of the catarrhal stage to approximately 3 weeks after onset of paroxysms.

Nosocomial transmission of pertussis has been reported infrequently. Although infection occurs less commonly in adults and may be limited to mild respiratory illness, personnel with pediatric patient contact may be involved in transmission of pertussis to patients.[75,76] However, the risk of pertussis infection and dissemination is probably not serious enough to warrant routine immunization of hospital personnel with current vaccines. Immunizing persons over age 6 is not recommended, because of the increased frequency of adverse reactions. In addition, current vaccines do not confer complete immunity, and protection against pertussis may decrease as the interval between immunization and reexposure increases. Natural immunity appears to be long-lasting, although infection in persons who reportedly had pertussis in the past has been reported.[76]

During an outbreak, removal of personnel with cough or upper respiratory tract symptoms from the care of patients may be important in preventing further spread.[75] Erythromycin prophylaxis of exposed susceptibles who are infected may abort or attenuate illness if administered in the early pre-paroxysmal cough stage of the illness. Prophylaxis for less than 14 days is frequently followed by bacteriologic relapse. Infected contacts may be identified rapidly by the fluorescent antibody (FA) technique; however, culture techniques identify infection more reliably than FA examination, because of both false-positive and false-negative results with the FA method. "Carriers" of pertussis are very unusual, because persons with positive cultures generally develop symptoms.

SCABIES

Scabies is a disease caused by infestation with the mite *Sarcoptes scabiei*. It is transmitted in hospitals primarily through intimate direct contact with an infested person, even when high levels of personal hygiene are maintained.[77–79] Transmission to personnel has occurred during activities such as sponge-bathing patients or applying body lotions. Transmission between patients may also be possible when patients are ambulatory. Transmission by casual contact, such as holding hands, has been infrequently reported.[80] Transmission via inaminate objects, such as infested bedding, clothes, or other fomites has not been implicated as a major mode of transferring mites.[77,81]

Treatment is recommended for persons with active infestation. A single, correct application[77,81] of agents used to treat scabies is curative in most cases and appears to eliminate the risk of transmission immediately after the first treatment.[77,78,81] Treatment destroys both eggs and the active forms of the mites; however, ovacidal activity has not been fully substantiated for all available agents. Repeating the treatment 7–10 days after the initial therapy will kill any newly hatched mites. Between treatments the risk of transmission is felt to be negligible.

Using appropriate precautions when taking care of infested patients will decrease the risk of transmission to personnel (see Guideline for Isolation Precautions in Hospitals). If personnel are infested with the mite, transmission can be prevented by excluding them from work until they are treated.

GLOSSARY

Exposure. An important exposure is one in which a person is subjected to an infectious agent in a way considered likely to lead to acquisition of disease. Whether an exposure to an infectious agent is important depends on various factors, including 1) the mechanism of transmission of the agent involved and the person's infective potential; for example, a non-coughing patient with pulmonary tuberculosis poses little threat; 2) the type and duration of contact; 3) host susceptibility; and 4) whether or not suggested precautions are used. The persons in each hospital who have been given the responsibility, in consultation with others who may be involved, will have to determine whether an important exposure has occurred and if some intervention after the exposure is needed.

Transmission. Microorganisms are transmitted by various routes, and the same microorganism may be transmitted by more than 1 route. For example, varicella-zoster virus can spread either by the airborne route (droplet nuclei) or by direct contact. The differences in infectivity and in the mode of transmission of the various agents form the basis for the differences in precautions that are recommended in this guideline.

There are 4 main routes of transmission—contact, vehicle, airborne, and vectorborne.

A. Contact transmission, the most important and frequent means of transmission of nosocomial infections, can be divided into 3 subgroups: direct contact, indirect contact, and droplet contact.
   1. Direct contact—This involves direct physical transfer between a susceptible host and an infected or colonized person, such as occurs between patient and hospital personnel when personnel are turning patients, giving baths, changing dressings, or performing other procedures requiring direct personal contact. Taking care of patients generally involves some direct contact. Direct contact can also occur between 2 patients, 1 serving as the source of infection and the other as a susceptible host.
   2. Indirect contact—This involves personal contact of the susceptible host with a contaminated intermediate object, usually inanimate, such as instruments, dressings, or other infective material. If proper care is not taken, personnel can contaminate objects when assembling or handling critical equipment (such as respiratory therapy equipment, pressure-monitoring devices, cardiac bypass pumps) or during other procedures that involve inanimate objects.
   3. Droplet contact—Infectious agents may come in contact with the conjunctivae, nose, or mouth of a susceptible person as a result of coughing, sneezing, or talking by an infected person. This occurrence is considered "contact" transmission rather than airborne since droplets usually travel no more than about 3 feet. "Close contact" is used to mean within 3 feet of an infected person.

B. The vehicle route applies in diseases transmitted through contaminated items, such as transmission of hepatitis non-A, non-B by contaminated blood.

C. Airborne transmission occurs by dissemination of either droplet nuclei (residue of evaporated droplets that may remain suspended in the air for long periods of time) or dust particles in the air containing the infectious agent. Organisms carried in this manner are then inhaled by or deposited on the susceptible host.

D. Vectorborne transmission is of greater concern in developing countries, for example, mosquito-transmitted malaria.

Since agent and host factors are more difficult to control, interruption of the chain of infection in the hospital is directed primarily at transmission. The precautions recommended in this guideline are based on this concept.

RECOMMENDATIONS*

1. Elements of a Personnel Health Service for Infection Control

a. Placement Evaluation
   1) A health inventory should be obtained from personnel who will have patient contact. *Category I*
   2) For infection control, complete physical and laboratory examinations should not be routinely required for all personnel but should be done when indicated; for example, the need for an examination or laboratory test may be determined from results of the health inventory. *Category I*
   3) Health assessments of personnel other than placement evaluations should be done depending only on need; for example, as required to evaluate work-related illness or exposures to infectious diseases. *Category I*
   4) Routine culturing of personnel, such as taking cultures of the nose, throat, or stool, should *not* be done as part of the placement evaluation or thereafter. *Category I* (See Guideline for Hospital Environmental Control: Microbiologic Surveillance of the Environment and of Personnel in the Hospital)

b. Personnel Health and Safety Education
   1) Initial job orientation and ongoing in-service education should include the infection control aspects of personnel health and the proper use of the personnel health service. *Category I*
   2) Specific written policies and procedures for control of infections in hospital personnel should be readily available. *Category I*

c. Job-related Illnesses and Exposures
   1) A record should be maintained on hospital personnel that includes information obtained during the placement evaluation, immunization records, results of tests obtained in any screening or con-

*The recommendations in this guideline are limited to prevention and control of infectious disease transmission among patient-care personnel and patients (see Introduction). These suggestions, however, can include other personnel. This guideline and other guidelines in the manual include all of the current recommendations of the Hospital Infections Program, CDC, on personnel health. Hospitals may choose to establish additional policies for personnel.

trol programs, and reports of work-related illnesses or exposures. *Category I*

2) A readily available mechanism should be established for personnel to obtain advice about illnesses they may acquire from or transmit to patients. *Category I*

3) Evaluation of job-related illnesses or important exposures and postexposure prophylaxis, when indicated, should be provided. *Category I*

4) Written protocols should be established for handling job-related infectious diseases or important exposures. These occurrences should be recorded in the person's record and, when applicable, the appropriate member of the infection control committee and personnel health service should be notified. *Category I*

d. Coordinated Planning and Administration

1) Each hospital should have ways to coordinate policy-making and planning among the administration, personnel health service, infection control program, and various departments. *Category I*

2) A system should be established for notifying the infection control program of 1) infections in personnel that require work restrictions or exclusion from work, 2) clearance for work after an infectious illness that required work restrictions or exclusion, 3) other work-related infections and exposures, and 4) when appropriate, results of epidemiologic investigations. *Category I*

3) A representative of the personnel health program should be on the infection control committee. *Category I*

2. Immunization of Hospital Personnel*

a. Hospitals should formulate a written comprehensive policy on immunizing hospital personnel. *Category I*

b. The following recommendations should be considered by the hospital in formulating its policies:

1) *Rubella*

a) All personnel (male or female) who are considered to be at increased risk of contact with patients with rubella or who are likely to have direct contact with pregnant patients should be immune to rubella.† *Category I*

b) Before immunizing, serologic screening for rubella need not be done unless the hospital considers it cost-effective or the potential vaccinee requests it. *Category I* (Persons can be considered susceptible unless they have laboratory evidence of immunity or documented immunization with live virus vaccine on or after their first birthday. Consideration should be given to giving rubella vaccine in combination with measles and mumps vaccines [measles-mumps-rubella (MMR) trivalent vaccine].)

2) *Hepatitis B*

a) Persons at substantial risk of HBV infection who are demonstrated or judged likely to be susceptible should be actively immunized (see text). *Category II*

b) Before immunizing, serologic screening for hepatitis B need not be done unless the hospital considers it cost-effective or the potential vaccinee requests it. *Category I*

c) Prophylaxis with an immune globulin (passive immunization) should be used when indicated, such as following needle-stick exposure to blood that is at high-risk of being HBsAg-positive. *Category I*

d) Immune globulins should not be used as a substitute for active immunization. *Category I*

3) *Measles*

All persons susceptible by history or serology who are considered to be at increased risk of contact with patients infected with measles should be protected.* *Category I* (Most persons born before 1957 have probably been infected naturally and generally need not be considered susceptible. Younger persons can be considered immune only if they have documentation of 1) physician-diagnosed measles, 2) laboratory evidence of measles immunity, or 3) adequate immunization with live measles vaccine on or after the first birthday. Consideration should be given to administering measles vaccine in combination with rubella and mumps vaccines [measles-mumps-rubella (MMR) trivalent vaccine].)

4) *Poliomyelitis*

a) Routine primary immunization for adults in the United States is not recommended. Personnel who may have direct contact with patients who may be excreting polioviruses should complete a primary series. Primary immunization with inactivated polio vaccine (IPV) instead of oral polio vaccine (OPV) is recommended for these persons whenever feasible. *Category I* (IPV is preferred because the risk of vaccine-associated paralysis following OPV is slightly higher in adults than in children and because personnel may shed virus after OPV and inadvertently expose susceptible or immunocompromised patients to live virus.)

b) In an outbreak, OPV should be provided to anyone who has not been completely immunized or whose immunization status is unknown.† *Category I*

5) *Influenza*

To avoid problems with staffing during the influenza season and to prevent spread of influenza

*Consult current ACIP recommendations for a detailed discussion of the rationale for each recommendation. See page 5 for information on obtaining the full ACIP guidelines.

†Pregnancy is a contraindication. Vaccine should not be given to pregnant women or those who may become pregnant within 3 months.

*Pregnancy is a contraindication. Vaccine should not be given to pregnant women or those who may become pregnant within 3 months.

†Exceptions to this recommendation are discussed in the current ACIP recommendations under the heading *Precautions and Contraindications: Immunodeficiency*.

from personnel to patients, efforts should be made to immunize hospital personnel against influenza in the fall of each year. *Category II*

c. Hospital personnel are not at substantially higher risk than the general adult population of acquiring diphtheria, pneumococcal disease, mumps, or tetanus. Therefore, hospital personnel should seek these immunizations from their primary care provider, according to the recommendations of ACIP. *Category I*

d. Hospitals should not assume responsibility for routine immunization of hospital personnel against pertussis, tuberculosis, cholera, meningococcal disease, plague, rabies, typhoid, typhus, or yellow fever. *Category I* (Smallpox vaccine is no longer recommended for general use.*)

3. Protection of Personnel and Other Patients from Patients with Infections

a. Patients with potentially transmissible infections should be placed on isolation precautions using recommendations in the current Guideline for Isolation Precautions in Hospitals. (This recommendation is not categorized. The working group for the Guideline for Isolation Precautions in Hospitals did not rank the isolation recommendations into categories. Although the isolation recommendations are based on well-documented modes of transmission identified in epidemiologic studies or on a reasonable theoretical rationale, there have been few studies to test the efficacy of isolation recommendations.)

4. Prevention of Needle-Stick Injuries

a. Training or instruction of personnel should include discussions of methods to prevent needle-stick injuries. *Category I*

b. Used needles should be placed in a prominently labeled, puncture-resistant container designated specifically for their disposal. *Category I*

c. Used needles should not be recapped, purposely bent, or broken by hand. *Category II*

5. Prophylaxis After Exposure

a. When prophylactic treatment with drugs, vaccines, or immune globulins is deemed necessary and is offered, personnel should be informed of alternative means of prophylaxis, the risk (if this is known) of infection if treatment is not accepted, the degree of protection provided by the therapy, and the potential side effects. *Category I*

b. Hepatitis A

1) Personnel who have had direct fecal-oral exposure to excretions from a patient found to have been incubating hepatitis A should be given immune globulin (IG) (0.02 ml/kg). *Category I*

2) Prophylaxis with immune globulin (IG) for all personnel who take care of patients with hepatitis A (other than as suggested in recommendation 5.b.1 above) should not be given. *Category I*

c. Hepatitis B

For prophylaxis against hepatitis B after percutaneous (needle-stick) or mucous membrane exposure to blood that might be infective, the recommendations in Table 1 should be followed. *Category I*

d. Hepatitis Non-A, Non-B

If needle-stick exposures occur involving patients known to have hepatitis non-A, non-B, IG (0.06 ml/kg) should be given. *Category II*

e. Meningococcal disease

Antimicrobial prophylaxis against meningococcal disease should be offered immediately to personnel who have had intensive direct contact with an infected patient without using proper precautions. If prophylaxis is deemed necessary, treatment should not await results of antimicrobial sensitivity testing. *Category I*

f. Pertussis

Antimicrobial prophylaxis against pertussis should be offered immediately to personnel who have had intensive contact with an infected patient without using proper precautions. *Category II*

g. Rabies

Hospital personnel who either have been bitten by a human with rabies or have scratches, abrasions, open wounds, or mucous membranes contaminated with saliva or other potentially infective material from a human with rabies should receive a full course of anti-rabies treatment. *Category I*

6. Personnel Restriction Because of Illnesses or Special Conditions

a. 1) Hospitals should have well-defined policies concerning contact of personnel with patients when personnel have potentially transmissible conditions. Policies should govern personnel responsibility in using the health service and reporting illness, removal of personnel from direct contact with patients, and clearance for work after an infectious disease that required work restriction. *Category I*

2) Hospitals should identify those with authority to relieve personnel of duties. *Category I*

3) Policies for exclusion from work should be designed to encourage personnel to report their illnesses or exposures and not penalize them with loss of wages, benefits, or job status. *Category I*

b. Personnel who have responsibilities for patient care and have signs and symptoms of a transmissible infectious disease should report promptly to their supervisor. *Category I*

c. Acute Diarrhea

1) Personnel with an acute diarrheal illness that is severe, is accompanied by other symptoms (such as fever, abdominal cramps, or bloody stools) or lasts longer than 24 hours should be excluded from direct patient contact pending evaluation. *Category II*

2) Whenever appropriate, specific treatment for documented infection with enteric pathogens should be made available to infected personnel. *Category I*

3) Personnel with non-typhoidal *Salmonella* enteric infections should be excluded from the direct care

*Consult current ACIP recommendations for a detailed discussion of the rationale for each recommendation. See page 5 for information on obtaining the full ACIP guidelines.

of high-risk patients until stool cultures are *Salmonella*-free on 2 consecutive specimens collected not less than 24 hours apart. *Category II*

4) a) Personnel infected by enteric pathogens other than *Salmonella* may return to work after symptoms resolve. *Category II*

b) These persons should be individually counseled before they return to work about the importance of handwashing. *Category I*

5) Follow-up cultures or examinations of stool for pathogens other than *Salmonella* may be done to determine when the stool is free of the infecting organism. *Category III*

d. Herpes Simplex Infections

1) Personnel with primary or recurrent orofacial herpes simplex infections should not take care of high-risk patients, for example, newborns, patients with burns, or severely immunocompromised patients, until the lesions are healed. *Category II*

2) Personnel with herpes simplex infections of the fingers or hands (herpetic whitlow) should not have direct contact with patients until lesions are healed. *Category I*

e. Respiratory Infections

1) Personnel with respiratory infections should not be assigned to the direct care of high-risk patients, for example, neonates, young infants, patients with chronic obstructive lung disease, or immunocompromised patients. *Category II*

2) If an influenza epidemic is anticipated, a prevention program should be started for all patient-care personnel and high-risk patients. This program could include use of influenza vaccine and antiviral chemoprophylaxis. *Category II*

f. Streptococcal Disease

If group A streptococcal disease is suspected, appropriate cultures should be taken, and the health worker should be excluded from work until she or he has received adequate therapy for 24 hours or until streptococcal infection has been ruled out. *Category I*

g. Management of Personnel Who Are Linked to Outbreaks

Personnel who are linked epidemiologically to an increase in bacterial infections caused by a pathogen associated with a carrier state should be cultured and, if positive, excluded from patient contact until carriage is eradicated or the risk of disease transmission is eliminated. *Category I*

7. Detection and Control of Tuberculosis

a. Skin Tests

1) During the placement evaluation a tuberculin skin test should be given to all personnel, unless a previously significant reaction (10 mm or more of induration by Mantoux or vesiculation by a multiple puncture test) can be documented. The results should be used as the baseline test in determining treatment and follow-up of these personnel. *Category I*

2) The Mantoux technique using 5 TU PPD should be used. *Category II*

3) The 2-step test should be used to minimize the likelihood of interpreting a boosted reaction as a true conversion due to recent infection. *Category II* (Evaluation of the efficacy of the 2-step method in a given area may be necessary.)

4) If there is a likelihood of a severe reaction to skin testing, an initial test using a 2-step method with 1 TU PPD or a partial dose of 5 TU PPD should be considered. *Category II*

5) After the initial skin test, the need for repeat testing should be determined in each hospital by the risk of acquiring new infection; for example, personnel need not have repeat testing if the incidence of tuberculosis in the community and in personnel is very low and personnel have not been exposed to an infective case. *Category II*

6) All personnel with significant reactions should be informed about risks of developing disease, risks they may pose to their contacts, and preventive treatment (see also recommendation 7.c.). *Category I*

b. Skin Tests After BCG Vaccination

1) Persons who have had prior BCG vaccination should be skin-tested using the Mantoux method, unless a previously significant reaction can be documented. *Category I*

2) The results of skin tests in persons who have had prior BCG vaccination should be interpreted and acted on in the same manner as those in personnel who have not been vaccinated with BCG (see Preventive Treatment and Work Restrictions below). *Category I*

c. Chest Roentgenograms

1) Chest roentgenograms should be taken on those persons with significant tuberculin skin test results a) who have never been evaluated, b) who have had recent conversions, c) who have never received adequate treatment for tuberculosis, or d) who have pulmonary symptoms that may be due to tuberculosis. If the chest film suggests pulmonary TB, these persons should be evaluated to rule out the possibility of current disease. *Category I*

2) *Routine* follow-up roentgenograms should not be taken. *Category I*

d. Preventive Treatment and Work Restrictions

1) Personnel with current pulmonary or laryngeal tuberculosis whose sputum smear shows bacilli should be excluded from work until adequate treatment has begun and the sputum is free of bacilli on 3 consecutive smears obtained on separate days or until sputum cultures show no growth. *Category I*

2) Personnel who have current TB at a site other than the lung or larynx should be allowed to continue their usual activities. *Category I*

3) Personnel who discontinue medications for current pulmonary or laryngeal disease before the rec-

ommended course of therapy has been completed should not be allowed to work. *Category I*

4) a) All personnel with significant skin-test reactions who do not have current tuberculosis and who have not had previous adequate therapy should be advised to receive preventive treatment, unless such therapy is specifically contraindicated. *Category I*

b) These personnel, if otherwise healthy and receiving preventive treatment, should be allowed to continue usual activities. *Category I*

5) a) Personnel who cannot take or do not accept or complete preventive treatment should have their work situations evaluated and may require reassignment. A change in assignment should be considered, if these persons work with high-risk patients. *Category III*

b) These persons should be counseled about the risk of developing disease and risks they may pose to their contacts and should be instructed to seek evaluation of any signs or symptoms that may be due to TB. *Category I*

6) All persons with a history of TB and all personnel with significant reactions are at risk for developing current disease. These persons should be instructed to report promptly for evaluation if symptoms that may be due to TB develop. *Category I*

7) Personnel who have completed preventive treatment or adequate therapy for current disease should be exempt from further screening unless symptomatic. *Category I*

e. Postexposure Prophylaxis

1) After exposure to an infective case of tuberculosis during which proper precautions were not used, all personnel, except those already known to have significant skin-test reactions, should be skin-tested 10 weeks after the exposure. Personnel whose skin test converts should have a chest roentgenogram taken and, unless specifically contraindicated, be advised to receive preventive treatment, provided current disease has been ruled out. If the chest film suggests pulmonary TB, these persons should be evaluated to rule out current disease. *Category I*

2) Unless a skin test was given during the 3 months before exposure, a baseline skin test should be done as soon as possible after the exposure to assist in interpreting the 10-week postexposure skin test. *Category II*

3) Personnel already known to have significant reactions should not have a chest roentgenogram taken unless they have pulmonary symptoms that may be due to tuberculosis. *Category I*

8. Personnel Exposed to Varicella or Zoster

a. After exposure to varicella (chickenpox) or zoster (shingles) personnel not known to be immune to varicella (by history or serology) should be excluded from work beginning on the tenth day after exposure and remain away from work for the maximum incubation period of varicella (21 days). *Category I*

b. Personnel who have onset of varicella should be excluded from work at least until all lesions have dried and crusted. *Category I*

9. Control of Hepatitis Infections

a. Personnel who are suspected of being infected with hepatitis A virus (HAV) should not take care of patients until 7 days after the onset of jaundice. *Category III*

b. Screening for evidence of prior infection with hepatitis B virus (HBV) in personnel who work in dialysis centers or other high-risk areas should be done only when needed to institute appropriate control measures. *Category I*

c. Personnel who are known carriers of HBsAg should be counseled about precautions to minimize their risk of infecting others. *Category I*

d. 1) Personnel who have no exudative lesions on the hands and who are acutely infected with HBV, are known to be carriers of HBsAg, or have hepatitis non A/non B (NANB) should not be restricted from patient-care responsibilities, unless there is evidence of disease transmission. *Category I*

2) Personnel who have no exudative lesions on the hands and who are acutely infected with HBV, are known to be carriers of HBsAg, or have hepatitis NANB should wear gloves for procedures that involve trauma to tissues or direct contact with mucous membranes or non-intact skin. *Category II*

e. Personnel with exudative lesions on the hands who are HBsAg-positive should either wear gloves for all direct patient contact and when handling equipment that will touch mucous membranes or non-intact skin or abstain from all direct patient care. *Category I*

f. Dental personnel should consider routine use of gloves, masks, and protective eyewear when performing dental procedures. *Category III*

10. Precautions for AIDS*

a. Personnel considered to have any of the clinical features described in the AIDS spectrum should be counseled about precautions to minimize their risk of infecting others (see discussion of AIDS and HBsAg carriers in text). *Category I*

b. Personnel considered to have any of the clinical features described in the AIDS spectrum who have no exudative lesions on the hands should wear gloves for procedures that involve trauma to tissues or direct contact with mucous membranes or non-intact skin. *Category II*

c. Personnel considered to have any of the clinical features described in the AIDS spectrum and who have exudative lesions on the hands should either wear gloves for all direct patient contact and when handling equipment that will touch mucous membranes or non-intact skin or abstain from all direct patient care. *Category II*

*These suggestions are not meant to restrict hospitals from using additional precautions.

d. Dental personnel taking care of patients considered to have any of the clinical features in the AIDS spectrum should consider routine use of gloves, masks, and protective eyewear when performing dental procedures. *Category II*

11. Personnel with Other Infectious Diseases

Table 2 is a summary of the important recommendations above and work restrictions for personnel with other infectious diseases not mentioned previously.

Table 2. Summary of Important Recommendations and Work Restriction for Personnel With Other Infectious Diseases

Disease/Problem	Relieve from direct patient contact	Partial work restriction	Duration	Category
Conjunctivitis, infectious	Yes		Until discharge ceases	II
Cytomegalovirus infections	No			II
Diarrhea (see 6.c.)				
Acute stage (diarrhea with other symptoms)	Yes		Until symptoms resolve and infection with *Salmonella* is ruled out	II
Convalescent stage				
Salmonella (non-typhoidal)	No	Personnel should not take care of high-risk patients	Until stool is free of the infecting organism on 2 consecutive cultures not less than 24 hours apart	II
Other enteric pathogens	No	(See text & recommendation 6.c.)		II
Enteroviral infections	No	Personnel should not take care of infants and newborns	Until symptoms resolve	II
Group A streptococcal disease	Yes		Until 24 hours after adequate treatment is started	I
Hepatitis, viral				
Hepatitis A	Yes		Until 7 days after onset of jaundice	III
Hepatitis B				
Acute	No	Personnel should wear gloves for procedures that involve trauma to tissues or contact with mucous membranes or non-intact skin	Until antigenemia resolves	II
Chronic antigenemia	No	Same as acute illness	Until antigenemia resolves	II
Hepatitis NANB	No	Same as acute hepatitis B	Period of infectivity has not been determined	II
Herpes simplex				
Genital	No			II
Hands (herpetic whitlow)	Yes	(Note: It is not known whether gloves prevent transmission)	Until lesions heal	I
Orofacial	No	Personnel should not take care of high-risk patients	Until lesions heal	II
Measles				
Active	Yes		Until 7 days after the rash appears	I
Postexposure (Susceptible personnel)	Yes		From the 5th through the 21st day after exposure and/or 7 days after the rash appears	II

*Mumps vaccine may be offered to susceptible personnel. When given after exposure, mumps vaccine may not provide protection. However, if exposure did not result in infection, immunizing exposed personnel should protect against subsequent infection. Neither mumps immune globulin nor immune serum globulin (ISG) is of established value in postexposure prophylaxis. Transmission of mumps among personnel and patients has not been a major problem in hospitals in the United States, probably due to multiple factors, including high levels of natural and vaccine-induced immunity.

Disease/Problem	Relieve from direct patient contact	Partial work restriction	Duration	Category
Mumps				
Active	Yes		Until 9 days after onset of parotitis	I
Postexposure	Yes*		From the 12th through the 26th day after exposure or until 9 days after onset of parotitis	III
Pertussis				
Active	Yes		From the beginning of the catarrhal stage through the 3rd week after onset of paroxysms or until 7 days after start of effective therapy	I
Postexposure (asymptomatic personnel)	No			II
Postexposure (symptomatic personnel)	Yes		Same as active pertussis	I
Rubella				
Active	Yes		Until 5 days after the rash appears	I
Postexposure (susceptible personnel)	Yes		From the 7th through the 21st day after exposure and/or 5 days after rash appears	II
Scabies	Yes		Until treated	I
Staphylococcus aureus (skin lesions)	Yes		Until lesions have resolved	II
Upper respiratory infections (high-risk patients)	Yes	Personnel with upper respiratory infections should not take care of high-risk patients (See 6.e.)	Until acute symptoms resolve	II
Zoster (Shingles)				
Active	No	Appropriate barrier desirable; personnel should not take care of high-risk patients	Until lesions dry and crust	II
Postexposure (susceptible personnel)	Yes		From the 10th through the 21st day after exposure or if varicella occurs until all lesions dry and crust	I
Varicella (Chickenpox)				
Active	Yes		Until all lesions dry and crust	I
Postexposure	Yes		From the 10th through the 21st day after exposure or if varicella occurs until all lesions dry and crust	I

REFERENCES

1. Dienstag JL, Stevens CE, Bhan AK, Szmuness W. Hepatitis B vaccine administered to chronic carriers of hepatitis B surface antigen. Ann Intern Med 1982;96:575–9.

2. Szmuness W, Stevens CE, Oleszko WR, Goodman A. Passive-active immunization against hepatitis B: immunogenicity studies in adult Americans. Lancet 1981;1:575–7.

3. Immunization Practices Advisory Committee. Recommendation on inactivated hepatitis B virus vaccine. MMWR 1982;31:317–28.

4. Mulley AG, Silverstein MD, Dienstag JL. Indications for use of hepatitis B vaccine, based on cost effectiveness analysis. N Engl J Med 1982; 307:644–52.

5. Immunization Practices Advisory Committee. Recommendation on rubella prevention. MMWR 1981; 30:37–47.

6. Centers for Disease Control. Acquired immune deficiency syndrome (AIDS): precautions for clinical and laboratory staffs. MMWR 1982; 31:557–80.

7. Maynard JE. Viral hepatitis as an occupational hazard in the health care profession. In: Vyas GN, Cohen SN, Schmid R, eds. Viral hepatitis: a contemporary assessment of epidemiology, pathogenesis and prevention. Philadelphia: Franklin Institute Press, 1978:321–31.

8. Seeberg S, Bandberg A, Hermodsson S, et al. Hospital outbreak of hepatitis A secondary to blood exchange in a baby (letter). Lancet 1981; 1:1155–6.

9. Coulepis AG, Locarnini SA, Lehmann NI, Gust ID. Detection of hepatitis A virus in the feces of patients with naturally acquired infections. J Infect Dis 1980;141:151–6.

10. Carl M, Kantor RJ, Webster HM, et al. Excretion of hepatitis A virus in the stools of hospitalized patients. J Med Virol 1982;9:125–9.

11. Reiner NE, Judson FN, Bond WW, et al. Asymptomatic rectal mucosal lesions and hepatitis B surface antigen at sites of sexual contact in homosexual men with persistent hepatitis B virus infection: evidence for de facto parenteral transmission. Ann Intern Med 1982;96:170–3.

12. Petersen NJ, Bond WW, Marshall JH, et al. An air sampling technique for hepatitis B surface antigen. Health Lab Sci 1976;13:233–7.

13. Petersen NJ, Bond WW, Favero MS. Air sampling for hepatitis B surface antigen in a dental operatory. JADA 1979;99:465–7.

14. Pattison CP, Maynard JE, Berquist KR, et al. Epidemiology of hepatitis B in hospital personnel. Am J Epidemiol 1975;101:59–64.

15. Dienstag JL, Ryan DM. Occupational exposure to hepatitis B virus in hospital personnel: infection or immunization? Am J Epidemiol 1982; 115:26–39.

16. Janzen J, Tripatzis I, Wagner U, et al. Epidemiology of hepatitis B surface antigen (HBsAg) and antibody to HBsAg in hospital personnel. J Infect Dis 1978;137:261–5.

17. Levy BS, Harris JC, Smith JL, et al. Hepatitis B in ward and clinical laboratory employees of a general hospital. Am J Epidemiol 1977;106:330–5.

18. Hirschowitz BA, Dasher CA, Whitt FJ, Cole GW. Hepatitis B antigen and antibody and tests of liver function—a prospective study of 310 hospital laboratory workers. Am J Clin Pathol 1980;73:63–8.

19. Leers WD, Kouroupis GM. Prevalence of hepatitis B antibodies in hospital personnel. Can Med Assoc J 1975;113:844–7.

20. Tabor E, Gerety RJ, Mott M, Wilbur J. Prevalence of hepatitis B in a high risk setting: a serologic study of patients and staff in a pediatric oncology unit. Pediatrics 1978;61:711–5.

21. Favero MS, Maynard JE, Leger RT, Graham DR, Dixon RE. Guidelines for care of patients hospitalized with viral hepatitis. Ann Intern Med 1979;91:872–6.

22. Hadler SC, Sorley DL, Acree KH, et al. An outbreak of hepatitis B in a dental practice. Ann Intern Med 1981;95:133–8.

23. Rimland D, Parkin WE, Miller GB, Schrack WD. Hepatitis B outbreak traced to an oral surgeon. N Engl J Med 1977;296:953–8.

24. Communicable Disease Surveillance Centre and the Epidemiological Research Laboratory of the Public Health Laboratory Service, London. Acute hepatitis B associated with gynecological surgery. Lancet 1980;1:1–6.

25. Reingold AL, Kane MA, Murphy BL, et al. Transmission of hepatitis B by an oral surgeon. J Infect Dis 1982;145:262–8.

26. Carl M, Francis DP, Blakey DL, Maynard JE. Interruption of hepatitis B transmission by modification of a gynecologist's surgical technique. Lancet 1982;1:731–3.

27. Alter HJ, Chalmers TC, Freeman BM, et al. Health-care workers positive for hepatitis B surface antigen: are their contacts at risk? N Engl J Med 1975;292:454–7.

28. Snydman DR, Hindman SH, Wineland MD, et al. Nosocomial viral hepatitis B: a cluster among staff with subsequent transmission to patients. Ann Intern Med 1976;85:573–7.

29. Center for Disease Control. Control measures for hepatitis B in dialysis centers. Atlanta: Department of Health, Education and Welfare, Public Health Service, Viral Hepatitis Investigations and Control Series, November 1977. (HEW publication no. [CDC] 78-8358).

30. Tong MJ, Thursby M, Rakela J, et al. Studies on the maternal-infant transmission of the viruses which cause acute hepatitis. Gastroenterology 1981; 80:999–1004.

31. Schweitzer IL, Dunn AE, Peters RL, Spears RL. Viral hepatitis B in neonates and infants. Am J Med 1973; 55:762–71.

32. Craig CP, Gribble C, Suarez K. Risk of hepatitis B among phlebotomists. Am J Infect Control 1981;9:11–4.

33. Centers for Disease Control. Hepatitis Surveillance Report No. 47. Issued December 1981:3.

34. Szmuness W, Stevens CE, Harley EJ, et al. Hepatitis B vaccine: demonstration of efficacy in a controlled clinical trial in a high-risk population in the United States. N Engl J Med 1980;303:833–41.

35. Francis DP, Hadler SC, Thompson SE, et al. The prevention of hepatitis B with vaccine: report of the CDC multi-center efficacy trial among homosexual men. Ann Intern Med 1982;97:362–6.

36. Szmuness W, Stevens CE, Zang EA, et al. A controlled clinical trial of the efficacy of the hepatitis B vaccine (Heptavax-B): a final report. Hepatology 1981;1:377–85.

37. Centers for Disease Control. Hepatitis B virus vaccine safety: report of an inter-agency group. MMWR 1982;31:465–8.

38. Centers for Disease Control. The safety of hepatitis B virus vaccine. MMWR 1983;32:134–6.

39. McCormick RD, Maki DG. Epidemiology of needle-stick injuries in hospital personnel. Am J Med 1981;70:928–32.

40. Seeff LB, Wright EC, Zimmerman HJ, et al. Type B hepatitis after needle-stick exposure: prevention with hepatitis B immune globulin; final report of the Veterans Administration Cooperative Study. Ann Intern Med 1978;88:285–93.

41. Osterman CA. Relationship of new disposal unit to risk of needle puncture injuries. Hosp Top 1975;53:12–13.

42. Immunization Practices Advisory Committee. Recommendation on immune globulins for protection against viral hepatitis. MMWR 1981;30:423–8, 433–5.

43. American Academy of Pediatrics Committee on Fetus and Newborn. Perinatal herpes simplex viral infections. Pediatrics 1980;66:147–9.

44. Greaves WL, Kaiser AB, Alford RH, Schaffner W. The problem of herpetic whitlow among hospital personnel. Infect Control 1980;1:381–5.

45. Stamm WE, Feeley JC, Facklam RR. Wound infections due to group A *Streptococcus* traced to a vaginal carrier. J Infect Dis 1978;138:287–92.

46. Berkelman RL, Martin D, Graham DR, et al. Streptococcal wound infections caused by a vaginal carrier. JAMA 1982;247:2680–2.

47. Centers for Disease Control. Guidelines for prevention of TB transmission in hospitals. Atlanta: U.S. Department of Health and Human Services. (HHS publication no. [CDC] 82-8371), 1982.

48. Craven RB, Wenzel RP, Anuk NO. Minimizing tuberculosis risk to hospital personnel and students exposed to unsuspected disease. Ann Intern Med 1975;82:628–32.

49. American Thoracic Society, Ad Hoc Committee of the Scientific Assembly on Tuberculosis. Screening for pulmonary tuberculosis in institutions. Am Rev Respir Dis 1977;115:901–6.

50. American Thoracic Society, American Lung Association, and Centers for Disease Control. Preventive therapy of tuberculous infection. Am Rev Respir Dis 1974;110:371–4.

51. American Thoracic Society Executive Committee. The tuberculin skin test. Am Rev Respir Dis 1981;124:356–63.

52. Thompson NJ, Glassroth JL, Snider DE, Farer LS. The booster phenomenon in serial tuberculin testing. Am Rev Respir Dis 1979;119:587–97.

53. American Thoracic Society Executive Committee. Diagnostic standards and classification of tuberculosis and other mycobacterial diseases. 14th ed. Am Rev Respir Dis 1981;123:343–58.

54. Valenti WM, Andrews BA, Presley BA, Reifler CB. Absence of the booster phenomenon in serial tuberculin skin testing. Am Rev Respir Dis 1982;125:323–5.

55. Barrett-Connor E. The periodic chest roentgenogram for the control of tuberculosis in health care personnel. Am Rev Respir Dis 1980;122:153–5.

56. American Thoracic Society, Ad Hoc Committee of the Scientific

Assembly on Tuberculosis. Discharge of tuberculosis patients from medical surveillance. Am Rev Respir Dis 1976;113:709–10.

57. American Thoracic Society. Guidelines for work for patients with tuberculosis. Am Rev Respir Dis 1973;108:160–1.

58. Ross AH. Modification of chickenpox in family contacts by administration of gamma globulin. N Engl J Med 1962; 267:369–76.

59. Hayden GF, Meyers JD, Dixon RE. Nosocomial varicella: II. Suggested guidelines for management. West J Med 1979;130:300–3.

60. Valenti WM, Hall, CB, Douglas RG Jr, et al. Nosocomial viral infections: I. Epidemiology and significance. Infect Control 1980; 1:33–7.

61. Valenti WM, Betts RF, Hall CB, et al. Nosocomial viral infections: II. Guidelines for prevention and control of respiratory viruses, herpes viruses, and hepatitis viruses. Infect Control 1981;1:165–78.

62. Valenti WM, Hruska JF, Menegus MA, Freeburn MJ. Nosocomial viral infections: III. Guidelines for prevention and control of exanthematous viruses, gastroenteritis viruses, picornaviruses, and uncommonly seen viruses. Infect Control 1981;2:38–49.

63. Hall CD, Douglass RG Jr. Nosocomial respiratory syncytial viral infections: should gowns and masks be used? Am J Dis Child 1981;135:512–5.

64. Hall CB, Douglass RG Jr. Modes of transmission of respiratory syncytial virus. J Pediatr 1981;99:100–3.

65. Tolkoff-Rubin NE, Rubin RH, Keller EE, et al. Cytomegalovirus infection in dialysis patients and personnel. Ann Intern Med 1978;89:625–8.

66. Duvall CP, Casazza AR, Grimley PM, et al. Recovery of cytomegalovirus from adults with neoplastic disease. Ann Intern Med 1966;65:531–9.

67. Yeager AS. Longitudinal, serological study of cytomegalovirus infections in nurses and in personnel without patient contact. J Clin Microbiol 1975;2:448–52.

68. Ahlfors, K, Ivarsson S-A, Johnsson T, Renmarker K. Risk of cytomegalovirus infection in nurses and congenital infection in their offspring. Acta Paediatr Scand 1981;70:819–23.

69. Jordan MC, Rousseau WE, Noble GR, et al. Association of cervical cytomegalovirus with venereal disease. N Engl J Med 1973;288:932–4.

70. Davis LE, Steward JA, Garvin S. Cytomegalovirus infection: a seroepidemiologic comparison of nuns and women from a venereal disease clinic. Am J Epidemiol 1975;102:327–30.

71. Stagno S, Reynolds DW, Huang E-S, et al. Congenital cytomegalovirus infection, occurrence in an immune population. N Engl J Med 1977; 296:1254–8.

72. Ahlfors K, Ivarsson S-A, Johnsson T, Svanberg L. Primary and secondary maternal cytomegalovirus infections and their relation to congenital infection. Acta Paediatr Scand 1082;71:109–13.

73. Cohen MS, Steere AC, Baltimore R, et al. Possible nosocomial transmission of group Y *Neisseria meningitidis* among oncology patients. Ann Intern Med 1979;91:7–12.

74. Rose HD, Lenz IE, Sheth NK. Meningococcal pneumonia: a source of nosocomial infection. Arch Intern Med 1981;141:575–7.

75. Linnemann CC Jr, Ramundo N, Perlstein PH, Minton SD. Use of pertussis vaccine in an epidemic involving hospital staff. Lancet 1975;2:540–3.

76. Kurt TL, Yeager AS, Guenette S, Dunlop S. Spread of pertussis by hospital staff. JAMA 1972;221:264–7.

77. Gooch JJ, Strasius SR, Beamer B, et al. Nosocomial outbreak of scabies. Arch Dermatol 1978;114:897–8.

78. Belle EA, D'Souza TJ, Zarzour JY, et al. Hospital epidemic of scabies: diagnosis and control. Can J Pub Health 1979;70:133–5.

79. Bernstein B, Mihan R. Hospital epidemic of scabies. J Pediatr 1973; 83:1086–7.

80. Haydon JR Jr, Caplan RM. Epidemic scabies. Arch Dermatol 1971; 103:168–73.

81. Estes SA. Diagnosis and management of scabies. Med Clin N Am 1982; 66:955–63.

FURTHER READING

1. National Institute for Occupational Safety and Health (NIOSH). Hospital occupational health services study, NIOSH I-VII. Cincinnati: U.S. Department of Health, Education and Welfare, Public Health Service, Center for Disease Control, July 1974 to April 1976. (HEW publication No. [NIOSH] 75-101, 75-137, 76-107, 76-115, 76-116, 77-140).

2. Haley RW, Emori TG. The employee health service and infection control in U.S. hospitals, 1976–1977: I. Screening procedures. JAMA 1981; 246:844–7.

3. Haley RW, Emori TG. The employee health service and infection control in U.S. hospitals, 1976–1977: II. Managing employee illness. JAMA 1981;246:962–6.

4. Werdegar D. Guidelines for infection control aspects of employee health. J Assoc Pract Infect Cont 1977;5(Sept):17–22.

5. Werdegar D. Guidelines for infection control aspects of employee health. J Assoc Pract Infect Cont 1977;5(Dec):15–22.

6. Werdegar D. Employee health. Nurs Clin N Am 1980;15:769–87.

7. Gardner P, Oxman MN, Breton S. Hospital management of patients and personnel exposed to communicable diseases. Pediatrics 1975;56:700–9.

8. Klein JO. Management of infections in hospital employees. Am J Med 1981;70:919–23.