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Infectious Diseases Handbook
For Medical School Affairs Officers

Second Edition

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Infectious Diseases Handbook

For Medical School Student Affairs Officers

Second Edition

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Contents

Appendices

List of Tables

Preface

This handbook is intended as a resource for those who are concerned about the transmission of infectious diseases in the health care setting. It is intended primarily for use by Student Affairs deans who are charged with the formulation and administration of policies related to medical student health. It contains information about common agents acquired in the clinical environment, methods of transmission, risks of infectivity, and control/prevention procedures. Both risks to health care workers (HCWs) as a result of caring for infected patients and risks to patients from infected HCWs are discussed, where appropriate. Well-accepted infection control practices are presented, and areas of continued controversy are addressed.

This document is written primarily in lay language so that it can be read and understood by those without a medical background. It also contains information that may be unfamiliar to many physicians who are not experts in infection control. It is not intended to address all concerns related to medical student health, and it specifically covers only those major organisms and diseases that are transmitted as a result of patient care activities.

Those interested in reviewing the 2006 AAMC-GSA Recommendations regarding Health Services for Medical Students and the 2005 AAMC-GSA Recommendations for Student Healthcare and Insurance should refer to Appendices A and B.

A glossary of abbreviations used in the text can be found after the Introduction.

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GROUP ON STUDENT AFFAIRS

Mission Statement

The mission of the Group on Student Affairs (GSA) is to advance medical education and, specifically, to represent the interests of medical schools and medical students in the areas of admissions, student affairs, financial aid, minority affairs, and student records. The functions of the GSA are to provide a means of communication among, and to facilitate interaction of the Association of American Medical Colleges (AAMC) with, institutional representatives with responsibilities in the above-named areas. The GSA advises the AAMC on matters of policy relating to the GSA's areas of interest and expertise and may recommend such policy to the AAMC governance for consideration. The GSA also engages in activities involving project analysis, program development, and data-gathering about emerging trends in order to assist the GSA and the AAMC to anticipate and respond effectively to environmental changes as they affect medical education, medical schools, and medical students in the areas of the GSA's interest and expertise.

Introduction

Some risk of contracting illness is inherent in caring for patients, and one of the fundamental tenets of the practice of medicine is that physicians care for patients despite this risk. Proper education about potential infectious agents, their routes of transmission, and appropriate prevention and control procedures is an essential part of all infection control programs. This education serves to prepare health care workers (HCWs) to reduce the risks to themselves and to their patients. Although students may receive instruction about appropriate precautions during their clinical clerkships, it is essential that they receive information about how to minimize the risks of transmission of infectious agents *before* they have patient contact. Since even many "traditional" medical school curricula expose students to patients in the first year, early instruction is critical. This very specialized and practical subject matter does not fit neatly into most conventional medical school courses. Consequently, the responsibility for arranging and organizing an infection control program for medical students often falls to the dean of Student Affairs and/or Academic Affairs. Some medical schools have made this information a mandatory part of the curriculum during first-year orientation. Principles taught early can then be reinforced in courses such as microbiology, introduction to clinical medicine, and laboratory medicine, as well as in the clinical clerkships.

Infectious diseases change over time. New pathogens emerge and old pathogens reemerge to pose greater risks. The recommendations presented in this monograph are those widely accepted in 2006. Should new issues arise, the Web site of the Centers for Disease Control and Prevention (www.cdc.gov) should be consulted for information.

List of Abbreviations

AFB	Acid fast bacillus
AIDS	Acquired Immunodeficiency Syndrome
anti-HBc	Antibody to Hepatitis B core antigen
anti-HBs	Antibody to Hepatitis B surface antigen
AZT	Zidovudine
BAMT	Blood Assay for *Mycobacterium tuberculosis*
CDC	Centers for Disease Control and Prevention
CMV	Cytomegalovirus
DNA	Deoxyribonucleic acid
ELISA	Enzyme-linked immunosorbent assay
HBV	Hepatitis B virus
HBeAg	Hepatitis B e antigen
HBsAg	Hepatitis B surface antigen
HCV	Hepatitis C virus
HCW	Healthcare worker
HEPA	High efficiency particulate air filter
HIV	Human Immunodeficiency Virus
INH	Isoniazid
IU	International unit
3TC	Lamivudine
mL	Milliliter
µm	Micro molar
MRSA	Methicillin-resistant *Staphylococcus aureus*
M. tb.	*Mycobacterium tuberculosis*
NRTI	Nucleoside reverse transcriptase inhibitor
OSHA	Occupational Safety and Health Administration
PHS	U.S. Public Health Service
PEP	Post-exposure prophylaxis
PPD	Purified protein derivative
RSV	Respiratory Synctial Virus
SARS-CoV	Severe Acute Respiratory Syndrome - associated Coronavirus
VRE	Vancomycin resistant enterococci
VZV	Varicella zoster virus
ZDV	Zidovudine

Administrative Issues

KEY POINTS

- The cooperation of hospital infection control personnel, student health services staff members, and others is often essential for the implementation of a medical student program.
- Costs vary widely. Decisions should be made about institutional versus individual responsibilities, but costs should not interfere with mandatory provision of services.
- Record-keeping should be coordinated and confidential, yet accessible to students and available when needed.
- Policies for students (including visiting students) should be stated clearly.
- The individual(s) with responsibility for program oversight should be identified.

This document is intended to provide background information so that those formulating policy and counseling students have a greater understanding of the principles of infection prevention and control. Since most administrators do not have a background in infectious disease, help from local individuals who are well-versed in the operation of an infection control program is key in the development and implementation of a program for medical students. These individuals should not be difficult to find, as infection control programs, often headed by physician/nurse teams, are mandated in the hospital setting. Hospital epidemiologists generally recognize the important role that medical students play in delivering health care in a teaching hospital, and they must also be concerned that students follow the same procedures required of employees.

What does an infection control program cost, and who should pay for it? Sample charges for some elements are listed in Table 1. Many of the costs incurred by an infection control program for students are small and relatively easily absorbed in a medical school or hospital budget. Often hospital programs are very willing to include students (in addition to both employees and volunteers) in tuberculosis surveillance and influenza vaccination programs, which cost relatively little and have major benefit. Some programs (such as providing varicella vaccine to those who are not immune) are costly, but are only required for a small number of students. The cost of providing hepatitis B vaccine for a large class of students can be substantial, but the recommendation that all schools make vaccination available to students (regardless of whether the institution or the individual student pays for it) is now part of the *AAMC-GSA Recommendations regarding Health Services for Medical Students* (Appendix A), and most students have already been vaccinated prior to coming to medical school. For more costly services, a "charge back" arrangement can be made with hospitals, a university health service, or an individual practitioner willing to care for students. Those administering programs for students should also be aware that charges for services in some instances may vary substantially from actual costs (e.g., the charge for a serology [antibody test] for varicella is generally $20 to $30, whereas the actual cost is closer to $2 to $3), and some negotiation between the medical school and the laboratory provider may result in considerable savings.

TABLE 1

Sample Costs/Infection Central Program		Investigation of a Needlestick Injury	
Hepatitis B Vaccine	$120.00 (3 injections)	Clinic visits	$490.00
Varicella Vaccine	$92.00 (2 injections)	Laboratory charges without antiretroviral drug monitoring	$400.00
Influenza Vaccine	$16.00 (1 injection)	With drug monitoring	$1100.00
PPD Skin Test	$18.00	Source testing	$90.00
HIV Prophylaxis 6 week course	$484.00	Hepatitis C exposure follow-up	$125.00

Although it is not essential that all elements of an infection control program originate from the same location, it is important that record-keeping be coordinated and that general information about student health be held confidentially, yet be accessible, if needed. Data about immunity to varicella and tuberculin skin test results, for example, are generally considered a mandatory part of employee health records. Hospitals may require these data about students before allowing them to begin a clinical rotation. Fit-testing of masks to protect against airborne agents may also be required. Thus, providing students with a "school-certified" copy of their own data (indicating tuberculin skin-test status; status of immunity to measles, mumps, rubella, hepatitis B, and varicella; and fit-testing results) may be of considerable benefit if an institution uses multiple teaching venues. Students will also undoubtedly find this helpful after graduation, as residency programs require similar health information.

It is the responsibility of the medical school to insure that an appropriate infection control program is in place for its students. The "teeth" for urging a recalcitrant student to comply with infection control mandates (such as yearly skin-testing for reactivity to tuberculosis) generally resides in the Student Affairs office. Policies with regard to student health issues and infection prevention and control should be stated clearly, approved by appropriate institutional committees, and published in institutional documents and on school Web sites. The rationale for individual program elements should be delineated, and penalties for lack of compliance should be clear. Without some administrative oversight, programs for student health can quickly become fragmented and student compliance can become haphazard; therefore, the individual(s) responsible for the supervision of this program should be clearly identified.

Principles of Infection Prevention and Control

Using appropriate infection control procedures is the responsibility of all HCWs. Education about infection control is especially important for physicians-in-training, who will eventually assume a leadership role in the health care team. Decisions made by physicians not only impact the health of their patients, but also have the potential to directly affect their own health and that of other HCWs. While the practice of "standard precautions" (i.e., assuming that the body fluids of all patients are potentially infectious [described more fully below]) has simplified the approach to infection control, physicians still must be vigilant with regard to agents spread by the airborne, contact, and droplet routes, and they must ensure that safe procedures are consistently followed by all members of the team. If infection control programs are successful, safe practices become "second nature." Most errors or breaks in technique occur when HCWs are rushed, stressed, or distracted, and those in training may be especially vulnerable to these pressures.

How Organisms Are Transmitted

Infection prevention and control in patient care settings require that HCWs understand the ways in which organisms are transmitted and take active steps to prevent their spread. Microorganisms enter people via:

- inhalation
- contact with skin or mucous membranes; this contact may be direct (i.e., from person to person) or indirect (i.e., from touching contaminated objects, called "fomites" in the environment, or via the hands of personnel)
- ingestion, or
- inoculation (i.e., from a puncture wound, needlestick injury, or bite).

Tuberculosis is an example of a disease spread by inhalation. Coughing leads to the generation of many small and large particle aerosols, which then may be inhaled by those in close proximity. Coughing and sneezing also generate aerosols (also called "droplets") that spread respiratory viruses such as influenza, although, interestingly, the viruses that cause most common colds are spread more efficiently by contact with nasal secretions, which contain many virus particles and are often present on the hands of those with a bad cold. Contamination of the environment is frequent around those with nasal discharge, as it is around those with infected wounds and those with diarrhea. Those who touch contaminated objects become contaminated themselves. Rubbing the eyes or nose or putting fingers in the mouth then results in self-inoculation. Not infrequently, HCWs unwittingly transmit pathogens (disease-causing organisms) from one patient to another whether or not they become ill themselves by failing to wash their hands between patients. Most transmission of agents spread by the fecal-oral route results from lack of appropriate handwashing after using the restroom or in caring for those who are incontinent. In the hospital setting, spread of pathogens by inoculation is generally inadvertent and results from injury from a needle or other sharp instrument. Examples of common pathogens and their routes of transmission are presented in Table 2.

TABLE 2

Common Pathogens and Their Routes of Transmission

Agents Spread Primarily by Inhalation and/or Contact with Infected Respiratory Secretions

Bacteria
- *Mycobacterium tuberculosis*
- *Hemophilus influenza*
- *Neisseria meningitidis*
- *Bordetella pertussis (whooping cough)*

Viruses
- Influenza
- Parainfluenza
- Respiratory syncytial virus
- Rhinovirus
- Measles
- Mumps
- Rubella
- Varicella zoster virus
- Adenovirus
- SARS-CoV

Agents Spread Primarily by Contact

Bacteria
- Group A streptococcus
- *Staphylococcus aureus*
- *Treponema pallidum (syphilis)*

Viruses
- Herpes simplex virus
- Varicella zoster virus

Parasites
- Pediculoses (lice)
- *Sarcoptes scabiei (scabies)*

Table 2 continued

TABLE 2 *(continued)*

Agents Spread Primarily by Ingestion (fecal-oral route)

Bacteria
- Salmonella
- Shigella
- Campylobacter
- *Clostridium difficile*
- *Escherichia coli*

Viruses
- Hepatitis A
- Poliovirus
- Enteroviruses
- Rotavirus
- Norwalk virus

Parasites
- *Giardia lamblia*
- *Cryptosporidium*
- *Entamoeba histolytica*

Agents Spread Primarily by the Blood-Borne Route

Viruses
- Hepatitis B
- Hepatitis C
- Human immunodeficiency virus
- Cytomegalovirus

Common Methods of Protection

The most important factor in the transmission of infectious agents in the clinical setting is the contamination of the hands of HCWs. Both Ignaz Semmelweis and Oliver Wendell Holmes recognized in the mid-1800s that physicians transmitted infection to mothers in the course of delivering their babies, and that the rate of infection could be reduced by decontamination of the physician's hands. Proper **hand hygiene** before and after patient contact is the cornerstone of all infection control procedures. Handwashing (lathering the hands with plain soap and water for at least 15 seconds) is recommended by the CDC after routine patient contact, while the use of an antimicrobial product containing an agent such as chlorhexidine gluconate or iodophors is recommended when caring for patients with "epidemiologically important pathogens" (i.e., those most likely to spread in the hospital setting). Numerous studies have demonstrated that compliance with handwashing protocols among HCWs is poor, however. HCWs do not wash their hands as frequently as they should, and, when they do wash, they often do not wash for the prescribed period of time. Male physicians appear to be the worst offenders. Lack of time, inconvenient location of sinks, and lack of appropriate role models ("When we're on rounds, residents don't wash their hands") are frequently cited as explanations. Recent evidence also suggests that, while plain soap and water may be effective in washing away bacteria, they may not kill any bacteria that remain behind. Alcohol-containing gels appear to be much more effective than handwashing in killing bacteria, and they are quicker and easier to use. Unless hands are visibly soiled, alcohol-based gels are now recommended for routinely decontaminating hands in patient care settings. Of note, artificial nails and long fingernails have been linked to outbreaks of nosocomial (hospital-acquired) infections, and hospitals now prohibit them for staff members who have direct patient care contact.

Barrier precautions, such as gloves, masks, eye protection, and impervious gowns, reduce the risk of skin and mucous membrane contact with infectious materials. Gloves protect the hands from contaminated secretions or body fluids, and, while not impervious to puncture, they have also been demonstrated to reduce the amount of material transmitted by a needlestick. **Gloves** should be changed between patients and should not be washed or used with petroleum-based hand creams. Even when gloves are used, hands may become contaminated through small, almost invisible tears; (one study demonstrated a 13 percent rate of hand contamination despite intact-appearing gloves). Wearing gloves should never replace handwashing, which should occur immediately after gloves are removed. A number of well-designed studies have also demonstrated that the appropriate use of gloves by HCWs can reduce the frequency of hospital-acquired infections in patients.

Common hospital **masks** were initially designed to prevent droplet aerosols from HCWs from infecting patients. Masks are sometimes worn by HCWs who have respiratory infections when they are caring for patients who may be susceptible, but there is no evidence that this precaution is effective, and it is more often recommended that staff members with symptoms of a cold or the flu not enter the rooms of high-risk patients. Standard surgical masks do not consistently protect HCWs from airborne organisms because they may not filter out tiny particles and they may not fit the face tightly enough. The appropriate fit of a mask to the face, which ensures

that the wearer breathes through and not around the filter material, appears to be important in protecting HCWs from transmission of inhaled organisms like tuberculosis.

The Occupational Safety and Health Administration (OSHA) now requires hospitals to provide their employees with special masks, termed "particulate respirators," designed to filter particles from 1 to 5 µm with 95% efficiency. Particulate respirators are thicker than standard surgical masks and have a tighter face seal. Breathing through them is more difficult than through standard surgical masks, and they are more costly. These respirators are required when entering the rooms of patients with known or suspected tuberculosis or during "high risk" situations for transmission, such as bronchoscopy or the administration of inhalation therapy. According to OSHA regulations, "fit-testing" (i.e., checking to be sure the mask fits the face properly) is required when such masks are issued and periodically thereafter. Demonstration that particulate respirators actually reduce transmission of agents spread by small particle aerosols is lacking, but their mechanical properties suggest that they should be effective. Both standard surgical masks and particulate respirators also prevent self-inoculation through touching of the nose or mouth and afford some degree of protection against splashes, depending on their permeability, as does eye protection. Masks and eye protection should be worn during procedures likely to result in splashes (e.g., in dental procedures, orthopedic procedures, endoscopy, inserting arterial lines, and deliveries). Gowns protect the clothing and skin of HCWs from being contaminated, and gowns made of impervious material to prevent "strike through" are used when contact with large quantities of blood or body fluids is anticipated, as in surgery.

Types of Infection Control Programs

Questions about the use of barrier precautions and isolation procedures led to the development of guidelines for the practice of infection control in the hospital setting. In 1970, the CDC published a manual, entitled *Isolation Techniques for Use in Hospitals*, to assist general hospitals with these issues. Two major systems eventually developed. *Category-specific isolation* (introduced in 1970) had as its foundation the method of transmission of the suspected or confirmed pathogen, while *disease-specific isolation* (introduced in 1983) allowed some individualization of procedures based on the knowledge of the individual disease process involved. Both, however, required HCWs to institute precautions based upon the suspicion of the presence of an infectious disease.

In the mid-1980s, with the advent of the AIDS epidemic and demonstration of frequent transmission of clinically silent hepatitis B from patients to HCWs, it became increasingly clear that a different system, not based on a known diagnosis or clinical illness, was necessary. Thus, the procedures of *Universal Precautions* and *Body Substance Isolation* were developed in 1985 and 1987, respectively. *Universal Precautions* required that HCWs handle certain body fluids (e.g., blood; amniotic, pleural, peritoneal and cerebrospinal fluids; semen; and vaginal secretions), in addition to any fluid contaminated with blood, as potentially infectious. Prevention of exposure to blood-borne pathogens by safe handling of all sharp devices and the use of appropriate protective devices when splashes were anticipated were also stressed. *Body Substance Isolation* was based on the premise that all moist body sites and all body fluids are potentially infectious and expanded the list of fluids to include feces, urine, saliva, nasal secretions, sputum, tears, and sweat. OSHA mandated the use of *Universal Precautions* in 1991. Both *Body Substances Isolation* procedures and *Universal Precautions* required the additional institution of respiratory or acid-fast bacillus (AFB) isolation to prevent transmission by aerosols or droplet nuclei.

Neither of the previous systems of isolation was without problems, however. Therefore, in 1996, the CDC issued new guidelines, termed *Standard Precaution*s and *Transmission-Based Precautions*, which combined the best features of both. *Standard Precautions* synthesizes the major features of *Universal Precautions* and *Body Substance Isolation* into a single set of procedures to be used in the care of all patients in hospitals, regardless of their presumed infection status. *Transmission-Based Precautions* are designed to contain diseases that are particularly contagious or are spread by the airborne route or by infectious droplets. These new recommendations are presented in Table 3.

Threats of bioterrorism, the outbreak of Severe Acute Respiratory Syndrome (SARS) in 2002-2003, and the emergence of multiple-drug resistant bacteria in many hospitals have provided challenges to those thinking about infection control, both within and outside of hospital settings. Additional guidelines for the handling of such situations have been developed that involve cohorting of infected patients, limiting the number of HCWs providing care, and quarantining those who may be exposed. These guidelines are preliminary and may evolve over time as experience in these situations warrants.

The biggest challenge to any system of infection control is a lack of compliance among HCWs. Physicians and medical students are often among the worst

TABLE 3

Standard and Transmission-based Precautions

STANDARD PRECAUTIONS

- Should be used in the care of all patients, regardless of diagnosis.
- Require the use of appropriate barrier precautions, as needed, to prevent contact with blood, body fluids, secretions, and contaminated items.
- Require handwashing after glove removal and after patient contact. Handwashing may be required between tasks or procedures on the same patient to prevent cross-contamination of different body sites.
- Emphasize safe handling of sharps and safe sharp disposal practices.

TRANSMISSION-BASED PRECAUTIONS*

Airborne Precautions

- Should be used for patients known to have, or suspected of having, microorganisms transmitted by small airborne droplet nuclei (e.g., tuberculosis, measles, varicella).
- Require a private room with negative air pressure to surrounding areas, and 6-12 air exchanges per hour.
- Require respiratory protection when entering the room if the patient is known to have or is suspected of having tuberculosis.
- Suggest that susceptible people should not enter the room of patients known to have or suspected of having measles or varicella. If susceptible persons must enter the room, they should wear respiratory protection. Immune individuals need not wear protection.

DROPLET PRECAUTIONS

- Should be used for patients known to have or suspected of having microorganisms transmitted by large particle aerosols generated by coughing, sneezing, or talking (e.g., Hemophilus influenza, Neisseria meningitides, Group A streptococcus, pertussis, rubella, adenovirus, influenza virus, mumps, parvovirus).
- Suggest the use of a private room, if possible. If a private room is not available, suggest cohorting of infected patients, if possible, or require spatial separation of at least three feet between patients. Special air handling and ventilation are not required.
- Require the uses of masks when within three feet of the patient.

offenders. Any program instituted should, therefore, include both periodic educational reinforcement and active surveillance of compliance. Identification of barriers to the use of safe practices when compliance is poor may be helpful in increasing program effectiveness. Medical students, house officers, and attending physicians serve as important role models, and both "top down" and "bottom up" educational approaches may be necessary.

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TABLE 3 *(continued)*

CONTACT PRECAUTIONS

- Should be used in caring for patients known to have or suspected of having epidemiologically important microorganisms that can be transmitted by direct contact or by contact with contaminated environmental surfaces (e.g., multidrug-resistant bacteria; Clostridium difficile and other agents that cause diarrhea; respiratory syncytial virus; para-influenza virus; herpes simplex virus; varicella zoster virus; agents causing wound, skin, or conjunctival infections; scabies; and lice.
- Suggest the use of a private room, if possible, cohorting, or consultation with infection control personnel.
- Require the uses of gloves when entering the room. Gloves should be changed after contact with infectious material and removed after leaving the patient environment. Hands should be washed with antibacterial soap immediately after glove removal.
- Require the use of gowns if substantial contact with the patient or environmental surfaces is anticipated.

*** The use of Standard Precautions is also required when Transmission-based Precautions are employed.**

Modified from Infection Control and Hospital Epidemiology:
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Agents Transmitted Through Contact with Blood or Body Fluids

Hepatitis B

KEY POINTS

- Exposure to hepatitis B virus may result in acute illness with jaundice or in chronic infection without illness. Late complications are relatively common.
- After a needlestick injury from a hepatitis B-infected person, risk of infection ranges from 3 to 30 percent.
- Risk of transmission is greatest from those who are HBeAg positive.
- All HCWs who have potential for contact with blood or body fluids should receive hepatitis B vaccination.
- Those with exposures to blood or body fluids should report immediately for appropriate treatment and follow-up.

Hepatitis B virus (HBV) is a small DNA virus that primarily infects the liver. The advent of a vaccine against hepatitis B has reduced the number of new cases each year in the United States among children, but recently the incidence in young adults has increased. It has been estimated that more than 400 million people worldwide and 1.25 million people in the United States carry this virus chronically. Initial infection may be silent or may result in signs and symptoms, such as loss of appetite, nausea, fever, fatigue, dark urine, light stools, yellow itchy skin, muscle and joint aches, and pain in the right upper abdomen. In general, infants and young children have a milder disease than older people, and the older the patient, the longer the period of jaundice (yellow skin). Most patients with acute HBV infection recover completely and are no longer contagious. A small percent develop fulminant hepatitis, which can lead to death. Approximately 10 percent fail to stop HBV from replicating and become chronic carriers. These patients may infect others and may go on to develop chronic liver disease or cancer of the liver (called hepatoma or hepatocellular carcinoma). Of interest, those who acquire hepatitis B at an early age and those who have mild initial illness are at greater risk for developing the carrier state than those who become jaundiced. The carrier state is defined by the continued presence in the blood of a marker of virus replication called hepatitis B surface antigen (abbreviated HBsAg). Chronic carriers can transmit hepatitis B even though they appear and feel well. Those carriers who also have hepatitis B e antigen (HBeAg) have greater numbers of virus particles in their blood than those who only possess HBsAg, and, for that reason, HBeAg is a marker of high infectivity.

Hepatitis B virus is transmitted from person to person by contact with blood, serum, saliva, vaginal fluid, or semen. Blood transfusions, acupuncture, tattooing, ear piercing, sharing needles among injecting drug users, and accidental needlesticks among HCWs can all transmit HBV, as can mucous membrane splashes, sexual intercourse, and human bites. The incubation period (time from exposure to illness) ranges from 45 to 180 days, but averages 60 to 90 days; the greater the amount of virus transmitted (inoculum), the shorter the incubation period and the more severe the illness. In the United States, hepatitis B infection generally occurs in young adults. Injecting drug users, hemodialysis patients, persons with multiple sexual partners, those in need of frequent blood transfusions or blood products, and HCWs are at increased risk. The incidence of acute infection and the prevalence of the hepatitis B carrier state vary widely among different populations. In parts of Asia and Africa, the prevalence of HBsAg in serum may exceed 25 percent; in high prevalence areas, infection generally occurs at birth from contact with HBsAg positive maternal blood. In the United States, the prevalence rate of the carrier state is 0.1 to 2.0 percent.

Risks of Infectivity

Exposure to hepatitis B is an occupational hazard for HCWs, especially those who are in frequent contact with blood or blood products. The risk of transmission of hepatitis B after a needlestick injury ranges from 3 percent, if the source of the blood is HBeAg negative, to 30 to 40 percent if HBeAg is present. Inoculation through blood contact with mucous membranes or through small breaks in the skin may also result in infection, but the risk of transmission via this route of exposure has not been precisely quantified. Infectivity relates directly to the titer of virus in the contaminating material and the amount of material inoculated. The concentration of HBV in semen and saliva is 1,000 to 10,000 times less than the concentration of virus in blood. Many believe that mucosal contact with saliva poses little, if any, risk, although hepatitis B has been transmitted by human bites. Transmission through contact with urine or feces has not been demonstrated and, thus, the risks associated with these substances appear to be very low.

Control/Prevention Procedures

In the health care setting, control and prevention of hepatitis B require:

- A program of active immunization of HCWs.
- An ongoing educational effort emphasizing the principles of standard precautions.
- Post-exposure management and follow-up.

All HCWs who potentially have contact with blood or body fluids should be vaccinated against hepatitis B. Medical students should be vaccinated early in their training, before clinical rotations begin. The earliest vaccine for hepatitis B (Heptavax-B) was purified from the plasma of HBsAg carriers; in developed countries, it has now been replaced by genetically engineered recombinant vaccines in which HBsAg particles are made by yeast. Three doses of vaccine (given at 0, 1, and 6 months) result in protective antibody titers in approximately 95 percent of healthy young adults. Side effects are minimal and consist of moderate soreness at the injection site in 12 percent and mild fever in less than 2 percent of adults, figures no different than with injections of placebo. Screening for the presence of immunity or prior exposure to hepatitis B, usually indicated by antibody to core antigen (anti-HBc) prior to vaccination, is generally not considered cost-effective for medical students, where the risk of previous infection is low, and is not generally done in most hospital settings. Vaccinating those who are immune or who are chronic carriers causes no ill effects. Most experts recommend screening for antibody to HBsAg (anti-HBs) after immunization since those who do not seroconvert are still at risk, and reimmunization results in an anti-HBs response in 50 percent of individuals. After successful vaccination, levels of anti-HBs gradually decrease over time, and whether subsequent routine booster doses of vaccine will be recommended in the future remains to be determined.

Strict adherence to the principles of standard precautions is important in caring for all patients, since those who carry HBsAg are often unknown and asymptomatic. Barrier precautions (e.g., gloves, gowns, masks, and/or face shields) should be used to prevent skin or mucous membrane exposure when potential contact with blood or body fluids is anticipated. Gloves should be worn by those performing venipuncture, and hands should be washed after every patient contact even if gloves are worn. Instruction regarding safe handling and disposal of needles, scalpels, and other sharps should be provided and periodically reinforced. Those just learning a technique such as venipuncture should become comfortable and reasonably skillful before attempting a procedure on anyone known to be infected.

Medical schools and health care facilities should have procedures in place for situations in which students become exposed to blood or body fluids. Frequently, students are able to access programs already in place for other HCWs, as such programs are mandated by the OSHA for hospital employees. With the multiplicity of sites to which many medical students rotate, providing information about whom to contact in the event of accidental exposure can be quite challenging. Because memory is short and, anxiety is often high after an injury, some medical schools have found wallet cards similar to the examples provided in Appendix C to be useful. If an injury occurs, the student should carefully note the source patient's name and identifying number and the nature of the injury (If a needlestick, what gauge needle caused the injury? Was the needle hollow bore or solid? Was blood visible on the needle? Did the injury cause bleeding?). The area should be washed immediately with soap or a disinfectant. As soon as possible, the student should report the injury to whomever is responsible for post-exposure management. Such management then generally consists of testing both the injured party and the source patient for HBsAg and anti-HBs, as well as testing for other pathogens such as hepatitis C virus (HCV) and human immunodeficiency virus (HIV). If the source of the blood is found to HBsAg positive and the student is anti-HBs negative (i.e., no previous vaccination or no response to previous vaccination), hepatitis B immune globulin should be given, and vaccination should be initiated or repeated. Vaccinees with titers of anti-HBs of <10 mIU/mL may benefit from hyperimmune globulin and/or a vaccine booster, but those with titers >10 mIU/mL are protected against infection and require no additional prophylaxis for hepatitis B. After an exposure to hepatitis B, those who receive proper prophylaxis are unlikely to become infected and pose minimal risk to patients, household contacts, or sexual partners. There is no contraindication to their participation in patient care, but the need for adherence to universal precautions and good personal hygiene should be stressed.

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Hepatitis C

KEY POINTS

- Frequently results in chronic infection.
- Risk of infection after needlestick injury from a positive source ranges from 2 to 10 percent.
- The use of standard precautions and the safe handling of sharps reduce the chance of exposure.
- No vaccine or accepted prophylactic treatment is currently available.

Hepatitis C virus (HCV), an RNA virus first identified in 1989, is similar to HBV in its mode of transmission and in its ability to cause persistent infection, cirrhosis, and hepatocellular carcinoma. Acute HCV infection is generally milder than that from hepatitis B – only approximately 25 percent of patients have jaundice, for example. However, it is even more likely to result in chronic infection. At least 50 percent, and perhaps as many as 70 to 90 percent, of infected individuals are unable to halt the replication of the virus and progress to chronic infection.

HCV is common in certain villages in Japan and in Middle Eastern countries. In the United States, approximately 0.6 percent of the general population has been infected, but in certain high risk groups (e.g., persons with hemophilia, dialysis patients, and those who use intravenous drugs) the prevalence of antibodies may exceed 70 percent. The virus is transmitted by blood and blood products. The incubation period after transfusion of infected blood averages about six weeks. Until specific serologic techniques to diagnose HCV were developed in the 1990s, the illness caused by this virus was generally called "non A-non B hepatitis." It is now known that approximately 85 percent of non A-non B hepatitis is caused by HCV, and, after screening begun in the 1970s eliminated HBV from the blood supply, most cases of post-transfusion hepatitis were caused by this agent. HCV probably also has other methods of spread, since 40 to 50 percent of patients with community-acquired HCV do not report contact with blood or blood products. Although firm data are lacking, other routes of transmission (e.g., sexual intercourse) probably play a limited role. There is at least one case report of HCV transmission after a human bite.

Risks of Infectivity

Many patients with HCV are asymptomatic and unaware that they carry the virus. Reasonable assays to detect for infection with HCV have only been available since 1992. Although data are limited, risk of transmission to HCWs after occupational exposure appears to be low, as the prevalence of antibodies against HCV among hospital personnel is only slightly higher than that of the general population. Only small numbers of virus particles are present in the blood, making this virus less transmissible than hepatitis B with a small inoculum exposure such as a needlestick. Several recent studies have estimated that the risk of seroconversion after accidental needlestick exposure ranges from 1.8 to 10 percent.

Control/Prevention Procedures

The fact that many persons are unaware that they have HCV infection argues strongly for the concept of Universal Precautions. Handling all blood and body fluids as if they were contagious reduces the likelihood of inadvertent exposure. Programs that reinforce safe handling of all sharp instruments also are important in reducing transmission of this agent. Unfortunately, no vaccine for HCV is available at this time, and there is no reliable post-exposure treatment that will prevent infection. Treatment with immune globulin was recommended after needlestick exposures to prevent non-A-non B hepatitis in the past, but currently available immunoglobulin preparations do not contain detectable antibody to HCV. Although there are drugs used for patients with chronic hepatitis C, no data about their prophylactic efficacy are available. However, early treatment with interferon-alpha based regimens of those who have become HCV-infected does appear to be beneficial. Therefore, testing for HCV RNA at 2 to 4 weeks and anti-HCV antibody at 6 and 12 months after exposure is warranted. Recent data suggest that the risk of transmitting HCV through sexual intercourse is not as low as previously thought. Therefore, counseling HCWs to avoid unsafe sexual practices to reduce any potential risk of transmission to their partners is advisable. Although the magnitude of this risk has not been defined, it appears to be much less than that with other blood-borne sexually transmitted diseases such as HIV and HBV.

Proper wound management and data collection after an occupational exposure to blood are discussed in the section on hepatitis B and also apply to hepatitis C.

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Human Immunodeficiency Virus

KEY POINTS

- Initial infection is non-specific and people may think they have the "flu." Chronic illness has a long incubation period, and many patients are unaware of infection.
- Risk of transmission from needle-stick exposures is approximately 0.3 percent.
- The use of standard precautions and safe sharp practices reduces the risk of injury and transmission.
- Those with exposure to blood or body fluids should report immediately for appropriate treatment and follow-up.
- Antiviral therapy after an exposure reduces, but does not eliminate, the risk of transmission. Therapy should be started as soon as possible after injury.

Human Immunodeficiency Virus

There are two types of human immunodeficiency virus (HIV): HIV-1 and HIV-2; these agents are the cause of the acquired immunodeficiency syndrome (AIDS). They are members of the lentivirus family of retroviruses, enveloped double-stranded RNA viruses that make a DNA template that can either silently integrate into the host cell DNA or cause lytic infection, destroying the infected cell. HIV-1 is much more common than HIV-2 in most parts of the world, while HIV-2 is found predominantly in West Africa. Both HIV-1 and HIV-2 cause AIDS, but HIV-2 may be less aggressive than HIV-1 and does not appear to be as easily transmitted from mother to infant. HIV infects cells by attaching to a specific receptor that is present on lymphocytes, macrophages, and monocytes, called the CD4 receptor. These cells normally form the body's defense against a number of other infections, and the primary result of HIV infection is the gradual loss of immune competence (i.e., the ability to fight infections). How quickly the disease progresses in any given individual is probably the result of a number of independent factors, including the size of the inoculum, the route of infection, the particular strain of virus, the natural immunity of the host, and the presence of concurrent infections.

HIV infection has three clinical phases. From several days to three months after exposure (the average is approximately three to six weeks), some individuals develop an acute "flu-like" illness with fever, chills, lymphadenopathy (swollen glands), muscle aches, fatigue, nausea, diarrhea, poor appetite, headache, and stiff neck. A rash is also sometimes present. This illness usually lasts two to three weeks and resolves spontaneously. During this acute symptomatic illness, high titers of virus are present in the blood. As the infection resolves, antibody appears and the amount of virus detectible in the blood declines. During this asymptomatic phase, which may last five to ten years, even without any treatment, patients feel well. Although there is little virus detectable in the blood, the lymph nodes may have large numbers of HIV-infected cells, and there is progressive decline in the body's immune function. The late phase of infection is again associated with increasing levels of virus in the blood. Illness results from infections with a number of organisms that uninfected people can easily defeat. Some patients develop unusual tumors such as Kaposi sarcoma or lymphoma, and some experience profound wasting and/or develop dementia.

HIV is spread primarily through sexual contact, and virus can be isolated from both semen and vaginal secretions. HIV can also be cultured from blood, tears, saliva, breast milk, cerebrospinal fluid, urine, and pleural and synovial fluid. The amount of virus in these fluids is generally quite low, however, and occupational exposure to non-bloody saliva, tears, sweat, breast milk, urine, or feces is not considered to be a risk factor for transmission. In the hospital setting, most transmission has been associated with exposure to blood or grossly bloody body fluids. As with other blood-borne agents, the rate of transmission is dependent upon the amount of virus present in the blood and the size of the inoculum. Although most patients infected with HIV have little virus in their blood, in the days before the blood supply was screened transfusion of a unit of blood from HIV-positive patients frequently resulted in infection in the recipient because of the large volume of blood involved. With the advent of effective screening, the risk of transmission from transfusion of a unit of blood now is estimated to be 1 in 450,000 to 600,000.

Risks of Infectivity

As of December 2001, the CDC had recorded 57 instances of occupational exposure to HIV in health care settings in the United States that have resulted in infection. Numerous studies have estimated the overall risk associated with occupational exposure to HIV through percutaneous injuries involving needles and other contaminated devices to be 0.3 percent. The risks of transmission increase with increasing amounts of virus in the blood of the source patient, and the amount of virus present in the blood of HIV-infected patients now is routinely quantified. Punctures with hollow bore needles and punctures that are deep are more likely to result in transmission than superficial lacerations

from suture needles. Although "splashes" to mucous membranes of the eyes or mouth have been responsible for transmitting HIV, mucocutaneous exposures pose less risk than accidental inoculations through the skin and are estimated at approximately 0.03 percent. HIV can also be transmitted through cuts or breaks in the skin, but transmission of HIV through intact skin has not been documented.

Control/Prevention Procedures

Adherence to standard precautions (i.e., assuming that all blood and bodily fluids are contagious and using appropriate barrier protection when potentially coming into contacting with them) and a program to insure that sharp devices are handled safely are the cornerstones of occupational HIV prevention. Needle punctures are the most frequent cause of HIV infection. The principles involved in the safe handling and disposal of all sharp devices should be periodically reinforced, and the use of safe, self-sheathing protective devices should be substituted for regular needles, whenever feasible.

Every clinical setting should have in place a program for testing after an accidental inoculation occurs. Such programs should involve both immediate testing for blood-borne pathogens for the donor and the HCW, and continued testing and counseling for the HCW for a period of at least 6 to 12 months post-exposure, if the source patient is HIV-positive or if the source patient's HIV status is unknown. Proper wound management and data collection after an occupational exposure to blood is discussed in the section on hepatitis B. As a protection for their partners, those exposed to HIV are counseled to practice "safe sex" (i.e., to use condoms and to avoid high risk sexual practices) until they have been assured that they are not infected. Blood and organ donation, as well as breast feeding, should also be avoided.

Antiretroviral therapy with drugs such as Zidovudine (AZT or ZDV) has prolonged the lives of patients with AIDS, and, in some animal models, ZDV given prophylactically has had some efficacy in preventing HIV infection. Whether ZDV should be given to HCWs in an attempt to prevent infection was initially a matter for conjecture. A placebo-controlled trial of ZDV after occupational exposure was begun, but terminated because of poor patient accrual. In 1990, after a review of available data regarding safety and efficacy, the United States Public Health Service (PHS) concluded that a recommendation for or against the use of postexposure ZDV could not be made. However, in December 1995, the CDC published a case control study of HIV seroconversion in HCWs and concluded that postexposure use of ZDV by HCWs was associated with a lower risk for HIV transmission. If the donor is known to be HIV-positive or is a member of a group at high risk for HIV infection and the injury is deep, involves a needle placed directly into an artery or vein, or involves a device visibly contaminated with the source patient's blood, post-exposure prophylaxis (PEP) should be strongly considered.

Single drug therapy of patients with HIV infection has led to the emergence of ZDV resistance, and the ability of HIV to acquire resistance to antiviral agents now is well known. In June 1996, a PHS interagency working group updated its recommendations for chemoprophylaxis after occupational exposure to HIV to include combination therapy with one or two additional antiviral agents in situations with the greatest risk of transmission. The rationale for these recommendations and additional discussion of PEP was published by the CDC in 2001 (see Tables 4 and 5). Prophylactic regimens now generally consist of two nucleoeside/nucleotide reverse transcriptase inhibitors (NRTI) such as emtricitabine & tenofovir (Truvada), with the addition of a third drug with a different mechanism of action (e.g., a protease inhibitor or a non-nucleoside reverse transcriptase inhibitor), if the exposure is high risk. If the source is suspected of having drug-resistant virus, an expert in HIV medicine should be consulted for recommendations. Since most authorities believe that the earlier therapy is initiated, the greater the likelihood of benefit, HCWs should report all injuries promptly, and a system providing quick access to appropriate counseling and antiretroviral therapy should be in place. Regimens then can be stopped or altered as additional data become available.

PEP is not without risks. Nausea and vomiting are common side effects of these regimens, and, in early studies of ZDV, for example, 30 percent of participants discontinued its use. The list of other adverse reactions to antiretroviral agents is extensive, ranging from fatigue and insomnia to severe bone marrow depression and hepatic dysfunction. Thus, the risks of transmission must always be balanced with the risks of prophylaxis, and those who receive medications must be carefully monitored. The optimal doses and duration of therapy also have not been firmly established by controlled trials, and they represent expert opinion based on available data. HCWs should also be aware that there are reports of at least 21 people who failed prophylaxis. The majority of these failures occurred with single drug therapy, but 25 percent involved multi-drug regimens.

Although PEP is common in the United States, systems for evaluating exposures, administering drugs, and monitoring therapy may not be well developed in other countries. Students who travel for rotations to areas where HIV infection is prevalent may be at increased risk for infection, with the additional consideration that fewer resources would be available should an exposure occur.

Counseling before travel to these rotations, with reinforcement of safe practice guidelines, may be helpful. Some students have brought the medicines required for PEP with them, with methods to contact reliable experts in the United States for advice arranged beforehand, if an exposure should occur.

There are a number of general resources available for those seeking information about post-exposure prophylaxis. Current information is available through the CDC Web site (www.cdc.gov) or the National Clinicians Post-exposure Hotline (888-448-4911).

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TABLE 4

Recommended HIV postexposure prophylaxis for percutaneous injuries

	Infection status of source				
Exposure type	HIV-Positive Class 1*	HIV-Positive Class 2*	Source of unknown HIV status†	Unknown source§	HIV-Negative
Less severe¶	Recommend basic 2-drug PEP	Recommend expanded 3-drug PEP	Generally, no PEP warranted; however, consider basic 2-drug PEP** for source with HIV risk factors††	Generally, no PEP warranted; however, consider basic 2-drug PEP** in settings where exposure to HIV-infected persons is likely	No PEP warranted
More severe§§	Recommend expanded 3-drug PEP	Recommend expanded 3-drug PEP	Generally, no PEP warranted; however, consider basic 2-drug PEP** for source with HIV risk factors††	Generally, no PEP warranted; however, consider basic 2-drug PEP** in settings where exposure to HIV-infected persons is likely	No PEP warranted

* HIV-Positive, Class 1 — asymptomatic HIV infection or known low viral load (e.g., <1,500 RNA copies/mL). HIV-Positive, Class 2 — symptomatic HIV infection, AIDS, acute seroconversion, or known high viral load. If drug resistance is a concern, obtain expert consultation. Initiation of postexposure prophylaxis (PEP) should not be delayed pending expert consultation, and, because expert consultation alone cannot substitute for face-to-face counseling, resources should be available to provide immediate evaluation and follow-up care for all exposures.

† Source of unknown HIV status (e.g., deceased source person with no samples available for HIV testing).

§ Unknown source (e.g., a needle from a sharps disposal container).

¶ Less severe (e.g., solid needle and superficial injury).

** The designation "consider PEP" indicates that PEP is optional and should be based on an individualized decision between the exposed person and the treating clinician.

†† If PEP is offered and taken and the source is later determined to be HIV-negative, PEP should be discontinued.

§§ More severe (e.g., large-bore hollow needle, deep puncture, visible blood on device, or needle used in patient's artery or vein).

Reprinted from MMWR2001;50(RR-11):1

TABLE 5

Recommended HIV postexposure prophylaxis for mucous membrane exposures and nonintact skin exposures

	Infection status of source				
Exposure type	HIV-Positive Class 1†	HIV-Positive Class 2†	Source of unknown HIV status§	Unknown source¶	HIV-Negative
Small volume**	Consider basic 2-drug PEP††	Recommend basic 2-drug PEP	Generally, no PEP warranted; however, consider basic 2-drug PEP†† for source with HIV risk factors§§	Generally, no PEP warranted; however, consider basic 2-drug PEP†† in settings where exposure to HIV-infected persons is likely	No PEP warranted
Large volume¶¶	Recommend basic 2-drug PEP	Recommend expanded 3-drug PEP	Generally, no PEP warranted; however, consider basic 2-drug PEP†† for source with HIV risk factors§§	Generally, no PEP warranted; however, consider basic 2-drug PEP†† in settings where exposure to HIV-infected persons is likely	No PEP warranted

* For skin exposures, follow-up is indicated only if there is evidence of compromised skin integrity (e.g., dermatitis, abrasion, or open wound).

† HIV-Positive, Class 1 — asymptomatic HIV infection or known low viral load (e.g., <1,500 RNA copies/mL). HIV-Positive, Class 2 — symptomatic HIV infection, AIDS, acute seroconversion, or known high viral load. If drug resistance is a concern, obtain expert consultation. Initiation of postexposure prophylaxis (PEP) should not be delayed pending expert consultation, and, because expert consultation alone cannot substitute for face-to-face counseling, resources should be available to provide immediate evaluation and follow-up care for all exposures.

§ Source of unknown HIV status (e.g., deceased source person with no samples available for HIV testing).

¶ Unknown source (e.g., splash from inappropriately disposed blood).

** Small volume (i.e., a few drops).

†† The designation, "consider PEP," indicates that PEP is optional and should be based on an individualized decision between the exposed person and the treating clinician.

§§ If PEP is offered and taken and the source is later determined to be HIV-negative, PEP should be discontinued.

¶¶ Large volume (i.e., major blood splash).

Reprinted from MMWR2001;50(RR-11):1

Agents Transmitted Primarily by Inhalation

Mycobacterium tuberculosis

KEY POINTS

- Tuberculosis continues to be a major public health concern, and new strains have developed that are resistant to many anti-tuberculous drugs.
- HCWs have a greater risk than the general population for acquisition of tuberculosis.
- Patients who are infected, but undiagnosed, pose the greatest risk of transmission, and AIDS patients have been the source of a number of outbreaks.
- The risks of transmission are greatly reduced by airborne isolation procedures.
- Masks with high efficiency filtering capacity should be worn when HCWs are in contact with those suspected of having or who have been documented to have tuberculosis or in high risk procedures.
- All tuberculin skin test-negative HCWs in high risk areas should undergo yearly purified protein derivative (PPD) skin-testing, and they should cooperate with additional skin-testing if an exposure occurs. PPD-positive HCWs should be monitored for symptoms of tuberculosis annually.

Mycobacterium tuberculosis (M. tb.) is a slowly growing, aerobic bacterium that is responsible for three million deaths a year worldwide, the most for any single infectious agent other than HIV. During the Industrial Revolution, this disease flourished due to crowding and poor nutrition. With the advent of effective chemotherapy and the development of public health programs aimed at preventing spread, the goal of eradicating this organism in the 20th century appeared to be a realistic one. Although the rates of tuberculosis declined each year until 1985, increases in cases were again noted in the late 1980s. The reemergence of this disease was attributed to multiple factors, including the AIDS epidemic, increasing homelessness and intravenous drug use, and a decline in funding for public health programs. In the last several years, with increased awareness and the reinstitution of public health controls, rates have again declined. However, tuberculosis is still a major threat and continues to be a disease of the medically underserved, especially those living in urban areas. A marked geographic variation in TB case rates still exists, with case rates ranging from 1.0 per 100,000 populations in Wyoming to 14.6 per 100,000 in Washington, D.C. in 2004.

M. tb. is generally acquired by inhaling small particle aerosols deep into the lungs. When a heavily infected individual coughs, sneezes, or even just talks, thousands of infectious droplets are released and may be inhaled by those sharing the air. Tuberculosis can also be spread by other routes (e.g., from aerosolization of particles from infected wounds or by needlestick injury from a needle used to biopsy an organ with tuberculosis), but such cases are extremely rare.

In thinking about tuberculosis, it is useful to distinguish between tuberculous infection and tuberculous disease. Primary infection occurs after inhalation of infectious small particle aerosols and is frequently asymptomatic. In some people, primary infection may progress to symptomatic disease, but, in most cases, the initial infection heals spontaneously as immunity develops two to ten weeks after exposure. The mark of tuberculous infection is a positive skin test to antigens of the organism (called Purified Protein Derivative or PPD) injected intradermally. A positive PPD skin test (generally indicated by induration of >10 mm at the test site) means that a person has had infection with M. tb., but it does not necessarily mean that the person has active disease and is contagious. A positive skin test is a marker of acquired immunity to the organism. The immunity that develops may allow some organisms to remain viable in the body, however. In approximately 10 percent of individuals, reactivated infection may develop later in life, with disease in the lung (most often in the upper lobes) or in other organs. The hallmark of progressive disease in the lung is destruction of lung tissue or cavitation. Tuberculous cavities contain large numbers of mycobacteria, and those individuals with cavitary tuberculosis are highly contagious. Because M. tb. grows slowly, lung destruction occurs gradually over months and is generally accompanied by only low grade fever, chronic cough, night sweats, and weight loss. Those with active tuberculosis should also have positive skin tests, but the skin test may be negative in patients with severe malnutrition or those who are immunocompromised. Frequently, the symptoms of tuberculosis are either misdiagnosed or ignored, and only about a third of patients receive appropriate therapy within a month of onset. Left

untreated, tuberculosis eventually results in death. In AIDS patients, because of impairment in cell-mediated immunity, the disease may be rapidly progressive and atypical in presentation, causing diagnostic confusion and leading to exposure of unsuspecting individuals *(vide infra)*.

Risks of Infectivity

Tuberculosis has been recognized as an occupational hazard for physicians and nurses since the 1920s. Despite programs to limit the spread of M. tb. in the hospital setting, there has traditionally been a two- to ten-fold increased risk of tuberculosis infection among HCWs as compared to the risk in the general population. In the AIDS era, tuberculosis has emerged as an even more important nosocomial pathogen. Early in the AIDS epidemic, outbreaks of multi-drug resistant organisms, which were characterized by high case fatality rates and significant rates of transmission to HCWs, were reported in a number of states.

In a survey of medical schools, the mean annual skin-test conversion rate for medical students (a measure of new infection) was between 1.3 and 2.2 percent, but 12 (16 percent) of the 75 responding schools reported rates of five percent or higher. Data from a 1992 survey of 359 hospitals revealed an annual skin-test conversion rate for all hospital workers of 0.65 percent. If these data are reliable, medical students in these 12 schools may have an annual risk of acquiring tuberculosis more than 500 times that of the general United States population, and students are among the HCWs at greatest risk.

The risk of acquiring tuberculosis from an infected patient is dependent on a number of factors. Important variables include the concentration of infectious droplet nuclei in the air, the proximity to the patient, and the duration of exposure. Procedures considered high risk for the spread of tuberculosis include bronchoscopy, surgery or other procedures requiring intubation, and autopsy. After exposure to a patient with active tuberculosis, the rate of infection in HCWs has ranged from 4 to 77 percent, as reported in the medical literature. Patients who are coughing, with cavities on their chest radiograph, and with visible organisms on stains of their sputum are most likely to spread infection. High rates of transmission generally occur when no one suspects a patient has tuberculosis and pulmonary disease is attributed to other causes. Of note, AIDS patients, who may be very heavily infected because of impairment in immunity, have been the source of a number of recent outbreaks. In most of these cases, tuberculosis was not suspected because cough was attributed to other more common illnesses and/or the usual manifestations of the disease were lacking. In patients with AIDS, chest x-ray findings may be atypical; patients lacking cavitary disease may still be highly contagious, and transmission may occur even when chest x-rays are normal. When infection control procedures for tuberculosis are initiated and enforced, rates of infection among HCWs generally drop dramatically. Prompt initiation of appropriate drug therapy is also important in reducing the spread of infection, as effective chemotherapy generally renders most patients non-infectious within several weeks.

Control/Prevention Procedures

Strategies for the control and prevention of the spread of tuberculosis in the health care setting are multifaceted and involve:

- education of HCWs to insure a high index of suspicion and prompt identification, isolation, and treatment of infected patients
- routine surveillance of HCWs to detect any inadvertent exposure
- a program of prompt post-exposure testing and management should inadvertent exposures occur
- the use of appropriate protective devices for those caring for patients known or suspected of having tuberculosis
- adherence to appropriate engineering standards (designed to reduce airborne infectious particles) and maintenance of the physical facilities necessary for patient isolation, and
- prompt microbiologic identification and sensitivity testing to insure that patients are receiving the right antibiotics.

While ensuring that isolation rooms are at negative pressure to the corridor and have the requisite number of air exchanges per hour is the province of hospital specialists, several of the strategies above warrant the attention of those responsible for medical student programs. Information about the myriad signs and symptoms of tuberculosis and how it is spread should be a part of the early education of medical students, and concepts should be periodically reinforced during the clinical years. At the time of initial medical school matriculation, all students should be aware of their status with regard to tuberculosis. A PPD skin test performed within six months generally is required, unless students are known to have already had a positive reaction. In students with known positive skin tests, one chest radiograph documenting the absence of disease should be performed, with subsequent screening for symptoms.

A change in the recommendations for routine surveillance of HCWs occurred in 2005. Previously, all HCWs with

patient contact were required to have skin tests on a yearly basis. Now recommendations are based on whether the health care setting is low risk (i.e., a hospital with more than 200 beds seeing less than six TB patients in a year) or moderate risk (i.e., six or more cases in a hospital with more than 200 beds). Recent recommendations require skin-testing for hospital workers deemed to be working in low risk settings only upon hiring and after a known exposure. Yearly skin-testing of all HCWs and students who work in settings known to be of moderate risk is still required. While some facilities through which students rotate may be low risk, the potential for multiple exposures to moderate risk health care settings for most medical students is significant and yearly skin-testing should be performed. Strategies to insure compliance with such programs are varied, and examples are included in Table 6.

TABLE 6

Strategies to Increase Compliance with Yearly PPD Skin-Testing of Medical Students

- Require testing before matriculation.
- Require testing before annual re-enrollment.
- Perform testing during mandatory orientation programs.
- Perform testing as a part of required course work (e.g., Microbiology, Laboratory Medicine, Medicine).
- Perform testing in the hospital setting associated with a student gathering.
- Contract with an affiliated hospital to include students in its yearly hospital employee program.

Those students with initial positive PPD skin tests should be evaluated for the presence of active disease, and a recommendation about taking isoniazid (INH), a medication used prophylactically to reduce the chances of those with infection progressing to disease, should be made. (Factors considered in such a recommendation include the age and health status of the student, the degree of reaction of the PPD skin test, and the student's prior PPD history.) Those with a prior negative skin test who develop a positive test should also be evaluated for active disease; in this setting (a recent "skin-test conversion"), therapy with INH for six to nine months is generally recommended.

In addition to the routine surveillance of health care personnel, hospital infection control programs typically skin-test those who have been exposed to patients with tuberculosis who have not been in respiratory isolation eight to ten weeks after the exposure. Those with newly positive skin tests should be evaluated for the presence of disease and should receive prophylactic INH. Some have recently recommended treating all exposed HCWs presumptively if the exposure has been heavy and discontinuing therapy in those found to have subsequent negative skin tests. Those immunologically intact HCWs with prior positive skin tests do not require prophylaxis since prior exposure to tuberculosis appears to confer considerable protection against reinfection in normal hosts. Reporting initial and yearly skin-test results of medical students to those who manage infection control programs in the hospitals where students rotate greatly facilitates post-exposure management and should be strongly considered by those responsible for students' testing.

Recently, a new type of test for detecting tuberculous infection has been developed. Tests that measure an immunologic response to specific TB antigens from a blood sample (abbreviated BAMT testing) have now been FDA-approved and are undergoing evaluation. These tests may have significant advantages over skin-testing, but whether they will serve as a replacement in most settings remains to be determined.

The most important protection against tuberculosis for HCWs is the prompt identification, isolation, and treatment of patients who may be contagious. In all respiratory isolation procedures, HCWs entering a patient's room wear masks, and patients wear masks outside of their rooms. More controversial is the type of mask required. In 1994, the CDC issued a 132-page set of guidelines designed to prevent the spread of tuberculosis in health care facilities. Included in these guidelines was a set of standard performance criteria for masks or respirators (also known as "personal protective devices") to be used upon exposure to tuberculosis. Those performance criteria are not met by ordinary surgical masks (which were designed to protect others from material exhaled by the wearer, rather than to protect the wearer against inhaling small droplet nuclei), generally because of poor fit and inefficiency in filtering small particles.

When these CDC guidelines were first issued, the only masks that met the CDC criteria were those with high efficiency particulate air filters (HEPA masks), which are cumbersome to wear and quite expensive. (A standard surgical mask costs $0.06; a HEPA mask costs $7.50 to $9.08.) After the CDC issued its guidelines, OSHA required hospitals to provide these devices for those at risk of acquiring tuberculosis. Many believed that the requirement for HEPA masks lacked appropriate documentation of benefit in the clinical setting, and questions about cost-effectiveness and compliance were raised, since the masks are uncomfortable to wear and may

impede breathing and communication. More recently, the CDC has revisited these regulations, and a wider variety of inexpensive (≤$1.00/respirator) and less cumbersome protective masks is now available and meets the guidelines.

"Fit-testing," a procedure to ensure that the mask fits the wearer with the proper facial seal, is required when masks are first issued and when there is significant change in the facial features of the wearer. OSHA also recommends yearly fit-testing for those in high risk areas such as bronchoscopy suites. Although OSHA guidelines, by definition, address employees and do not specifically include unpaid medical students, medical schools should strongly consider a program to ensure that students participate in the respiratory protection programs of the facilities where they have rotations. In urban areas and those with other than a minimal prevalence of tuberculosis, a program initiated by the school to provide appropriate respiratory protective devices to all students before significant patient exposure would seem prudent and affordable.

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Neisseria meningitidis

KEY POINTS

- This organism causes meningitis and shock.
- Transmission can occur to those with very close contact, but the risk of infection is low.
- HCWs caring for patients with this disease should wear masks, follow standard precautions, and wash their hands after patient contact.
- The antibiotic rifampin may be prescribed for those with intimate contact.

Neisseria meningitidis (N. meningitidis) is a gram-negative bacterium that causes meningitis (inflammation of the lining of the brain and spinal cord). It also can cause a shock-like illness, often associated with a non-blanching skin rash (purpura) caused by the profound abnormalities in bloodclotting, which may accompany infection with this organism. Disease can occur in epidemics, and mortality has ranged from 10 percent (with meningitis) to 70 percent (with shock). Children are more frequently infected than adults; crowding and lack of sanitation are common precipitants. Sporadic cases of infection also occur. Transmission is from person to person, probably via respiratory secretions. In one study of families, 18 percent of individuals carried this organism in the oropharynx without any symptoms or disease. The carrier state persisted for an average of 9.6 months, and more than 50 percent of those not carrying these bacteria escaped acquiring it, indicating a low risk of transmission. The reasons that one individual can carry the organism asymptomatically, while another develops overwhelming infection are incompletely understood. However, the carrier state leads to the development of antibody and the presence of antibody protects against infection. Those who develop illness probably do so relatively quickly after acquiring the organism

Risks of Infectivity

Many people have antibody to *N. meningitidis* in their blood and appear to be protected against severe disease with this organism. During epidemics and in the case of sporadic infection, household contacts appear to be at 500 to 800 times the risk of those in the general population, and those in closed environments such as military barracks, college dormitories, and nursery schools are also at high risk. The risk of transmission in the hospital setting appears to be low, but has not been precisely quantified. Patients with pneumonia may pose more of a risk for infecting others than those with meningitis. Secondary cases generally occur within ten days of the primary case.

Control/Prevention Procedures

Those caring for patients with suspected meningococcal disease should wear masks and wash their hands after patient contact. Chemoprophylaxis with rifampin to eradicate the carrier state may be recommended for close contacts, but generally is not recommended for HCWs unless intimate exposure (e.g., mouth to mouth resuscitation) has occurred. A tetravalent vaccine that confers protection against many strains of *N. meningitidis* is recommended for first-year college students entering dormitories for the first time and may be recommended for HCWs in the setting of a recognized outbreak. Immunity from the current commercial vaccine preparations is short-lived and is generally not routinely recommended for HCWs.

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Influenza and Other Respiratory Viruses

KEY POINTS

- Outbreaks usually occur in the winter months.
- Infection is generally not serious in healthy young people, but may be fatal in those with underlying illness.
- HCWs are at high risk for acquiring infection and transmitting it to patients.
- Vaccination against influenza is effective in preventing/modifying infection, and all HCWs in patient care areas should be vaccinated yearly.
- Antiviral drugs can also prevent influenza A infection and/or reduce the severity of illness if it occurs.

There are two types of influenza viruses that infect humans: influenza A and influenza B. Outbreaks of influenza A virus infection generally occur each year during the winter months. This virus is remarkable in its ability to change its surface antigenic coat, a property that allows it to reconstitute itself and reinfect those previously immune. When new strains emerge, epidemics affecting large numbers of people may result. Influenza B also causes outbreaks in the winter months and, like influenza A, is responsible for sporadic cases of the "flu" throughout the year, but influenza B's structure is more stable. Influenza viruses spread from person to person via infectious small particle aerosols. Large amounts of virus are present in respiratory secretions for approximately 24 hours before the onset of illness, and may be present for days after symptoms occur. The incubation period for influenza is generally one to five days.

Classic influenza begins abruptly and is characterized by severe muscle aches, malaise, fever, headache, and a dry cough. Stuffy nose and some clear nasal discharge may be present, and cough and sore throat may become more prominent as the fever, headache, and myalgias (muscle aches) abate. Those experiencing infection with influenza virus for the first time are usually the most ill. Recovery is generally complete over one to two weeks, but fatigue and malaise may persist in a small subset for months. Reinfection with a similar, but antigenically distinct variant at a later time may result in an illness more like the common cold than the "flu syndrome." With reinfection, there may be nasal discharge and cough, but high fever and severe myalgias are usually lacking. A new strain of influenza A, previously found in birds, has recently infected humans who have had close contact with chickens. Because humans lack immunity to this virus, death rates have been high. So far, very limited or no spread from person to person has occurred from those who have acquired infection. Should this virus acquire the ability to spread efficiently from human to human, an epidemic similar to the Influenza Epidemic of 1918 could occur, with resultant high morbidity and mortality.

After infection with influenza virus, pulmonary complications (e.g., bronchitis, worsening asthma, viral pneumonia, and secondary bacterial pneumonia) are not infrequent, especially in the elderly or in those with other medical illnesses. School absenteeism and increasing hospitalization for pneumonia are both markers for influenza circulating in the community. The morbidity and mortality attributable to influenza are substantial, especially with major outbreaks. In those who are previously healthy, death is generally due to pulmonary complications, but, in the elderly, influenza may precipitate a heart attack or exacerbate other conditions that are eventually fatal. Reye Syndrome (altered and depressed consciousness associated with liver failure) is a well-recognized, but infrequent complication of influenza B and, less commonly, influenza A infection in children; it has a mortality of 10 to 40 percent. Guillain-Barre Syndrome also has been reported after influenza infection, as it has after a number of other viral illnesses.

In addition to influenza, many different viruses can cause respiratory infection. For example, there are more than 100 strains of rhinovirus, the most common virus to infect the upper respiratory tract, and each is able to cause infection. Coronaviruses also cause the common cold syndrome, and a new strain of coronavirus was responsible for the 2002-2003 outbreak of Severe Acute Respiratory Syndrome (SARS), in which a number of healthy HCWs died. Parainfluenza viruses are a common cause of croup in young children, and they can cause pneumonia, bronchitis, and the common cold in adults. Respiratory synctial virus (RSV) is the leading cause of pneumonia in young babies, and it can be fatal in those who have underlying illnesses. In general, initial infections with these agents are the most severe. With some, repeated infections may be required for immunity to develop, and even this immunity may fade over time.

Risks of Infectivity

Influenza viruses are highly contagious, and one infected individual can transmit illness to a number of others who are susceptible. HCWs are at particular risk for acquiring influenza because of occupational exposure to those with respiratory illness. They, in turn, may be responsible for transmission to the

patients they serve. Outbreaks of influenza occur not uncommonly in hospital settings, especially when vaccination rates are low. With most of the respiratory agents, both small particle aerosols and contact with infected secretions can easily spread infection. Nasal discharge may contain millions of virus particles, and the hands and environment of those with respiratory illness quickly become contaminated.

Control/Prevention Procedures

The mainstay for the prevention of influenza is a program of vaccination with inactivated virus vaccines. Influenza vaccines (which generally contain both the A and B types of virus that have recently been circulating around the world) either protect against infection (with estimates of efficacy ranging from 67 to 92 percent) or result in less severe illness in those who receive them. Because the viruses that circulate may change and protection with these dead virus particles is generally short-lived, yearly revaccination is recommended. Side effects of vaccination are generally mild and consist of some discomfort at the vaccination site and fever or other systemic symptoms in 2 to 10 percent. The appearance of such symptoms may mimic "the flu," but inactivated vaccines do not contain any live virus and cannot cause infection. During the 1976 "swine flu" influenza vaccination campaign, an increase in Guillain-Barre Syndrome among vaccinees was observed, but has not been noted subsequently. Recently, a live influenza virus vaccine has become available. The viruses contained in this vaccine have been grown at increasingly lower temperatures, which has led to changes in the viruses that prevent them from causing illness, but still induce immunity. The immunity that results from the live virus vaccine may be superior to that from the inactivated vaccine, but the live vaccine is not recommended for HCWs because they subsequently may shed the viruses and could potentially infect patients with altered immune systems. Development and production of a vaccine to protect against the strain of influenza known as "avian flu" is ongoing.

Four antiviral drugs to treat influenza are currently available. Amantadine and rimantadine are active only against influenza A, and the recent emergence of strains resistant to these drugs has limited their effectiveness. Zanamivir and oseltamivir have a different mechanism of action and inhibit both influenza A and B viruses. Zanamivir is not well absorbed and is supplied as an inhaled powder. Oseltamivir is available in pill form, and it may have activity against the avian flu strains of influenza that have recently emerged. In an influenza outbreak, vaccinating any unvaccinated HCW and encouraging use of an antiviral agent for the two weeks required for the vaccine to become effective is a reasonable strategy, but one certainly less preferable to early, routine vaccination. Antiviral agents can also reduce the symptoms of influenza if given early in the course of illness. HCWs who become ill should be encouraged to remain at home. Those caring for patients with a compatible illness in the setting of an influenza outbreak should wear masks and pay careful attention to handwashing, both reasonable precautions to prevent the acquisition of infection and its spread in the hospital environment.

Currently, neither vaccination nor antiviral drugs are available for the other respiratory agents, although there are treatments available for babies with RSV infection. Those caring for patients with respiratory infection should wear masks, disinfect their hands frequently, and encourage patients to do so, as well. HCWs who are ill themselves should remain at home, whenever possible.

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Varicella Zoster Virus

KEY POINTS

- Varicella zoster virus (VZV) causes chickenpox. The virus remains in the body and may reoccur as herpes zoster (shingles).
- Most adults have already had chickenpox and are immune to reinfection.
- VZV is highly contagious to those who are susceptible.
- HCWs who are not immune to VZV should receive varicella vaccine.
- HCWs who do not have antibody to VZV should not care for those with chickenpox or shingles.
- Non-immune HCWs inadvertently exposed to chickenpox should avoid patient contact from 9 to 21 days after exposure.
- Antiviral drugs are effective in treating both chickenpox and shingles.

Varicella zoster virus (VZV), a member of the herpes virus family, causes chickenpox (varicella), a highly contagious disease usually acquired in childhood. The illness has an incubation period of 10 to 21 days and is spread primarily by the respiratory route. It begins with a 24 to 48-hour prodrome of mild fever, malaise, and cough. Red blotches (macules) soon appear, generally most heavily on the trunk, and then develop into small, clear blisters (vesicles). The vesicles, in turn, become cloudy (pustules) and rupture, leaving crusts. Vesicles and pustules contain large numbers of virus particles, and, while the airborne route spreads chickenpox most efficiently, touching the rash can also lead to infection in susceptible people. The rash generally is not very painful, but itching may be intense, especially as healing begins. New vesicles may continue to form over the first several days of illness; recovery usually occurs within seven to ten days.

In normal children, chickenpox is generally a mild, self-limited disease, but superinfection of the skin lesions with bacteria (most commonly with Group A strep) may be fatal. In immunologically normal adults and in children with malignancy, transplants, or AIDS or who are otherwise immunocompromised, VZV infection itself can cause severe illness and even death. In addition, chickenpox occurring in the first trimester of pregnancy is associated with limb malformations, skin scarring, and eye and central nervous system abnormalities in the fetus. The occurrence of varicella very late in pregnancy (i.e., maternal infection from five days prior to delivery to 48 hours postpartum) can result in overwhelming fetal infection and fetal demise.

Varicella zoster virus, like other members of the herpes virus family, remains latent in the body and may recur in a more localized skin eruption, called herpes zoster or shingles. After primary infection, the virus takes up residence in the sensory ganglia adjacent to the spinal column, and recurrent infection usually occurs in a patch of skin supplied by the nerves from one sensory ganglion (termed a "dermatome"). Herpes zoster is most common in the elderly and the immunocompromised. The factors which lead to reactivation are incompletely understood, but presumably the delicate balance between host defense and virus replication tips in favor of the virus.

Risks of Infectivity

Chickenpox usually occurs in epidemics in late winter and early spring. In the household setting, 70 to 90 percent of susceptible individuals will develop disease after one member acquires infection. Because chickenpox is so highly contagious, most people experience the disease in childhood, usually during elementary school. However, approximately 10 percent of adults remain susceptible. Patients with infection are generally contagious from approximately 48 hours before vesicles develop until all vesicles are crusted. As with chickenpox, the vesicles of shingles contain many virus particles and are highly contagious until crusts develop. Because there are case reports of susceptible HCWs who acquired chickenpox from patients with zoster without known direct contact with lesions, in the hospital setting both those with varicella and those with shingles are placed under contact and airborne precautions (Table 4). Those who have already had chickenpox are in no danger when caring for those with varicella or zoster. Once an individual with normal immunity has had chickenpox, he or she is generally considered to be immune from developing the generalized rash again, and zoster does not result from exposure to chickenpox.

Hospital workers who are susceptible to chickenpox are not only at risk for acquiring infection themselves (which may be serious), but they also may, in turn, infect their susceptible patients, who may then be at risk for developing life-threatening disease. Screening for immunity to varicella by checking for antibody to VZV in the blood of HCWs is now routine in many hospitals, and screening of medical students prior to the time of any significant patient contact is strongly recommended. Screening only those without a solid

history of prior chickenpox infection is an alternative strategy. Antibody assays using enzyme-linked immunosorbent assay (ELISA), latex agglutination, or fluorescent antibody techniques are quite sensitive and reliable. When results are available, students should be informed about whether they are immune or susceptible. HCWs and students who are susceptible to varicella should be vaccinated with the live, attenuated Oka varicella vaccine. Over 90 percent of healthy young adults who receive two doses of vaccine, one or two months apart, will develop antibody to varicella and be protected from natural infection. Of note, those who do not develop antibody are still considered susceptible.

After vaccination, a very mild eruption resembling chickenpox may develop in up to 10 percent of adults. Immunocompromised children often have difficulty controlling virus infections. Those given live varicella vaccine not infrequently develop rash, and transmission of vaccine virus from these children to other susceptible individuals has been documented. The potential for the spread of vaccine virus from adults with mild post-vaccination rash thus exists, but the risk is probably quite low. While shingles can develop after vaccination, the incidence is lower than that in natural infection.

How long immunity lasts after varicella vaccination is a yet-unanswered question. In studies of Japanese children who received varicella vaccine, protective antibody was present for ten or more years after vaccination. However, in adults, antibody levels may decline fairly rapidly, and infection with varicella has been documented within two years after successful vaccination. Natural infection occurring after vaccination tends to be much abbreviated, however, with few vesicles and mild symptoms. No cases of transmission of natural chickenpox from an immunologically normal, previously vaccinated immune individual have yet been documented.

Recently, a more potent varicella vaccine has been approved by the FDA for older adults who have already had chickenpox. In clinical trials, this vaccine has been shown to prevent zoster and/or decrease its severity.

Control/Prevention Procedures

Because of the danger that HCWs with chickenpox pose to non-immune patients, HCWs who lack antibody to varicella generally are limited from patient contact for a period of 9 to 21 days after exposure to an individual with chickenpox. Whether it is necessary to "furlough" vaccinated HCWs in whom antibody has waned to non-measurable levels is a matter of debate, and few data exist to provide guidance. Some advocate removal from patient contact at the first sign of any illness, while others treat seronegative, previously immune individuals similarly to those who are seronegative and have never been vaccinated. An intermediate position, which seems quite reasonable, is to remove seronegative vaccinees from contact with high risk patients, since the risks of transmission from seronegative vaccinees, should they acquire infection, appear to be quite small. Should a medical student acquire chickenpox, antiviral agents such as acyclovir, famciclovir, or valacyclovir provide effective treatment. Beginning medication early in the illness is of greatest benefit. Once new vesicles cease to form, antiviral therapy adds little. Susceptible immunocompromised HCWs who have been exposed to VZV might also benefit from treatment with varicella zoster immune globulin, which can reduce the severity of infection.

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Agents Transmitted Primarily by Skin Contact or Environmental Contamination

Staphylococcus aureus and Other Bacteria

KEY POINTS

- Bacteria are easily spread from patients to HCWs and from HCWs to patients in the hospital setting.
- Appropriate handwashing and the use of barrier precautions reduce the spread of bacteria.
- Those HCWs with skin infections or illness should consult with a physician before patient contact.

Staphylococcus aureaus (S. aureus) is a gram-positive bacterium that is a major cause of surgical wound infections, hospital-acquired pneumonia, and infections of intravenous catheters. Humans are the most common source of *S. aureus*. In the hospital setting, when transmission from one patient to another occurs, the hands of a HCW are often the method of spread. HCWs can become colonized with *S. aureus*, usually in the anterior part of the nose, and chronic *S. aureus* carriers have served as the source of a number of hospital outbreaks.

Particular strains of *S. aureus* that have acquired resistance to the usual antibiotics used to treat this organism (called methicillin-resistant *S. aureus* or MRSA) are particularly troublesome. These organisms first developed in a small number of patients, but then became endemic (established) in hospitals through spread to other patients and colonization of health care providers. MRSA infections now are common outside of the hospital and nursing home settings, and MRSA is an increasingly frequent cause of community-acquired skin infections. Colonized HCWs can also serve as the reservoir of Group A streptococci, the "strep" of "strep throat." (The Group A streptococci also have the ability to cause severe wound infections and death of tissue and have been termed "flesh eating bacteria.")

Hospitals often contain other less virulent endemic bacteria, such as multidrug-resistant Pseudomonas or other gram-negative rods, which are not a danger to most people who do not have underlying illnesses, but which can be very dangerous to hospitalized patients. These organisms spread among compromised patients in areas such as the intensive care or burn units, and result in pneumonia, urinary tract infection, and/or bacteremia in those already critically ill with other diseases. Recently, many hospitals in the United States and abroad have had problems with the emergence of one type of gram-positive bacteria, the enterococci, which have become very resistant to antibiotics. These bacteria (termed vancomycin-resistant enterococci or VRE) are not very virulent on their own, but, like the resistant gram-negative rods, they tend to infect those who are ill already, and these infections then become both difficult and expensive to treat. Many also fear that these primarily non-pathogenic gram-positive bacteria may transfer their resistance to other more virulent gram-positive organisms such as *S. aureus* and spread widely.

Risks of Infectivity

Organisms such as *S. aureus* and Group A streptococci can infect HCWs, causing skin abscesses or sore throat, respectively, but most frequently these organisms just "pass through" on their way to infecting patients. Agents like Pseudomonas, other gram-negative rods, and VRE generally do not cause disease in healthy people.

Control/Prevention Procedures

The category of "Contact Precautions" in the *Transmission-based Precautions* guidelines (see Table 3) were specifically developed for control of the organisms discussed above. Good hand hygiene before and after patient contact generally prevents the spread of bacterial agents in the hospital. Gloves should be worn on any contact with the patient or his/her patient care environment, and gowns should be worn if soilage is likely. Colonized HCWs, especially those carrying MRSA, may require treatment to eradicate the organism if they are found to be the source of an outbreak. Those HCWs with chronic skin disease (e.g., psoriasis) or skin infection may be particularly heavily colonized and should be especially careful to wear gloves with patient contact. Those with any skin infection or illness should consult with a physician before patient contact.

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Scabies

Key Points

- Scabies mites cause a very itchy eruption.
- Intimate contact usually is required for spread, but those caring for patients should use appropriate barrier precautions.

Scabies mites are members of the class Arachnida, like spiders. These mites burrow into the skin and cause a very itchy eruption. Fertilized females lay their eggs at the base of a burrow several millimeters in length in the epidermis, the superficial layer of the skin. Larvae emerge from the burrows, mature, and mate (a process taking about 17 days), and the cycle begins again. Male mites generally die quickly, but gravid (pregnant) females (who are generally approximately 0.35 mm in length) may live for four to six weeks. Scabies is generally spread by intimate sexual contact, but hospital outbreaks have occurred. The hallmarks of the infestation are intense itching, especially at night, and the presence of papules, nodules, and linear burrows, often between the fingers, on the wrists, around the belt-line, and in the genital area. Treatment with permethrin 5% cream, topical lindane, and/or oral ivermectin is most often curative. A severe variant of this disease, called Norwegian scabies, occurs in the immunocompromised and those too ill or infirm to care for themselves. Those with Norwegian scabies may be infested with thousands of organisms. Norwegian scabies is highly contagious.

Risks of Infectivity

Most patients with scabies harbor few organisms, and transmission through casual contact is not usual. However, there have been a number of reports of outbreaks among those caring for infected, hospitalized, or nursing home patients. Contact precautions are indicated until patients are treated. Norwegian scabies poses considerable risk to those in the hospital environment, and those with this infestation require private rooms with strict attention to contact precautions.

Control/Prevention Procedures

Gloves should be worn by those touching patients with rashes. HCWs caring for patients suspected of having scabies should observe contact precautions and wear gowns and gloves while in contact with patients. These articles should be discarded or decontaminated properly after use. Appropriate precautions should also be taken where handling the clothing of those infested.

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Special Considerations

The HIV-infected Medical Student

Counseling students who experience any major medical illness while facing the rigors of medical school is never simple; counseling those with HIV infection may be particularly challenging. Although there has been considerable enlightenment in the attitude of many Americans since the 1980s, those with HIV infection still face considerable social stigma, and the well-publicized case of HIV transmission from a Florida dentist to some of his patients has made the situation particularly difficult for HIV-infected HCWs. Issues to consider in formulating policies for the HIV-infected student include: (1) special risks to the student from exposures in the health care environment and (2) potential risks to patients from exposure to an HIV-positive HCW.

Health Issues for the HIV-infected Student

Since the start of the AIDS epidemic, there have been major advances in our understanding of HIV infection and in our ability to control virus replication. Judicious use of combination antiretroviral chemotherapy has led to prolongation in the time to the development of illness in those who are HIV-infected, and better treatment of a number of opportunistic infections in those with advanced disease has led to prolongation and better quality of life. That an HIV-infected student should receive state-of-the-art health care from a physician trained in the management of HIV infection goes without saying.

Early in infection, halting virus replication and preserving T cell (CD4 cell) function are the goals, as those with CD4 counts greater than 500 cells/mm3 are essentially immunologically normal and are at no greater risk for infection than other HCWs. Tuberculosis and some viral infections may be more severe in those with CD4 counts between 200 and 500 cells/mm3. Only those with CD4 counts less than 200 cells/mm3 are at risk for major unusual infections, and many viral, bacterial, fungal, and parasitic agents can cause serious illness in these individuals. Many of these infections are a result of the body's inability to contain an organism that is innocuous to immunologically normal people, and most of these organisms are ubiquitous, both inside and outside of the hospital. Frequently, as immunity wanes, patients become ill from organisms they acquired previously. Strict adherence to appropriate infection control procedures is especially important for those HCWs who are immunocompromised to prevent acquisition of new agents, which may be "concentrated" in the hospital environment. HIV-infected students should undergo yearly screening for tuberculosis and should receive hepatitis B, pneumococcal, and yearly influenza vaccinations. Any illness should be investigated promptly.

Risks to Patients from the HIV-infected Student

In 1991, after publicity about a Florida dentist with AIDS who transmitted HIV infection to six of his patients, the CDC issued guidelines for the management of health care practitioners infected with blood-borne pathogens. Included in these recommendations were:

- the use of standard and transmission-based precautions by all health care personnel
- voluntary HIV and hepatitis B testing of all HCWs who perform invasive procedures, and
- exclusion of all HIV-positive and HBsAg-positive HCWs from the performance of "exposure-prone" procedures unless approved by an expert panel.

The CDC defined exposure-prone procedures as those that had been previously implicated in the transmission of hepatitis B from HCWs to patients (Table 7) and those in which there was recognizable risk of percutaneous injury to the HCW, with the subsequent likelihood that the HCW's blood could contact the patient's body cavity, subcutaneous tissue, or mucous membranes. The CDC guidelines also required that infected providers who had been approved by the expert panel to perform invasive procedures inform patients about their infection prior to the procedure.

TABLE 7

Procedures Linked to the Transmission of Hepatitis B from HCWs to Patients

- Oral surgery
- Cesarean section/vaginal deliveries requiring suturing
- Abdominal and vaginal hysterectomy
- Cardiothoracic surgery
- Major orthopedic procedures
- Intra-abdominal and colorectal surgery

These guidelines generated a great deal of controversy. "Look back" studies in which over 22,000 patients of 64 HIV-infected HCWs were tested for HIV antibodies initially failed to demonstrate any additional provider-to-patient transmission. Two additional cases of transmission from a HCW to a patient have subsequently been reported; both occurred in France. In one case, a surgeon was implicated, and, in the other, a nurse appeared to be the source of a patient's infection. Mathematical modeling based on small studies of injuries during surgery with subsequent patient contact with surgeon's blood has led to the estimate of a patient's risk for HIV infection from an exposure-prone procedure performed by an HIV-infected surgeon to be between 2.4 and 24 per million. Debate about whether such small risks warrant restriction of practice and informed consent seemed quite reasonable to many. However, responding to public pressure, after the CDC guidelines were issued, the United States Congress passed a law requiring states to certify that they had implemented the CDC, or equivalent, guidelines or they would lose federal funds. Subsequently, a meeting was called by the CDC to establish a list of exposure-prone procedures, but no agreement was reached because many experts believed that the determination of risk for a particular procedure should also include consideration of an individual HCW's skill, technique, and medical status. Considerable variability in implementing the CDC guidelines has emerged, and advances in antiretroviral therapy, leading to potentially profound reductions in the amount of virus in an individual's blood, have also called into question the need for restrictions based solely on serological status. In general, most agree that restrictions of HIV-infected HCWs are indicated if there has been a pattern of failure to adhere to appropriate infection control practices, if the HCW has been implicated in transmission, or if there is any evidence of impairment.

HIV-infected students pose negligible risks to patients as long as they adhere to standard infection control procedures. Students, in general, are rarely operators or assistants in "exposure-prone procedures," which include procedures in which there is "digital palpation of a needle tip in a body cavity or the simultaneous presence of the HCW's fingers and a needle or other sharp instrument or object in a poorly visualized or highly confined anatomic site." If they are called upon to assist in exposure-prone procedures, it would appear prudent to advise HIV-infected students to seek counsel from those knowledgeable about both the transmissibility of HIV and the invasive procedure under consideration. It is clear that HCWs who adhere to universal precautions and who do not perform invasive procedures pose no risk of transmitting HIV infection to patients. As a precaution, because HBV transmission has probably occurred from skin lesions and/or exudative dermatitis on the hands of HCWs, students should be advised that, if they possess any weeping skin lesions, they should seek medical attention and refrain from all direct patient contact and from handling patient care equipment until the condition resolves.

The risks of transmission of other pathogens from HIV-infected individuals to patients are small since (1) many opportunistic infections are not transmitted from person to person (e.g., Toxoplasma gondii, Cryptococcus neoformans), (2) many people have been exposed to these agents from childhood and have already been colonized (e.g., Pneumocystis carinii), or (3) transmission would require a major breakdown in infection control procedures (e.g., herpes simplex virus, salmonella, cryptosporidium). The need for appropriate precautions to protect both HCWs and patients should be stressed in all educational programs for students. Illness in HIV-positive students should be investigated and treated promptly, and all students who are acutely ill should absent themselves from patient care activities. Should impairment arise, existing programs and policies for ill or impaired students should be utilized.

The Hepatitis B-infected Student

Although there has been only three reports of an infected HCW transmitting HIV infection to patients, cases of transmission of HBV from HCWs to patients have been reported more frequently. To date, HBV has been transmitted from 34 HCWs to at least 350 patients in the United States and abroad. Many of the outbreaks reported in the medical literature occurred before the widespread use of universal precautions or involved lapses in appropriate infection control practices. The institution of appropriate controls resulted in the termination of transmission in most of these cases. However, in some outbreaks, no break in technique was detected and no known blood contact between HCWs and patient was discerned. Non-apparent injury to the hands of surgeons from suturing or injury during wire closure of the sternum has been hypothesized to explain these episodes of transmission. Of note, the HCWs who transmitted hepatitis B to patients and who were tested generally possessed HBeAg, a serologic marker indicating high infectivity. Recent estimates of the risk of the transmission of hepatitis B from an HBeAg positive surgeon to a patient have ranged from 1 in 420 to 1 in 4200 invasive procedures. (Of note, although little data and no guidelines exist with regard to hepatitis C [a virus intermediate in its potential for transmission

between HBV and HIV], there also has been a recent report of transmission of HCV from an infected cardiac surgeon to several patients.)

At the present time in the United States, testing for HBsAg and HBeAg among HCWs is voluntary, and the same practice guidelines that apply to HIV infection in HCWs (*vide supra*) have been recommended for those who are HBV-positive. Since most HCWs acquire hepatitis B from patients, the availability of a safe and effective vaccine for HBV should eventually result in a much lower incidence of HBV infection in current students than in years past, and the potential problems of HBV-infected HCWs only serve to underscore the need for early mandatory vaccination programs. Current immunization practices also call for vaccination of teenagers (who are at risk for sexual transmission) and of infants of HBsAg-positive mothers. However, since HBV infection is still prevalent in many parts of the world (especially in China, Japan, and Southeast Asia), the need for counseling of HBV-infected students will undoubtedly persist, and current vaccination programs may serve to identify those who are infected, but who previously went undetected. Appropriate health care for such students (who might benefit from antiviral therapy and who, at the least, should be monitored for the complications of chronic infection) is clearly important.

Counseling about risk reduction procedures and the steps to be taken to reduce the chances of transmission (see section on HIV transmission), especially for those who are HBeAg-positive, is essential. In some HBeAg patients, antiviral treatment has led to loss of infectivity. As with HIV infection, those who follow universal precautions and who do not perform invasive procedures pose no risk to patients. Of note, the United Kingdom has implemented mandatory testing of all HCWs and prohibition of HBeAg-positive physicians from performing exposure-prone procedures. Appropriate career counseling for HBeAg-positive students should involve discussion of the risks a surgical career might pose.

The Pregnant Medical Student

Pregnancy should not be viewed as an impediment to working in the health care environment and, with adherence to proper infection control procedures, pregnant medical students may be safer from acquiring infection than teachers, day care workers, and young mothers with children in play groups. For example, studies of transmission of cytomegalovirus (CMV) in the hospital setting have shown that pediatric nurses have the same risk of acquiring CMV as those in the general population, while other studies have demonstrated relatively high rates of seroconversion in day care center workers and among parents of children who attend day care.

There are, however, inherent risks in the health care setting that may be a cause for concern. Some infections are more severe in pregnancy, and others have the potential to cause significant problems in the developing fetus or newborn. It is especially important that female students be sure that they have received all of their recommended immunizations and that they adhere closely to appropriate infection control procedures (Table 8). If an illness does occur, evaluation and initiation of any appropriate therapy should be prompt. Pathogens that pose particular risk to the mother and/or the fetus are included in Table 9. Pregnant women who have not had varicella should not care for those with chickenpox or zoster.

TABLE 8

Health Care Considerations for the Pregnant Student

Prior to Pregnancy

- Ensure that all immunizations are up to date and know serologic status for measles, mumps, rubella, polio, varicella, and hepatitis B.

During Pregnancy

- Influenza vaccine.
- Routine tuberculosis screening.
- Strict adherence to proper infection control practices.
- Prompt evaluation and treatment of illness.

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TABLE 9

Infectious Agents of Particular Concern in Pregnancy		
Agent	**Major Risk**	**Infection Control Procedure**
Cytomegalovirus (CMV)	Fetal infection/fetal malformation	Standard precautions/gloves while handling all body fluids/strict handwashing
Hepatitis B	Maternal infection, with transmission to fetus	Vaccination/standard precautions/safe sharp practices
HIV	Maternal infection, with transmission to fetus	Standard precautions/safe sharp practices/antiviral therapy if known significant exposure
Influenza Virus	Potentially more severe maternal Infection	Vaccination/droplet precautions/strict handwashing
Enteroviruses	Severe infection in the newborn if infection of the mother late in pregnancy	Standard precautions/gloves while handling all body fluids/strict handwashing
Parvovirus B19	Spontaneous abortion if infection acquired early in pregnancy	Droplet precautions if patients with B19 identified/standard precautions
Rubella	Fetal malformations/fetal infection	Prior to pregnancy: Proof of immunity of all health care personnel with vaccination if not immune. Non-immune individuals should not care for those suspected of having infection.
Varicella Zoster Virus	Fetal malformations/fetal infection	Prior to pregnancy: Proof of immunity or vaccination, if not immune. Non-immune individuals should not care for those with chickenpox or zoster.

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Appendix A

Association of American Medical Colleges

Group on Student Affairs

Recommendations regarding Health Services for Medical Students

General

1. Medical schools should have a system for preventive and therapeutic health services for students. This system should include, but not be limited to, written institutional policies regarding provisions for outpatient care, mental health services, and hospitalization for medical students. These policies should be reviewed with students on a regular basis. Efforts should be taken to ensure that students understand that the cost of hospitalization is their personal responsibility.

2. Schools are encouraged to have written policies about the availability of medical leave of absence for students. Such policies should be clearly communicated with students.

3. Schools should require students to undergo a complete history and physical examination after admission to school is assured but prior to matriculation. The results of the physical examination should be reported to the medical school.

4. Schools are encouraged to develop a program to identify students at high risk for treatable conditions (e.g., hypertension, diabetes, hypercholesterolemia), and refer them to appropriate services.

Insurance

5. Schools are strongly encouraged to establish the requirement that all medical students and their dependents have health insurance. Schools should assist students to understand the limits of their insurance coverage and the provisions for hospitalization should be clearly delineated. If insurance is made available but not required, students should understand the risks of being uninsured.

6. Schools should be encouraged to work with other national health organizations such as the American College Health Association toward the establishment of adequate mandatory health insurance for all undergraduate, graduate, and professional students at the lowest possible cost.

7. Schools should make available disability insurance for their students.

Mental Health

8. Schools should provide access to confidential counseling by mental health professionals for all students. Institutional policies regarding the confidentiality of mental health service records for medical students should be established. These policies should make the necessary distinction between voluntary and administratively mandated evaluation and/or treatment. For administratively mandated evaluation, disclosure of evaluation and/or treatment results should be limited to those who required the evaluation and should be in accordance with federal or state laws governing the disclosure of confidential information.

9. Schools should have guidelines regarding the utilization of mental health professionals and/or records of assessment and treatment by mental health professionals in proceedings regarding student advancement and dismissal.

The committee recommends that evaluation and/or treatment of students be undertaken by non-teaching faculty or, at a minimum, by different individuals than those rendering advancement or promotion decisions.

10. Schools should publish and regularly update a list of available mental health assessment and counseling services, the institutional assurance of confidentiality, the means of access, and the associated costs for their students.

Chemical Dependency

11. Schools should establish written policies regarding institutional response to known or suspected chemical dependency in students, including definition of what constitutes impairment. Schools are also encouraged to develop programs that will identify and assist impaired students.

Immunizations

12. Pre-matriculation and annual testing for tuberculosis (TB) should be required at all medical schools for all students. In view of the significant incidence of multi-drug-resistant TB, the development of appropriate policies concerning student exposure to infections and environmental hazards and implementation of effective instruction in appropriate precautionary measures and infection control measures are of particular importance and should be undertaken by all schools.

13. All schools should require all students to present proof of immunity consistent with current recommendations of the Centers for Disease Control and Prevention (CDC) for healthcare workers. (As of September 2006, CDC recommendations included immunity to rubeola, mumps, rubella, pertussis, varicella, and hepatitis B, as well as a booster every 10 years for diphtheria and tetanus and every year for influenza.)

14. A student who declines hepatitis B vaccination should be required to sign a formal declination waiver form consistent with procedures promulgated by the Occupational Safety and Health Administration (OSHA) for hospital employees (see: www.osha.gov/SLTC/etools/hospital/hazards/bbp/declination.html).

15. Medical schools should not be required to pay the cost of immunizations, but are encouraged to do whatever is possible to make the vaccines available to students at the lowest possible cost. Medical schools should inform affiliated institutions of the vaccination status of students in training.

16. "Proof of immunity" should include either documentation of completion of the full vaccination series OR reliable medical documentation of prior illness OR documentation via positive titer of immunization status.

17. Schools should require documentation that visiting students meet the same health examination and immunization requirements as regularly enrolled students.

18. Schools should develop a centralized system for confidentially monitoring the health and immunization status of medical students.

19. Students who travel outside of the United States as a component of their medical education or who may be at risk of exposure (e.g., to polio, rabies) in laboratory or field experiences should be advised of and follow CDC health and immunization guidelines for those destinations and settings.

Occupational Exposure

20. In accordance with the Liaison Committee on Medical Education "Standards for Accreditation of Medical Education Programs Leading to the M.D. Degree", schools should develop policies concerning students' exposure to infectious and environmental hazards. The policies must include:

    a. education of students about methods of prevention

    b. the procedures for care and treatment after exposure, including definition of financial responsibility

    c. the effects of infectious and/or environmental disease or disability on student educational activities

21. Schools should be particularly diligent in their implementation of effective instruction in precautionary and infection control measures for airborne and blood-borne pathogens prior to students' first contact with patients and first contact with human tissue, blood products, and body fluids. Schools are urged to require their graduate students in the medical sciences to participate in these instructional sessions.

Approved: June 25, 1992, AAMC Executive Council

Revised: September 28, 2006, AAMC Executive Council

Appendix B

Association of American Medical Colleges

Group on Student Affairs

Recommendations for Student Healthcare and Insurance

Part 1. Healthcare Recommendations

1. Access to, and insurance coverage for, mental health services by mental health professionals should be offered to all medical students in concordance with current LCME standards. This coverage should include a broad spectrum of psychiatric diagnoses.

2. Medical students should have the choice of medical care from physicians not directly involved in their evaluation or decisions about their promotion or graduation.

Part 2. Health Insurance Recommendations

3. Medical schools should require that all medical students have an active health insurance policy. Schools should offer a policy that provides coverage for the 12-month calendar year. Medical students should be allowed to select a personal policy after providing documentation that the policy provides comparable coverage.

4. Schools should document, on an annual basis, the health insurance coverage for each medical student.

5. The school-sponsored health insurance policy should cover medical students when they are on approved rotations in another state.

6. A medical student on an approved Leave of Absence should be allowed to continue coverage under the school-sponsored health insurance policy. Medical students who withdraw or are dismissed from medical school, and who have prepaid for their health insurance, should be allowed to remain on the school-sponsored health insurance policy for the remainder of the policy period.

7. The choice of a school-sponsored health insurance policy to cover medical students must take into consideration the unique and special needs of students in a medical education program.

8. School-sponsored health insurance policies should cover pre-existing conditions.

9. School-sponsored health insurance policies should offer medical students the opportunity to purchase additional coverage for spouses, domestic partners, and dependents at a market value cost.

10. School-sponsored health insurance policies for medical students should offer some form of prescription drug coverage, including hormonal contraception.

11. School-sponsored health insurance policies for medical students should have lifetime coverage limits consistent with the cost of a major or catastrophic medical illness.

12. Schools should offer medical students the option of electing insurance coverage for a reasonable level of dental care.

13. Schools should be in compliance with Occupational Safety and Health

Administration (OSHA) standards related to infection control, and they should provide coverage for any differences between the cost of treatment and follow-up for an "education-related" injury sustained by a medical student and the reimbursement provided by the school-sponsored health insurance policy.

14. Schools should require medical students to obtain evacuation insurance (for medical illness and injury and for reasons of civil unrest) when they are engaged in school-sanctioned activities outside of the United States. Consideration should also be given to coverage that would ensure the return of remains in the case of death.

15. Medical students should be provided with clear and concise explanations of school-sponsored health, liability and disability insurance plans, including information related to additional fees for services beyond those covered by the school-sponsored insurance policy.

Part 3. Liability Insurance Recommendations

16. Schools should provide sufficient liability insurance for medical students to complete all school-sponsored aspects of their medical education and training, including any community service activities provided under the supervision of school faculty members.

Part 4. Disability Insurance Recommendations

17. Schools should require disability insurance coverage for all medical students and provide access to policies with benefits extending to age 65.

18. Disability insurance coverage for medical students should begin the first day of enrollment and should have the option of portability into residency programs.

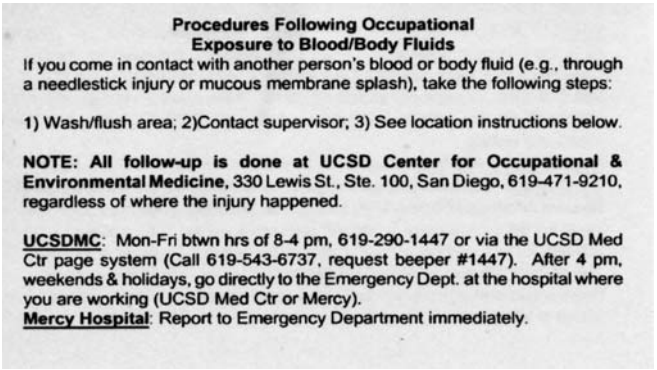
Approved: AAMC Executive Council, February 2005

Appendix C

Examples of "Wallet Cards" regarding Exposures

From: University of California, San Diego School of Medicine

Side 1 and Side 2



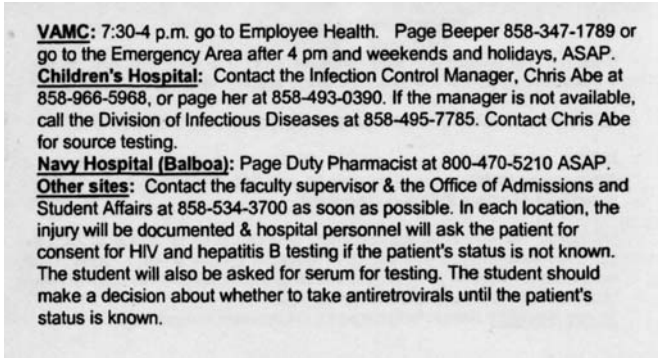
Procedures Following Occupational Exposure to Blood/Body Fluids

If you come in contact with another person's blood or body fluid (e.g., through a needlestick injury or mucous membrane splash), take the following steps:

1) Wash/flush area; 2)Contact supervisor; 3) See location instructions below.

NOTE: All follow-up is done at UCSD Center for Occupational & Environmental Medicine, 330 Lewis St., Ste. 100, San Diego, 619-471-9210, regardless of where the injury happened.

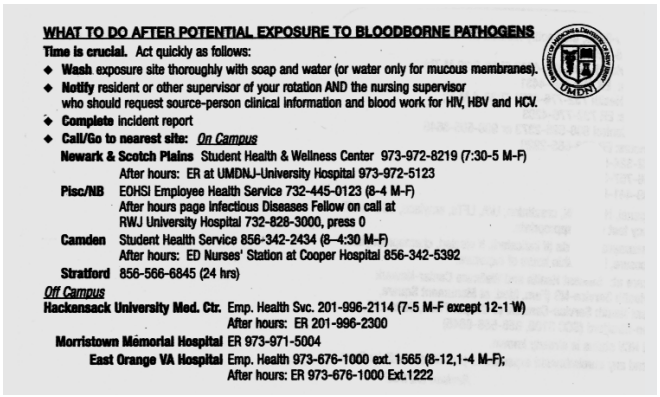
UCSDMC: Mon-Fri btwn hrs of 8-4 pm, 619-290-1447 or via the UCSD Med Ctr page system (Call 619-543-6737, request beeper #1447). After 4 pm, weekends & holidays, go directly to the Emergency Dept. at the hospital where you are working (UCSD Med Ctr or Mercy).
Mercy Hospital: Report to Emergency Department immediately.



VAMC: 7:30-4 p.m. go to Employee Health. Page Beeper 858-347-1789 or go to the Emergency Area after 4 pm and weekends and holidays, ASAP.
Children's Hospital: Contact the Infection Control Manager, Chris Abe at 858-966-5968, or page her at 858-493-0390. If the manager is not available, call the Division of Infectious Diseases at 858-495-7785. Contact Chris Abe for source testing.
Navy Hospital (Balboa): Page Duty Pharmacist at 800-470-5210 ASAP.
Other sites: Contact the faculty supervisor & the Office of Admissions and Student Affairs at 858-534-3700 as soon as possible. In each location, the injury will be documented & hospital personnel will ask the patient for consent for HIV and hepatitis B testing if the patient's status is not known. The student will also be asked for serum for testing. The student should make a decision about whether to take antiretrovirals until the patient's status is known.

From: The University of Medicine and Dentistry of New Jersey Robert Wood Johnson Medical School

Side 1 and Side 2



WHAT TO DO AFTER POTENTIAL EXPOSURE TO BLOODBORNE PATHOGENS

Time is crucial. Act quickly as follows:

- **Wash** exposure site thoroughly with soap and water (or water only for mucous membranes).
- **Notify** resident or other supervisor of your rotation AND the nursing supervisor who should request source-person clinical information and blood work for HIV, HBV and HCV.
- **Complete** incident report
- **Call/Go to nearest site:** *On Campus*

Newark & Scotch Plains Student Health & Wellness Center 973-972-8219 (7:30-5 M-F)
After hours: ER at UMDNJ-University Hospital 973-972-5123
Piscl/NB EOHSI Employee Health Service 732-445-0123 (8-4 M-F)
After hours page Infectious Diseases Fellow on call at RWJ University Hospital 732-828-3000, press 0
Camden Student Health Service 856-342-2434 (8–4:30 M-F)
After hours: ED Nurses' Station at Cooper Hospital 856-342-5392
Stratford 856-566-6845 (24 hrs)

Off Campus
Hackensack University Med. Ctr. Emp. Health Svc. 201-996-2114 (7-5 M-F except 12-1 W)
After hours: ER 201-996-2300
Morristown Memorial Hospital ER 973-971-5004
East Orange VA Hospital Emp. Health 973-676-1000 ext. 1565 (8-12,1-4 M-F);
After hours: ER 973-676-1000 Ext.1222

Christ Hospital	ER 201-795-8280; then notify Medical Ed. Office 201-418-7043
Muhlenberg Regional Med. Ctr.	ER 908-668-2200
University Med. Ctr. at Princeton	Employee Health 609-497-4288 (7:30-2:30 M-Th); After hours: ER 609-497-4431
Jersey Shore University Med. Ctr.	Employee Health 732-776-4251 (7:30-4 M-F); After hours: ER 732-776-4203
Somerset Med. Ctr.	Infection Control 908-595-2373 or 908-595-8646 After Hours: ER 908-685-2920
Raritan Bay Med. Ctr.	ER 732-324-5095
Our Lady of Lourdes Med. Ctr.	ER 856-757-3803
Atlantic City Med. Ctr.	ER 609-441-8050

- **Get appropriate tests,** e.g., for HIV, HBV panel, HCV, BUN, creatinine, U/A, LFTs, amylase, CBC w/diff & plt, electrolytes, glucose, urine pregnancy test when appropriate.
- **Get risk-assessment counseling and chemoprophylaxis** (if indicated). If elected, chemoprophylaxis should begin as soon as possible after exposure, best within hours of exposure.
- **Report** all exposures and get follow-up care at: Student Health and Wellness Center-Newark (DOC 1750, 973-972-8219); or Student Health Service-NB (Fam. Med. at Monument Square, 317 George St., 732-235-8993); or Student Health Service-Camden (3 Cooper Plaza, Suite 215, 856-342-2434); or SOM Internal Medicine-Stratford (SCC 3100, 856-566-6845)
- **Test source person** unless HIV, HBV and HCV status is already known.
- **Send bills** to your insurance company; send any unreimbursed expenses to your Student Affairs Dean.

Revised 6/21/05

From: University of South Carolina School of Medicine

Side 1 and Side 2

IN CASE OF BLOODBORNE PATHOGEN EXPOSURES
AFTER WORKING HOURS

1. Wash, irrigate or flush area with soap and water for 5 minutes
2. Notify USCSM faculty member in charge of service.
3. IMMEDIATELY report for evaluation and treatment (optimally within 2 hours)
   Emergency Room at PHR or call GMH Administrative Coordinator On duty via hospital operator.

On reporting for evaluation tell staff immediately that you have had a bloodborne exposure.

All costs for evaluation and treatment are covered by Workers' Compensation Program.
For any questions contact F. Rene Davis at 1-803-434-2479
USCSM Student and Employee Health) Dr. Joshua Mann at 803-434-2556 or 803-434-7399

POST-BLOODBORNE EXPOSURE WALLET CARD

IN CASE OF BLOODBORNE PATHOGEN EXPOSURES
DURING WORKING HOURS

1. Wash, irrigate or flush area with soap and water for 5 minutes
2. Notify USCSM faculty member in charge of service.
3. IMMEDIATELY report for evaluation and treatment (optimally within 2 hours)
   Student and Employee Health at PHR Family Practice Center 3209 Colonial Drive
   Or DVMC Employee Health Clinic at Room 1C112 or Call extension 6530 or pager 084
   Or GMH Exposure Control Nurse at Extension 5-4209 follow voice mail instructions

On reporting for evaluation tell staff immediately that you have had a bloodborne exposure.

All costs for evaluation and treatment are covered by Workers' Compensation Program
For any questions contact F. Rene Davis at 1-803-434-2479
USCSM Student and Employee Health) or Dr. Joshua Mann at 803-434-2556 or 803-434-7399

Appendix D

A Sample Health Care/Infection Control Program for Medical Students

Before Matriculation

1. Require documentation of a recent history and physical examination
2. Require proof of immunity to measles, mumps and rubella

   Proof of immunity may be documented by serology or proof of two doses of live attenuated MMR vaccine.
3. Require documentation of tuberculin status/infection with *Mycobacterium tuberculosis*

   Documentation demonstrated by a negative PPD skin test or negative BAMT, or if positive, demonstration of a negative chest radiograph within six months of matriculation.

At Matriculation

1 Require proof of immunity to hepatitis B or provide hepatitis B vaccination

   Proof of immunity demonstrated by serology (antibody to hepatitis B surface antigen) or by documentation of the series of hepatitis B vaccinations.*
2. Require proof of immunity to varicella. Provide vaccination to those not immune.

   Proof of immunity demonstrated by a history of natural infection, a positive serology, or documentation of previous vaccination.
3. Begin instruction in Infection Control Procedures and Sharps Safety
4. Provide information about procedures should occupational exposures occur
5. Consider providing students with wallet cards documenting vaccination history

Yearly

1. Institute procedures to ensure students' compliance with tuberculin testing, as required by hospital procedures.
2. Reinforce education about Infection Control, Sharps Safety and Procedures to Follow Should Occupational Exposures Occur before students begin their clinical rotations.

Other Considerations

1. Insure that appropriate procedures are in place to provide education to students traveling to other countries for rotations. Such considerations might include:

   a) Consultation with a travel clinic

   b) Documentation of appropriate health insurance

   c) A provision for evacuation insurance

   d) Discussion about special health risks/provision for HIV postexposure prophylaxis

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