Chapter 2: Infection Control and Prevention

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10 Contact Hours

Learning objectives

- Give five examples of scientifically accepted practices for infection prevention and control for airborne, droplet, and contact transmission.
- Define and discuss the professional’s responsibility to adhere to scientifically accepted infection prevention and control practices in all health care settings and the consequences of failing to comply.
- List and explain five steps to monitor infection prevention and control practices, including procedures for intervention as necessary for compliance and safety.
- Describe how pathogenic organisms may be spread in healthcare settings.
- Identify the factors that influence the outcome of an exposure.
- List strategies used to prevent the transmission of pathogenic organisms.
- Describe how infection control concepts are applied in professional practice.
- Define health care-associated disease transmission, engineering controls, safe injection practices, and work practice controls.
- Describe specific high-risk practices and procedures that increase the opportunity for health care personnel and patient exposure to potentially infectious material.
- Describe measures used to prevent transmission of bloodborne pathogens from patient to patient, health care personnel to patient, and patient to health care personnel via contaminated injection equipment.
- Identify work practice controls designed to eliminate the transmission of bloodborne pathogens during use of sharp instruments (e.g., scalpel blades and their holders (if not disposable), lancets, lancet platforms/pens, puncture devices, injections).
- Identify where engineering or work practice controls can be utilized to prevent patient exposure to bloodborne pathogens.
- Describe the circumstances that require the use of barriers and personal protective equipment (PPE) to prevent patient or healthcare personnel contact with potentially infectious material.
- Identify specific barriers or personal protective equipment for patient and healthcare personnel protection from exposure to potentially infectious material.
- Define cleaning, disinfection, and sterilization.
- Differentiate between noncritical, semi-critical, and critical medical devices.
- Describe the three levels of disinfection.
- List and explain correct application of reprocessing methods used to assure the safety and integrity of patient care equipment in preventing transmission of bloodborne pathogens.
- Identify the professional’s responsibility for maintaining a safe patient care environment in all healthcare settings.
- Discuss six strategies for, and importance of, effective and appropriate pre-cleaning, chemical disinfection and sterilization of instruments and medical devices aimed at preventing transmission of bloodborne pathogens.
- Define and discuss the role of occupational health strategies in protecting health care personnel and patients.
- Recognize nonspecific disease findings that should prompt evaluation of healthcare personnel.
- Identify occupational health strategies used to prevent transmission of bloodborne pathogens and other communicable diseases in health care personnel.
- Discuss the strategies and procedures for the prevention of the transmission and control of the Ebola virus.
- Identify resources for evaluation of health care personnel infected with Ebola, human immunodeficiency virus (HIV), hepatitis B virus HBV, and hepatitis C virus (HCV).

Health-associated infection prevalence survey

The CDC health care-associated infection (HAI) prevalence survey provides an updated national estimate of the overall problem of HAIs in U.S. hospitals. Based on a large sample of U.S. acute care hospitals, the survey found that on any given day, about 1 in 25 hospital patients has at least one health care-associated infection. There were an estimated 722,000 HAIs in U.S. acute care hospitals in 2011. About 75,000 hospital patients with HAIs died during their hospitalizations. More than half of all HAIs occurred outside of the intensive care unit.

Table 1: Estimates of health care-associated infections occurring in acute care hospitals in the United States, 2011.

<table>
<thead>
<tr>
<th>Major site of infection</th>
<th>Estimated no.</th>
</tr>
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<tbody>
<tr>
<td>Pneumonia</td>
<td>157,500</td>
</tr>
<tr>
<td>Gastrointestinal illness</td>
<td>123,100</td>
</tr>
<tr>
<td>Urinary tract infections</td>
<td>93,300</td>
</tr>
<tr>
<td>Primary bloodstream infections</td>
<td>71,900</td>
</tr>
</tbody>
</table>

| Other types of infections         | 118,500       |
| Estimated total number of infections in hospitals | 721,800       |

Surgical site infections from any inpatient surgery: 157,500
Other types of infections: 118,500
Estimated total number of infections in hospitals: 721,800


Health care-associated infections (HAI) cause significant morbidity and mortality. Following infection prevention strategies can prevent many of these occurrences. This course provides guidelines for infection prevention and control. The standards were developed by the Health care Infection-control practices Advisory Committee (HICPAC) and the Centers for Disease Control and Prevention (CDC).
This continuing education course reports on changes in health care delivery and addresses new concerns about current transmission of infectious agents to patients and health care personnel in the United States. The information is drawn from the documents listed at the end of the chapter, with the more recent publications building upon earlier infection prevention, isolation, and control standards. In combination, these documents provide comprehensive guidance for ensuring a safe environment for patients and health care personnel. It is critical that all health care providers implement the most current standards in accordance with the rules and regulations of their state and specific workplace or agency.

**Standards**

Recent revisions to infection prevention and control standards include the following:

- The term “nosocomial infection” refers only to infections acquired in hospitals.
- The term health care-associated infection (HAI) is used to refer to infections associated with health care delivery in any setting (e.g., hospitals, long-term care facilities, ambulatory settings, home care).
- A new addition to the practice recommendations for standard precautions is respiratory hygiene/cough etiquette. While standard precautions generally apply to the recommended practices of health care personnel during patient care, respiratory hygiene/cough etiquette applies broadly to all people who enter a health care setting, including health care personnel, patients, and visitors.
- New additions to the recommendations for standard precautions are safe injection practices, including the use of a mask when performing certain high-risk, prolonged procedures involving spinal canal punctures (e.g., myelography, epidural anesthesia).
- The continued occurrence of outbreaks of hepatitis B and hepatitis C viruses in ambulatory settings indicated a need to re-iterate safe injection practice recommendations as part of standard precautions. The addition of a mask for certain spinal injections grew from recent evidence of an associated risk for developing meningitis caused by respiratory flora.
- The emergence of pathogens such as SARS-associated coronavirus (SARS-CoV) associated with the severe acute respiratory syndrome [SARS], Avian influenza in humans), renewed concern for evolving known pathogens (e.g., C. difficile, noroviruses, influenza, community-associated MRSA [CA-MRSA]) and the Ebola virus has established a need to address a broader scope of issues than in previous isolation guidelines.
- Evidence that organizational characteristics and engineering controls influence health care personnel adherence to recommended infection-control practices, and therefore are important factors in preventing transmission of infectious agents, led to a new emphasis and recommendations for engineering controls in the development and support of infection control programs.
- Continued increase in the incidence of health care-associated infections caused by multidrug-resistant organisms (MDROs) in all health care settings and the expanded body of knowledge concerning prevention of transmission of MDROs created a need for more specific recommendations for surveillance and control of these pathogens that would be practical and effective in various types of health care settings.
- Revised recommendation to don and doff the indicated personal protective equipment (gowns, gloves, and mask) upon entry and exit from patient’s room for patients since the nature of the interaction with the patient cannot be predicted with certainty and contaminated environmental surfaces are important sources for transmission of pathogens.
- Guidelines for preventing the transmission of tuberculosis in health care settings were updated in 2012.
- Guidelines for preventing the transmission of the Ebola virus were instituted by the CDC in 2014.

**Modes and mechanisms of transmission of pathogenic organisms in the health care setting and strategies for prevention and control**

**Definitions**

- **Asymptomatic infection**: An infection where there is an absence of symptoms or signs of illness in the infected person.
- **Bloodborne pathogens**: Microorganisms in blood that can cause illness in humans. Of primary concern are the human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV).
- **Colonization**: A large group of the same type of microorganisms on or within the body without a detectable host immune response, apparent cellular damage, symptom or signs of disease. The presence of a microorganism within a host may vary in duration and may proliferate and become a source of transmission. This is synonymous with the terms carriage or carrier state.
- **Common vehicle**: A contaminated material, product, or substance that serves as an intermediate means by which an infectious agent is introduced into a susceptible host through a suitable portal of entry.
- **Fomite**: An inanimate object, such as a dish, doorknob, toilet seat, or an article of clothing that may be contaminated with infectious organisms and serve in their transmission. Health care equipment, supplies, or surfaces can become contaminated with pathogens and become a fomite.
- **Incubation period**: The time from the moment of exposure to an infectious agent until signs and symptoms of the disease appear. The incubation periods vary among infectious agents and may be 24 to 48 hours for a cold virus, for example, and up to months or years for HIV symptoms to appear.
- **Parenterally**: Introduced into the body by a route other than the digestive tract (i.e., as by intravenous or intramuscular injection).
- **Pathogen or infectious agent**: A biological, physical or chemical entity capable of causing disease. Biological agents may be bacteria, viruses, fungi, protozoa, helminthes, or prions. It is synonymous with the terms causative agent and etiologic agent.
- **Portal of entry**: The path(s) by which an infectious agent enters the susceptible host, including eyes, nose, ears, mouth, breaks in the skin, needle pricks, wounds, injury, surgery, and intravenous sites.
- **Portal of exit**: The path(s) by which an infectious agent leaves the reservoir.
- **Reservoir**: A source of an infectious agent which may be a person, animal, plant, soil, substance, or combination of these, where a causative agent survives and multiplies in sufficient amounts to be transmitted to a new host. Health care personnel may also be reservoirs for a number of nosocomial organisms.
- **Standard precautions**: A set of infection prevention guidelines that combine the major features of Universal Precautions and Body Substance Isolation guidelines and are based on the principle that all blood, body fluids, secretions, excretions (except sweat), nonintact skin, and mucous membranes may contain transmissible infectious agents. Standard Precautions include a group of practices that apply to all patients, regardless of suspected or
confirmed infection status, in any setting in which health care is delivered. These include: hand hygiene; use of gloves, gown, mask, eye protection, or face shield, depending on the anticipated exposure; and safe injection practices. Also, equipment or items in the patient environment that may have been contaminated with infectious body fluids must be handled in a manner to prevent transmission of infectious agents (e.g. wear gloves for direct contact, contain heavily soiled equipment, properly clean and disinfect or sterilize reusable equipment before use on another patient).

- **Susceptible host**: A person or animal not possessing sufficient resistance to a particular infectious agent to prevent contracting infection or disease when exposed to the agent.
- **Transmission**: Any mechanism by which a pathogen is spread by a source or reservoir to a person.

### Overview of the infectious disease process

Infectious diseases are caused by pathogenic microorganisms, or germs, as they are commonly referred to, such as bacteria, viruses, parasites, or fungi. The diseases can be spread directly from person to person such as when a person coughs; animal to person when an animal scratches or bites; from mother to unborn child through the placenta or during labor or delivery; or indirectly, such as when a person touches a faucet handle, because some germs can linger on objects.

There are effective strategies for preventing the transmission of infectious diseases. These include:

- Placing procedures and systems in communities to ensure immunizations are up-to-date.
- Enabling sanitary practices by installing sinks for washing hands.
- Influencing community resources and cultures to facilitate risk reduction practices for sexual behavior and injection drug use.
- Setting up support systems to ensure medicines are taken as prescribed.

Health care personnel (HCP), including dental health care personnel, as well as patients, can be exposed to pathogenic microorganisms as a source of health care-associated infections.

### Chain of infection

Transmission of infectious agents within a health care setting requires three elements: a source (or reservoir) of infectious agents, a susceptible host with a portal of entry receptive to the agent, and a mode of transmission for the agent. This section describes the interrelationship of these elements in the epidemiology of health care-associated infections. Effective infection-control strategies prevent disease transmission by interrupting one or more links in the chain.

The transmission of infection can be demonstrated as a chain with six links as follows:

1. The pathogen or causative agent.
2. The reservoir, which can be human, animal, or environmental, that serves as the source for the pathogen.
3. The portal of exit from the reservoir.
4. The mode of transmission.
5. The portal of entry into a susceptible host.
6. The host that is susceptible to the pathogen.

The prevention and control of infection involves blocking the links in the chain thus disabling the progression and transmission of the infection to a new host.

### Pathogen or infectious agents

Infectious agents transmitted during health care derive primarily from human sources, but inanimate environmental sources also are implicated in transmission. Human reservoirs include patients, health care personnel, and household members and other visitors. Individuals may have active infections, may be in the asymptomatic or incubation period of an infectious disease, or may be transiently or chronically colonized with pathogenic microorganisms, particularly in the respiratory and gastrointestinal tracts. The endogenous flora of patients (e.g., bacteria residing in the respiratory or gastrointestinal tract) also are the source of health care-associated infections.

### Susceptible hosts

Infection is the result of a complex interrelationship between a potential host and an infectious agent. Most of the factors that influence infection and the occurrence and severity of disease relate to the host. However, characteristics of the host-agent interaction as it relates to pathogenicity, virulence and anti-genicity are also important, as are the infectious dose, mechanisms of disease production and route of exposure.

There is a spectrum of possible outcomes following exposure to an infectious agent. Some people who are exposed to pathogenic microorganisms never develop symptomatic disease, while others become severely ill and even die. Some individuals are prone to becoming transiently or permanently colonized but remain asymptomatic. Still others progress from colonization to symptomatic disease either immediately following exposure or after a period of asymptomatic colonization. The immune state at the time of exposure to an infectious agent, interaction between pathogens and virulence factors intrinsic to the agent are important predictors of an individual’s outcome.

Host factors such as extremes of age and underlying disease (e.g. diabetes), human immunodeficiency virus/acquired immune deficiency syndrome [HIV/AIDS], malignancy, and transplants can increase susceptibility to infection as do a variety of medications that alter the normal flora (e.g., antimicrobial agents, gastric acid suppressants, antacids, H2 blockers, and proton pump inhibitors).
corticosteroids, anti-rejection drugs, antineoplastic agents, and immunosuppressive drugs).

Surgical procedures and radiation therapy impair defenses of the skin and other involved organ systems. Indwelling devices such as urinary catheters, endotracheal tubes, central venous and arterial catheters, and synthetic implants facilitate development of health care-associated infections by allowing potential pathogens to bypass local defenses that would ordinarily impede their invasion. They also provide surfaces for development of biofilms that may facilitate adherence of microorganisms and protect from antimicrobial activity. Some infections associated with invasive procedures result from transmission within the health care facility; others arise from the patient’s endogenous flora.

Modes of transmission

Several classes of pathogens can cause infection, including bacteria, bacterial spores, viruses, fungi, protozoa, parasites, and prions. The modes of transmission vary by type of organism and some infectious agents may be transmitted by more than one route: some are transmitted primarily by direct or indirect contact, (e.g., herpes simplex virus [HSV], respiratory syncytial virus, Staphylococcus aureus), others by the droplet, (e.g., influenza virus, B. pertussis) or airborne routes (e.g., M. tuberculosis). Other infectious agents, such as bloodborne viruses (e.g., hepatitis B and C viruses [HBV, HCV] and HIV are transmitted rarely in health care settings, via percutaneous or mucous membrane exposure).

Indirect contact transmission involves the transfer of an infectious agent through a contaminated intermediate object or person. Opportunities for indirect contact transmission between patients and health care personnel have been summarized in the CDC’s “Guideline for Infection Control in Health Care Personnel,” 1998. Examples of opportunities for indirect contact transmission include:

- Hands of health care personnel may transmit pathogens after touching an infected or colonized body site on one patient or a contaminated inanimate object, if hand hygiene is not performed before touching another patient.
- Patient care devices (e.g., electronic thermometers, glucose-monitoring devices) may transmit pathogens if devices contaminated with blood or body fluids are shared between patients without cleaning and disinfecting between patients.
- Shared toys may become a vehicle for transmitting respiratory viruses (e.g., respiratory syncytial virus or pathogenic bacteria (e.g., Pseudomonas aeruginosa) among pediatric patients.
- Instruments that are inadequately cleaned between patients before disinfection or sterilization (e.g., endoscopes or surgical instruments) or that have manufacturing defects that interfere with the effectiveness of reprocessing may transmit bacterial and viral pathogens.
- Clothing, uniforms, laboratory coats, or isolation gowns used as personal protective equipment (PPE), may become contaminated with potential pathogens after care of a patient colonized or infected with an infectious agent, (e.g., MRSA, VRE, and C. difficile). Although contaminated clothing has not been implicated directly in transmission, the potential exists for soiled garments to transfer infectious agents to successive patients.

Droplet transmission is a form of contact transmission, and the direct and indirect contact routes may transmit some infectious agents this way. However, in contrast to contact transmission, respiratory droplets carrying infectious pathogens transmit infection when they travel directly from the respiratory tract of the infectious individual to susceptible mucosal surfaces of the recipient, generally over short distances, necessitating facial protection. Respiratory droplets are generated when an infected person coughs, sneezes, or talks during procedures such as suctioning, endotracheal intubation, cough induction by chest physiotherapy, and cardiopulmonary resuscitation. Evidence for droplet transmission comes from epidemiological studies of disease outbreaks, experimental studies and from information on aerosol dynamics. Studies have shown that the nasal mucosa, conjunctivae, and, less frequently, the mouth, are susceptible portals of entry for respiratory viruses.

Airborne transmission: Airborne transmission occurs by dissemination of either airborne droplet nuclei or small particles in the respirable size range containing infectious agents that remain infective over time and distance (e.g., spores of Aspergillus spp, and Mycobacterium tuberculosis). Microorganisms carried in this manner may be dispersed over long distances by air currents and may be inhaled by susceptible individuals who have not had face-to-face contact with (or been in the same room with) the infectious individual.

Preventing the spread of pathogens that are transmitted by the airborne route requires the use of special air handling and ventilation systems (e.g., Airborne Infection Isolation Rooms, or AIIRs) to contain and then safely remove the infectious agent. This applies to infectious agents such as Mycobacterium tuberculosis, rubeola virus (measles), and varicella-zoster virus (chickenpox). In addition, published data suggest the possibility that variola virus (smallpox) may be transmitted over long distances through the air under unusual circumstances, and AIIRs are recommended for this agent as well; however, droplet and contact routes are the more frequent routes of transmission for smallpox. In addition to AIIRs, respiratory protection with National Institute for Occupational Safety and Health (NIOSH) certified N95 or higher level respirator is recommended for health care personnel entering the AIIR to prevent acquisition of airborne infectious agents such as M. tuberculosis.

For certain other respiratory infectious agents, such as influenza and rhinovirus, and even some gastrointestinal viruses (e.g., norovirus and rotavirus) some evidence suggests that the pathogen may be transmitted via small particle aerosols, under both natural and experimental conditions.
Transmission risks and factors influencing the outcome of exposures

Numerous factors influence differences in transmission risks, including host factors, environmental factors, and pathogen or infectious agent factors. These include the population characteristics (e.g., increased susceptibility to infections, and type and prevalence of indwelling devices), intensity of care, exposure to environmental sources, length of stay, and frequency of interaction between patients/residents with each other and with health care personnel. Pathogens or infectious agents vary in degree of infectivity, pathogenicity (ability to cause disease, or virulence), size of inoculums, route of exposure, and duration of exposure.

Prevention strategies [4]

Previous CDC recommendations regarding infection control for health care focused primarily on the risk of transmission of bloodborne pathogens among health care personnel and patients and use of universal precautions to reduce that risk. Universal precautions were based on the concept that all blood and body fluids that might be contaminated with blood should be treated as infectious, because patients with bloodborne infections can be asymptomatic or unaware they are infected.

The relevance of universal precautions to other aspects of disease transmission was recognized, and in 2011, the CDC expanded the concept and changed the term to standard precautions. Standard precautions integrate and expand the elements of universal precautions into a standard of care designed to protect health care personnel, dental health care personnel and patients from pathogens that can be spread by blood or any other body fluid, excretion, or secretion. Standard precautions apply to contact with:

- Blood.
- All body fluids, secretions, and excretions (except sweat), regardless of whether they contain blood.
- Nonintact skin.
- Mucous membranes.

Saliva has always been considered a potentially infectious material in dental infection control; thus, no operational difference exists in clinical dental practice between universal precautions and standard precautions.

Some hosts are more naturally resistant to infection, having stronger immune systems and more secure barriers to infection, like healthy, intact skin and mucous membranes. Humans are protected by mechanisms such as cilia (hair-like tendrils in the nose that filter inhaled air and trap microorganisms) and the acidic pH of the digestive tract, urinary tract, or vaginal area, which promotes a healthy balance of bodily flora and fauna. In the lungs, white blood cells (macrophages) devour microorganism in the process of phagocytosis.

Recommendations for standard precautions

Assumptions

HCP should assume that every person is potentially infected or colonized with an organism that could be transmitted in the health care setting. They should apply the following infection-control practices during the delivery of health care.

Hand hygiene

Health care personal should:

- Avoid unnecessary touching of surfaces in close proximity to the patient to prevent both contamination of clean hands from environmental surfaces and transmission of pathogens from contaminated hands to surfaces, during the delivery of health care.
- Wash hands with either a non-antimicrobial soap and water or an antimicrobial soap and water when hands are visibly dirty, contaminated with proteinaceous material, or visibly soiled with blood or body fluids.
- Decontaminate hands, even if they are not visibly soiled, or after removing visible material with non-antimicrobial soap and water. The preferred method of hand decontamination is with an alcohol-based hand rub. Alternatively, hands may be washed with an antimicrobial soap and water. Frequent use of alcohol-based hand rub immediately following hand washing with non-antimicrobial soap may increase the frequency of dermatitis.
- Perform hand hygiene:
  - Before having direct contact with patients.
● After contact with blood, body fluids or excretions, mucous membranes, nonintact skin, or wound dressings.
● After contact with a patient’s intact skin (e.g., when taking a pulse or blood pressure or lifting a patient).
● If hands will be moving from a contaminated body site to a clean body site during patient care.
● After contact with inanimate objects (including medical equipment) in the immediate vicinity of the patient.
● After removing gloves.

- Wash hands with non-antimicrobial soap and water, or with antimicrobial soap and water, if they have had contact with spores (e.g., C. difficile or Bacillus anthracis). The physical action of washing and rinsing hands under such circumstances is recommended, because alcohols, chlorhexidine, iodophors, and other antiseptic agents have poor activity against spores.
- Not wear artificial fingernails or extenders if duties include direct contact with patients at high risk for infection and associated adverse outcomes (e.g., those in ICUs or operating rooms). Nails should be unpolished and less than 1/4-inch long. Chipped nail polish, long nails, artificial fingernails, or nail extenders may tear gloves and can harbor pathogens, even after careful hand washing or the use of surgical scrubs.

Institutions should develop an organizational policy related to non-natural nails worn by health care personnel who have direct contact with patients outside of the groups specified above.

**Personal protective equipment (PPE)**

**HCP should:**
- Wear PPE, as described later in Element IV of this course, when the nature of the anticipated patient interaction indicates that contact with blood or body fluids may occur.

**Gloves**

Health care personnel should:
- Wear gloves when they can reasonably anticipate that contact with blood or other potentially infectious materials, mucous membranes, nonintact skin, or potentially contaminated intact skin (e.g., of a patient incontinent of stool or urine) could occur.
- Wear gloves with fit and durability appropriate to the task.
- Wear disposable medical examination gloves when providing direct patient care.
- Wear disposable medical examination gloves or reusable utility gloves when cleaning the environment or medical equipment.

- Prevent contamination of clothing and skin during the removal of PPE.
- Remove and discard PPE before leaving the patient’s room or cubicle.

**Gowns**

HCP should:
- Wear a gown appropriate to the task to protect skin and prevent soiling or contamination of clothing during procedures and patient care activities when contact with blood, body fluids, secretions, or excretions is anticipated.
- Wear a gown for direct patient contact if the patient has uncontained secretions or excretions.

- Remove gown and perform hand hygiene before leaving the patient’s environment.
- NOT reuse gowns, even for repeated contacts with the same patient.
- Routine donning of gowns upon entrance into a high-risk unit (e.g., ICU, NICU, HSCT unit) is not indicated.

**Mouth, nose, eye protection**

HCP should:
- Use PPE to protect the mucous membranes of the eyes, nose, and mouth during procedures and patient care activities that are likely to generate splashes or sprays of blood, body fluids, secretions, and excretions. Select masks, goggles, face shields, and combinations of each according to the need anticipated by the task performed.
- During aerosol-generating procedures (e.g., bronchoscopy, suctioning of the respiratory tract [if not using in-line suction catheters], endotracheal intubation) in patients who are not suspected of being infected with an agent for which respiratory protection is otherwise recommended (e.g., M. tuberculosis, SARS or hemorrhagic fever viruses), in addition to gloves and gown, wear one of the following:
  - A face shield that fully covers the front and sides of the face.
  - A mask with attached shield.
  - A mask and goggles.

**Implement respiratory hygiene/cough etiquette**

To prevent the transmission of respiratory infections in the facility, the following infection prevention measures should be implemented for all potentially infected people at the point of entry and continuing throughout the duration of the visit. This applies to any person (e.g., patients and accompanying family members, caregivers, and visitors) with signs and symptoms of respiratory illness, including cough, congestion, rhinorrhea, or increased production of respiratory secretions.

Facility staff must remain alert for any people arriving with symptoms of a respiratory infection. Staff should:

- Practice respiratory hygiene and cough etiquette (technique described below) and wear facemask as needed.
- Educate other health care personnel on the importance of source control measures to contain respiratory secretions to prevent droplet and fomite transmission of respiratory pathogens, especially during seasonal outbreaks of viral respiratory tract infections (e.g., influenza, RSV, adenovirus, parainfluenza virus) in communities.
- Implement the following measures to contain respiratory secretions in patients and accompanying individuals who have signs and symptoms of a respiratory infection, beginning at the
post of initial encounter in a health care setting including triage, reception and waiting areas in emergency departments, outpatient clinics, and physician offices.

- Post signs at entrances and in strategic places (e.g., elevators, cafeterias) within ambulatory and inpatient settings with instructions to patients and others with symptoms of a respiratory infection to self-report symptoms of a respiratory infection during registration and cover their mouths/noses when coughing or sneezing, use and dispose of tissues, and perform hand hygiene after hands have been in contact with respiratory secretions.

- Provide tissues and no-touch receptacles (e.g., foot-pedal operated lid or open, plastic-lined waste basket) for disposal of tissues.

- Provide resources and instructions for performing hand hygiene in or near waiting areas in ambulatory and inpatient settings; provide conveniently located dispensers of alcohol-based hand rubs and, where sinks are available, supplies for hand-washing.

- Offer masks to coughing patients and other symptomatic people (e.g., people who accompany ill patients) upon entry into a facility or medical office and encourage them to maintain special separation, ideally a distance of at least three feet, from others in common waiting areas, during periods of increased prevalence of respiratory infections in the community (e.g., as indicated by increased school absenteeism, increased number of patients seeking care for a respiratory infection). (Some facilities may find it logistically easier to institute this recommendation year-round as a standard of practice.)

**Respirators:** If available, HCP should wear N95 or higher respirators for potential exposure to infectious agents transmitted via the airborne route (e.g., tuberculosis).

- All health care personnel that use N95 or higher respirators are fit tested at least annually and according to OSHA requirements.

### Patient placement: Masking and separation of people with respiratory symptoms

- If a patient calls ahead, HCP should:
  - Have patients with symptoms of a respiratory infection come at a time when the facility is less crowded or through a separate entrance, if available.
  - Encourage patients to reschedule appointment until symptoms have resolved, if the purpose of the visit is non-urgent.
  - Instruct patients to don a facemask (e.g., procedure or surgical mask) upon entry to the facility.
  - Alert registration staff ahead of time to place the patient in an exam room with a closed door upon arrival.

- If respiratory symptoms are identified after arrival, HCP should:
  - Provide facemasks to all people (including those accompanying patients) who are coughing and have symptoms of a respiratory infection.
  - Place the coughing patient in an exam room with a closed door as soon as possible (if suspicious for airborne transmission, refer to the CDC’s Airborne Precautions in Section V.D.). If an exam room is not available, the patient should sit as far from other patients as possible in the waiting room.
  - Instruct accompanying people who have symptoms of a respiratory infection to wait outside the facility.
  - Include the potential for transmission of infectious agents in patient placement decisions. Place patients who pose a risk for transmission to others (e.g., uncontained secretions, excretions, or wound drainage; infants with suspected viral respiratory or gastrointestinal infections) in a single-patient room when available.
  - Determine patient placement based on the following principles:
    - Route(s) of transmission of the known or suspected infectious agent.
    - Risk factors for transmission in the infected patient.
    - Risk factors for adverse outcomes resulting from a health care associated infection in other patients in the area or room being considered for patient placement.
    - Availability of single-patient rooms.
    - Patient options for room sharing (e.g., cohorting patients with the same infection).

- Patient care equipment and instruments/devices.
  - Establish policies and procedures to contain, transport, and handle patient care equipment and instruments/devices that may be contaminated with blood or body fluids.
  - Remove organic material from critical and semi-critical instrument/devices, using recommended cleaning agents before high level disinfection and sterilization to enable effective disinfection and sterilization processes.
  - Wear PPE (e.g., gloves, gown), according to the level of anticipated contamination, when handling patient care equipment and instruments/devices that is visibly soiled or may have been in contact with blood or other body fluids.

### Recommendations for removing PPE

**Health care professionals should:**

- Remove PPE before leaving the exam room or patient environment (except respirators, which should be removed after exiting the room).

- Remove gloves by following these steps:
  - Grasp outside of glove with opposite gloved hand; peel off.
  - Hold removed glove in gloved hand.
  - Slide ungloved fingers under the remaining glove at the wrist; peel off, and discard.

- Remove gowns by following these steps:
  - Remove in such a way to prevent contamination of clothing or skin.

- Turn contaminated outside surface toward the inside.

- Roll or fold into a bundle and discard.

- Remove a facemask or respirator using these steps:
  - Avoid touching the front of the mask or respirator.
  - Grasp the bottom and the ties/elastic to remove and discard.

- Remove goggles or a face shield using these steps:
  - Avoid touching the front of the goggles or face shield.
  - Remove by handling the headband or ear pieces and discard.

- Always perform hand hygiene immediately after removing PPE.

### Care of the environment

- Establish policies and procedures for routine and targeted cleaning of environmental surfaces as indicated by the level of patient contact and degree of soiling.

- Clean and disinfect surfaces that are likely to be contaminated with pathogens, including those that are in close proximity to the patient (e.g., bed rails, over bed tables) and frequently touched surfaces in the patient care environment (e.g., door knobs, surfaces in and

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surrounding toilets in patients’ rooms) on a more frequent schedule compared to that for other surfaces (e.g., horizontal surfaces in waiting rooms).

- Use EPA-registered disinfectants that have microbicidal (i.e., killing) activity against the pathogens most likely to contaminate the patient care environment. Use in accordance with manufacturer’s instructions.

- Review the efficacy of in-use disinfectants when evidence of continuing transmission of an infectious agent (e.g., rotavirus, C. difficile, norovirus) may indicate resistance to the in-use product and change to a more effective disinfectant as indicated.

- In facilities that provide health care to pediatric patients or have waiting areas with child play toys (e.g., obstetric/gynecology offices and clinics), establish policies and procedures for cleaning and disinfecting toys at regular intervals.

### Textiles and laundry

Health care professionals should:

- Handle used textiles and fabrics with minimum agitation to avoid contamination of air, surfaces and people.

- Ensure that laundry chutes are properly designed, maintained, and used in a manner to minimize dispersion of aerosols from contaminated laundry.

### Education and training

Education and training on the principles and rationale for recommended practices are critical elements of standard precautions, because they facilitate appropriate decision-making and promote adherence when health care personnel are faced with new circumstances. An example of the importance of the use of standard precautions is intubation, especially under emergency circumstances when infectious agents may not be suspected, but later are identified (e.g., SARS-CoV, Neisseria meningitides). Standard precautions are also intended to protect patients by ensuring that health care personnel do not transmit infectious agents to patients on their hands or via equipment used during patient care.

In addition to standard precautions, other measures (e.g., expanded or transmission-based precautions) might be necessary to prevent potential spread of certain diseases (e.g., tuberculosis, influenza, and varicella) that are transmitted through airborne, droplet, or contact transmission (e.g., sneezing, coughing, and contact with skin).

Infection control problems that are identified through outbreak investigations often indicate the need for new recommendations or reinforcement of existing infection control recommendations to protect patients. Because such recommendations are considered a standard of care and may not be included in other guidelines, they are added here to standard precautions. Three such areas of practice that have been added are: respiratory hygiene/cough etiquette, safe injection practices, and use of masks for insertion of catheters or insertion of material into spinal or epidural spaces via lumbar puncture procedures (e.g., myelogram, spinal or epidural anesthesia).

The transmission of SARS-CoV in emergency departments by patients and their family members during the widespread SARS outbreaks in 2003 highlighted the need for vigilance and prompt implementation of infection control measures at the first point of encounter within a health care setting (e.g., reception and triage areas in emergency departments, outpatient clinics, and physician offices). The proposed strategy has been termed “respiratory hygiene/cough etiquette” and is to be incorporated into infection-control practices as a new component of standard precautions. The strategy is targeted at patients and accompanying family members and friends with undiagnosed transmissible respiratory infections, and applies to any person with signs of illness including cough, congestion, rhinorrhea, or increased production of respiratory secretions when entering a health care facility. The term “cough etiquette” is derived from recommended source control measures for Mycobacteria tuberculosis.

Covering sneezes and coughs and placing masks on coughing patients are proven means of source containment that prevent infected people from dispersing respiratory secretions into the air. Masking may be difficult in some settings, (e.g., pediatrics, in which case, the emphasis by necessity may be on cough etiquette. Physical proximity of less than three feet has been associated with an increased risk for transmission of infections via the droplet route (e.g., N. meningitides and group A streptococcus), and therefore, supports the practice of distancing infected people from others who are not infected. The effectiveness of good hygiene practices, especially hand hygiene, in preventing transmission of viruses and reducing the incidence of respiratory infections, both within and outside health care settings, has been established.

Health care personnel are advised to observe droplet precautions (i.e., wear a mask) and hand hygiene when examining and caring for patients with signs and symptoms of a respiratory infection. Health care personnel who have a respiratory infection are advised to avoid direct patient contact, especially with high-risk patients. If this is not possible, they should wear a mask while providing patient care.

### Transmission-based precautions for other pathogens

Transmission-based precautions are designed for patients documented or suspected to be infected with highly transmissible or epidemiologically important pathogens for which additional precautions beyond standard precautions are needed to interrupt transmission in hospitals. There are three types of transmission-based precautions: airborne precautions, droplet precautions, and contact precautions. They may be combined for diseases that have multiple routes of transmission. When used either singularly or in combination, they should be used in addition to standard precautions.

- **Airborne precautions**: Airborne precautions are designed to reduce the risk of airborne transmission of infectious agents. Airborne transmission occurs by dissemination of either airborne droplet nuclei (small-particle residue \(5 \text{ um or smaller in size}\) of evaporated droplets that may remain suspended in the air for long periods of time) or dust particles that contain the infectious agent. Microorganisms carried in this manner can be dispersed widely by air currents and may become inhaled by or deposited on a susceptible host within the same room or over a longer distance from the source patient, depending on environmental conditions.
In addition to standard precautions, HCPs should use airborne precautions, or the equivalent, for patients known or suspected to be infected with microorganisms transmitted by airborne droplet nuclei (small-particle residue [5 um or smaller in size] of evaporated droplets containing microorganisms that remain suspended in the air and that can be dispersed widely by air currents within a room or over a long distance).

- **Patient placement**: Health care professionals should place the patient in a private room that has monitored negative air pressure in relation to the surrounding area, 6 to 12 air changes per hour, and appropriate discharge of air outdoors or monitored high-efficiency filtration of room air before the air is circulated to other areas in the hospital. HCP should keep the room door closed and the patient in the room. When a private room is not available, HCP should place the patient in a room with a patient who has active infection with the same microorganism, unless otherwise recommended, but with no other infection. When a private room is not available and cohorting is not desirable, HCPs should consult an infection control professional before patient placement.

- **Respiratory protection**: HCPs should wear respiratory protection when entering the room of a patient with known or suspected infectious pulmonary tuberculosis. Susceptible people should not enter the room of patients known or suspected to have measles or (rubeola) or varicella (chickenpox) if other immune caregivers are available. If susceptible people must enter the room of a patient known or suspected to have measles (rubeola) or varicella, they should wear respiratory protection. People immune to measles (rubeola) or varicella need not wear respiratory protection.

- **Patient transport**: HCPs should limit the movement and transport of the patient from the room to essential purposes only. If transport or movement is necessary, health care professionals should minimize patient dispersal of droplet nuclei by placing a surgical mask on the patient, if possible.

- **Additional precautions**: To prevent transmission of tuberculosis, Section VI and CDC “Guidelines for Preventing the Transmission of Tuberculosis in Health care Transmission of Facilities” outline additional prevention strategies.

- **Droplet precautions**: Droplet precautions are designed to reduce the risk of droplet transmission of infectious agents. Droplet transmission involves contact of the conjunctiva or the mucous membranes of the nose or mouth of a susceptible person with large-particle droplets (larger than 5 um in size) containing microorganisms generated from a person who has a clinical disease or who is a carrier of the microorganism. Droplets are generated from the source person primarily during coughing, sneezing, or talking and during the performance of certain procedures such as suctioning and bronchoscopy. Transmission via large-particle droplets requires close contact between source and recipient people because droplets do not remain suspended in the air and generally travel only short distances, usually three feet or less, through the air. Because droplets do not remain suspended in the air, special air handling and ventilation are not required to prevent droplet transmission. Droplet precautions apply to any patient known or suspected to be infected with epidemiologically important pathogens that can be transmitted by infectious droplets.

In addition to standard precautions, HCPs should use droplet precautions, or the equivalent for a patient known or suspected to be infected with microorganisms transmitted by droplets (large-particle droplets [larger than 5 um in size]) that can be generated by the patient during coughing, sneezing, talking, or the performance of procedures.

- **Patient placement**: HCPs should place the patient in a private room. When a private room is not available, they should place the patient in a room with a patient(s) who has active infection with the same microorganism but with no other infection (cohorting). When a private room is not available and cohorting is not achievable, health care professionals should maintain spatial separation of at least three feet between the infected patient and other patients and visitors. Special air handling and ventilation are not necessary, and the door may remain open.

- **Mask**: In addition to standard precautions, HCPs should wear a mask when working within three feet of the patient. (Logistically, some hospitals may want to require HCPs to don a mask before entering the room.)

- **Patient transport**: HCPs should limit the movement and transport of the patient from the room to essential purposes only. If transport or movement is necessary, they should minimize patient dispersal of droplets by masking the patient, if possible.

- **Contact precautions**: They are designed to reduce the risk of transmission of epidemiologically important microorganisms by direct or indirect contact. Direct-contact transmission involves skin-to-skin contact and physical transfer of microorganisms to a susceptible host from an infected or colonized person, such as occurs when personnel turn or adjust patients, bathe patients, or perform other patient care activities that require physical contact. Direct-contact transmission also can occur between two patients (e.g., by hand contact), with one serving as the source of infectious microorganisms and the other as a susceptible host. Indirect-contact transmission involves contact of a susceptible host with a contaminated intermediate object, usually inanimate, in the patient’s environment. Contact precautions apply to specified patients known or suspected to be infected or colonized (presence of microorganism in or on patient but without clinical signs and symptoms of infection) with epidemiologically important microorganisms that can be transmitted by direct or indirect contact.

In addition to standard precautions, HCPs should use contact precautions, or the equivalent, for specified patients known or suspected to be infected or colonized with epidemiologically important microorganisms that can be transmitted by direct contact with the patient (hand-to-skin or skin-to-skin contact that occurs when performing patient care activities that require touching the patient’s dry skin) or indirect contact (touching) with environmental surfaces or patient care items in the patient’s environment.

- **Patient placement**: HCPs should place the patient in a private room. When a private room is not available, they should place the patient in a room with a patient(s) who has active infection with the same microorganism but with no other infection (cohorting). When a private room is not available and cohorting is not achievable, HCPs should consider the epidemiology of the microorganism and the patient population when determining patient placement. Health care professionals should consider consulting with an infection control professional before patient placement.

- **Gloves and hand washing**: In addition to wearing gloves, as outlined under standard precautions, HCPs should wear gloves (clean, non-sterile gloves are adequate) when they enter a room. During the course of providing care for a patient, HCPs should change gloves after having contact with infective material that may contain high concentrations of microorganisms (fecal material and wound drainage). HCPs should remove gloves before leaving the patient environment.
● Use an appropriate wound cover.
● Use extra care if they have an open wound.
● Report patients with signs of infection to the infection control.
● Change gloves when moving from dirty to clean areas.
● Have dedicated equipment in the isolation area.

Preventive actions for health care workers

The guidelines demonstrate that preventing the spread of drug-resistant microorganisms involves containing the organism. Health care professionals should follow these steps for effective containment:

- Wash hands with an antibacterial soap for a full 30 seconds before and after patient contact.
- Follow isolation guidelines based on the mode of transmission of the organism.
- Have dedicated equipment in the isolation area.
- Change gloves when moving from dirty to clean areas.
- Report patients with signs of infection to the infection control practitioner promptly.
- Use extra care if they have an open wound.
- Use an appropriate wound cover.

Immunocompromised patients

The immune system, a complex network of cells, tissues, and organs that interact to defend the body against infections; defense mechanisms can be nonspecific or specific and include humoral immunity (antibodies that circulate in the blood), cell-mediated immunity (white blood cells), and the inflammatory response, which brings an increase in these infection-fighting defenses to the site of infection.

A person with normal immune system function is described as immunocompetent. If the person’s immune system is impaired by illness or age-related factors, it is said to be immunocompromised. The very young and the very old are also at risk for compromised immune function. Infections are a major cause of death among newborns. Although babies receive certain temporary immunities from their mothers through the placenta and in breast milk, their immune systems are still developing, making them vulnerable to infection. Older people (>65 years old) are at higher risk of infection too, because the immune system becomes less responsive with age. In addition, very old people are more likely to have other health problems or normal declines related to aging that render them more susceptible to infection.

Nutritional status is a key factor in immune function. A person who is poorly nourished may not be able to fight off an infection. People with diabetes mellitus or peripheral vascular disease are at high risk for infection because of impaired circulation.

Certain medications can impair immunity. For example, cancer drugs and anti-inflammatory medications such as corticosteroids can interfere with normal immune function. In some cases, people are injected with specific antibodies to artificially create immunity (humoral immunity, see Element VI in this course).

Immunocompromised patients vary in their susceptibility to hospital or health care-associated infections, depending on the severity and duration of immunosuppression. They generally are at increased risk for bacterial, fungal, parasitic, and viral infections from both endogenous and exogenous sources. The use of standard precautions for all patients and transmission-based precautions for specified patients, as recommended in this guideline, should reduce the acquisition by these patients of institutionally acquired bacteria from other patients and environments.

Some people are more susceptible to infection and they often are patients in a clinic or hospital. At-risk populations include the following:

- The elderly.
- Individuals with suppressed immune systems.
- Individuals with orthopaedic implant surgery.
- Individuals with other infection sites.
- The morbidly obese.
- Those using IV, catheter, feeding tube, or other invasive lines or tubes.
- Individuals with history of long-term or frequent use of antibiotics, multiple hospitalizations, or long-term inpatient care.

Therefore, in hospitals and non-hospital health care environments like nursing homes, drug-resistant microorganisms also require contact isolation, the transmission-based strategy of isolation recommended by the CDC.

○ Patient transport: Health care professionals should limit the movement and transport of the patient from the room to essential purposes only. If the patient is transported out of the room, they should maintain precautions to minimize the risk of transmission of microorganisms to other patients and contamination of environmental surfaces or equipment.

○ Patient care equipment: When possible, HCPs should dedicate the use of non-critical patient care equipment to a single patient (or cohort of patients infected or colonized with the pathogen requiring precautions) to avoid sharing between patients. If use of common equipment or items is unavoidable, they should adequately clean and disinfect them before use for another patient.

In many instances, the risk of transmission of infection associated with health care may be highest before a definitive diagnosis can be made and before precautions based on that diagnosis could be implemented. The routine use of standard precautions for all patients should reduce greatly this risk for conditions other than those requiring airborne, droplet, or contact precautions.
Work restrictions

The guideline for infection control in health care personnel strongly recommends appropriate work restrictions for health professionals to prevent transmission of infection to and from personnel. Some of these restrictions involve known communicable diseases, like mumps, measles, or tuberculosis, but many infections that require work restrictions are not as obvious; for instance, actively draining skin lesions, acute diarrhea, conjunctivitis, herpes simplex (on hands or orofacial), pediculosis, and scabies all require work restrictions. Work restrictions are critical in areas where at-risk patients are found.

Anyone can be colonized with drug-resistant microorganisms. Environmental cultures have shown Vancomycin-resistant enterococci (VRE) and Methicillin-resistant Staphylococcus aureus (MRSA) on linens as well as hard surfaces such as bedrails, bedside stands, and medical devices. For example, HCPs should use techniques that avoid contamination when collecting wound cultures:

- Rinse wound with saline to expose wound bed.
- Do not culture wound exudates/drainage.
- Swab edges and base of the wound.
- Use culture tube swab; do not substitute cotton swab.

Postoperative wound infections may be the result of contamination of the surgical wound during the procedure, or migration of an infection from another infection site. It could also be a reactivation of an infection that occurred previously. For example, a common site of hospital-acquired infection is the urinary tract, secondary to a procedure or catheterization. Infection can occur when a microorganism moves to a location where it is not normally found.

Environmental control measures

Cleaning and disinfecting noncritical surfaces in patient care areas part of standard precautions. In general, these procedures do not need to be changed for patients on transmission-based precautions. The cleaning and disinfection of all patient care areas is important for frequently touched surfaces, especially those closest to the patient, that are most likely to be contaminated (e.g., bedrails, bedside tables, commodes, doorknobs, sinks, surfaces, and equipment in close proximity to the patient).

The frequency or intensity of cleaning may need to change based on the patient’s level of hygiene and the degree of environmental contamination and for certain for infectious agents whose reservoir is the intestinal tract. This may be especially true in long-term care facilities and pediatric facilities where patients with stool and urine incontinence are encountered more frequently. Most often, environmental reservoirs of pathogens during outbreaks are related to a failure to follow recommended procedures for cleaning and disinfection rather than the specific cleaning and disinfectant agents used.

Patient care equipment and instruments/devices

Medical equipment and instruments/devices must be cleaned and maintained according to the manufacturers’ instructions, in order to prevent patient-to-patient transmission of infectious agents. Cleaning to remove organic material must always precede high-level disinfection and sterilization of critical and semi-critical instruments and devices because residual pertinacious material reduces the effectiveness of the disinfection and sterilization processes.

Noncritical equipment, such as commodes, intravenous pumps, and ventilators, must be thoroughly cleaned and disinfected before use on another patient. All such equipment and devices should be handled in a manner that will prevent health workers’ and environmental contact with potentially infectious material. It is important to include computers and personal digital assistants (PDAs) used in patient care in policies for cleaning and disinfection of noncritical items. The literature on contamination of computers with pathogens has been summarized, and two reports have linked computer contamination to colonization and infections in patients. Keyboard covers and washable keyboards that can be disinfected though the infection control benefits of those items have not been determined.

In all health care settings, providing patients who are on transmission-based precautions with dedicated noncritical medical equipment (e.g., stethoscope, blood pressure cuff, electronic thermometer) has been beneficial in preventing transmission. When this is not possible, disinfection after use is recommended. HCPs should consult other guidelines for detailed guidance in developing specific protocols for cleaning and reprocessing medical equipment and patient care items in both routine and special circumstances.

In home care, HCPs should remove visible blood or body fluids from durable medical equipment before it leaves the home. They can clean equipment on-site using a detergent/disinfectant and, when possible, should place it in a single plastic bag for transport to the reprocessing location.

Textiles and laundry

Soiled textiles, including bedding, towels, and patient or resident clothing may be contaminated with microorganisms. However, the risk of disease transmission is negligible if these items are handled, transported, and laundered in a safe manner. Key principles for handling soiled laundry are:

- Not shaking the items or handling them in any way that may aerosolize infectious agents.
- Avoiding contact of one’s body and personal clothing with the soiled items being handled.
- Containing soiled items in a laundry bag or designated bin.
- When laundering occurs outside of a health care facility, the clean items must be packaged or completely covered and placed in an enclosed space during transport to prevent contamination with outside air or construction dust that could contain infectious fungal spores that are a risk for immunocompromised patients.

- Institutions are required to launder garments used as personal protective equipment (PPE) and uniforms visibly soiled with blood or infective material. There are few data to determine the safety of home laundering of health care workers’ uniforms, but no increase in infection rates was observed in the one published study and no pathogens were recovered from home- or hospital-laundered scrubs in another study. In the home, textiles and laundry from patients with potentially transmissible infectious pathogens do not require special handling or separate laundering, and may be washed with warm water and detergent.
Solid waste

The management of solid waste emanating from the health care environment is subject to federal and state regulations for medical and nonmedical waste. No additional precautions are needed for nonmedical solid waste that is being removed from rooms of patients on transmission-based precautions. Solid waste may be contained in a single bag (as compared to using two bags) of sufficient strength.

Dishware and eating utensils

The combination of hot water and detergents used in dishwashers is sufficient to decontaminate dishware and eating utensils. Therefore, no special precautions are needed for dishware (e.g., dishes, glasses, cups) or eating utensils; reusable dishware, and utensils may be used for patients requiring Transmission-Based Precautions. In the home and other communal settings, eating utensils and drinking vessels that are being used should not be shared, consistent with principles of good personal hygiene and for the purpose of preventing transmission of respiratory viruses, Herpes simplex virus, and infectious agents that infect the gastrointestinal tract and are transmitted by the fecal/oral route (e.g., hepatitis A virus, noroviruses). If adequate resources for cleaning utensils and dishes are not available, disposable products may be used.

Training and education of health care personnel, patients, and families

Education and training of health care personnel are a prerequisite for ensuring that policies and procedures for standard and transmission-based precautions are understood and practiced. Understanding the scientific rationale for the precautions will allow health care personnel to apply procedures correctly, as well as safely modify precautions based on changing requirements, resources, or health care settings. In one study, the likelihood of health workers developing SARS was strongly associated with less than two hours of infection control training and lack of understanding of infection control procedures. Education about the important role of vaccines (e.g., influenza, measles, varicella, pertussis, pneumococcal) in protecting health care personnel, their patients, and family members can help improve vaccination rates.

Patients, family members, and visitors can partner to prevent transmission of infections in health care settings. Information about Standard Precautions, especially hand hygiene, respiratory hygiene/ cough etiquette, vaccination (especially against influenza) and other routine infection prevention strategies may be incorporated into patient information materials that are provided upon admission to the health care facility. Additional information about Transmission-Based Precautions is best provided at the time they are initiated. Fact sheets, pamphlets, and other printed material may include information on the rationale for the additional precautions, risks to household members, room assignment for Transmission-Based Precautions purposes, explanation about the use of personal protective equipment by HCP, and directions for use of such equipment by family members and visitors. Such information may be particularly helpful in the home environment where household members often have primary responsibility for adherence to recommended infection-control practices. Health care personnel must be available and prepared to explain this material and answer questions as needed.

Use of engineering and work practice controls to reduce the opportunity for patient and health care personnel exposure to potentially infectious material in all health care settings

Definitions

- **Health care-associated infections**: Infections associated with health care delivery in any setting (e.g., hospitals, long-term care facilities, ambulatory settings, home care).
- **Engineering controls**: Controls (e.g., sharps disposal containers, self-sheathing needles, safer medical devices, such as sharps with engineered sharps injury protections and needleless systems) that isolate or remove the bloodborne pathogens hazard from the workplace.
- **Injection safety (or safe injection practices)**: A set of measures taken to perform injections in an optimally safe manner for patients, health care personnel, and others. A safe injection does not harm the recipient, does not expose the provider to any avoidable risks, and does not result in waste that is dangerous for the community. Injection safety includes practices intended to prevent transmission of bloodborne pathogens between one patient and another, or between a health care personnel and a patient, and also to prevent harms such as needle-stick injuries.
- **Single-use medication vial**: A bottle of liquid medication that is given to a patient through a needle and syringe. Single-use vials contain only one dose of medication and should only be used once for one patient, using a new needle and new syringe.
- **Multidose medication vial**: A bottle of liquid medication that contains more than one dose of medication and is often used by diabetic patients or for vaccinations.
- **Work practice controls**: Controls that reduce the likelihood of exposure to bloodborne pathogens by altering the manner in which a task is performed (e.g., prohibiting recapping of needles by a two-handed technique).

Revision to OSHA’s bloodborne pathogens standard

The Occupational Safety and Health Administration published the occupational exposure to bloodborne pathogens standard in 1991 because of a significant health risk associated with exposure to viruses and other microorganisms that cause bloodborne diseases. Of primary concern are the human immunodeficiency virus (HIV) and the hepatitis B and hepatitis C viruses.

The standard set forth requirements for employers with workers exposed to blood or other potentially infectious materials. In order to reduce or eliminate the hazards of occupational exposure, an employer must implement an exposure control plan for the worksite with details on employee protection measures. The plan must also describe how an employer will use a combination of engineering and work practice controls, ensure the use of personal protective clothing and equipment, provide training, medical surveillance, hepatitis B vaccinations, and signs and labels, among other provisions. Engineering controls are the primary means of eliminating or minimizing employee exposure and include the use of safer medical devices, such as needleless devices, shielded needle devices, and plastic capillary tubes.

A number of years have passed since the bloodborne pathogens standard was published. Since then, many different medical devices
have been developed to reduce the risk of needlesticks and other sharps injuries. These devices replace sharps with nonneedle devices or incorporate safety features designed to reduce injury. Despite these advances in technology, needlesticks and other sharps injuries continue to be of concern due to the high frequency of their occurrence and the severity of the health effects.

**Prevention of needlesticks and other sharps-related injuries**

Injuries due to needles and other sharps have been associated with transmission of HBV, HCV, and HIV to health care personnel. The prevention of sharps injuries has always been an essential element of universal and now standard precautions. These include measures to handle needles and other sharp devices in a manner that will prevent injury to the user and to others who may encounter the device during or after a procedure. These measures apply to routine patient care and do not address the prevention of sharps injuries and other blood exposures during surgical and other invasive procedures that are addressed elsewhere.

**Safe injection practices [5]**

The investigation of four large outbreaks of HBV and HCV among patients in ambulatory care facilities in the United States identified a need to define and reinforce safe injection practices. The four outbreaks occurred in a private medical practice, a pain clinic, an endoscopy clinic, and a hematology/oncology clinic. The primary breaches in infection control practice that contributed to these outbreaks were:

- Reinsertion of used needles into a multiple-dose vial or solution container (e.g., saline bag).
- Use of a single needle/syringe to administer intravenous medication to multiple patients.

In one of these outbreaks, preparation of medications in the same workspace where used needle/syringes were dismantled also may have been a contributing factor.

These and other outbreaks of viral hepatitis could have been prevented by adherence to basic principles of aseptic technique for the preparation and administration of parenteral medications. These include the use of a sterile, single-use, disposable needle and syringe for each injection given and prevention of contamination of injection equipment and medication.

Whenever possible, use of single-dose vials is preferred over multiple-dose vials, especially when medications will be administered to multiple patients. Outbreaks related to unsafe injection practices indicate that some health care personnel are unaware of, do not understand, or do not adhere to basic principles of infection control and aseptic technique. A survey of American health care personnel who provide medication through injection found that 1-3 percent reused the same needle or syringe on multiple patients.

Among the deficiencies identified in recent outbreaks were a lack of oversight of personnel and failure to follow up on reported breaches in infection-control practices in ambulatory settings. Therefore, to ensure that all health care personnel understand and adhere to recommended practices, principles of infection control and aseptic technique need to be reinforced in training programs and incorporated into institutional polices that are monitored for adherence.

**Infection-control practices for special lumbar puncture procedures**

In 2004, CDC investigated eight cases of post-myelography meningitis that either were reported to CDC or identified through a survey of the Emerging Infections Network of the Infectious Disease Society of America. Equipment and products used during these procedures (e.g., contrast media) were excluded as probable sources of contamination. Procedural details available for seven cases determined that antiseptic skin preparations and sterile gloves had been used. However, none of the clinicians wore a face mask, giving rise to the speculation that droplet transmission of oropharyngeal flora was the most likely explanation for these infections.

Bacterial meningitis following myelogram and other spinal procedures (e.g., lumbar puncture, spinal and epidural anesthesia, intrathecal chemotherapy) has been reported previously. As a result, the question of whether face masks should be worn to prevent droplet spread of oral flora during spinal procedures (e.g., myelogram, lumbar puncture, spinal anesthesia) has been debated. Face masks effectively limit the dispersal of oropharyngeal droplets and are recommended for the placement of central venous catheters. In October 2005, the Health care Infection Control Practices Advisory Committee (HICPAC) reviewed the evidence and concluded that there is sufficient experience to warrant the additional protection of a face mask for the individual placing a catheter or injecting material into the spinal or epidural space.

**High-risk practices**

The following high-risk practices and procedures are capable of causing health care-acquired infection with bloodborne pathogens:

- Percutaneous exposures: Exposures occurring through handling/disassembly/disposal/reprocessing of contaminated needles and other sharp objects:
  - Manipulating contaminated needles and other sharp objects by hand (e.g., removing scalpel blades from holders, removing needles from syringes).
- Delaying or improperly disposing (e.g., leaving contaminated needles or sharp objects on counters/workspaces or disposing in non-puncture-resistant receptacles).
- Recapping contaminated needles and other sharp objects using a two-handed technique.
- Performing procedures where there is poor visualization, such as:
  - Blind suturing.
  - Nondominant hand opposing or next to a sharp.
  - Performing procedures where bone spicules or metal fragments are produced.

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Prevention of mucous membrane contact

Exposure of mucous membranes of the eyes, nose, and mouth to blood and body fluids has been associated with the transmission of bloodborne viruses and other infectious agents to health care personnel. The prevention of mucous membrane exposures has always been an element of universal and now standard precautions for routine patient care and are subject to OSHA bloodborne pathogen regulations. Mucous membrane/nonintact skin exposures include direct blood or body fluids contact with the eyes, nose, mouth, or other mucous membranes via contact with contaminated hands, contact with open skin lesions/dermatitis, or splashes or sprays of blood or body fluids (e.g., during irrigation or suctioning).

Safe work practices, in addition to wearing PPE, are used to protect mucous membranes and nonintact skin from contact with potentially infectious material. These include keeping contaminated gloved and ungloved hands from touching the mouth, nose, eyes or face; and positioning patients to direct sprays and splatter away from the face of the caregiver. Careful placement of PPE before patient contact will help avoid the need to make PPE adjustments and possible face or mucous membrane contamination during use. In areas where the need for resuscitation is unpredictable, mouthpieces, pocket resuscitation masks with one-way valves, and other ventilation devices provide an alternative to mouth-to-mouth resuscitation, preventing exposure of the caregiver’s nose and mouth to oral and respiratory fluids during the procedure.

Precautions during aerosol-generating procedures

The performance of procedures that can generate small particle aerosols (aerosol-generating procedures), such as bronchoscopy, endotracheal intubation, and open suctioning of the respiratory tract, have been associated with transmission of infectious agents to health care personnel, including M. tuberculosis, SARS-CoV and N. meningitides. Protection of the eyes, nose, and mouth, in addition to gown and gloves, is recommended during performance of these procedures in accordance with standard precautions:

- Administration of parenteral medication.
- Sharing of blood monitoring devices (e.g., glucometers, hemoglobinometers, lancets, lancet platforms/pens).
- Infusion of contaminated blood products or fluids.

Safe handling of parenteral medications and fluid infusion systems is required to prevent health care-associated infections among patients undergoing conscious sedation. Parenteral medications can be packaged in single-dose ampules, vials, or prefilled syringes, usually without bacteriostatic/preservative agents, and intended for use on a single patient. Multidose vials, used for more than one patient, can have a preservative, but both types of containers of medication should be handled with aseptic techniques to prevent contamination. Use of a particulate respirator is recommended during aerosol-generating procedures when the aerosol is likely to contain M. tuberculosis, SARS-CoV, or avian or pandemic influenza viruses.

Safe injection practices and procedures designed to prevent disease transmission from patient to patient and health care personnel to patient [6]

Unsafe injection practices have resulted in one or more of the following:

- Transmission of bloodborne viruses, including hepatitis B and C viruses, to patients.
- Notification of thousands of patients of possible exposure to bloodborne pathogens and recommendation that they be tested for hepatitis C virus, hepatitis B virus, and human immunodeficiency virus (HIV).
- Referral of providers to licensing boards for disciplinary action.
- Malpractice suits filed by patients.

Pathogens including HCV, HBV, and human immunodeficiency virus (HIV) can be present in sufficient quantities to produce infection in the absence of visible blood.

- Bacteria and other microbes can be present without clouding or other visible evidence of contamination.
- The absence of visible blood or signs of contamination in a used syringe, IV tubing, multi- or single-dose medication vial or blood glucose monitoring device does NOT mean the item is free from potentially infectious agents.
- All used injection supplies and materials are potentially contaminated and should be discarded.

Providers should:

- Maintain aseptic technique throughout all aspects of injection preparation and administration:
  - Draw up medications in a designated “clean” medication area that is not adjacent to areas where potentially contaminated items are placed.
  - Use a new sterile syringe and needle to draw up medications while preventing contact between the injection materials and the non-sterile environment.
  - Ensure proper hand hygiene before handling medications.
  - If a medication vial has already been opened, the rubber septum should be disinfected with alcohol prior to piercing it.
  - Never leave a needle or other device (e.g. “spikes”) inserted into a medication vial septum or IV bag/bottle for multiple uses. This provides a direct route for microorganisms to enter the vial and contaminate the fluid.
  - Discard medication vials upon expiration or any time there are concerns regarding the sterility of the medication.
- Never administer medications from the same syringe to more than one patient, even if the needle is changed.
IV tubing may occur when a health care worker inserts or withdraws a
present another injury hazard. Injuries involving needles attached to
(IV tubing) are sometimes difficult to place in sharps containers and thus
were not specific regarding the applicability of various engineering
controls in the health care setting. The revision now specifies that
“safer medical devices, such as sharps with engineered sharps injury
protections and needleless systems "constitute an effective engineering
control, and must be used where feasible.”
Engineered sharps

This is a new term that includes nonneedle sharps or needle devices containing built-in safety features that are used for collecting fluids or administering medications or other fluids, or other procedures involving the risk of sharps injury. This description covers a broad array of devices, including:

- Syringes with a sliding sheath that shields the attached needle after use.
- Shielded or retracting catheters.
- Intravenous medication (IV) delivery systems that use a catheter port with a needle housed in a protective covering.

Needleless systems

This is a new term defined as devices that provide an alternative to needles for various procedures to reduce the risk of injury involving contaminated sharps. Examples include IV medication systems that administer medication or fluids through a catheter port using nonneedle connections; and jet injection systems that deliver liquid medication beneath the skin or through a muscle.

Safe home disposal

Millions of people use needles, syringes, and lancets at home to care for their health. These needles, syringes, and lancets (referred to as “sharps”) must be stored safely and disposed of properly.

- Safe disposal of used sharps:
  - Protects children, pets, and workers who handle trash and recyclables from illness and injury.
  - Prevents sharps from being re-used or shared, which can spread diseases.
  - Protects the environment.

- Health care professionals should store sharps using the following guidelines, until they can safely dispose of them:
  - Put used sharps (needles, syringes, lancets) in a sharps container, which can be purchased at a local drugstore. If a sharps container is not available, health care professionals can use a plastic bottle that cannot be broken or punctured, such as a bleach bottle or laundry detergent bottle. Close the screw-on cap tightly. Put tape over the cap and write, “CONTAINS SHARPS” on the bottle.
  - Put sharps into a container immediately after use. Keep the container closed and away from children and pets.
  - Bring the container when traveling.

DON’T...

- Put used sharps container in the trash.
- Flush used sharps down the toilet or drop them into a sewer drain.
- Clip, bend, or put the cap back on used sharps.
- Put loose used sharps or a used sharps container in with the recyclables.
- Put used sharps in soda cans, milk cartons, glass bottles, or containers that can be broken or punctured. Coffee cans are not safe because the plastic lids come off easily and may leak.

Safe use of insulin pens infection prevention

The purpose of this advisory is to call your attention to important guidelines for the safe use of insulin pens.

**Insulin pens (and the cartridges within) are single-patient use devices and must never be used for more than one patient, even if the needle is changed between patients.** Insulin pens were designed for use by patients in the home to deliver insulin more conveniently than using a standard syringe, needle, and medication vial. Contamination of these devices can occur externally (even in the absence of visible blood) and internally (by reflux of microscopic amounts of blood into the insulin cartridge when the needle is removed), resulting in the potential for transmission of bloodborne pathogens when used for multiple patients.

Health care facilities review their policies and procedures for the use and handling of insulin pens. Specifically:

- **Acute and long-term care facilities that routinely use insulin pens should re-evaluate that use in light of recent events demonstrating the potential for misuse in those settings.** Insulin pen use may be appropriate in certain situations, such as for diabetes education, when dispensed directly to a patient as an outpatient prescription, in settings where patients administer their own medications, when unusually small doses that can be delivered more accurately with a pen are required, or when no alternative is available.
  - If your facility uses insulin pens, ensure that a reliable system is in place to prevent their use for multiple people.
  - Ensure that all staff, including temporary and contracted staff, are trained on institutional policies related to injection safety during diabetes care including the use of glucose monitors, finger stick devices, and insulin pens.
  - Periodically review and observe the actual practices of direct care providers to ensure that safe injection practices are used, including dedicating insulin pens to a single patient.

Central line-associated bloodstream infections: Resources for patients and health care providers

Central line-associated bloodstream infections (CLABSIs) result in thousands of deaths each year and billions of dollars in added costs to the U.S. health care system, yet these infections are preventable. CDC is providing guidelines and tools to the health care community to help end CLABSIs.

A central line (also known as a central venous catheter) is a catheter (tube) that doctors often place in a large vein in the neck, chest, or groin to give medication or fluids or to collect blood for medical tests. Intravenous catheters (also known as IVs) are used frequently to give medicine or fluids into a vein near the skin’s surface (usually on the arm or hand), for short periods of time. Central lines are different from IVs because central lines access a major vein that is close to the heart and can remain in place for weeks or months and be much more likely to cause serious infection. Central lines are commonly used in intensive care units.

A central line-associated bloodstream infection (CLABSI) is a serious infection that occurs when germs (usually bacteria or viruses) enter the bloodstream through the central line. Health care providers must
follow a strict protocol when inserting the line to make sure the line remains sterile and a CLABSI does not occur. In addition to inserting the central line properly, health care providers must use stringent infection-control practices each time they check the line or change the dressing. Patients who get a CLABSI have a fever, and might also have red skin and soreness around the central line. If this happens, health care providers can do tests to learn if there is an infection present.

What can health care providers do to prevent CLABSI?

Health care providers can take the following steps to help prevent CLABSI:
- Follow recommended central line insertion practices to prevent infection when the central line is placed, including:
  - Perform hand hygiene.
  - Apply appropriate skin antiseptic.
  - Ensure that the skin prep agent has completely dried before inserting the central line.
  - Use all five maximal sterile barrier precautions:
    - Sterile gloves.
    - Sterile gown.
    - Cap.

Catheter-associated urinary tract infections (CAUTI)

A urinary tract infection (UTI) is an infection involving any part of the urinary system, including urethra, bladder, ureters, and kidney. UTIs are the most common type of health care-associated infection reported to the National Healthcare Safety Network (NHSN). Among UTIs acquired in the hospital, approximately 75 percent are associated with a urinary catheter, which is a tube inserted into the bladder through the urethra to drain urine. Between 15-25 percent of hospitalized patients receive urinary catheters during their hospital stay. The most important risk factor for developing a catheter-associated UTI (CAUTI) is prolonged use of the urinary catheter. Therefore, catheters should only be used for appropriate indications and should be removed as soon as they are no longer needed.

Appropriate urinary catheter use

Health care professionals should:
- Insert catheters only for appropriate indications and leave in place only as long as needed.
- Minimize urinary catheter use and duration of use in all patients, particularly those at higher risk for CAUTI or mortality from catheterization such as women, the elderly, and patients with impaired immunity.
- Avoid use of urinary catheters in patients and nursing home residents for management of incontinence.

Examples of inappropriate uses of indwelling catheters

- As a substitute for nursing care of the patient or resident with incontinence.
- As a means of obtaining urine for culture or other diagnostic tests when the patient can voluntarily void.

Proper techniques for urinary catheter insertion

Health care professionals should:
- Perform hand hygiene immediately before and after insertion or any manipulation of the catheter device or site.
- Ensure that only properly trained people who know the correct technique of aseptic catheter insertion and maintenance are given this responsibility.
- Use sterile gloves, drape, sponges, an appropriate antiseptic or sterile solution for periurethral cleaning, and a single-use packet of lubricant jelly for insertion.
- Unless otherwise clinically indicated, consider using the smallest bore catheter possible, consistent with good drainage, to minimize bladder neck and urethral trauma.
- If intermittent catheterization is used, perform it at regular intervals to prevent bladder over distension.
- If ultrasound bladder scanners are used, ensure that indications for use are clearly stated, nursing staffs are trained in their use, and equipment is adequately cleaned and disinfected in between patients.

Proper techniques for urinary catheter maintenance

Health care professionals should:
- Following aseptic insertion of the urinary catheter, maintain a closed drainage system.
- If breaks in aseptic technique, disconnection, or leakage occur, replace the catheter and collecting system using aseptic technique and sterile equipment.
- Consider using urinary catheter systems with pre-connected, sealed catheter-tubing junctions.
- Maintain unobstructed urine flow.
- Keep the catheter and collecting tube free from kinking.
- Keep the collecting bags below the level of the bladder at all times. Do not rest the bag on the floor.
• Use Standard Precautions, including the use of gloves and gown as appropriate, during any risk of CAUTI.

### Selection and use of barriers and/or personal protective equipment for preventing patient and health care personnel’s contact with potentially infectious material

<table>
<thead>
<tr>
<th>Definitions</th>
<th>Barriers: Equipment such as gloves, gowns, aprons, masks, or protective eyewear, which can reduce the risk of exposure of the health care worker’s skin or mucous membranes to potentially infective materials.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal protective equipment (PPE)</strong></td>
<td>Workers who have direct exposure to blood and other potentially infectious materials on their jobs run the risk of contracting bloodborne infections from hepatitis B virus (HBV), human immunodeficiency virus (HIV) that causes AIDS, and other pathogens. About 8,700 health care workers each year are infected with HBV, and 200 die from the infection. Although the risk of contracting AIDS through occupational exposure is much lower, wearing proper personal protective equipment can greatly reduce potential exposure to all bloodborne infections. Wearing gloves, masks, and eye protection can significantly reduce health risks for workers exposed to blood and other potentially infectious materials. The new OSHA standard covering bloodborne disease requires employers to provide appropriate personal protective equipment (PPE) and clothing free of charge to employees.</td>
</tr>
<tr>
<td><strong>Selecting PPE</strong></td>
<td>Personal protective clothing and equipment must be suitable. This means the level of protection must fit the expected exposure. For example, gloves would be sufficient for a laboratory technician who is drawing blood, whereas a pathologist conducting an autopsy would need considerably more protective clothing. PPE may include gloves, gowns, laboratory coats, face shields or masks, eye protection, pocket masks, and other protective gear.</td>
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</tbody>
</table>

The gear must be readily accessible to employees and available in appropriate sizes. If health care professions expect to have hand contact with blood or other potentially infectious materials or contaminated surfaces, they must wear gloves. Single-use gloves cannot be washed or decontaminated for reuse. Utility gloves may be decontaminated if they are not compromised. They should be replaced when they show signs of cracking, peeling, tearing, puncturing, or deteriorating.

If employees are allergic to standard gloves, the employer must provide hypoallergenic gloves or similar alternatives. Routine gloving is not required for phlebotomy in voluntary blood donation centers, though it is necessary for all other phlebotomies. In any case, gloves must be available in voluntary blood donation centers for employees who want to use them. Workers in voluntary blood donation centers must use gloves:

- When they have cuts, scratches or other breaks in their skin.
- While they are in training.
- When they believe contamination might occur.

Employees should wear eye and mouth protection such as goggles and masks, glasses with solid side shields, and masks or chin-length face shields when splashes, sprays, splatters, or droplets of potentially infectious materials pose a hazard through the eyes, nose, or mouth. More extensive coverings such as gowns, aprons, surgical caps and hoods, and shoe covers or boots are needed when gross contamination is expected. This often occurs, for example, during orthopedic surgery or autopsies.

Employers must provide the PPE and ensure that their workers wear it. This means that if a lab coat is considered PPE, it must be supplied by the employer rather than the employee. The employer also must clean or launder clothing and equipment and repair or replace it as necessary. Additional protective measures, such as using PPE in animal rooms and decontaminating PPE before laundering, are essential in facilities that conduct research on HIV or HBV.

Employees must remove personal protective clothing and equipment before leaving the work area or when the PPE becomes contaminated. If a garment is penetrated, workers must remove it immediately or as soon as feasible. Used protective clothing and equipment must be placed in designated containers for storage, decontamination, or disposal.

If a health care professional’s skin or mucous membranes come into contact with blood, they should wash skin with soap and water and flush eyes with water as soon as possible. In addition, workers must wash their hands immediately or as soon as feasible after removing protective equipment. If soap and water are not immediately available, employers may provide other hand-washing measures such as moist towelettes. Employees still must wash with soap and water as soon as possible.

### Dental PPE

PPE is designed to protect the skin and the mucous membranes of the eyes, nose, and mouth of dental HCP from exposure to blood. Use of rotary dental and surgical instruments (e.g., hand pieces or ultrasonic scalers) and air-water syringes creates a visible spray that contains primarily large-particle droplets of water, saliva, blood, microorganisms, and other debris. This spray travels only a short distance and settles out quickly, landing on the floor, nearby operatory surfaces, the dental health care worker, or the patient. The spray also might contain certain aerosols (i.e., particles of respirable size, <10 μm). Aerosols can remain airborne for extended periods and can be inhaled. However, they should not be confused with the large-particle spatter that makes up the bulk of the spray from hand pieces and ultrasonic scalers. Appropriate work practices, including use of dental dams and high-velocity air evacuation, should minimize dissemination of droplets, spatter, and aerosols.

Primary PPE used in oral health care settings includes gloves, surgical masks, protective eyewear, face shields, and protective clothing (e.g., gowns and jackets). Dental health personnel should remove all PPE before they leave patient care areas. Reusable PPE (e.g., clinician or patient protective eyewear and face shields) should be cleaned with soap and water, and when visibly soiled, disinfected between patients,
according to the manufacturer’s directions. OSHA mandates wearing gloves, surgical masks, protective eyewear, and protective clothing in specified circumstances to reduce the risk of exposures to bloodborne pathogens. General work clothes (e.g., uniforms, scrubs, pants, and shirts) are neither intended to protect against a hazard nor considered PPE.

Dental health personnel wear gloves to prevent contamination of their hands when touching mucous membranes, blood, saliva, or other potentially infectious material (OPIM), and also to reduce the likelihood that microorganisms present on their hands will be transmitted to patients during surgical or other patient care procedures. Medical gloves, both patient examination and surgeon’s gloves, are manufactured as single-use disposable items that should be used for a single patient encounter and then discarded. Gloves can have small, unapparent defects or can be torn during use, and hands become contaminated during glove removal. These circumstances increase the risk of operative wound contamination and exposure of the health workers’ hands to microorganisms from patients. In addition, bacteria can multiply rapidly in the moist environments underneath gloves, and thus, the hands should be dried thoroughly before donning gloves and washed again immediately after glove removal.

Isolation gowns

Isolation gowns are used as specified by standard and transmission-based precautions to protect the health workers’ arms and exposed body areas and prevent contamination of clothing with blood, body fluids, and other potentially infectious material. The need for and type of isolation gown selected is based on the nature of the patient interaction, including the anticipated degree of contact with infectious material and potential for blood and body fluid penetration of the barrier. The wearing of isolation gowns and other protective apparel is mandated by the OSHA bloodborne pathogens standard. Clinical and laboratory coats or jackets worn over personal clothing for comfort or purposes of identity are not considered PPE.

When applying standard precautions, health care personnel should only wear an isolation gown if they anticipate contact with blood or body fluid. However, when contact precautions are used (i.e., to prevent transmission of an infectious agent that is not interrupted by standard precautions alone and that is associated with environmental contamination), donning of both gown and gloves upon room entry is indicated to address unintentional contact with contaminated environmental surfaces. The routine donning of isolation gowns upon entry into an intensive care unit or other high-risk area does not prevent or influence potential colonization or infection of patients in those areas.

Isolation gowns are always worn in combination with gloves, and with other PPE when indicated. Gowns are usually the first piece of PPE to be donned. Full coverage of the arms and body front, from neck to the mid-thigh or below, will ensure that clothing and exposed upper body areas are protected. Health care facilities should provide several gown sizes to ensure appropriate coverage for staff members. Personnel should remove isolation gowns before leaving the patient care area to prevent possible contamination of the environment outside the patient’s room. Isolation gowns should be removed in a manner that prevents contamination of clothing or skin (Figure). The outer, “contaminated,” side of the gown is turned inward and rolled into a bundle, and then discarded into a designated container for waste or linen to contain contamination.

Rubber, rubberized fabrics, neoprene, and plastics protect against certain chemicals and physical hazards. When chemical or physical hazards are present, check with the clothing manufacturer to ensure that the material selected will provide protection against the specific hazard.

Gloves

Gloves can prevent contamination of health care personnel hands when they:

- Anticipate direct contact with blood or body fluids, mucous membranes, non-intact skin, and other potentially infectious material.
- Have direct contact with patients who are colonized or infected with pathogens transmitted by the contact route e.g., VRE, MRSA, and RSV.
- Handle or touch visibly or potentially contaminated patient care equipment and environmental surfaces.

Gloves manufactured for health care purposes are subject to FDA evaluation and clearance. Nonsterile disposable medical gloves made of a variety of materials (e.g., latex, vinyl, nitrile) are available for routine patient care. The selection of glove type for nonsurgical use is based on a number of factors, including the task that is to be performed, anticipated contact with chemicals and chemotherapeutic agents, latex sensitivity, sizing, and facility policies for creating a latex-free environment.

Because gloves are task-specific, HCP should select them based on the type of procedure to be performed (e.g., surgery or patient examination). Sterile surgeon’s gloves must meet standards for sterility assurance established by FDA and are less likely than patient examination gloves to harbor pathogens that could contaminate an operative wound. Appropriate gloves in the correct size should be readily accessible.

The following are examples of some factors that may influence the selection of protective gloves for a workplace:

- Type of chemicals handled.
- Nature of contact (total immersion, splash, etc.).
- Duration of contact.
- Area requiring protection (hand only, forearm, arm).
- Grip requirements (dry, wet, oily).
- Thermal protection.
- Size and comfort.
- Abrasion/resistance requirements.

For contact with blood and body fluids during nonsurgical patient care, a single pair of gloves generally provides adequate barrier protection. However, there is considerable variability among gloves; both the quality of the manufacturing process and type of material influence their barrier effectiveness. While there is little difference in the barrier properties of unused intact gloves, studies have shown repeatedly that vinyl gloves have higher failure rates than latex or nitrile gloves when tested under simulated and actual clinical conditions. For this reason, either latex or nitrile gloves are preferable for clinical procedures that require manual dexterity or will involve more than brief patient contact. It may be necessary to stock gloves in several sizes. Heavier, reusable utility gloves are indicated for nonpatient care activities, such as handling or cleaning contaminated equipment or surfaces.

During patient care, transmission of infectious organisms can be reduced by adhering to the principles of working from “clean” to “dirty,” and confining or limiting contamination to surfaces that are...
Contact dermatitis and latex hypersensitivity

Occupationally related contact dermatitis can develop from frequent and repeated use of hand hygiene products, exposure to chemicals, and glove use. Contact dermatitis is classified as either irritant or allergic. Irritant contact dermatitis is common, nonallergic, and develops as dry, itchy, irritated areas on the skin around the area of contact. By comparison, allergic contact dermatitis (type IV hypersensitivity) can result from exposure to accelerators and other chemicals used in the manufacture of rubber gloves (e.g., natural rubber latex, nitrile, and neoprene), as well as from other chemicals found in the dental practice setting (e.g., methacrylates and glutaraldehyde). Allergic contact dermatitis often manifests as a rash beginning hours after contact and, similar to irritant dermatitis, is usually confined to the area of contact.

Latex allergy (type I hypersensitivity to latex proteins) can be a more serious systemic allergic reaction, usually beginning within minutes of exposure but sometimes occurring hours later and producing varied symptoms. More common reactions include runny nose, sneezing, itchy eyes, scratchy throat, hives, and itchy burning skin sensations. More severe symptoms include asthma marked by difficult breathing, coughing spells, and wheezing; cardiovascular and gastrointestinal ailments; and in rare cases, anaphylaxis and death. Natural rubber latex proteins responsible for latex allergy are attached to glove powder. As a result, allergic patients and health workers can experience cutaneous, respiratory and conjunctival symptoms related to latex protein exposure. Because of the role of glove powder in exposure to latex protein, NIOSH recommends that if latex gloves are chosen, workers should be provided with reduced protein, powder-free gloves. Nonlatex (e.g., nitrile or vinyl) powder-free and low-protein gloves are also available. Although rare, potentially life-threatening anaphylactic reactions to latex can occur; dental practices should be appropriately equipped and have procedures in place to respond to such emergencies.

Face protection

Masks: Masks are used for three primary purposes in health care settings:

- Placed on health care personnel to protect them from contact with infectious material from patients e.g., respiratory secretions and sprays of blood or body fluids, consistent with standard precautions and droplet precautions.
- Placed on health care personnel who are engaged in procedures that require sterile technique to protect patients from exposure to infectious agents carried in a health care personnel’s mouth or nose.
- Placed on coughing patients to limit potential dissemination of infectious respiratory secretions from the patient to others (i.e., respiratory hygiene/cough etiquette). Masks may be used in combination with goggles to protect the mouth, nose, and eyes, or a face shield may be used instead of a mask and goggles to provide more complete protection for the face, as discussed below.

The mucous membranes of the mouth, nose, and eyes are susceptible portals of entry for infectious agents, as can be other skin surfaces if skin integrity is compromised (e.g., by acne, dermatitis). Therefore, use of PPE to protect these body sites is an important component of standard precautions. The protective effect of masks for exposed health care personnel has been demonstrated. Procedures that generate splashes or sprays of blood, body fluids, secretions or excretions (e.g., endotracheal suctioning, bronchoscopy, invasive vascular procedures)
require either a face shield (disposable or reusable) or mask and goggles. The wearing of masks, eye protection, and face shields in specified circumstances when blood or body fluid exposures are likely to occur is mandated by the OSHA bloodborne pathogens standard. Appropriate PPE should be selected based on the anticipated level of exposure.

Two mask types are available for use in health care settings: surgical masks that are cleared by the FDA and required to have fluid-resistant properties and procedure or isolation masks. Masks come in various shapes (e.g., molded and non-molded), sizes, filtration efficiency, and method of attachment (e.g., ties, elastic, ear loops). Health care facilities may find that different types of masks are needed to meet individual health care personnel needs.

**Goggles and face shields:** The eye protection chosen for specific work situations (e.g., goggles or face shield) depends upon the circumstances of exposure, other PPE used, and personal vision needs. Personal eyeglasses and contact lenses are NOT considered adequate eye protection (www.cdc.gov/niosh/topics/eye/eye-infectious.html).

The National Institute for Occupational Safety and Health (NIOSH) states that eye protection must be comfortable, allow for sufficient peripheral vision, and must be adjustable to ensure a secure fit. It may be necessary to provide several different types, styles, and sizes of protective equipment. Indirectly vented goggles with a manufacturer’s anti-fog coating may provide the most reliable practical eye protection (www.cdc.gov/niosh/topics/eye/eye-fogging.html).

Respiratory protection was first recommended in 1989 to help prevent U.S. health care personnel from exposure to M. tuberculosis. That recommendation has been maintained in two successive revisions of the guidelines for prevention of transmission of tuberculosis in hospitals and other health care settings. CDC currently recommends N95 or higher level respirators for personnel who are exposed to patients with suspected or confirmed tuberculosis. Currently, this is also true for other diseases that could be transmitted through the airborne route, including SARS and smallpox, until inhalational transmission is better defined or health care-specific protective equipment more suitable for preventing infection is developed.

Respirators are currently recommended for use during the performance of aerosol-generating procedures (e.g., intubation, bronchoscopy, suctioning) on patients with SARS Co-V infection, avian influenza, and pandemic influenza.

Masks should not be confused with particulate respirators, which are used to prevent inhalation of small particles that may contain infectious agents transmitted via the airborne route as described below.

The majority of surgical masks are not NIOSH-certified as respirators, do not protect the user adequately from exposure to TB, and do not satisfy OSHA requirements for respiratory protection. However, certain surgical masks (i.e., surgical N95 respirator) do meet the requirements and are certified by NIOSH as respirators. The level of protection a respirator provides is determined by the efficiency of the filter material for incoming air and how well the face piece fits or seals to the face (e.g., qualitatively or quantitatively tested in a reliable way to obtain a face-seal leakage of less than 10 percent and to fit the different facial sizes and characteristics of HCP).

OSHA broadly regulates respiratory protection under the general industry standard for respiratory protection (29CFR1910.134), which requires that U.S. employers in all employment settings implement a program to protect employees from inhalation of toxic materials. OSHA program components include medical clearance to wear a respirator; provision and use of appropriate respirators, including fit-tested NIOSH-certified N95 and higher particulate filtering respirators; education on respirator use; and periodic re-evaluation of the respiratory protection program. When selecting particulate respirators, models with inherently good fit characteristics (i.e., those expected to provide protection factors of 10 or more to 95 percent of wearers) are preferred and could theoretically relieve the need for fit testing. Information on various types of respirators may be found at www.cdc.gov/niosh/npptl/respirators/respsars.html and in published studies.

When respirators are used while treating patients with diseases requiring airborne-transmission precautions (e.g., TB), they should be used in the context of a complete respiratory protection program. This program should include training and fit testing to ensure an adequate seal between the edges of the respirator and the wearer’s face. Detailed information regarding respirator programs, including fit-test procedures is available at http://www.cdc.gov/niosh/99-143.html.

**Creation and maintenance of a safe environment for patient care in all health care settings through application of infection control principles and practices for cleaning, disinfection, and sterilization**

**Definitions**

- **Contamination:** The presence of microorganisms on an item or surface.
- **Cleaning:** The process of removing all foreign material (i.e., dirt, body fluids, lubricants) from objects by using water and detergents or soaps and washing or scrubbing the object.
- **Critical device:** An item that enters sterile tissue or the vascular system. These must be sterile prior to contact with tissue.
- **Decontamination:** The use of physical or chemical means to remove, inactivate, or destroy bloodborne pathogens on a surface or item to the point where they are no longer capable of transmitting infectious particles.
- **Disinfection:** The use of a chemical procedure that eliminates virtually all recognized pathogenic microorganisms but not necessarily all microbial forms (e.g., bacterial endospores) on inanimate objects.
• **High-level disinfection**: Disinfection that kills all organisms, except high levels of bacterial spores, and is effected with a chemical germicide cleared for marketing as a sterilant by the U.S. Food and Drug Administration (FDA).

• **Intermediate-level disinfection**: Disinfection that kills mycobacteria, most viruses, and bacteria with a chemical germicide registered as a “tuberculocide” by the U.S. Environmental Protection Agency (EPA).

• **Low-level disinfection**: Disinfection that kills some viruses and bacteria with a chemical germicide registered as a hospital disinfectant by the EPA.

**Universal principles**

- Industry guidelines as well as equipment and chemical manufacturer recommendations should be used to develop and update reprocessing policies and procedures.
- Written instructions should be available for each instrument, medical device, and equipment reprocessed.
- Instruments, medical devices, and equipment should be managed and reprocessed according to recommended/appropriate methods, regardless of a patient’s diagnosis, except for cases of suspected prion disease.
  - Prions are transmissible pathogenic agents that cause a variety of neurodegenerative diseases of humans and animals, including sheep and goats, bovine spongiform encephalopathy in cattle, and Creutzfeldt-Jakob disease (CJD) in humans.
  - Prions are extremely resistant to inactivation by sterilization processes and disinfecting agents. Special procedures are required for handling brain, spinal, or nerve tissue from patients with known or suspected prion disease (e.g., Creutzfeldt-Jakob disease). Consultation with infection control experts prior to performing procedures on such patients is warranted.

**Potential for contamination**

Potential for contamination is dependent on the type of instrument, medical device, equipment, or environmental surface (item may be made from more than one material). Hinges and crevices increase the potential for external contamination, as does frequency of hand contact. Internal contamination is complicated by the presence of lumens, bends, and physical composition, design or configuration of the instrument, device, equipment, or surface. Body substances and environmental sources of microorganisms vary in number, type, and potential for cross-contamination.

Health care professionals must recognize potential sources of cross-contamination in the health care environment, including the following:

- Surfaces or equipment that require cleaning between patient procedures/treatments.
- Practices that contribute to hand contamination and the potential for cross-contamination.
- Improper use of single-use/disposable instruments, medical devices, or equipment.

**Factors that have contributed to contamination in reported cases of disease transmission**

At any point in reprocessing or handling, breaks in infection-control practices can compromise the integrity of instruments, medical devices, or equipment. Specific factors include:

- Failure to reprocess or dispose of items between patients.
- Inadequate cleaning.
- Inadequate disinfection or sterilization.
- Contamination of disinfectant or rinse solutions.
- Improper packaging, storage, and handling.
- Inadequate/inaccurate record keeping of reprocessing requirements.
- Knowledge regarding levels of disinfection, sterilization methods, and agents varies according to area of professional practice, setting, and scope of responsibilities.
  - Professionals who practice in settings where handling, cleaning, and reprocessing equipment, instruments, or medical devices is performed elsewhere (e.g., in a dedicated sterile processing department) must understand the following core concepts and principles:
    - Cleaning, disinfection, and sterilization described above.
    - Appropriate application of safe practices for handling instruments, medical devices, and equipment in the area of professional practice.

- Designation and physical separation of patient care areas from cleaning and reprocessing areas is strongly recommended.
- Verify with those responsible for reprocessing what steps are necessary prior to submission, such as:
  - Pre-cleaning.
  - Soaking.
- Professionals who have primary or supervisory responsibilities for equipment, instruments, or medical device reprocessing (e.g., sterile processing department staff or clinics and physician practices where medical equipment is reprocessed on-site) must understand:
  - Core concepts and principles.
  - Standard and universal precautions.
  - Cleaning, disinfection, and sterilization described above.
  - Appropriate application of safe practices for handling instruments, medical devices, and equipment in the area of professional practice.
  - Designation and physical separation of patient care areas from cleaning and reprocessing areas is strongly recommended.
How to determine appropriate reprocessing practices, taking into consideration

- Selection of appropriate methods.
- Anti-microbial efficacy.
- Time constraints and requirements for various methods.
- Compatibility among equipment/materials (consider corrosiveness, penetrability, leaching, disintegration, heat tolerance, and moisture sensitivity).
- Toxicity (including occupational health risks, environmental hazards, abatement methods, monitoring exposures, and potential for patient toxicity/allergy).
- Ease of use, including the need for specialized equipment and special training requirements.
- Stability, including concentration, potency, efficacy of use, and effect of organic material.
- Odor.
- Cost.
- Monitoring (including frequency and regulations for reprocessing single-use devices).

Cleaning

Pre-cleaning: Removes soil, salts, debris, and lubricants from internal and external surfaces. It should be done as soon as possible after use.

Cleaning: Items must be cleaned using water with detergents or enzymatic cleaners before processing. Cleaning reduces the bioburden and removes foreign material (i.e., organic residue and inorganic salts) that interferes with the sterilization process by acting as a barrier to the sterilization agent. Cleaning is the removal of visible soil from objects and surfaces and normally is accomplished manually or mechanically using water with detergents or enzymatic products.

Thorough cleaning is essential before high-level disinfection and sterilization because inorganic and organic materials that remain on the surfaces of instruments interfere with the effectiveness of these processes. If soiled materials dry or bake onto the instruments, the removal process becomes more difficult and the disinfection or sterilization process less effective or ineffective. Surgical instruments should be presoaked or rinsed to prevent drying of blood and to soften or remove blood from the instruments.

Cleaning is done manually in use areas without mechanical units (e.g., ultrasonic cleaners or washer-disinfectors) or for fragile or difficult-to-clean instruments. With manual cleaning, the two essential components are friction and fluids. Friction (e.g., rubbing/scrubbing the soiled area with a brush) is an old and dependable method. Fluidics (i.e., fluids under pressure) is used to remove soil and debris from internal channels after brushing and when the design does not allow passage of a brush through a channel.

Cleaning machines: Several types of mechanical cleaning machines (e.g., utensil washer-sanitizer, ultrasonic cleaner, washer-sterilizer, dishwasher, washer-disinfector) may facilitate cleaning and decontamination of most items. This equipment often is automated and may increase productivity, improve cleaning effectiveness, and decrease worker exposure to blood and body fluids.

Delicate and intricate objects and heat- or moisture-sensitive articles may require careful cleaning by hand. All used items sent to the central processing area should be considered contaminated (unless decontaminated in the area of origin), handled with gloves (forceps or tongs are sometimes needed to avoid exposure to sharps), and decontaminated by one of the aforementioned methods to render them safer to handle. Items composed of more than one removable part should be disassembled. Care should be taken to ensure that all parts are kept together, so that reassembly can be accomplished efficiently.

When a washer-disinfector is used, care should be taken in loading instruments: hinged instruments should be opened fully to allow adequate contact with the detergent solution; stacking of instruments in washers should be avoided; and instruments should be disassembled as much as possible. The most common types of mechanical or automatic cleaners are ultrasonic cleaners, washer-decontaminators, washer-disinfectors, and washer-sterilizers.

Ultrasonic cleaning removes soil by cavitation and implosion, in which waves of acoustic energy are propagated in aqueous solutions to disrupt the bonds that hold particulate matter to surfaces. Bacterial contamination can be present in used ultrasonic cleaning solutions (and other used detergent solutions), because these solutions generally do not make antibacterial label claims. Those who use ultrasonic cleaners should be aware that the cleaning fluid could result in endotoxin contamination of surgical instruments, which could cause severe inflammatory reactions. Washer-sterilizers are modified steam sterilizers that clean by filling the chamber with water and detergent through which steam passes to provide agitation. Instruments are subsequently rinsed and subjected to a short steam-sterilization cycle.

Cleaning agents: For instrument cleaning, a neutral or near-neutral pH detergent solution commonly is used because such solutions generally provide the best material compatibility profile and good soil removal. Enzymes, usually proteases, sometimes are added to neutral pH solutions to assist in removing organic material. Enzymes in these formulations attack proteins that make up a large portion of common soil (e.g., blood, pus). Cleaning solutions also can contain lipases (enzymes active on fats) and amylases (enzymes active on starches). Enzymatic cleaners are not disinfectants, and germicides can inactivate proteinaceous enzymes. As with all chemicals, enzymes must be rinsed from the equipment or adverse reactions (e.g., fever, residual amounts of high-level disinfectants, proteinaceous residue) could result.

Enzyme solutions should be used in accordance with manufacturer’s instructions, which include proper dilution of the enzymatic detergent and contact with equipment for the amount of time specified on the label. Detergent enzymes can result in asthma or other allergic effects in users. Neutral pH detergent solutions that contain enzymes are compatible with metals and other materials used in medical instruments and are the best choice for cleaning delicate medical instruments, especially flexible endoscopes. Alkaline-based cleaning agents are used for processing medical devices because they efficiently dissolve protein and fat residues; however, they can be corrosive.

Personnel working in the decontamination area should wear household-cleaning-type rubber or plastic gloves when handling or cleaning contaminated instruments and devices. Face masks, eye protection such as goggles or full-length face shields, and appropriate gowns should be worn when exposure to blood and contaminated fluids may occur (e.g., when manually cleaning contaminated devices). Contaminated instruments are a source of microorganisms that could inoculate personnel through nonintact skin on the hands or through contact with the mucous membranes of eyes, nose, or mouth. Reusable sharps that have been in contact with blood present a special hazard. Employees must not reach with their gloved hands into trays or containers that hold these sharps to retrieve them. Rather, employees should use engineering controls (e.g., forceps) to retrieve these devices.

Decontamination: This process removes pathogenic microorganisms from objects so they are safe to handle, use, or discard. Decontaminating agents may have the suffix -cide or -cidal, meaning killing action. For example, a germicide is an agent that can kill microorganisms, particularly pathogenic organisms (germs). The term germicide includes both antiseptics and disinfectants. Antiseptics are...
germicides applied to living tissue and skin; disinfectants are antimicrobials applied only to inanimate objects. In general, antiseptics are used only on the skin and not for surface disinfection, and disinfectants are not used for skin antisepsis because they can injure skin and other tissues. Virucide, fungicide, bactericide, sporicide, and tuberculocide can kill the type of microorganism identified by the prefix. For example, a bactericide is an agent that kills bacteria.

More than 30 years ago, Earle H. Spaulding devised a rational approach to disinfect and sterilize patient care items and equipment. This classification scheme is so clear and logical that it has been retained, refined, and successfully used by infection control professionals and others when they plan methods for disinfection or sterilization. Spaulding believed the nature of disinfection could be understood readily if instruments and items for patient care were categorized as critical, semi-critical, and noncritical, according to the degree of risk for infection involved in use of the items.

**Disinfection:** This describes a process that eliminates many or all pathogenic microorganisms, except bacterial spores, on inanimate objects. In health care settings, objects usually are disinfected by liquid chemicals or wet pasteurization. Each of the various factors that affect the efficacy of disinfection can nullify or limit the efficacy of the process. Factors that affect the efficacy of both disinfection and sterilization include prior cleaning of the object; organic and inorganic load present; type and level of microbial contamination; concentration of and exposure time to the germicide; physical nature of the object (e.g., crevices, hinges, and lumens); presence of biofilms; temperature and pH of the disinfection process; and in some cases, relative humidity of the sterilization process (e.g., ethylene oxide).

Unlike sterilization, disinfection is not sporicidal. A few disinfectants will kill spores with prolonged exposure times (3-12 hours); these are called chemical sterilants. At similar concentrations but with shorter exposure periods (e.g., 20 minutes for 2 percent glutaraldehyde), these same disinfectants will kill all microorganisms except large numbers of bacterial spores; they are called high-level disinfectants. Low-level disinfectants can kill most vegetative bacteria, some fungi, and some viruses in a practical period of time (less than 10 minutes). Intermediate-level disinfectants might be effective for mycobacteria, vegetative bacteria, most viruses, and most fungi, but they do not necessarily kill bacterial spores. Germicides differ markedly, primarily in their antimicrobial spectrum and rapidity of action.

The chemical disinfectants discussed for patient care equipment include alcohols, glutaraldehyde, formaldehyde, hydrogen peroxide, iodophors, ortho-phthalaldehyde, peracetic acid, phenolics, quaternary ammonium compounds, and chlorine. The choice of disinfectant, concentration, and exposure time is based on the risk for infection associated with use of the equipment and other factors discussed in this guideline. The sterilization methods discussed include steam sterilization, ethylene oxide (ETO), hydrogen peroxide gas plasma, and liquid peracetic acid. When properly used, these cleaning, disinfection, and sterilization processes can reduce the risk for infection associated with use of invasive and noninvasive medical and surgical devices. However, for these processes to be effective, health care workers should adhere strictly to the cleaning, disinfection, and sterilization recommendations in this document and to instructions on product labels.

**Sterilization:** A process that destroys or eliminates all forms of microbial life and is carried out in health care facilities by physical or chemical methods. Steam under pressure, dry heat, ETO gas, hydrogen peroxide gas plasma, and liquid chemicals are the principal sterilizing agents used in health care facilities. Sterilization is intended to convey an absolute meaning, but some health professionals and the technical and commercial literature refer to “disinfection” as “sterilization” and items as “partially sterile.” When chemicals are used to destroy all forms of microbiologic life, they can be called chemical sterilants. These same germicides used for shorter exposure periods also can be part of the disinfection process (i.e., high-level disinfection).

**Reprocessing**

HCP should make selections based on manufacturer’s recommendations:

- Confirm compatibility among equipment components, materials, and chemicals used.
- Confirm equipment’s heat and pressure tolerance.
- Confirm time and temperature requirements for reprocessing.

**Critical items:** These confer a high risk for infection if they are contaminated with any microorganism. Thus, objects that enter sterile tissue or the vascular system must be sterile, because any microbial contamination could transmit disease. This category includes surgical instruments, cardiac and urinary catheters, implants, and ultrasound probes used in sterile body cavities. Most of the items in this category should be purchased as sterile or be sterilized with steam if possible. Heat-sensitive objects can be treated with ETO, hydrogen peroxide gas plasma; or if other methods are unsuitable, by liquid chemical sterilants. Liquid chemical sterilants reliably produce sterility only if cleaning precedes treatment and if proper guidelines are followed regarding concentration, contact time, temperature, and pH.

**Semi-critical items:** These contact mucous membranes or nonintact skin. This category includes respiratory therapy and anesthesia equipment, some endoscopes, laryngoscope blades, esophageal manometry probes, cystoscopes, anorectal manometry catheters, and diaphragm fitting rings. These medical devices should be free from all microorganisms, although small numbers of bacterial spores are permissible. Intact mucous membranes, such as those of the lungs and the gastrointestinal tract, generally are resistant to infection by common bacterial spores but susceptible to other organisms, such as bacteria, mycobacteria, and viruses. Semi-critical items minimally require high-level disinfection using chemical disinfectants. When a disinfectant is selected for use with certain patient care items, HCP must consider the chemical compatibility after extended use with the items to be disinfected.

High-level disinfection traditionally is defined as complete elimination of all microorganisms in or on an instrument, except for small numbers of bacterial spores. Cleaning followed by high-level disinfection should eliminate enough pathogens to prevent transmission of infection.

Laparoscopes and arthroscopes entering sterile tissue ideally should be sterilized between patients. However, in the United States, this equipment sometimes undergoes only high-level disinfection between patients. As with flexible endoscopes, these devices can be difficult to clean and high-level disinfect or sterilize because of intricate device design (e.g., long narrow lumens, hinges). Meticulous cleaning must precede any high-level disinfection or sterilization process. Although sterilization is preferred, no reports have been published of outbreaks resulting from high-level disinfection of these scopes when they are properly cleaned and high-level disinfected. Newer models of these instruments can withstand steam sterilization that for critical items would be preferable to high-level disinfection.

Rinsing endoscopes and flushing channels with sterile water, filtered water, or tap water will prevent adverse effects associated with disinfectant retained in the endoscope (e.g., disinfectant-induced colitis). Items can be rinsed and flushed using sterile water after high-level disinfection to prevent contamination with organisms in tap water, such as nontuberculous mycobacteria, Legionella, or gram-negative bacilli such as Pseudomonas. Alternatively, a tap water or filtered water (0.2μ filter) rinse should be followed by an alcohol rinse...
and forced air drying. Forced-air drying markedly reduces bacterial contamination of stored endoscopes, most likely by removing the wet environment favorable for bacterial growth. After rinsing, items should be dried and stored (e.g., packaged) in a manner that protects them from recontamination.

Some items that may come in contact with nonintact skin for a brief period of time (i.e., hydrotherapy tanks, bed side rails) are usually considered noncritical surfaces and are disinfected with intermediate-level disinfectants (i.e., phenolic, iodophor, alcohol, chlorine). Since hydrotherapy tanks have been associated with spread of infection, some facilities have chosen to disinfect them with recommended levels of chlorine.

In the past, high-level disinfection was recommended for mouthpieces and spirometry tubing (e.g., glutaraldehyde), but cleaning the interior surfaces of the spirometers was considered unnecessary. This was based on a study that showed that mouthpieces and spirometry tubing become contaminated with microorganisms, but there was no bacterial contamination of the surfaces inside the spirometers. Filters have been used to prevent contamination of this equipment distal to the filter; such filters and the proximal mouthpiece are changed between patients.

Noncritical items: These come in contact with intact skin but not mucous membranes. Intact skin acts as an effective barrier to most microorganisms; therefore, the sterility of items that come in contact with intact skin is not critical. In this guideline, noncritical items are divided into noncritical patient care items and noncritical environmental surfaces. Examples of noncritical patient care items are bedpans, blood pressure cuffs, crutches, and computers. In contrast to critical and some semi-critical items, most noncritical reusable items may be decontaminated where they are used and do not need to be transported to a central processing area. Virtually no risk has been documented for transmission of infectious agents to patients through noncritical items when they are used as noncritical items and do not contact non-intact skin and/or mucous membranes.

Noncritical environmental surfaces: These include bed rails, some food utensils, bedside tables, patient furniture, and floors. Noncritical environmental surfaces frequently touched by hand (e.g., bedside tables, bed rails) potentially could contribute to secondary transmission by contaminating hands of health care workers or by contacting medical equipment that subsequently contacts patients. Mops and reusable cleaning cloths are regularly used to achieve low-level disinfection on environmental surfaces. However, they often are not adequately cleaned and disinfected, and if the water-disinfectant mixture is not changed regularly (e.g., after every three to four rooms, at no longer than 60-minute intervals), the mopping procedure actually can spread heavy microbial contamination throughout the health care facility. In one study, standard laundering provided acceptable decontamination of heavily contaminated mop heads, but chemical disinfection with a phenolic was less effective. Frequent laundering of mops (e.g., daily), therefore, is recommended. Single-use disposable towels impregnated with a disinfectant also can be used for low-level disinfection when spot-cleaning of noncritical surfaces is needed.

Dental offices

Scientific articles and increased publicity about the potential for transmitting infectious agents in dentistry have focused attention on dental instruments as possible agents for pathogen transmission. The American Dental Association recommends that surgical and other instruments that normally penetrate soft tissue or bone (e.g., extraction forceps, scalpels blades, bone chisels, periodontal scalers, and surgical burs) be classified as critical devices that should be sterilized after each use or discarded.

Instruments not intended to penetrate oral soft tissues or bone (e.g., amalgam condensers, and air/water syringes) but that could contact oral tissues are classified as semi-critical, but sterilization after each use is recommended if the instruments are heat-tolerant. If a semi-critical item is heat-sensitive, it should, at a minimum, be processed with high-level disinfection. Hand pieces can be contaminated internally with patient material and should be heat sterilized after each patient. Hand pieces that cannot be heat sterilized should not be used. Methods of sterilization that can be used for critical or semi-critical dental instruments and materials that are heat-stable include steam under pressure (autoclave), chemical (formaldehyde) vapor, and dry heat (e.g., 320 degrees F for two hours). Dental professionals most commonly use the steam sterilizer. All three sterilization procedures can damage some dental instruments, including steam-sterilized hand pieces. Heat-tolerant alternatives are available for most clinical dental applications and are preferred.

CDC has divided noncritical surfaces in dental offices into clinical contact and housekeeping surfaces. Clinical contact surfaces are surfaces that HCP might touch frequently with gloved hands during patient care or that might become contaminated with blood or other potentially infectious material and subsequently contact instruments, hands, gloves, or devices (e.g., light handles, switches, dental X-ray equipment, chairside computers). Barrier protective coverings (e.g., clear plastic wraps) can be used for these surfaces, particularly those that are difficult to clean (e.g., light handles, chair switches). The coverings should be changed when visibly soiled or damaged and routinely (e.g., between patients). Protected surfaces should be disinfected at the end of each day or if contamination is evident. If not barrier-protected, these surfaces should be disinfected between patients with an intermediate-disinfectant (i.e., EPA-registered hospital disinfectant with tuberculocidal claim) or low-level disinfectant (i.e., EPA-registered hospital disinfectant with an HBV and HIV label claim).

Most housekeeping surfaces need to be cleaned only with a detergent and water or an EPA-registered hospital disinfectant, depending on the nature of the surface and the type and degree of contamination. When housekeeping surfaces are visibly contaminated by blood or body substances, however, prompt removal and surface disinfection is a sound infection control practice and required by the Occupational Safety and Health Administration (OSHA).

Disinfection of HBV-, HCV-, HIV-, or TB-contaminated devices

The CDC recommendation for high-level disinfection of HBV-, HCV-, HIV-, or TB-contaminated devices is appropriate because experiments have demonstrated the effectiveness of high-level disinfectants to inactivate these and other pathogens that might contaminate semi-critical devices.

Effectiveness of reprocessing

The activity of germicides against microorganisms depends on a number of factors, some of which are intrinsic qualities of the organism, others of which are the chemical and external physical environment.
All other conditions remaining constant, the larger the number of microbes, the more time a germicide needs to destroy all of them. Researchers also have shown that aggregated or clumped cells are more difficult to inactivate than monodispersed cells. The location of microorganisms also must be considered when factors that affect the efficacy of germicides are assessed. Medical instruments with multiple pieces must be disassembled, and equipment such as endoscopes that have crevices, joints, and channels are more difficult to disinfect than are flat-surface equipment because penetration by the disinfectant to all parts of the equipment is more difficult. Only surfaces that directly contact the germicide will be disinfected, so there must be no air pockets, and the equipment must be completely immersed for the entire exposure period. Manufacturers should be encouraged to produce equipment engineered for ease of cleaning and disinfection.

Microorganisms vary greatly in their resistance to chemical germicides and sterilization processes. Intrinsic resistance mechanisms in microorganisms to disinfectants vary. For example, spores are resistant to disinfectants because the spore coat and cortex act as a barrier. Mycobacteria have a waxy cell wall that prevents disinfectant entry, and gram-negative bacteria possess an outer membrane that acts as a barrier to the uptake of disinfectants. Implicit in all disinfection strategies is the consideration that the most resistant microbial subpopulation controls the sterilization or disinfection time. That is, to destroy the most resistant types of microorganisms (i.e., bacterial spores), the user needs to employ exposure times and a concentration of germicide needed to achieve complete destruction. Except for prions, bacterial spores possess the highest innate resistance to chemical germicides.

With other variables constant, and with one exception (iodophors), the more concentrated the disinfectant, the greater its efficacy and the shorter the time necessary to achieve microbial kill. Several physical and chemical factors also influence disinfectant procedures: temperature, pH, relative humidity, and water hardness. For example, the activity of most disinfectants increases as the temperature increases, but some exceptions exist. Furthermore, too great an increase in temperature causes the disinfectant to degrade and weakens its germicidal activity and thus might produce a potential health hazard.

An increase in pH improves the antimicrobial activity of some disinfectants (e.g., glutaraldehyde, quaternary ammonium compounds) but decreases the antimicrobial activity of others (e.g., phenols, hypochlorites, and iodine). The pH influences the antimicrobial activity by altering the disinfectant molecule or the cell surface. Relative humidity is the single most important factor influencing the activity of gaseous disinfectants/sterilants, such as EtO, chlorine dioxide, and formaldehyde. Water hardness (i.e., high concentration of divalent cations) reduces the rate of kill of certain disinfectants, because divalent cations (e.g., magnesium, calcium) in the hard water interact with the disinfectant to form insoluble precipitates.

### Organic and inorganic matter

Organic matter in the form of serum, blood, pus, or fecal or lubricant material can interfere with the anti-microbial activity of disinfectants in at least two ways. Most commonly, interference occurs by a chemical reaction between the germicide and the organic matter, resulting in a complex that is less germicidal or nongermicidal, leaving less of the active germicide available for attacking microorganisms. Chlorine and iodine disinfectants, in particular, are prone to such interaction. Alternatively, organic material can protect microorganisms from attack by acting as a physical barrier. Protection by inorganic contaminants of microorganisms to all sterilization processes results from occlusion in salt crystals. This further emphasizes the importance of meticulous cleaning of medical devices before any sterilization or disinfection procedure because both organic and inorganic soils are easily removed by washing.

### Duration of exposure

Items must be exposed to the germicide for the appropriate minimum contact time. Multiple investigators have demonstrated the effectiveness of low-level disinfectants against vegetative bacteria (e.g., Listeria, E. coli, Salmonella, VRE, MRSA), yeasts (e.g., Candida), mycobacteria (e.g., M. tuberculosis), and viruses (e.g., poliovirus) at exposure times of 30-60 seconds. By law, all applicable label instructions on EPA-registered products must be followed. If the user selects exposure conditions that differ from those on the EPA-registered product label, the user assumes liability for any injuries that result from off-label use and is potentially subject to enforcement action under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

All lumens and channels of endoscopic instruments must contact the disinfectant. Air pockets interfere with the disinfection process, and items that float on the disinfectant will not be disinfected. The disinfectant must be introduced reliably into the internal channels of the device. The exact times for disinfecting medical items are somewhat elusive because of the effect of the aforementioned factors on disinfection efficacy. In general, longer contact times are more effective than shorter contact times.

### Biofilms

Microorganisms may be protected from disinfectants by production of thick masses of cells and extracellular materials, or biofilms. Biofilms are microbial communities that are tightly attached to surfaces and cannot be easily removed. Once these masses form, microbes within them can be resistant to disinfectants by multiple mechanisms, including physical characteristics of older biofilms, genotypic variation of the bacteria, microbial production of neutralizing enzymes, and physiologic gradients within the biofilm (e.g., pH). Bacteria within biofilms are up to 1,000 times more resistant to antimicrobials than are the same bacteria in suspension. Although new decontamination methods are being investigated for removing biofilms, chlorine and monochloramines can effectively inactivate biofilm bacteria.

Biofilms have been found in whirlpools, dental unit waterlines and numerous medical devices (e.g., contact lenses, pacemakers, hemodialysis systems, urinary catheters, central venous catheters, endoscopes). Their presence can have serious implications for immunocompromised patients and patients who have indwelling medical devices. Some enzymes and detergents can degrade biofilms or reduce numbers of viable bacteria within a biofilm, but no products are EPA-registered or FDA-cleared for this purpose.

### Monitoring

The sterilization procedure should be monitored routinely by using a combination of mechanical, chemical, and biological indicators to evaluate the sterilizing conditions, and indirectly, the microbiologic status of the processed items. The mechanical monitors for steam
sterilization include the daily assessment of cycle time and temperature by examining the temperature record chart (or computer printout) and an assessment of pressure via the pressure gauge. The mechanical monitors for EtO include time, temperature and pressure records that provide data via computer printouts, gauges or displays. Generally, two essential elements for EtO sterilization, the gas concentration, and humidity, cannot be monitored in health care EtO sterilizers.

Chemical indicators are convenient, inexpensive, and they indicate that the item has been exposed to the sterilization process. In one study, chemical indicators were more likely than biological indicators to inaccurately indicate sterilization at marginal sterilization times (e.g., 2 minutes). Chemical indicators should be used in conjunction with biological indicators. However, based on current studies, they should not replace them because they indicate sterilization at marginal sterilization time and because only a biological indicator consisting of resistant spores can measure the microbial killing power of the sterilization process.

Packaging

Once items are cleaned, dried, and inspected, those that require sterilization must be wrapped or placed in rigid containers and should be arranged in instrument trays/baskets according to the guidelines provided by the AAMI and other professional organizations. These guidelines state that hinged instruments should be opened; items with removable parts should be disassembled, unless the device manufacturer or researchers provide specific instructions or test data to the contrary; complex instruments should be prepared and sterilized according to device manufacturer’s instructions and test data; devices with concave surfaces should be positioned to facilitate drainage of water; heavy items should be positioned not to damage delicate items; and the weight of the instrument set should be based on the design and density of the instruments and the distribution of metal mass.

There are several choices in methods to maintain sterility of surgical instruments, including rigid containers, peel-open pouches (e.g., self-sealed or heat-sealed plastic and paper pouches), roll stock or reels (i.e., paper-plastic combinations of tubing designed to allow the user to cut and seal the ends to form a pouch) and sterilization wraps (woven and nonwoven). Health care facilities may use all of these packaging options. The packaging material must allow penetration of the sterilant, provide protection against contact contamination during handling, provide an effective barrier to microbial penetration, and maintain the sterility of the processed item after sterilization.

Loading

All items to be sterilized should be arranged so all surfaces will be directly exposed to the sterilizing agent. Thus, loading procedures must allow for free circulation of steam (or another sterilant) around each item. Several important basic principles for loading a sterilizer include:

- Allow for proper sterilant circulation.
- Place perforated trays should be placed parallel to the shelf; nonperforated containers should be placed on their edge (e.g., basins).
- Place small items loosely in wire baskets.
- Place peel packs on edge in perforated or mesh bottom racks or baskets.

Storage

Although some hospitals continue to date every sterilized product and use the time-related shelf-life practice, many hospitals have switched to an event-related shelf-life practice. This latter practice recognizes that the product should remain sterile until some event causes the item to become contaminated (e.g., tear in packaging, packaging becomes wet, seal is broken). Event-related factors that contribute to the contamination of a product include bioburden (i.e., the amount of contamination in the environment), air movement, traffic, location, humidity, insects, vermin, flooding, storage area space, open/closed shelving, temperature, and the properties of the wrap material. There are data that support the event-related shelf-life practice.

Following the sterilization process, medical and surgical devices must be handled using aseptic technique in order to prevent contamination. Sterile supplies should be stored far enough from the floor (8 to inches), the ceiling (5 inches unless near a sprinkler head, in which case it should be 18 inches from sprinkler head), and the outside walls (2 inches) to allow for adequate air circulation, ease of cleaning, and compliance with local fire codes.

Medical and surgical supplies should not be stored under sinks or in other locations where they can become wet. Sterile items that become wet are considered contaminated, because moisture brings with it microorganisms from the air and surfaces. Closed or covered cabinets are ideal, but open shelving may be used for storage. Any package that has fallen or been dropped on the floor must be inspected for damage to the packaging and contents (if the items are breakable). If the package is heat-sealed in impervious plastic and the seal is still intact, the package should be considered not contaminated. If undamaged, items packaged in plastic need not be reprocessed.
Toxicological, environmental, and occupational concerns

Health hazards associated with the use of germicides in health care vary from mucous membrane irritation to death, with the latter involving accidental injection by mentally disturbed patients. Although their degrees of toxicity vary, all disinfectants should be used with the proper safety precautions and only for the intended purpose.

Exposure limits have been published for many chemicals used in health care to help provide a safe environment and, as relevant, are discussed in each section of this guideline. Only the exposure limits published by OSHA carry the legal force of regulations. OSHA publishes a limit as a time-weighted average (TWA), that is, the average concentration for a normal 8-hour workday and a 40-hour work week to which nearly all workers can be repeatedly exposed to a chemical without adverse health effects. Information about workplace exposures and methods to reduce them (e.g., work practices, engineering controls, PPE) is available on the OSHA (http://www.osha.gov) and NIOSH (http://www.cdc.gov/niosh) websites.

Some states have excluded or limited concentrations of certain chemical germicides (e.g., glutaraldehyde, formaldehyde and some phenols) from disposal through the sewer system. These rules are intended to minimize environmental harm. Safe disposal of regulated chemicals is important throughout the medical community. For disposal of large volumes of spent solutions, users might decide to neutralize the microbical activity before disposal (e.g., glutaraldehyde). Solutions can be neutralized by reaction with chemicals such as sodium bisulfite or glycine.

Single-use medical devices

HCP should not re-use single-use items. The reuse of single-use medical devices began in the late 1970s as a cost-saving measure. Reuse of single-use devices involves regulatory, ethical, medical, legal, and economic issues and has been extremely controversial for more than two decades. The U.S. public has expressed increasing concern regarding the risk of infection and injury when reusing medical devices intended and labeled for single use. The FDA website will provide the latest guidance (www.fda.gov).

Prevention and control of infectious and communicable diseases in health care personnel

Definitions

- **Infectious disease**: A clinically manifest disease of humans or animals resulting from an infection.
- **Communicable disease**: An illness due to a specific infectious agent or its toxic products that arises through transmission of that agent from an infected person, animal, or inanimate source to a susceptible host.
- **Occupational health strategies**: As applied to infection control, a set of activities intended to assess, prevent, and control infections and communicable diseases in health care personnel.

Immunization and screening programs

The Advisory Committee on Immunization Practices (ACIP) recommends the use of certain immunizing agents in health care workers in the United States. ACIP statements on individual vaccines and disease updates in the Morbidity Mortality Weekly Report (MMWR) should be consulted for current details regarding the epidemiology of the diseases, immunization schedules, vaccine doses, and the safety and efficacy of the vaccines.

On the basis of documented health care-associated transmission, health care personnel are considered to be at substantial risk for acquiring or transmitting hepatitis B, influenza, measles, mumps, rubella, and varicella. All of these diseases are vaccine-preventable. ACIP recommends that all HCP be vaccinated or have documented immunity to these diseases. ACIP does not recommend routine immunization of HCP against TB (i.e., inoculation with bacille Calmette-Guérin vaccine) or hepatitis A. No vaccine exists for HCV. ACIP guidelines also provide recommendations regarding immunization of health workers with special conditions (e.g., pregnancy, HIV infection, or diabetes).

Immunization of health workers before they are placed at risk for exposure remains the most efficient and effective use of vaccines in health care settings. Some educational institutions and infection-control programs provide immunization schedules for students and dental health care personnel. OSHA requires that employers make hepatitis B vaccinations available to all employees who have potential contact with blood or other potentially infectious materials (OPIM). Employers are also required to follow CDC recommendations for vaccinations, evaluations, and follow-up procedures. Health workers who are unable or unwilling to be vaccinated as required or recommended should be educated regarding their exposure risks, infection-control policies, and procedures for the facility, and the management of work-related illness and work restrictions (if appropriate) for exposed or infected worker.

**Hepatitis B virus (HBV)** is the major infectious hazard for health care personnel. The risk for acquiring HBV infection from occupational exposures is dependent on the frequency of percutaneous and per mucousal exposures to blood or body fluids containing blood. Depending on the tasks performed, any health care or public safety worker may be at high risk for HBV exposure. Workers who perform tasks that involve exposure to blood or blood-contaminated body fluids should be vaccinated. Public safety workers who are rarely exposed to blood may consider timely post-exposure prophylaxis, post-exposure rather than routine pre-exposure vaccination. During 1982, when hepatitis B vaccine was first recommended for HCP, an estimated 10,000 infections occurred among people employed in a medical or dental field. By 2004, the number of HBV infections among HCP had decreased to an estimated 304 infections, largely resulting from the implementation of routine preexposure vaccination and improved infection-control precautions.

**Influenza**: During community influenza outbreaks, admitting patients infected with influenza to hospitals has led to nosocomial transmission of the disease, including transmission from staff to patients. Transmission of influenza among medical staff causes absenteeism and considerable disruption of health care. In addition, influenza outbreaks have caused morbidity and mortality in nursing homes. In a recent study of long-term care facilities with uniformly high patient influenza vaccination levels, patients in facilities in which greater than 60 percent of the staff had been vaccinated against influenza experienced less influenza-related mortality and illness, compared with patients in facilities with no influenza-vaccinated staff.
Clostridium difficile infection

People receiving medical care can catch serious infections called health care-associated infections (HAIs). While most types of HAIs are declining, one—caused by the germ C. difficile—remains at historically high levels. C. difficile causes diarrhea linked to 14,000 American deaths each year. Those most at risk are people, especially older adults, who take antibiotics and also get medical care. CDC provides guidelines and tools to the health care community to help prevent Clostridium difficile infections as well as provides resources to help the public safeguard their own health.

Measles: During 1990-1991, 1,788 of 37,429 (4.8 percent) measles cases were acquired in medical settings. Of these, 668 (37.4 percent) occurred among health care personnel, 561 (84 percent) of whom were unvaccinated. Even though medical settings were a primary site of measles transmission during the 1989-1991 measles resurgence (145,146), as of September 2011, only three states (New York, Oklahoma, and Rhode Island) had laws mandating that all hospital personnel have proof of measles immunity and did not allow for religious or philosophic exemptions.

Mumps: During recent years, the overall incidence of mumps has fluctuated only minimally, but an increasing proportion of cases have been reported in people age 15 or older. Programs to ensure that medical personnel are immune to mumps are prudent and are easily linked with measles and rubella control programs.

Rubella: Although vaccination has decreased the overall risk for rubella transmission in all age groups in the United States to at least 95 percent, the potential for transmission in hospitals and similar settings persists because 10 percent to 15 percent of young adults are still susceptible. Although not as infectious as measles, rubella can be transmitted effectively by both males and females. Transmission can occur whenever many susceptible people congregate in one place. Aggressive rubella vaccination of susceptible men and women with trivalent measles-mumps-rubella (MMR) vaccine can eliminate rubella (as well as measles) transmission.

Varicella zoster virus (VZV): Identification of the few people who are susceptible to varicella when they begin employment that involves patient contact is recommended. A reliable history of chickenpox is a valid measure of VZV immunity. Only personnel who are immune to varicella should care for patients who have confirmed or suspected varicella or zoster. Varicella virus vaccine protects approximately 70 percent to 90 percent of recipients against infection and 95 percent of recipients against severe disease for at least 7-10 years after vaccination. Vaccination should be considered for unvaccinated health workers who lack documented immunity if they are exposed to varicella. However, because the effectiveness of post-exposure vaccination is unknown, people vaccinated after an exposure should be managed in the manner recommended for unvaccinated people. In hospitals, airborne transmission of VZV from people who had varicella or zoster to susceptible people who had no direct contact with the index case-patient has occurred. Although all susceptible hospitalized adults are at risk for severe varicella disease and complications, certain patients are at increased risk: pregnant women, premature infants born to susceptible mothers, infants, and immunocompromised people of all ages (including people who are undergoing immunosuppressive therapy, have malignant disease, or are immunodeficient).

Tuberculosis screening and control

The Centers for Disease Control and Prevention (CDC) issued new guidelines for preventing transmission of Mycobacterium tuberculosis in health care settings in 2012. The entire document can be directly obtained from the CDC at http://www.cdc.gov/tb/topic/infectioncontrol/default.htm. All facility staff should be knowledgeable about these guidelines and are aware of their responsibilities, so that the health and safety of residents in all facilities are protected.

Revised guidelines were issued in response to:
- A resurgence of tuberculosis (TB) disease that occurred in the United States in the mid-1980s and early 1990s.
- The documentation of several high-profile health care-associated (previously termed “nosocomial”) outbreaks related to an increase in the prevalence of TB disease and human immunodeficiency virus (HIV) coinfection.
- Lapses in infection-control practices.
- Delays in the diagnosis and treatment of people with infectious TB disease.
- The appearance and transmission of multidrug-resistant (MDR) TB strains.

M. tuberculosis is usually transmitted only through air, not by surface contact. After the droplet nuclei are in the alveoli, local infection might be established, followed by dissemination to draining lymphatics and hematogenous spread throughout the body. Infection occurs when a susceptible person inhales droplet nuclei containing M. tuberculosis, and the droplet nuclei traverse the mouth or nasal passages, upper respiratory tract, and bronchi to reach the alveoli. People with TB pleural effusions might also have concurrent unsuspected pulmonary or laryngeal TB disease.

According to the CDC, all health care settings need an infection-control program designed to ensure the following:
- Prompt detection of infectious patients.
- Airborne precautions.
- Treatment of people who have suspected or confirmed tuberculosis (TB) disease.

In order to be effective, the primary emphasis of the TB infection-control program should be on achieving these three goals.

In all health care settings, particularly those in which people who are at high risk for exposure to Mycobacterium tuberculosis work or receive care, policies and procedures for TB control should be developed, reviewed periodically, and evaluated for effectiveness to determine the actions necessary to minimize the risk for transmission of M. tuberculosis.

Overview of TB infection-control measures

The TB infection-control program should be based on a three-level hierarchy of control measures and include:
1. Administrative controls.
2. Environmental controls.
3. Use of respiratory protective equipment.
• Developing and instituting a written TB infection-control plan to ensure prompt detection, airborne precautions, and treatment of people who have suspected or confirmed TB disease.
• Ensuring the timely availability of recommended laboratory processing, testing, and reporting of results to the ordering physician.
• Implementing effective work practices for the management of patients with suspected or confirmed TB disease.
• Ensuring proper cleaning and sterilization or disinfection of potentially contaminated equipment (e.g., bronchoscopes, endoscopes).
• Training and educating health care workers (HCWs) regarding TB, with specific focus on prevention, transmission, and symptoms.
• Screening and evaluating HCP who are at risk for TB disease or who might be exposed to M. tuberculosis.
• Applying epidemiologic-based prevention principles, including the use of setting-related infection-control data.
• Using appropriate signage advising respiratory hygiene and cough etiquette.
• Coordinating efforts with the local or state health department.

The second level of the hierarchy is the use of environmental controls to prevent the spread and reduce the concentration of infectious droplet nuclei in ambient air. Primary environmental controls regulate the source of infection by using local exhaust ventilation (hoods, tents, or booths) and dilute and remove contaminated air by using general ventilation. Secondary environmental controls regulate the airflow to prevent contamination of air in areas adjacent to the source (airborne infection isolation rooms, or AIIRs) and clean the air by using high-efficiency particulate air (HEPA) filtration, or ultraviolet germicidal irradiation.

The first two control levels of the hierarchy minimize the number of areas in the health care setting where exposure to M. tuberculosis may occur. They reduce, but do not eliminate, the risk in those few areas where exposure to M. tuberculosis can still occur (e.g., AIIR housing TB patients, and treatment rooms in which cough-inducing or aerosol-generating procedures are performed on TB patients). Therefore, the third level of the hierarchy is the use of respiratory protective equipment in situations that pose a high risk of exposure to M. tuberculosis.

Use of respiratory protection equipment can further reduce risk for exposure of HCP to infectious droplet nuclei that have been expelled into the air from a patient with infectious TB disease. The following measures can be taken to reduce the risk for exposure:
• Implementing a respiratory protection program.
• Training HCP on respiratory protection.
• Training patients on respiratory hygiene and cough etiquette procedures.

### Determining the Infectiousness of TB Patients

In general, patients who have suspected or confirmed TB disease should be considered infectious if:
1. They are coughing, undergoing cough-inducing procedures, or have positive sputum smear results for acid-fast bacilli (AFB); and
2. They are not receiving adequate antituberculosis therapy, have just started therapy, or have a poor clinical or bacteriologic response to therapy.

For patients placed under airborne precautions because of suspected infectious TB disease of the lungs, airway, or larynx, airborne precautions can be discontinued when infectious TB disease is considered unlikely and either:
• Another diagnosis is made that explains the clinical syndrome; or
• The patient produces three consecutive negative sputum smears collected in 8- to 24-hour intervals (one should be an early morning specimen).

Patients for whom the suspicion of infectious TB disease remains after the collection of three negative sputum smear results should not be released from airborne precautions until they:
• Receive standard multidrug antituberculosis treatment (minimum of 2 weeks); and
• Demonstrate clinical improvement.

For these patients, additional diagnostic approaches (e.g., sputum induction) and, after sufficient time on treatment, bronchoscopy may need to be considered.

Patients who have drug-susceptible TB of the lung, airway, or larynx, should remain under airborne precautions until they:
1. Produce three consecutive negative sputum smears collected in 8- to 24-hour intervals (one should be an early morning specimen).
2. Receive standard multidrug antituberculosis treatment (minimum of 2 weeks).
3. Demonstrate clinical improvement.

Usually within 2 to 12 weeks after initial infection with M. tuberculosis, the immune response limits additional multiplication of the tubercle bacilli and immunologic test results for M. tuberculosis infection become positive. However, certain bacilli remain in the body and are viable for multiple years. This condition is referred to as latent tuberculosis infection (LTBI). People with LTBI are asymptomatic (they have no symptoms of TB disease) and are not infectious.

All part-time, temporary, contract, and full-time health care personnel should be included in TB screening programs. In addition, workers who perform any of the following activities should also be included in the TB screening program:
• Entering patient rooms or treatment rooms, regardless of whether a patient is present.
• Participating in aerosol-generating or aerosol-producing procedures (e.g., bronchoscopy, sputum induction, and administration of aerosolized medications) [29].
• Participating in suspected or confirmed M. tuberculosis specimen processing.
• Installing, maintaining, or replacing environmental controls in areas in which people with TB disease are encountered.

In accordance with relevant local, state, and federal laws, implementation of all recommendations must safeguard the confidentiality and civil rights of all health care personnel and patients who have been infected with M. tuberculosis and TB disease. At initial hire, health care personnel with documentation of previous treatment for latent TB infection or TB disease do not need to undergo a TB test. These health workers should receive an annual clinical evaluation for symptoms suggestive of TB, including a cough for more than three weeks, loss of appetite, unexplained weight loss, night sweats, bloody sputum (hemoptysis), hoarseness, fever, fatigue, or chest pain. If symptomatic, a chest x-ray examination and further clinical evaluation are indicated.

Annual TB screening and education of employees should be performed in long-term care facilities (LTCF). If previously negative, the TST or QFT should be performed. If previously positive, a screen for symptoms should be performed and the employee evaluated as appropriate. All screening activities should be documented in the employee health record. All potential residents should be screened for symptoms consistent with active TB disease prior to arrival. Potential residents with symptoms suggestive of active TB disease, including persistent or productive cough for more than three weeks, loss of appetite, unexplained weight loss, night sweats, bloody sputum (hemoptysis), hoarseness, fever, fatigue, or chest pain, should be evaluated prior to admission. If symptoms are present, active TB disease should be ruled out prior to admission, unless the long-term
Education and training
Personnel subject to occupational exposure should receive infection-control training on initial assignment, when new tasks or procedures affect their occupational exposure, and at a minimum, annually. Education and training should be appropriate to the assigned duties of specific health care workers (e.g., techniques to prevent cross-contamination or instrument sterilization). For workers who perform tasks or procedures likely to result in occupational exposure to infectious agents, training should include:

- A description of exposure risks.
- Review of prevention strategies and infection-control policies and procedures.
- Discussion regarding how to manage work-related illness and injuries, including post-exposure prophylaxis (PEP).
- Review of work restrictions for the exposure or infection.

Exposure prevention and post-exposure management
Avoiding exposure to blood and other potentially infected materials (OPIM) and protection by immunization remain primary strategies for reducing occupationally acquired infections, but occupational exposures can still occur. A combination of standard precautions, engineering, work practices, and administrative controls is the best means to minimize occupational exposures. Written policies and procedures to facilitate prompt reporting, evaluation, counseling, treatment, and medical follow-up of all occupational exposures should be available to all health workers. Written policies and procedures should be consistent with federal, state, and local requirements addressing education and training, post-exposure management, and exposure reporting.

Dental health care personnel who have contact with patients can also be exposed to people with infectious TB, and should have a baseline tuberculin skin test (TST), preferably by using a two-step test, at the beginning of employment. Thus, if an unprotected occupational exposure occurs, TST conversions can be distinguished from positive TST results caused by previous exposures. The facility’s level of TB risk will determine the need for routine follow-up TSTs.

Medical conditions, work-related illness, and work restrictions
Health care workers are responsible for monitoring their own health status. Those who have acute or chronic medical conditions that render them susceptible to opportunistic infection should discuss with their personal physicians or other qualified authority whether the condition might affect their ability to safely perform their duties. However, under certain circumstances, health care facility managers might need to exclude some staff from work or patient contact to prevent further transmission of infection. Decisions concerning work restrictions are based on the mode of transmission and the period of infectivity of the disease. Exclusion policies should be written, include a statement of authority that defines who can exclude workers (e.g., personal physicians), and be clearly communicated through education and training. Policies should also encourage staffers to report illnesses or exposures without jeopardizing wages, benefits, or job status.

With increasing concerns regarding bloodborne pathogens and introduction of universal precautions, use of latex gloves among dental workers has increased markedly. Increased use of these gloves has been accompanied by increased reports of allergic reactions to natural rubber latex among both medical and dental staffs and patients, as well as increased reports of irritant and allergic contact dermatitis from frequent and repeated use of hand-hygiene products, exposure to chemicals and glove use.

Maintenance of records, data management, and confidentiality
The health status of health care workers can be monitored by maintaining records of work-related medical evaluations, screening tests, immunizations, exposures, and post-exposure management. Such records must be kept in accordance with all applicable state and federal laws. Examples of laws that might apply include the Privacy Rule of the Health Insurance Portability and Accountability Act (HIPAA) of 1996, 45 CFR 160 and 164, and the OSHA Occupational Exposure to Bloodborne Pathogens; Final Rule 29 CFR 1910.1030(h)(1).

Symptoms requiring immediate evaluation
Symptoms requiring immediate evaluation by a licensed medical professional and possible restriction from patient care activities include:
- Fever.
- Cough.
- Rash.
- Vesicular lesions.

Management strategies for potentially communicable conditions:
- Appropriate evaluation and treatment.
- Limiting contact with susceptibles.
- Furlough until noninfectious.

Preventing transmission of bloodborne pathogens
The risk of occupational exposure to bloodborne viruses is largely determined by their prevalence in the patient population and the nature and frequency of contact with blood and body fluids through percutaneous or permcusosal routes of exposure. The risk of infection after exposure to a bloodborne virus is influenced by inoculum size, route of exposure, and susceptibility of the exposed HCP.

Avoiding occupational exposures to blood is the primary way to prevent transmission of HBV, HCV, and HIV to workers in health care settings. Exposures occur through percutaneous injury (e.g., a
needlestick or cut with a sharp object), as well as through contact between potentially infectious blood, tissues, or other body fluids and mucous membranes of the eye, nose, mouth, or nonintact skin (e.g., exposed skin that is chapped, abraded, or shows signs of dermatitis).

Standard precautions include use of PPE (e.g., gloves, masks, protective eyewear or face shield, and gowns) intended to prevent skin and mucous membrane exposures. Other protective equipment (e.g., finger guards while suturing) might also reduce injuries during dental procedures.

Engineering controls are the primary method to reduce exposures to blood and OPIM from sharp instruments and needles. These controls are frequently technology-based and often incorporate safer designs of instruments and devices (e.g., self-sheathing anesthetic needles and dental units designed to shield burs in hand pieces) to reduce percutaneous injuries.

### Hand hygiene

**Hand hygiene** – hand-washing, hand antisepsis, or surgical hand antisepsis – substantially reduces potential pathogens on the hands and is considered the single most critical measure for reducing the risk of transmitting organisms to patients and health workers. Hospital-based studies have demonstrated that noncompliance with hand-hygiene practices is associated with health care-associated infections and the spread of multiresistant organisms. Noncompliance also has been a major contributor to outbreaks.

The preferred method for hand hygiene depends on the type of procedure, the degree of contamination, and the desired persistence of antimicrobial action on the skin. For routine dental examinations and nonsurgical procedures, hand-washing and hand antisepsis is achieved by using either a plain or antimicrobial soap and water. If the hands are not visibly soiled, an alcohol-based hand rub is adequate.

The purpose of surgical hand antisepsis is to eliminate transient flora and reduce resident flora for the duration of a procedure to prevent introduction of organisms in the operative wound if gloves become punctured or torn. Skin bacteria can rapidly multiply under surgical gloves if hands are washed with soap that is not anti-microbial. Thus, an anti-microbial soap or alcohol hand rub with persistent activity should be used before surgical procedures.

Agents used for surgical hand antisepsis should substantially reduce microorganisms on intact skin, contain a nonirritating anti-microbial preparation, have a broad spectrum of activity, be fast-acting, and have a persistent effect. Persistence (extended anti-microbial activity that prevents or inhibits survival of microorganisms after the product is applied) is critical because microorganisms can colonize on hands in the moist environment underneath gloves.

Alcohol hand rubs are rapidly germicidal when applied to the skin but should include such antiseptics as chlorhexidine, quaternary ammonium compounds, octenidine, or triclosan to achieve persistent activity. Factors that can influence the effectiveness of the surgical hand antisepsis, in addition to the choice of antisepctic agent, include duration and technique of scrubbing, as well as condition of the hands and techniques used for drying and gloving. CDC’s 2002 guideline on hand hygiene in health care settings provides more complete information at [http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5116a1.htm](http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5116a1.htm).

Hand-washing products, including plain (non-antimicrobial) soap and antiseptic products, can become contaminated or support the growth of microorganisms. Liquid products should be stored in closed containers and dispensed from either disposable containers or containers that are washed and dried thoroughly before refilling. Soap should not be added to a partially empty dispenser, because this practice of topping off might lead to bacterial contamination. HCP should store and dispense products according to manufacturers’ directions.

Lotions are often recommended to ease the dryness that results from frequent hand-washing and to prevent dermatitis from glove use. However, petroleum-based lotion formulations can weaken latex gloves and increase permeability. For that reason, lotions that contain petroleum or other oil emollients should only be used at the end of the workday. Dental practitioners should obtain information from lotion manufacturers regarding interaction between lotions, gloves, dental materials, and anti-microbial products.

Health care personnel should keep their fingernails short, because the majority of flora on the hands are found under and around the fingernails. Fingernails should be short enough to allow health workers to thoroughly clean underneath them and prevent glove tears. Sharp nail edges or broken nails are also likely to increase glove failure. Long artificial or natural nails can make donning gloves more difficult and can cause gloves to tear more readily. Hand carriage of gram-negative organisms has been determined to be greater among wearers of artificial nails than among nonwearers, both before and after hand-washing. In addition, artificial fingernails or extenders have been epidemiologically implicated in multiple outbreaks on natural nails does not increase the microbial load from periungual skin if fingernails are short; however, chipped nail polish can harbor added bacteria.

Studies have demonstrated that skin underneath rings is more heavily colonized than comparable areas of skin on fingers without rings. Rings and decorative nail jewelry can make donning gloves more difficult and cause gloves to tear more readily. Thus, jewelry should not interfere with glove use (e.g., impair ability to wear the correctly sized glove or alter glove integrity).

Employees must refrain from eating, drinking, smoking, applying cosmetics or lip balm, and handling contact lenses in areas where they may be exposed to blood or other potentially infectious materials [Guideline for Preventing Transmission of Mycobacterium tuberculosis in Health care Settings, 2005 (CDC.MMWR 2005; 54: RR-17 )].

### Post-exposure management and prophylaxis

After an occupational blood exposure, first aid should be administered as necessary. Puncture wounds and other injuries to the skin should be washed with soap and water; mucous membranes should be flushed with water. No evidence exists that using antiseptics for wound care or expressing fluid by squeezing the wound further reduces the risk of bloodborne pathogen transmission; however, use of antiseptics is not contraindicated. The application of caustic agents (e.g., bleach) or the injection of antiseptics or disinfectants into the wound is not recommended.

Exposed health care personnel should immediately report the exposure to the infection-control coordinator or other designated person, who should then initiate referral to the qualified health care professional and complete necessary reports. Because multiple factors contribute to the risk of infection after an occupational exposure to blood, the following information should be included in the exposure report, recorded in the exposed person’s confidential medical record, and provided to the qualified health care professional:

- Date and time of exposure.
Details of the procedure being performed, including where and how the exposure occurred and whether the exposure involved a sharp device, the type and brand of device, and how and when during its handling the exposure occurred.

Details of the exposure, including its severity and the type and amount of fluid or material. For a percutaneous injury, severity might be measured by the depth of the wound, gauge of the needle, and whether fluid was injected; for a skin or mucous membrane exposure, the estimated volume of material, duration of contact and the condition of the skin (e.g., chapped, abraded, or intact) should be noted.

Details regarding whether the source material was known to contain HIV or other bloodborne pathogens, and if the source was infected with HIV, the stage of disease, history of antiretroviral therapy, and viral load, if known.

Details regarding the exposed person (e.g., hepatitis B vaccination and vaccine-response status).

Details regarding counseling, post-exposure management, and follow-up.

Each occupational exposure should be evaluated individually for its potential to transmit HBV, HCV, and HIV, based on the following:

- The type and amount of body substance involved.
- The type of exposure (e.g., percutaneous injury, mucous membrane or nonintact skin exposure, or bites resulting in blood exposure to either person involved).
- The infection status of the source.
- The susceptibility of the exposed person.

All of these factors should be considered in assessing the risk for infection and the need for further follow-up (e.g., PEP). During 1990-1998, The U.S. Public Health Service (PHS) published guidelines for post-exposure prophylaxis (PEP) and other management of health care worker exposures to HBV, HCV, or HIV. In 2001, these recommendations were updated and consolidated into one set of PHS guidelines. The new guidelines reflect the availability of new antiretroviral agents, new information regarding the use and safety of HIV PEP, and considerations regarding employing HIV PEP when resistance of the source patient’s virus to antiretroviral agents is known or suspected. In addition, the 2001 guidelines provide guidance to clinicians and exposed HCP regarding when to consider HIV PEP and recommendations for PEP regimens.

Post-exposure management is an integral component of a complete program to prevent infection after an occupational exposure to blood. During dental procedures, saliva is predictably contaminated with blood. Even when blood is not visible, it can still be present in limited quantities, and therefore, is considered a potentially infectious material by OSHA. A qualified health care professional should evaluate any occupational exposure incident to blood or OPIM, including saliva, regardless of whether blood is visible, in dental settings.

Dental practices and laboratories should establish written, comprehensive programs that include hepatitis B vaccination and post-exposure management protocols that describe the types of contact with blood or OPIM that can place dental workers at risk for infection; describe procedures for promptly reporting and evaluating such exposures, and identify a health care professional who is qualified to provide counseling and perform all medical evaluations and procedures in accordance with current recommendations of the U.S. Public Health Service (PHS), including PEP (post-exposure prophylaxis) with chemotherapeutic drugs when indicated.

Dental health care personnel, including students, who might reasonably be considered at risk for occupational exposure to blood or OPIM should be taught strategies to prevent contact with blood or OPIM and the principles of post-exposure management, including PEP options, as part of their job orientation and training. Educational programs for dental health workers and students should emphasize reporting all exposures to blood or OPIM as soon as possible, because certain interventions have to be initiated promptly to be effective. Policies should be consistent with the practices and procedures for worker protection required by OSHA and with current PHS recommendations for managing occupational exposures to blood.

**Policy statement**

Based on evaluation of available medical and scientific data, the following HIV- and HBV-related policies best safeguard patients and protect the viability of its health care system:

- The most effective means of preventing HIV and HBV transmission in health care settings is through strict adherence to universal barrier precautions and established infection-control practices that decrease the opportunity of direct exposure to blood and body fluids for both workers and patients.

- Voluntary testing without fear of disclosure or discrimination is the best means of encouraging people at risk for HTV or HBV to seek counseling and testing.

- All patients and health care personnel who have been potentially exposed to HTV or HBV through personal risk behavior, blood products, or occupational accidents should be strongly counseled to seek testing so they may benefit from medical management.

- HIV or HBV infection alone does not justify limiting a health care worker’s professional duties. Limitations, if any, should be determined on a case-by-case basis after consideration of the factors that influence transmission risk, including inability or unwillingness to comply with infection control standards or functional impairment which interferes with job performance.

- Requiring health care workers to inform patients or employers that they are HIV- or HBV-positive would only serve as a deterrent to workers seeking voluntary testing and medical evaluation. It also would endanger the professional careers of competent and needed health personnel who pose no risk to patients.

- After a needle-stick exposure to an infected patient, a health care worker’s risk of infection depends on the pathogen involved, the immune status of the worker, the severity of the needle-stick injury, and the availability and use of appropriate post-exposure prophylaxis (PEP).

- Although exposure to HBV poses a high risk for infection, administration of pre-exposure vaccination or post-exposure prophylaxis to workers can dramatically reduce this risk. Such is not the case with HCV and HIV. Preventing the needlestick injury is the best approach to preventing these diseases in health care workers, and it is an important part of any bloodborne pathogen prevention program in the workplace.

**CDC Guidance for Evaluating Health care Personnel for Hepatitis B Virus Protection and for Administering Post-exposure Management**

This report published in 2013, contains CDC guidance that augments the 2011 recommendations of the Advisory Committee on Immunization Practices (ACIP) for evaluating hepatitis B protection among health care personnel (HCP) and administering post-exposure prophylaxis. Explicit guidance is provided for people working, training, or volunteering in health care settings who have documented hepatitis B (HepB) vaccination years before hire or matriculation (e.g., when HepB vaccination was received as part of routine infant [recommended since 1991] or catch-up adolescent [recommended since 1995] vaccination).

In the United States, 2,890 cases of acute hepatitis B were reported to CDC in 2011, and an estimated 18,800 new cases of hepatitis B occurred after accounting for underreporting of cases and asymptomatic infection. Although the rate of acute hepatitis B virus
HBV) infections have declined approximately 89 percent during 1990-2011, from 8.5 to 0.9 cases per 100,000 population in the United States, the risk for occupationally acquired HBV among HCP persists, largely from exposures to patients with chronic HBV infection.

ACIP recommends HepB vaccination for unvaccinated or incompletely vaccinated HCP, with reasonably anticipated risk for blood or body fluid exposure. ACIP also recommends that vaccinated HCP receive post-vaccination serologic testing (antibody to hepatitis B surface antigen [anti-HBs]) 1-2 months after the final dose of vaccine is administered (CDC. Immunization of health care personnel: recommendations of the Advisory Committee on Immunization Practices [ACIP]. MMWR 2011;60 [No. RR-7]). Increasing numbers of HCP have received routine HepB vaccination either as infants (recommended since 1991) or as catch-up vaccination (recommended since 1995) in adolescence. HepB vaccination results in protective anti-HBs responses among approximately 95 percent of healthy-term infants. Certain institutions test vaccinated HCP by measuring anti-HBs upon hire or matriculation, even when anti-HBs testing occurs greater than two months after vaccination. This guidance can assist clinicians, occupational health and student health providers, infection-control specialists, hospital and health care training program administrators, and others in selection of an approach for assessing HBV protection for vaccinated HCP. This report emphasizes the importance of administering HepB vaccination for all HCP, provides explicit guidance for evaluating hepatitis B protection among previously vaccinated HCP (particularly those who were vaccinated in infancy or adolescence), and clarifies recommendations for post-exposure management of HCP exposed to blood or body fluids.

Pre-exposure management
Education and infrastructure

At the time of hire or matriculation, health care providers and health care institutions should provide training to HCP to improve recognition and encourage timely reporting of blood and body fluid exposures. The possibility that the post-exposure evaluation will cause the HCP to have time lost from work should not be a barrier to reporting. Institutions should ensure that HCP have rapid access to post-exposure testing and prophylaxis, including HBIG and HepB vaccine.

Occupational risk for HBV exposure and exposure reporting

Blood from people with HBV infection contains the highest HBV titers of all body fluids and is the most important vehicle of transmission in the health care setting (1). The following body fluids also are considered potentially infectious: cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, and amniotic fluid (1). Although studies have documented HBV in saliva and tears, these body fluids have generally not represented an occupational risk for HBV infection unless they contain blood (1). Semen and vaginal secretions have been implicated in the sexual transmission of HBV, but they have not been implicated in occupational transmission from patients to HCP (1). The presence of HBsAg, usually an indicator of active HBV infection, also is found in other body fluids (e.g., breast milk, bile, feces, nasopharyngeal washings, and sweat). However, most body fluids are not efficient vehicles of transmission (unless they contain blood) because they contain low quantities of infectious HBV (1). Sputum, urine, and vomitus are not considered potentially infectious unless they contain blood (1).

HBV is highly infectious, can be transmitted in the absence of visible blood (1), and remains infectious on environmental surfaces for at least seven days (24). HBV is transmitted through percutaneous (i.e., needlesticks), mucosal (i.e., direct contact with mucous membranes), or nonintact skin (e.g., psoriasis, eczema, burns, wounds, cuts, and scratches) exposure to infectious blood or body fluids. Although percutaneous exposures are among the most efficient modes of HBV transmission, these exposures might account for only a minority of HBV infections among HCP. In several investigations of HBV outbreaks, most infected HCP could not recall an overt percutaneous exposure (2,25).

Hepatitis B e antigen (HBeAg) is a marker for high HBV replication and viral load (15). Although testing occupational exposure source patients for HBeAg is not practical and is not recommended, the risk for acquiring HBV infection is particularly high in occupational exposures to blood or body fluids from source patients who are HBeAg-positive (4). In studies of HCP who sustained injuries from needles contaminated with blood containing HBV, the risk for developing clinical hepatitis if the blood was both HBsAg-positive and HBeAg-positive was 22 to 31 percent; the risk for developing serologic evidence of HBV infection was 37-62 percent (1,26). By comparison, the risk for developing clinical hepatitis from a needle contaminated with HBsAg-positive, HBeAg-negative blood was 1-6 percent, and the risk for developing serologic evidence of HBV infection was 23-37 percent (1,26).

The Needlestick Safety and Prevention Act of 2001 directed the Occupational Safety and Health Administration (OSHA) to revise the Occupational Exposure to Bloodborne Pathogens Standard and established in greater detail requirements for employers regarding the identification and use of effective and safer medical devices (27). Percutaneous injuries have since decreased from 39.6 injuries per 100 occupied beds in 1999 to 19.5 injuries per 100 occupied beds in 2011 (Figure 3) (28). Data since 2002 indicate that 18 percent of HCP trainees sustain a percutaneous exposure annually, and 54 percent of percutaneous exposures are reported to occupational health (3,29-32). Reluctance to report exposures to occupational health might be influenced by fear of being reprimanded, concerns regarding confidentiality, and the belief that reporting might be time consuming (29,31). The annual risk for a mucosal exposure among trainees is 22 percent, of which 17 percent are reported to occupational health (3,29-32). The risk for exposure is generally lower among nontrainees and varies by occupation and job duties (32,33). Surveillance data indicate nurses and physicians account for 41.9 percent and 22.8 percent, respectively, of HCP reporting percutaneous exposures (28). The purpose of the sharp item that resulted in the exposure was for intramuscular or subcutaneous injection in 30.5 percent of exposures and was for suturing in 18.7 percent of exposures (28). Medical students account for 44.3 percent of HCP reporting a mucosal exposure (28).

The probability of HBV infection among HCP trainees will vary by the prevalence of HBsAg-positivity of source patients and the approach to assessment (Figure 4). Exposure logs during 2000-2012 representing 7,170 exposures at three health care systems in the United States indicated that 0.9 percent of source patients were HBsAg-positive (34). This figure likely varies substantially by setting; in some community screening programs among populations considered at higher risk, 11-25 percent of people screened are infected with HBV (35).

The source patient is identifiable in approximately 95 percent of exposures (28). The source patient might not be identifiable after exposure from an item protruding from a disposal container, an item disposed of in an inappropriate container, or from an item left in an inappropriate place (28).
Vaccination

**HepB vaccines**

All HCP whose work-, training-, and volunteer-related activities involve reasonably anticipated risk for exposure to blood or body fluids should be vaccinated with a complete, ≥3-dose HepB vaccine series. OSHA mandates that vaccination be available for employees within 10 days of initial assignment (27). HCP trainees should complete the series before the potential for exposure with blood or body fluids, when possible, as higher risk has been reported during professional training (e.g., residency training).

Incompletely vaccinated HCP should receive additional dose(s) to complete the vaccine series (15). The vaccine series does not need to be restarted for HCP with an incomplete series; however, minimum dosing intervals should be heeded (15). Minimum dosing intervals are 4 weeks between the first and second dose, 8 weeks between the second and third dose, and 16 weeks between the first and third dose (15).

HCP who lack documentation of HepB vaccination should be considered unvaccinated (when documentation for HepB vaccine doses is lacking) or incompletely vaccinated (when documentation for some HepB vaccine doses is lacking) and should receive additional doses to complete a documented HepB series. Health care institutions are encouraged to seek documentation of “missing” HepB doses in IIS, when feasible, to avoid unnecessary vaccination.

OSHA mandates that HCP who refuse HepB vaccination sign a declination statement (http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10052&p_table=STANDARDS). HCP who refuse HepB vaccination can obtain vaccination at a later date at no expense if the HCP is still covered under OSHA's Bloodborne Pathogens Standard. Health care institutions should encourage HepB vaccination among HCP to improve HBV protection and to achieve the Healthy People 2020 target of 90 percent vaccination (66).

HepB vaccine is available as a single-antigen formulation and also in combination with other vaccines (Table 1) (15). Two single-antigen recombinant HBsAg vaccines are available in the United States: Recombivax HB (Merck and Co., Inc., Whitehouse Station, NJ) and Engerix-B (GlaxoSmithKline Biologicals, Rixensart, Belgium) (15). Of the three licensed combination vaccines, one (Twinrix [GlaxoSmithKline Biologicals]) is available for people aged ≥18 years. Twinrix contains recombinant HBsAg and inactivated hepatitis A virus (15).

Primary HepB vaccination of adults usually consists of 3 doses of 10 or 20 μg of recombinant HBsAg protein administered intramuscularly into the deltoid muscle on a 0-, 1-, and 6-month schedule (15). Alternative schedules (including a 4-dose schedule at 0, 1, 2, and 12 months) are U.S. approved for routine vaccination for specific ages and vaccine formulations; vaccination according to these schedules elicits final rates of seroprotection similar to those obtained on a 0-, 1-, and 6-month schedule (15). Obese people might require adjustment in the needle length for administering HepB vaccine to achieve optimal seroprotection (11,15).

**Standard precautions and advising HCP to report exposures**

All HCP should adhere to infection-control guidelines and follow Standard Precautions (90), including the use of engineering and work-practice controls, to reduce the risk for blood or body fluid exposure. All HCP, including those who have demonstrated protection against HBV, should be advised to immediately report blood or body fluid exposures to occupational health for evaluation of the appropriate measures to prevent transmission of bloodborne pathogens (including HIV, hepatitis C, and hepatitis B).

**Post-exposure management**

**Initial post-exposure management**

Wounds and skin sites that have been in contact with blood or body fluids should be washed with soap and water; mucous membranes should be flushed with water. Using antiseptics (e.g., 2-4 percent chlorhexidine) for wound care or expressing fluid by squeezing the wound further have not been shown to reduce the risk for HBV transmission; however, the use of antiseptics is not contraindicated. The application of caustic agents (e.g., bleach) or the injection of antiseptics or disinfectants into the wound is not recommended.

Procedures should be followed for testing known source people, including obtaining informed consent, in accordance with applicable laws. Source patients determined to be HBsAg-positive should be referred for appropriate management and should be reported to the state or local health department. When a source patient is unknown (e.g., as occurs from a puncture with a needle in the trash), the exposed HCP should be managed as if the source patient were HBsAg-positive. Testing needles and other sharp instruments implicated in an exposure is not recommended, regardless of whether the source patient is known or unknown. The reliability and interpretation of findings in such circumstances are unknown, and testing could be hazardous to people handling the sharp instrument. Exposures that involve human bites should be managed with the knowledge that both the person being bitten and the person who engaged in biting were potentially exposed.

Institutions should ensure that HCP have timely access to post-exposure management and prophylaxis, including HBIG and HepB vaccine. For exposed HCP thought to be susceptible to HBV infection, HBIG and HepB vaccine should be administered as soon as possible after an exposure when indicated. The effectiveness of HBIG when administered >7 days after percutaneous, mucosal, or nonintact skin exposures is unknown. HBIG and HepB vaccine can be administered simultaneously at separate injection sites.

Anti-HBs testing of HCP who received HBIG should be performed after anti-HBs from HBIG is no longer detectable (six months after administration) (11). Anti-HBs testing should be performed using a method that allows detection of the protective concentration of anti-HBs (≥10 mIU/mL) (Table 2).

**HBV infection among vaccinated and unvaccinated HCP**

From 1983 to 2010, the number of HBV infections among HCP declined approximately 98 percent, from an estimated 17,000 infections to 263 acute HBV infections (considering that occupational history was assessed for 43.6 percent of cases and using a correction factor of 10.5 to account for underreporting and asymptomatic infection) (10). The decrease in acute HBV infection among HCP probably resulted from routine pre-exposure HepB vaccination and reduced risk for exposure through improvements in infection-control practices (28,72,73).

Although few studies have evaluated the vaccination history of people with acute hepatitis B (74), some cases of acute hepatitis B and chronic HBV infection can be expected in unvaccinated people and among...
vaccine non-responders. During 2005-2010, a total of 203 cases of people with acute hepatitis B among HCP were reported to CDC’s National Notifiable Diseases Surveillance System (NNDSS) (75). Six of 17 patients with information on the development of chronic HBV infection developed chronic HBV infection (75). Follow-up of 67 (76.1 percent) of 88 HCP initially reported as having a positive or unknown HepB vaccination history indicated that 35 HCP reported vaccination with ≥3 HepB vaccine doses (seven had documentation to support the reported vaccination history) (75). Among the 35 HCP reporting vaccination with ≥3 HepB vaccine doses, one HCP demonstrated an immune response (i.e., anti-HBs ≥10 mIU/mL); the remaining 34 were non-responders or had an unknown response status (75). Four of eight HCP with ≥3-dose HepB vaccination with information developed chronic HBV infection; none of the four had complete documentation of ≥3 HepB vaccine doses (75). Post-vaccination serologic testing was available for only one of seven HCP with documentation of ≥3-doses of HepB vaccine; this HCP had an anti-HBs level <10 mIU/mL after 4 doses of vaccine (75).

Although reported data did not enable identification of the modes of transmission or information on receipt of post-exposure prophylaxis, 28 (16.7 percent) of 168 HCP for whom data were available reported an accidental stick or puncture with a needle or other object contaminated with blood during the six weeks through six months before illness, possibly representing occupational acquisition of infection (75). Unrecognized exposures might have resulted in HBV infections among HCP who did not report an exposure (2). Other risk factors for HBV exposure in the six weeks through six months before illness (i.e., injection drug use, men who have sex with men, multiple sex partners, contact with a hepatitis B case, dialysis patient, receipt of blood transfusion, surgery, acupuncture, and tattoo receipt) were present among 121 (59.6 percent of 203 HCP, possibly suggesting their exposures were not occupational (75).

### Updated CDC recommendations for the management of hepatitis B virus-infected health care providers and students

The material in this report originated in the National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, Kevin Fenton, MD, PhD, Director, and the Division of Viral Hepatitis, John W. Ward, MD, Director.

This report updates the 1991 CDC recommendations for the management of hepatitis B virus (HBV)–infected health care providers and students to reduce risk for transmitting HBV to patients during the conduct of exposure-prone invasive procedures. This update reflects changes in the epidemiology of HBV infection in the United States and advances in the medical management of chronic HBV infection and policy directives issued by health authorities since 1991.

The primary goal of this report is to promote patient safety while providing risk management and practice guidance to HBV-infected health care providers and students, particularly those performing exposure-prone procedures such as certain types of surgery. Because percutaneous injuries sustained by health care personnel during certain surgical, obstetrical, and dental procedures provide a potential route of HBV transmission to patients as well as providers, this report emphasizes prevention of operator injuries and blood exposures during exposure-prone surgical, obstetrical, and dental procedures.

These updated recommendations reaffirm the 1991 CDC recommendation that HBV infection alone should not disqualify infected people from the practice or study of surgery, dentistry, medicine, or allied health fields. The previous recommendations have been updated to include the following changes: no prenotification of patients of a health care provider’s or student’s HBV status; use of HBV DNA serum levels rather than hepatitis B e-antigen status to monitor infectivity; and, for those health care professionals requiring oversight, specific suggestions for composition of expert review panels and threshold value of serum HBV DNA considered “safe” for practice (<1,000 IU/mL). These recommendations also explicitly address the issue of medical and dental students who are discovered to have chronic HBV infection. For most chronically HBV-infected providers and students who conform to current standards for infection control, HBV infection status alone does not require any curtailing of their practices or supervised learning experiences. These updated recommendations outline the criteria for safe clinical practice of HBV-infected providers and students that can be used by the appropriate occupational or student health authorities to develop their own institutional policies. These recommendations also can be used by an institutional expert panel that monitors providers who perform exposure-prone procedures.

This report is intended to guide the practices of chronically HBV-infected providers and students and the institutions that employ, oversee, or train them; it does not address those with acute HBV infection. This report is limited to the provider-to-patient transmission of HBV; it does not address infection control measures to prevent bloodborne transmission of HBV to patients through receipt of human blood products, organs, or tissues, because these measures have been described elsewhere. Nor does this report provide comprehensive guidance about prevention of patient-to-health care provider bloodborne pathogen transmission, because this guidance also has been published previously.

On the basis of a through literature review, reports of providers who experienced curtailed scope of practice, and expert consultation, CDC considered the following issues when developing these recommendations: 1) very rare or, for most types of clinical practice, no detected transmission of HBV from providers to patients; 2) nationally decreasing trends in the incidence of acute HBV infection in both the general population and health care providers; 3) successful implementation and efficacy of policies promoting hepatitis B vaccination; 4) evolving and improving therapies for HBV infection; 5) guidelines in the United States and other developed countries that propose expert-based approaches to the risk management of infected health care providers; 6) the adoption of Standard Precautions (formerly known as universal precautions) as a primary prevention intervention for the protection of patients and providers from infectious agent transmission; 7) the implementation of improved work practice and engineering controls, including safety devices; 8) the testing and vaccination of providers; 9) increasing availability of HBV viral load testing; and 10) instances of restrictions or prohibitions for HBV-infected providers and students that are not consistent with CDC and other previous recommendations.
### National trends in acute hepatitis B incidence and prevalence

Symptomatic acute HBV infections in the United States, as reported through health departments to CDC, have declined approximately 85 percent from the early 1990s to 2009, following the adoption of universal infant vaccination and catch-up vaccinations for children and adolescents. If declining trends continue, an ever-increasing proportion of patients receiving health care and their providers will be protected by receipt of hepatitis B vaccination.

Patient-to-health care provider transmission of HBV also has declined markedly. Reflecting this finding, the reported number of acute HBV infections among providers in the United States, not all of which reflect occupational exposure, decreased from approximately 10,000 in 1983 to approximately 400 in 2002 and to approximately 100 by 2009.

### Treatments for chronic hepatitis B infection

Medications for hepatitis B have been improving continually and are usually effective at reducing viral loads markedly or even to undetectable levels. Currently, seven therapeutic agents are approved by the Food and Drug Administration for the treatment of chronic hepatitis B, including two formulations of interferon (interferon alpha and pegylated interferon) and five nucleoside or nucleotide analogs (lamivudine, telbivudine, abacavir, entecavir, and tenofovir). Among the approved analogs, both entecavir and tenofovir have potent antiviral activity as well as very low rates of drug resistance. Treatment with these agents reduces HBV DNA levels to undetectable or nearly undetectable levels in most treated people. Virtually all treated patients, even those few still receiving older agents (e.g., lamivudine), can expect to achieve a reduction of HBV DNA viral loads to very low levels within weeks or months of initiating therapy. The newer medications are effective in suppressing viral replication, and it is expected that they will be used for a newly identified HBV-infected health care provider who is performing exposure-prone procedures and who has HBV virus levels above the threshold suggested in this report (1,000 IU/ml [i.e., about 5,000 genome equivalents (GE)/ml]) or as adopted by their institution’s expert review panel. However, clinicians caring for infected health care providers or students who are not performing exposure-prone procedures and who are not subject to expert panel review should consider both the benefits and risks associated with life-long antiviral therapy for chronic HBV started at young ages.

### Actions taken against HBV-infected health care providers and students

CDC is aware of several recent instances in which HBV-infected people have been threatened with dismissal or actually dismissed from surgical practice on the basis of their HBV infection, and others have had their acceptances to medical or dental schools rescinded or deferred because of their infection. Some of these instances have involved requirements that the infected provider, applicant, or student demonstrate undetectable HBV viral load or hepatitis B e-antigen negativity and, in at least one case, that this be demonstrated continuously by weekly testing. These actions might not be based on clear written guidance and procedures at the institutions involved.

### Specifying exposure-prone procedures

In general, three conditions are necessary for health care personnel to pose a risk for bloodborne virus transmission to patients. First, the health care provider must be sufficiently viremic, including those who have an infectious virus circulating in the bloodstream. Second, the health care provider must have an injury, such as a puncture wound or nonintact skin, which allows exposure to the blood or other infectious body fluids. Third, the provider’s blood or infectious body fluid must come in direct contact with a patient’s wound, traumatized tissue, mucous membranes, or similar portal of entry during an exposure-prone procedure. The vast majority of HBV-infected health care personnel pose no risk for patients because they do not perform activities in which both the second and third conditions are met.

Beyond meeting these three basic conditions, defining exposure-prone invasive procedures that pose a risk for HBV transmission between infected provider and patient has been problematic in the development of all recommendations and guidelines; this process is made especially difficult by varying surgical techniques used by health care providers doing the same procedure. More recent guidelines and published articles indicate that exposure-prone procedures can be defined broadly, and lists of potentially exposure-prone procedures have been developed. Principles cited are that exposure-prone procedures include those in which access for surgery is difficult or those in which needlestick injuries are likely to occur, typically in very closed and unvisualized operating spaces in which double gloving and the skin integrity of the operator might be compromised.

### Specifying exposure-prone procedures

Defining exposure-prone procedures in dentistry and oral surgery has been particularly difficult. Many intra-oral procedures, such as injection or scaling, occur in a confined cavity and might lead to injuries to the operator, so some institutions have considered these procedures to be exposure-prone. However, no transmission of HBV from a U.S. dentist to a patient has been reported since 1987, and no transmission has ever been reported from a dental or medical student. Procedures classified as Category I Procedures are defined as those known or likely to pose an increased risk of percutaneous injury to a health care provider that have resulted in provider-to-patient transmission of hepatitis B virus (HBV) include only major oral surgery, and do not include the procedures that medical and dental students or most dentists would be performing or assisting. These procedures are limited to major abdominal, cardiothoracic, and orthopedic surgery, repair of major traumatic injuries, abdominal and vaginal hysterectomy, caesarean section, vaginal deliveries, and major oral or maxillofacial surgery (e.g., fracture reductions). Techniques that have been demonstrated to increase the risk for health care provider percutaneous injury and provider-to-patient blood exposure include:

- Digital palpation of a needle tip in a body cavity.
- The simultaneous presence of a health care provider’s fingers and a needle or other sharp instrument or object (e.g., bone spicule) in a poorly visualized or highly confined anatomic site.

Category I procedures, especially those that have been implicated in HBV transmission, are not ordinarily performed by students fulfilling the essential functions of a medical or dental school education.

In addition to these lists of specific procedures, an institutional expert review panel convened to oversee an HBV-infected surgeon or other health care provider performing exposure-prone procedures may consult the classification of such procedures for guidance. Given the variety of procedures, practices, and providers, each HBV-infected health care provider performing potentially exposure-prone procedures will need individual consideration. However, this evaluation should not define exposure-prone procedures too broadly; the great majority of surgical and dental procedures have not been associated with the transmission of HBV.
Notification of patients of HBV-infected health care providers

There is no clear justification for or benefit from routine notification of the HBV infection status of a health care provider to his or her patient, with the exception of instances in which an infected provider transmits HBV to one or more patients or documented instances in which a provider exposes a patient to a bloodborne infection. Routine mandatory disclosure might actually be counterproductive to public health, as providers and students might perceive that a positive test would lead to loss of practice or educational opportunities. This misconception might lead to avoidance of HBV testing, of hepatitis B vaccination (if susceptible), of treatment and management (if infected), or of compliance with practice oversight from an expert panel (if infected and practicing exposure-prone procedures). In general, a requirement for disclosure is accepted to be an insurmountable barrier to practice and might limit patient and community access to quality medical care.

Ethical considerations

On July 18, 2011, the Consult Subcommittee of CDC’s Public Health Ethics Committee reviewed these proposed recommendations. The reviewing team also included three external ethicists. The opinion of the Consult Subcommittee was that guidelines that allow providers with HBV to practice, while requiring those doing exposure-prone procedures to be monitored to maintain low load, strikes the right balance between protecting patients’ interests and providers’ rights. The Consult Subcommittee also noted that providers have an ethical and professional obligation to know their HBV status and to act on such knowledge accordingly (CDC Public Health Ethics Committee, personal communication, 2011). The Consult Subcommittee supported the new recommendation that mandatory disclosure of provider HBV status to patients was no longer warranted and that the 1991 recommendation for disclosure was discriminatory and unwarranted. In addition, the Consult Subcommittee determined that there was no scientific or ethical basis for the restrictions that some medical and dental schools have placed on HBV-infected students and concluded that such restrictions were detrimental to the professions as well as to the individual students.

Guidance for expert review panels at institutions

HBV infection in health care providers and students who do not perform invasive exposure-prone procedures should be managed as a personal health issue and does not require special panel oversight. However, for providers who perform exposure-prone procedures, all recent guidelines advocate the constitution of an expert panel to provide oversight of the infected health care provider’s practice. For HBV-infected providers performing exposure-prone procedures, expert review panels should evaluate the infected provider’s clinical and viral burden status; assess his or her practices, procedures and techniques, experience, and adherence to recommended surgical and dental technique; provide recommendations, counseling, and oversight of the provider’s continued practice or study within the institution; and investigate and notify appropriate people and authorities such as an institutional review team if indicated. The confidentiality of the infected provider or student should be respected. Certain members of the panel should be familiar with issues relating to bloodborne pathogens and their infectivity. In instances when it is generally accepted (or thought) that a patient might have been exposed to the blood of an infected health care provider, institutions should have in place a protocol for communicating to the patient that such an exposure might have occurred. The patient should receive appropriate follow-up, including post-exposure vaccination or receipt of hepatitis B immune globulin and testing (i.e., similar to the reverse situation of prophylaxis for providers exposed to the blood of an HBV-infected patient). The confidentiality of the infected provider or student should be respected. Certain expert review panels might elect to consider cases without knowledge of the name of the infected provider or student. However, awareness of the infected provider’s or student’s identity might be unavoidable. In such cases, respect for the confidentiality of the person under review should be accorded as it is for any other patient.

Recommendations for chronically HBV-infected health care providers and students

CDC recommends the following measures for the management of hepatitis B virus–infected health care providers and students:

- **Practice scope**
  - Chronic HBV infection in itself should not preclude the practice or study of medicine, surgery, dentistry, or allied health professions. Standard Precautions should be adhered to rigorously in all health care settings for the protection of both patient and provider.
  - CDC discourages constraints that restrict chronically HBV-infected health care providers and students from the practice of medicine, dentistry, or surgery, such as repeated demonstration of persistently nondetectable viral loads on a greater than semiannual frequency; pre-notification of patients of the HBV-infection status of their caregiver; mandatory antiviral therapy with no other option such as maintenance of low viral load without therapy; and forced change of practice, arbitrary exclusion from exposure-prone procedures, or any other restriction that essentially prohibits the health care provider from practice or the student from study.
Hepatitis B vaccination and screening

1. All health care providers and students should receive hepatitis B vaccine according to current CDC recommendations. Vaccination (3-dose series) should be followed by assessment of hepatitis B surface antibody to determine vaccination immunogenicity and, if necessary, revaccination. Health care providers who do not have protective concentration of anti-HBs (>10 mIU/ml) after revaccination (i.e., after receiving a total of 6 doses) should be tested for HBsAg and anti-HBc to determine their infection status.

2. Prevaccination serologic testing is not indicated for most people being vaccinated, except for those providers and students at increased risk for HBV infection, such as those born to mothers in or from endemic countries and sexually active men who have sex with men.

3. Providers who are performing exposure-prone procedures also should receive prevaccination testing for chronic HBV infection. Exposure of a patient to the blood of an HBV-infected health care provider, in the performance of any procedure, should be handled with post-exposure prophylaxis and testing of the patient in a manner similar to the reverse situation of prophylaxis for providers exposed to the blood of an HBV-infected patient.

Expert panel oversight not needed

Providers, residents, and medical and dental students with active HBV infection (i.e., those who are HBsAg-positive) who do not perform exposure-prone procedures but who practice non- or minimally invasive procedures, classified as Category II, should not be subject to any restrictions of their activities or study. These and similar procedures are not included in Category I as they pose low or no risk for percutaneous injury to a health care provider, or, if a percutaneous injury occurs, it usually happens outside a patient’s body and generally does not pose a risk for provider-to-patient blood exposure. These include:

1. Surgical and obstetrical/gynecologic procedures that do not involve the techniques listed for Category I.

2. The use of needles or other sharp devices when the health care provider’s hands are outside a body cavity (e.g., phlebotomy, placing and maintaining peripheral and central intravascular lines, administering medication by injection, performing needle biopsies, or lumbar puncture).

3. Dental procedures other than major oral or maxillofacial surgery.

4. Insertion of tubes (e.g., nasogastric, endotracheal, rectal, or urinary catheters).

5. Endoscopic or bronchoscopic procedures.

6. Internal examination with a gloved hand that does not involve the use of sharp devices (e.g., vaginal, oral, and rectal examination).

7. Procedures that involve external physical touch (e.g., general physical or eye examinations or blood pressure checks).

They do not need to achieve low or undetectable levels of circulating HBV DNA, hepatitis e-antigen negativity, or have review and oversight by an expert review panel, as recommended for those performing exposure-prone procedures. However, they should receive medical care for their condition by clinicians, which might be in the setting of student or occupational health.

Expert panel oversight recommended

Surgeons, including oral surgeons, obstetrician/gynecologists, surgical residents, and others who perform exposure-prone procedures listed under Category I activities should fulfill the following criteria:

- In accordance with the 1991 recommendations and Advisory Committee on Immunization Practices (ACIP) recommendations, their procedures should be guided by review of a duly constituted expert review panel with a balanced perspective (i.e., providers’ and students’ personal, occupational or student health physicians, infectious disease specialists, epidemiologists, ethicists, and others as indicated above) regarding the procedures that they can perform and prospective oversight of their practice (28). Confidentiality of the health care provider’s or student’s HBV serologic status should be maintained.

- HBV-infected providers can conduct exposure-prone procedures if a low or undetectable HBV viral load is documented by regular testing at least every six months, unless higher levels require more frequent testing; for example, as drug therapy is added or modified or testing is repeated to determine if elevations above a threshold are transient.

- CDC recommends that an HBV level 1,000 IU/ml (5,000 GE/ml) or its equivalent is an appropriate threshold for a review panel to adopt. Monitoring should be conducted with an assay that can detect as low as 10-30 IU/ml, especially if the individual institutional expert review panel wishes to adopt a lower threshold.

- Spontaneous fluctuations (blips) of HBV DNA levels and treatment failures might both present as higher-than-threshold (1,000 IU/ml; 5,000 GE/ml) values. This will require the HBV-infected provider to abstain from performing exposure-prone procedures, while subsequent retesting occurs, and if needed, modifications or additions to the health care provider’s drug therapy and other reasonable steps are taken.

Institutional policies and procedures

Hospitals, medical and dental schools, and other institutions should have written policies and procedures to identify and convene an expert review panel aware of these and other relevant guidelines and recommendations before considering the management of HBV-infected providers performing exposure-prone procedures.

CDC tightened guidance for U.S. health care workers on personal protective equipment for ebola

The Centers for Disease Control and Prevention (CDC) is tightening previous infection control guidance for health care workers caring for patients with Ebola, to ensure there is no ambiguity. The guidance focuses on specific personal protective equipment (PPE) that health care workers should use and offers detailed step-by-step instructions for how to put the equipment on and take it off safely.

Recent experience from safely treating patients with Ebola at Emory University Hospital, Nebraska Medical Center, and National Institutes of Health Clinical Center are reflected in the guidance.
The enhanced guidance is centered on three principles:

- All health care workers undergo rigorous training and are practiced and competent with PPE, including putting it on and taking it off in a systematic manner.
- No skin exposure when PPE is worn.
- All workers are supervised by a trained monitor who watches each worker putting PPE on and taking it off.

All patients treated at Emory University Hospital, Nebraska Medical Center, and the National Institutes of Health Clinical Center have followed the three principles. None of the workers at these facilities have contracted the illness.

**Principle #1: Rigorous and repeated training**

Focusing only on PPE gives a false sense of security of safe care and worker safety. Training is a critical aspect of ensuring infection control. Facilities need to ensure all health care providers practice numerous times to make sure they understand how to appropriately use the equipment, especially in the step-by-step process of putting on and taking off PPE. CDC and partners will ramp up training offerings for health care personnel across the country to reiterate all the aspects of safe care recommendations.

**Principle #2: No skin exposure when PPE is worn**

Given the intensive and invasive care that U.S. hospitals provide for Patients with Ebola, the tightened guidelines are more directive in recommending no skin exposure when PPE is worn.

CDC is recommending all of the same PPE included in the August 1, 2014 guidance, with the addition of coveralls and single-use, disposable hoods. Goggles are no longer recommended, as they may not provide complete skin coverage in comparison to a single-use, disposable full-face shield. Additionally, goggles are not disposable, may fog after extended use, and health care workers may be tempted to manipulate them with contaminated gloved hands. PPE recommended for U.S. health care workers caring for patients with Ebola includes:

1. Double gloves.
2. Boot covers that are waterproof and go to at least mid-calf or leg covers.
3. Single-use fluid resistant or impermeable gown that extends to at least mid-calf or coverall without integrated hood.
4. Respirators, including either N95 respirators or powered air-purifying respirator (PAPR).
5. Single-use, full-face shield that is disposable.
6. Surgical hoods to ensure complete coverage of the head and neck.

The guidance describes different options for combining PPE to allow a facility to select PPE for their protocols based on availability, health care personnel familiarity, comfort, and preference while continuing to provide a standardized, high level of protection for health care personnel. The guidance includes having:

- Two specific, recommended PPE options for facilities to choose from. Both options provide equivalent protection if worn, put on, and removed correctly.
- Designated areas for putting on and taking off PPE. Facilities should ensure that space and layout allows for clear separation between clean and potentially contaminated areas.
- Trained observer to monitor PPE use and safe removal.
- Step-by-step PPE removal instructions that include:
  - Disinfecting visibly contaminated PPE using an EPA-registered disinfectant wipe prior to taking off equipment.
  - Disinfection of gloved hands using either an EPA-registered disinfectant wipe or alcohol-based hand rub between steps of taking off PPE.

**Principle #3: Trained monitor**

CDC is recommending a trained monitor actively observe and supervise each worker who is putting on and/or taking off PPE. This helps to ensure each worker follows the step-by-step processes, especially to disinfect visibly contaminated PPE. The trained monitor can spot any missteps in real-time and immediately address them.

**PPE is only one aspect of infection control**

It is critical to focus on other prevention activities to halt the spread of Ebola in health care settings, including:

- Prompt screening and triage of potential patients.
- Designated site managers to ensure proper implementation of precautions.
- Limiting personnel in the isolation room.
- Effective environmental cleaning.

**Think ebola and care carefully**

The CDC reminds health care workers to “Think Ebola” and to “Care Carefully.” Health care workers should take a detailed travel and exposure history with patients who exhibit fever, severe headache, muscle pain, weakness, diarrhea, vomiting, stomach pain, and unexplained hemorrhage. If the patient is under investigation for

Ebola, health care workers should activate the hospital preparedness plan for Ebola, isolate the patient in a separate room with a private bathroom, and ensure standardized protocols are in place for PPE use and disposal. Health care workers should not have physical contact with the patient without putting on appropriate PPE.

**CDC’s guidance for U.S. health care settings is similar to MSF’s (Doctors without Borders) guidance**

Both CDC’s and MSF’s guidance documents focus on:

1. Protecting skin and mucous membranes from all exposures to blood and body fluids during patient care.
2. Meticulous, systematic strategy for putting on and taking off PPE to avoid contamination and to ensure correct usage of PPE.
3. Use of oversight and observers to ensure processes are followed.
4. Disinfection of PPE prior to taking off. CDC recommends disinfecting visibly contaminated PPE using an EPA-registered disinfectant wipe prior to taking off equipment. Additionally, CDC recommends disinfection of gloved hands using either an EPA-
registered disinfectant wipe or alcohol-based hand rub between steps of taking off PPE. Due to differences in the U.S. health care system and West African health care settings, MSF’s guidance recommends spraying as a method for PPE disinfection rather than disinfectant wipes.

Five pillars of safety

CDC reminds all employers and health care workers that PPE is only one aspect of infection control and providing safe care to patients with Ebola. Other aspects include five pillars of safety:

- Facility leadership has the responsibility to provide resources and support for implementation of effective prevention precautions. Management should maintain a culture of worker safety, in which appropriate PPE is available and correctly maintained, and workers are provided with appropriate training.
- Designated an onsite Ebola site manager responsible for oversight of implementing precautions for health care personnel and patient safety in the health care facility.
- Clear, standardized procedures where facilities choose one of two options and have a back-up plan in case supplies are not available.
- Trained health care personnel: facilities need to ensure all health care providers practice numerous times to make sure they understand how to appropriately use the equipment.
- Oversight of practices are critical to ensuring that implementation protocols are done accurately, and any error in putting on or taking off PPE is identified in real-time, corrected and addressed, in case potential exposure occurred.

Source: U.S. Department of Health and Human Services

Ebola preparedness and the use of personal protective equipment (PPE)

The following procedures provide detailed guidance on the types of personal protective equipment (PPE) to be used and on the processes for donning and doffing (i.e., putting on and removing) PPE for all health care workers entering the room of a patient hospitalized with Ebola virus disease (Ebola). The guidance in this document reflects lessons learned from the recent experiences of U.S. hospitals caring for Patients with Ebola and emphasizes the importance of training, practice, competence, and observation of health care workers in correct donning and doffing of PPE selected by the facility.

This guidance contains the following key principles:
- Prior to working with Patients with Ebola, all health care workers involved in the care of Patients with Ebola must have received repeated training and have demonstrated competency in performing all Ebola-related infection-control practices and procedures, and specifically in donning and doffing proper PPE.
- While working in PPE, health care workers caring for Patients with Ebola should have no skin exposed.
- The overall safe care of Patients with Ebola in a facility must be overseen by an onsite manager at all times, and each step of every PPE donning/doffing procedure must be supervised by a trained observer to ensure proper completion of established PPE protocols.

In health care settings, Ebola is spread through direct contact (e.g., through broken skin or through mucous membranes of the eyes, nose, or mouth) with blood or body fluids of a person who is sick with Ebola, or with objects (e.g., needles, syringes) that have been contaminated with the virus. For all health care workers caring for Patients with Ebola, PPE with full body coverage is recommended to further reduce the risk of self-contamination.

To protect health care workers during care of an Ebola patient, health care facilities must provide onsite management and oversight on the safe use of PPE and implement administrative and environmental controls with continuous safety checks through direct observation of health care workers during the PPE donning and doffing processes.

Recommended administrative and environmental controls for health care facilities

Protecting health care workers and preventing spread of Ebola requires that proper administrative procedures and safe work practices be carried out in appropriate physical settings. These controls include the following:

1. At an administrative level, the facility’s infection prevention management system, in collaboration with the facility’s occupational health department, should:
   a. Establish and implement triage protocols to effectively identify patients who may have Ebola and institute the precautions detailed in this document.
   b. Designate individuals as site managers responsible for overseeing the implementation of precautions for health care workers and patient safety. A site manager’s sole responsibility is to ensure the safe and effective delivery of Ebola treatment. These individuals are responsible for all aspects of Ebola infection control including supply monitoring and evaluation with direct observation of care before, during, and after staff enter an isolation and treatment area.
   i. At least one site manager should be on-site at all times in the location where the Ebola patient is being cared for.
   c. Identify critical patient care functions and essential health care workers for care of Patients with Ebola, for collection of laboratory specimens, and for management of the environment and waste ahead of time.
   d. Ensure health care workers have been trained in all recommended protocols for safe care of Patients with Ebola before they enter the patient care area.
   e. Train health care workers on all PPE recommended in the facility’s protocols. Health care workers should practice donning and doffing procedures and must demonstrate during the training process competency through testing and assessment before caring for Patients with Ebola.
   f. Use trained observers to monitor for correct PPE use and adherence to protocols for donning and doffing PPE, and guide health care workers at each point of use using a checklist for every donning and doffing procedure.
   g. Document training of observers and health care workers for proficiency and competency in donning and doffing PPE, and in performing all necessary care-related duties while wearing PPE.
   h. Designate spaces so that PPE can be donned and doffed in separate areas.

2. Key safe work practices include the following:
   a. Identify and isolate the Ebola patient in a single patient room with a closed door and a private bathroom as soon as possible.
   b. Limit the number of health care workers who come into contact with the Ebola patient (e.g., avoid short shifts), and restrict non-essential personnel and visitors from the patient care area.
   c. Monitor the patient care area at all times, and log, at a minimum, entry and exit of all health care workers who enter the room of an Ebola patient.
d. Ensure that a trained observer watches closely each donning and each doffing procedure, and provides supervisory assurance that donning and doffing protocols are followed.

e. Ensure that health care workers have sufficient time to don and doff PPE correctly without disturbances.

f. Ensure that practical precautions are taken during patient care, such as keeping hands away from the face, limiting touch of surfaces and body fluids, preventing needlestick and sharps injuries, and performing frequent disinfection of gloved hands using an alcohol-based hand rub (ABHR), particularly after handling body fluids.

g. Disinfect immediately any visibly contaminated PPE surfaces, equipment, or patient care area surfaces using an *EPA-registered disinfectant wipe.

h. Perform regular cleaning and disinfection of patient care area surfaces, even absent visible contamination.

i. This should be performed only by nurses or physicians as part of patient care activities in order to limit the number of additional health care workers who enter the room.

j. Establish a facility exposure management plan that addresses decontamination and follow-up of an affected health care worker in case of any unprotected exposure. Training on this plan and follow-up should be part of the health care worker training.

**Principles of PPE**

Health care workers must understand the following basic principles to ensure safe and effective PPE use, which include that no skin may be exposed while working in PPE:

- **Donning**
  - PPE must be donned correctly in proper order before entry into the patient care area and not be later modified while in the patient care area. The donning activities must be directly observed by a trained observer.

- **During patient care**
  - PPE must remain in place and be worn correctly for the duration of exposure to potentially contaminated areas. PPE should not be adjusted during patient care.
  - Health care workers should perform frequent disinfection of gloved hands using an ABHR, particularly after handling body fluids.
  - If during patient care a partial or total breach in PPE (e.g., gloves separate from sleeves leaving exposed skin, a tear develops in an outer glove, a needlestick) occurs, the health care worker must move immediately to the doffing area to

- **Doffing**
  - The removal of used PPE is a high-risk process that requires a structured procedure, a trained observer, and a designated area for removal to ensure protection.
  - PPE must be removed slowly and deliberately in the correct sequence to reduce the possibility of self-contamination or other exposure to Ebola virus.
  - A stepwise process should be developed and used during training and daily practice.

Double gloving provides an extra layer of safety during direct patient care and during the PPE removal process. Beyond this, more layers of PPE may make it more difficult to perform patient care duties and put health care workers at greater risk for percutaneous injury (e.g., needlesticks), self-contamination during care or doffing, or other exposures to Ebola. If health care facilities decide to add additional PPE or modify this PPE guidance, they must consider the risk/benefit of any modification, and train health care workers on correct donning and doffing in the modified procedures.

**Training on correct use of PPE**

Training ensures that health care workers are knowledgeable and proficient in the donning and doffing of PPE prior to engaging in management of patient with Ebola. Comfort and proficiency when donning and doffing are only achieved through repeated practice on the correct use of PPE. Health care workers should be required to demonstrate competency in the use of PPE, including donning and doffing while being observed by a trained observer, before working with patients with Ebola. In addition, during practice, health care workers and their trainers should assess their proficiency and comfort with performing required duties while wearing PPE. Training should be available in formats accessible to individuals with disabilities or limited English proficiency. Target training to the educational level of the intended audience.

**Use of a trained observer**

Because the sequence and actions involved in each donning and doffing step are critical to avoiding exposure, a trained observer will read aloud to the health care worker each step in the procedure checklist and visually confirm and document that the step has been completed correctly. The trained observer is a dedicated individual with the sole responsibility of ensuring adherence to the entire donning and doffing process. The trained observer will be knowledgeable about all PPE recommended in the facility’s protocol and the correct donning and doffing procedures, including disposal of used PPE, and will be qualified to provide guidance and technique recommendations to the health care worker. The trained observer will monitor and document successful donning and doffing procedures, providing immediate corrective instruction if the health care worker is not following the recommended steps. The trained observer should know the exposure management plan in the event of an unintentional break in procedure.

**Designating areas for PPE donning and doffing**

Facilities should ensure that space and layout allow for clear separation between clean and potentially contaminated areas. It is critical that physical barriers (e.g., plastic enclosures) be used where necessary, along with visible signage, to separate distinct areas and ensure a one-way flow of care moving from clean areas (e.g., area where PPE is donned and unused equipment is stored) to the patient room and to the PPE removal area (area where PPE is removed and discarded).
Facility staff should post signage to highlight key aspects of PPE donning and doffing, including

- Designating clean areas vs. potentially contaminated areas.
- Reminding health care workers to wait for a trained observer before removing PPE.
- Reinforcing need for slow and deliberate removal of PPE to prevent self-contamination.
- Reminding health care workers to perform disinfection of gloved hands in between steps of the doffing procedure, as indicated below.

Designate the following areas with appropriate signage:

1. **PPE storage and donning area** – This is an area outside the Ebola patient room (e.g., a nearby vacant patient room, a marked area in the hallway outside the patient room) where clean PPE is stored and where health care workers can don PPE before entering the patient’s room. Do not store potentially contaminated equipment, used PPE, or waste removed from the patient’s room in this area. If waste must pass through this area, it must be properly contained.

2. **Patient room** – This is a single-patient room. The door is kept closed. Any item or health care worker exiting this room should be considered potentially contaminated.

3. **PPE removal area** – This is an area in proximity to the patient’s room (e.g., anteroom or adjacent vacant patient room that is separate from the clean area) where health care workers leaving the patient’s room can doff and discard their PPE. Alternatively, some steps of the PPE removal process may be performed in a clearly designated area of the patient’s room near the door, provided these steps can be seen and supervised by a trained observer (e.g., through a window such that the health care worker doffing PPE can still hear the instructions of the trained observer). HCP should not use this clearly designated area within the patient room for any other purpose. Gloves should be stocked in a clean section of the PPE removal area accessible to the health care worker while doffing. In the PPE removal area, supplies for disinfection of PPE and for performing hand hygiene should be provided, and space to remove PPE, including a place for sitting that can be easily cleaned and disinfected, where the health care workers can remove boot covers. Provide leak-proof infectious waste containers for discarding used PPE. Perform frequent environmental cleaning and disinfection of the PPE removal area, including upon completion of doffing procedure by health care workers. If a facility must use the hallway outside the patient room as the PPE removal area, physical barriers should be constructed to close the hallway to through traffic, and thereby, create an anteroom. In so doing, the facility should make sure that this hallway space complies with fire codes. Access to this hallway should be restricted to essential personnel who are properly trained on recommended infection prevention practices for the care of patients with Ebola.

Facilities should consider making showers available for use by health care workers after doffing of PPE.

**Selection of PPE for health care workers during management of patients with ebola**

This section outlines several PPE combinations and how they should be correctly worn. The key to all PPE is consistent implementation through repeated training and practice. A facility should select and standardize the PPE to be used by all essential health care workers directly interacting with patients with Ebola and provide a written protocol outlining procedures for donning and doffing of this PPE, which will be reviewed and monitored by the trained observer.

CDC recommends facilities use a powered air-purifying respirator (PAPR) or an N95 or higher respirator in the event of an unexpected aerosol-generating procedure.

**Recommended personal protective equipment**

- PAPR or N95 Respirator. If a NIOSH-certified PAPR and a NIOSH-certified fit-tested disposable N95 respirator is used in facility protocols, ensure compliance with all elements of the OSHA Respiratory Protection Standard, 29 CFR 1910.134, including fit testing, medical evaluation, and training of the health care worker.
  - PAPR: A powered air-purifying respirator (PAPR) with a full face shield, helmet, or headpiece. Any reusable helmet or headpiece must be covered with a single-use (disposable) hood that extends to the shoulders and fully covers the neck and is compatible with the selected PAPR. The facility should follow manufacturer’s instructions for decontamination of all reusable components, and, based upon those instructions, develop facility protocols that include the designation of responsible personnel who assure that the equipment is appropriately reprocessed and that batteries are fully charged before reuse.
    - A PAPR with a self-contained filter and blower unit integrated inside the helmet is preferred.
    - A PAPR with external belt-mounted blower unit requires adjustment of the sequence for donning and doffing, as described below.
  - N95 Respirator: Single-use (disposable) N95 respirator in combination with single-use (disposable) surgical hood extending to shoulders and single-use (disposable) full face shield.** If N95 respirators are used instead of PAPRs, careful observation is required to ensure health care workers are not inadvertently touching their faces under the face shield during patient care.
- Single-use (disposable) fluid-resistant or impermeable gown that extends to at least mid-calf or coverall without integrated hood. Coveralls with or without integrated socks are acceptable. Consideration should be given to selecting gowns or coveralls with thumb hooks to secure sleeves over inner glove. If gowns or coveralls with thumb hooks are not available, personnel may consider taping the sleeve of the gown or coverall over the inner glove to prevent potential skin exposure from separation between sleeve and inner glove during activity. However, if taping is used, care must be taken to remove tape gently. Experience in some facilities suggests that taping may increase risk by making the doffing process more difficult and cumbersome.
- Single-use (disposable) nitrile examination gloves with extended cuffs. Two pairs of gloves should be worn. At a minimum, outer gloves should have extended cuffs.
- Single-use (disposable), fluid-resistant, or impermeable boot covers that extend to at least mid-calf or single-use (disposable) shoe covers. Boot and shoe covers should allow for ease of movement and not present a slip hazard to the worker.
Recommended PPE for trained observer during observations of PPE doffing

The trained observer should not enter the room of a patient with Ebola, but will be in the PPE removal area to observe and assist with removal of specific components of PPE, as outlined below. The observer should not participate in any Ebola patient care activities while conducting observations. The following PPE are recommended for trained observers:

- Single-use (disposable) fluid-resistant or impermeable shoe covers are acceptable only if they will be used in combination with a coverall with integrated socks.
- Single-use (disposable), fluid-resistant or impermeable apron that covers the torso to the level of the mid-calf should be used if patients with Ebola have vomiting or diarrhea. An apron provides additional protection against exposure of the front of the body to body fluids or excrement. If a PAPR will be worn, HCP may consider selecting an apron that ties behind the neck to facilitate easier removal during the doffing procedure.

1. Engage trained observer: The donning process is conducted under the guidance and supervision of a trained observer, who confirms visually that all PPE is serviceable and has been donned successfully. The trained observer uses a written checklist to confirm each step in donning PPE and can assist with ensuring and verifying the integrity of the ensemble. No exposed skin or hair of the healthcare worker should be visible at the conclusion of the donning process.

2. Remove personal clothing and items: Change into surgical scrubs (or disposable garments) and dedicated washable (plastic or rubber) footwear in a suitable clean area. No personal items (e.g., jewelry, watches, cell phones, pagers, pens) should be brought into patient room.

3. Inspect PPE prior to donning: Visually inspect the PPE ensemble to be worn to ensure that it is in serviceable condition, that all required PPE and supplies are available, and that the sizes selected are correct for the healthcare worker. The trained observer reviews the donning sequence with the healthcare worker before the healthcare worker begins the donning process and reads it to the healthcare worker in a step-by-step fashion.

4. Perform hand hygiene: Perform hand hygiene with an alcohol-based hand rub (ABHR). When using ABHR, allow hands to dry before moving to next step.

5. Put on inner gloves: Put on first pair of gloves.

6. Put on boot or shoe covers.

7. Put on gown or coverall: Put on gown or coverall. Ensure gown or coverall is large enough to allow unrestricted freedom of movement. Ensure cuffs of inner gloves are tucked under the sleeve of the gown or coverall:
   a. If a PAPR with a self-contained filter and blower unit that is integrated inside the helmet is used, then the belt and battery unit must be put on prior to donning the impermeable gown or coverall so that the belt and battery unit are contained under the gown or coverall.
   b. If a PAPR with external belt-mounted blower is used, then the blower and tubing must be on the outside of gown or coverall to ensure proper airflow.

8. Put on outer gloves: Put on second pair of gloves (with extended cuffs). Ensure the cuffs are pulled over the sleeves of the gown or coverall.

9. Put on respirator: Put on PAPR with a full face-shield, helmet, or headpiece.
   a. If a PAPR with a self-contained filter and blower unit integrated inside the helmet is used, then a single-use (disposable) hood that extends to the shoulders and fully covers the neck must also be used. HCP should be sure that the hood covers all of the hair and the ears, and that it extends past the neck to the shoulders.
   b. If a PAPR with external belt-mounted blower unit and attached reusable headpiece is used, then a single-use (disposable) hood that extends to the shoulders and fully covers the neck must also be used. HCP should ensure that the hood covers all of the hair and the ears, and that it extends past the neck to the shoulders.

10. Put on outer apron (if used): HCP should put on full-body apron to provide additional protection to the front of the body against exposure to body fluids or excrement from the patient.

11. Verify: After completing the donning process, the integrity of the ensemble is verified by the trained observer. The healthcare worker should be comfortable and able to extend the arms, bend at the waist, and go through a range of motions to ensure a sufficient range of movement while all areas of the body remain covered. A mirror in the room can be useful for the healthcare worker while donning PPE.

12. Disinfect outer gloves: HCP should disinfect outer-gloved hands with ABHR. Allow to dry prior to patient contact.

Donning PPE, N95 respirator option – This donning procedure assumes the facility has elected to use N95 respirators. An established protocol facilitates training and compliance. Use a trained observer to verify successful compliance with the protocol.

1. Engage trained observer: The donning process is conducted under the guidance and supervision of a trained observer who confirms visually that all PPE is serviceable and has been donned successfully. The trained observer will use a written checklist to confirm each step in donning PPE and can assist with ensuring and verifying the integrity of the ensemble. No exposed skin or hair of the healthcare worker should be visible at the conclusion of the donning process.

2. Remove personal clothing and items: HCP should change into surgical scrubs (or disposable garments) and dedicated washable (plastic or rubber) footwear in a suitable clean area. No personal items (e.g., jewelry, watches, cell phones, pagers, pens) should be brought into the patient room.

3. Inspect PPE prior to donning: HCP should visually inspect the PPE ensemble to be worn to ensure it is in serviceable condition, all required PPE and supplies are available, and that the sizes selected are correct for them. The trained observer reviews the donning sequence with the healthcare worker before the healthcare worker begins and reads it to the healthcare worker in a step-by-step fashion.
4. Perform hand hygiene: Perform hand hygiene with ABHR. When using ABHR, allow hands to dry before moving to next step.
5. Put on inner gloves: Put on first pair of gloves.
6. Put on boot or shoe covers.
7. Put on gown or coverall: HCP should put on gown or coverall and ensure the gown or coverall is large enough to allow unrestricted freedom of movement. They should ensure cuffs of inner gloves are tucked under the sleeve of the gown or coverall.
9. Put on surgical hood: Over the N95 respirator, HCP should place a surgical hood that covers all of the hair and the ears, and ensure that it extends past the neck to the shoulders. They should be certain that hood completely covers the ears and neck.
10. Put on outer apron (if used): NCP should put on a full-body apron to provide additional protection to the front of the body against exposure to body fluids or excrement from the patient.

**Preparing for doffing**

The purpose of this step is to prepare for the removal of PPE. Before entering the PPE removal area, HCP should inspect and disinfect (using an *EPA-registered disinfectant wipe) any visible contamination on the PPE. As a final step, they should disinfect outer-gloved hands with either an *EPA-registered disinfectant wipe or ABHR, and allow to dry. They should verify that the trained observer is available in the PPE removal area before entering and beginning the PPE removal process.

Doffing PPE, PAPR option – PPE doffing should be performed in the designated PPE removal area. HCP should place all PPE waste in a leak-proof infectious waste container.

1. Engage trained observer: The doffing process is conducted under the supervision of a trained observer, who reads aloud each step of the procedure and confirms visually that the PPE is removed properly. Prior to doffing PPE, the trained observer must remind the health care worker to avoid reflexive actions that may put them at risk, such as touching their face. They should post this instruction and repeat it verbally during doffing. Although the trained observer should minimize touching the health care worker or the health care worker’s PPE during the doffing process, the trained observer may assist with removal of specific components of PPE, as outlined below. The trained observer disinfects the outer-gloved hands immediately after handling any health care worker PPE.

2. Inspect: HCP should inspect the PPE to assess for visible contamination, cuts, or tears before starting to remove. If any PPE is potentially contaminated, they should disinfect using an *EPA-registered disinfectant wipe. If the facility conditions permit and appropriate regulations are followed, an *EPA-registered disinfectant spray can be used, particularly on contaminated areas.

3. Disinfect outer gloves: HCP should disinfect outer-gloved hands with either an *EPA-registered disinfectant wipe or ABHR, and allow to dry.

4. Remove apron (if used): HCP should remove and discard apron, taking care to avoid contaminating gloves by rolling the apron from inside to outside.

5. Inspect: Following apron removal, HCP should inspect the PPE ensemble to assess for visible contamination or cuts or tears. If visibly contaminated, they should disinfect the affected PPE using an *EPA-registered disinfectant wipe.

6. Disinfect outer gloves: HCP should disinfect outer-gloved hands with either an *EPA-registered disinfectant wipe or ABHR.

7. Remove boot or shoe covers: While sitting down, HCP should remove and discard boot or shoe covers.

8. Disinfect and remove outer gloves: HCP should disinfect outer-gloved hands with either an *EPA-registered disinfectant wipe or ABHR. They should remove and discard outer gloves, taking care not to contaminate inner glove during the removal process.

9. Inspect and disinfect inner gloves: HCP should inspect the inner gloves’ outer surfaces for visible contamination, cuts, or tears.

10. Remove respirator (PAPR)****: 
   a. If a PAPR with a self-contained filter and blower unit integrated inside the helmet is used, then HCP should wait until Step 15 for removal and go to Step 11.
   b. If a PAPR with an external belt-mounted blower unit is used, then all components must be removed at this step. HCP should:
      i. Remove and discard disposable hood.
      ii. Disinfect inner gloves with either an *EPA-registered disinfectant wipe or ABHR.
      iii. Remove headpiece, blower, tubing, and the belt and battery unit. This step might require assistance from the trained observer.
      iv. Disinfect inner gloves with either an *EPA-registered disinfectant wipe or ABHR.
   v. Place all reusable PAPR components in an area or container designated for the collection of PAPR components for disinfection.

11. Remove gown or coverall: Remove and discard.
   a. Depending on gown design and location of fasteners, the health care worker can either untie fasteners, receive assistance by the trained observer to unfasten the gown, or gently break fasteners. They should avoid contact of scrubs or disposable garments with outer surface of gown during removal. Pull gown away from body, rolling inside out and touching only the inside of the gown.
   b. To remove coverall, HCP should tilt head back and reach under the PAPR hood to reach zipper or fasteners. Use a mirror to help avoid touching the skin. Unzip or unfasten coverall completely before rolling down and turning inside out. Avoid contact of scrubs with outer surface of coverall during removal, touching only the inside of the coverall.

12. Disinfect inner gloves: HCP should disinfect inner gloves with either an *EPA-registered disinfectant wipe or ABHR.

13. Disinfect wearable shoes: Sitting on a new clean surface (e.g., second clean chair, clean side of a bench) HCP should use an
Disinfect and remove inner gloves: HCP should disinfect inner-gloved hands with either an *EPA-registered disinfectant wipe or ABHR. If an inner glove is visibly soiled, cut, or torn, they should then disinfect the glove with either an *EPA-registered disinfectant wipe or ABHR. Then remove the inner gloves, perform hand hygiene with ABHR on bare hands, and don a clean pair of gloves. If no visible contamination, cuts, or tears are identified on the inner gloves, they should disinfect the inner-gloved hands with either an *EPA-registered disinfectant wipe or ABHR.

Remove surgical hood: HCP should unfasten (if applicable) surgical hood, gently remove, and discard. The trained observer may assist with unfastening hood.

Disinfect inner gloves: HCP should disinfect inner gloves with either an *EPA-registered disinfectant wipe or ABHR. They should then remove and discard gloves, taking care not to contaminate bare hands during removal process.

Inspect: Perform a final inspection of health care workers for any indication of contamination of the surgical scrubs or disposable garments. If contamination is identified, HCP should immediately inform infection preventionist or occupational safety and health coordinator or their designee before exiting PPE removal area.

Scrub: Health care workers can leave PPE removal area wearing dedicated washable footwear and surgical scrubs or disposable garments.

Shower: Showers are recommended at each shift’s end for HCP performing high-risk patient care (e.g., exposed to large quantities of blood, body fluids, or excreta). Showers are also suggested for health care workers spending extended periods of time in the Ebola patient room.

Protocol evaluation/medical assessment: Either the infection preventionist or occupational safety and health coordinator or their designee on the unit at the time should meet with the health care worker to review the patient care activities performed to identify any concerns about care protocols and to record health care worker’s level of fatigue.

Doffing PPE, N95 respirator option – PPE doffing is performed in the designated PPE removal area. Place all PPE waste in a leak-proof infectious waste container.

1. Engage trained observer: The doffing process is conducted under the supervision of a trained observer, who reads aloud each step of the procedure and confirms visually that the PPE has been removed properly. Prior to doffing PPE, the trained observer must remind health care workers to avoid reflexive actions that may put them at risk, such as touching their face. They should post this instruction and repeat it verbally during doffing. Although the trained observer should minimize touching health care workers or their PPE during the doffing process, the trained observer may assist with removal of specific components of PPE as outlined below. The trained observer disinfects the outer-gloved hands immediately after handling any health care worker PPE.

2. Inspect: HCP should inspect the PPE to assess for visible contamination, cuts, or tears before starting to remove. If any PPE is visibly contaminated, then they should disinfect using an *EPA-registered disinfectant wipe. If the facility conditions permit and appropriate regulations are followed, an *EPA-registered disinfectant spray can be used, particularly on contaminated areas.

3. Disinfect outer gloves: HCP should disinfect outer-gloved hands with either an *EPA-registered disinfectant wipe or ABHR.

4. Remove apron (if used): HCP should remove and discard the apron, taking care to avoid contaminating gloves by rolling the apron from inside to outside.

5. Inspect: Following apron removal, health care workers should inspect the PPE ensemble to assess for visible contamination or cuts or tears. If visibly contaminated, they should then disinfect affected PPE using an *EPA-registered disinfectant wipe.

6. Disinfect outer gloves: HCP should disinfect outer-gloved hands with either an *EPA-registered disinfectant wipe or ABHR.

7. Remove boot or shoe covers: While sitting down, HCP should remove and discard boot or shoe covers.

8. Disinfect and remove outer gloves: Health care workers should disinfect outer-gloved hands with either an *EPA-registered disinfectant wipe or ABHR. They should remove and discard outer gloves, taking care not to contaminate inner gloves during removal process.

9. Inspect and disinfect inner gloves: HCP should inspect the inner gloves’ outer surfaces for visible contamination, cuts, or tears. If an inner glove is visibly soiled, cut, or torn, they should then disinfect the glove with either an *EPA-registered disinfectant wipe or ABHR. Then remove the inner gloves, perform hand hygiene with ABHR on bare hands, and don a clean pair of gloves. If no visible contamination, cuts, or tears are identified on the inner gloves, they should disinfect the inner-gloved hands with either an *EPA-registered disinfectant wipe or ABHR.

10. Remove face shield: HCP should remove the full face shield by tilting the head slightly forward, grabbing the rear strap and pulling it over the head, gently allowing the face shield to fall forward and discard. Health care workers should avoid touching the front surface of the face shield.

11. Disinfect inner gloves: HCP should disinfect inner gloves with either an *EPA-registered disinfectant wipe or ABHR.

12. Remove surgical hood: HCP should unfasten (if applicable) surgical hood, gently remove, and discard. The trained observer may assist with unfastening hood.

13. Disinfect inner gloves: HCP should disinfect inner gloves with either an *EPA-registered disinfectant wipe or ABHR.

14. Remove gown or coverall: Remove and discard.

a. Depending on gown design and location of fasteners, health care workers can either untie fasteners, receive assistance by the trained observer to unfasten to gown, or gently break fasteners. They should avoid contact of scrubs or disposable garments with outer surface of gown during removal. They should pull the gown away from the body, rolling inside out and touching only the inside of the gown.

b. To remove coverall, HCP should tilt the head back to reach zipper or fasteners. They should unzip or unfasten coverall completely before rolling down and turning inside out. HCP should avoid contact of scrubs with outer surface of coverall during removal, touching only the inside of the coverall.

15. Disinfect and change inner gloves: Health care workers should disinfect inner gloves with either an *EPA-registered disinfectant wipe or ABHR. They should then remove and discard gloves taking care not to contaminate bare hands during removal process. Finally, they should perform hand hygiene with ABHR and don a new pair of inner gloves.

16. Remove N95 respirator: HCP should remove the N95 respirator by tilting the head slightly forward, grasping first the bottom tie or elastic strap, then the top tie or elastic strap, and remove without touching the front of the N95 respirator. Then they should discard the N95 respirator.

17. Disinfect inner gloves: HCP should disinfect inner gloves with either an *EPA-registered disinfectant wipe or ABHR.

18. Disinfect washable shoes: Sitting on a new clean surface (e.g., second clean chair, clean side of a bench) HCP should use an *EPA-registered disinfectant wipe to wipe down every external surface of the washable shoes.
19. Disinfect and remove inner gloves: HCP should disinfect inner-gloved hands with either an *EPA-registered disinfectant wipe or ABHR. They should then remove and discard gloves, taking care not to contaminate bare hands during removal process. 

20. Perform hand hygiene: HCP should perform hand hygiene with ABHR.

21. Inspect: A trained observer should perform a final inspection of health care workers for any indication of contamination of the surgical scrubs or disposable garments. If contamination is identified, they immediately inform infection preventionist or occupational safety and health coordinator or their designee before exiting the PPE removal area.

22. Scrubs: Health care workers can leave the PPE removal area wearing dedicated washable footwear and surgical scrubs or disposable garments.

23. Shower: Showers are recommended at each shift’s end for health care workers performing high risk patient care (e.g., exposed to large quantities of blood, body fluids, or excreta). Showers are also suggested for health care workers spending extended periods of time in the Ebola patient room.

24. Protocol evaluation/medical assessment: Either the infection preventionist or occupational health safety and health coordinator or their designee on the unit at the time should meet with the health care worker to review the patient care activities performed to identify any concerns about care protocols and to record health care worker’s level of fatigue.

Footnotes

*EPA-registered disinfectant wipe: Use a disposable wipe impregnated with a U.S. Environmental Protection Agency (EPA)-registered hospital disinfectant with a label claim of potency at least equivalent to that for a non-enveloped virus (e.g., norovirus, rotavirus, adenovirus, poliovirus).

** Note: A full face shield may not provide full face protection in the setting of significant splashing.

***All facilities should have a protocol for removing their particular PAPR and preparing equipment for reprocessing (e.g., bagging for temporary storage before reprocessing, immediate reprocessing in the donning area).

Content source: Centers for Disease Control, Prevention National Center for Emerging and Zoonotic Infectious Diseases (NCEZID), Division of High-Consequence Pathogens and Pathology (DHCPP). Viral Special Pathogens Branch (VSPB).

Endnotes


7. Of nearly 5,000 percutaneous injuries reported by hospitals between June 1995 and July 1999, 62% were associated with hollow-bore needles—primarily hypodermic needles attached to disposable syringes (29%) and winged-steel (butterfly-type) needles (13%).


9. The CDC Guideline for Handwashing and Hospital Environmental Control, Guidelines for the Prevention of Transmission of Human Immunodeficiency Virus (HIV) and Hepatitis B Virus (HBV) to Health-Care and Public-Safety Workers, and Guideline for Environmental Infection Control in Health-Care Facilities employ this terminology.

Citations and references

- Guidelines for Infection Control in Dental Health-Care Settings - 2003: http://www.cdc.gov/mmwr/preview/mmwrhtml/035217a1.htm.
- Guidance on Personal Protective Equipment To Be Used by Healthcare Workers During Management of Patients with Ebola Virus Disease in U.S. Hospitals, Including Procedures for Putting On (Doming) and Removing (Doffing), 2014: http://www.cdc.gov/vhf/ebola/hcp/procedures-for-ppp.htm.
1. Health care-associated infections (HAI) do not cause significant morbidity and mortality.
   - True
   - False

2. M. tuberculosis is usually transmitted only through air, not by surface contact.
   - True
   - False

3. Symptoms requiring immediate evaluation by a licensed medical professional and possible restriction from patient care activities include serious blood loss and increased white cell count not fever, cough and rash.
   - True
   - False

4. HBV infection in health-care providers and students who do not perform invasive exposure-prone procedures should be managed as a personal health issue and does not require special panel oversight.
   - True
   - False

5. When treating patients with Ebola, single latex gloves are adequate.
   - True
   - False

6. A designated onsite Ebola site manager responsible for oversight of implementing precautions for healthcare personnel and patient safety in the healthcare facility is one of the 5 pillars of safety.
   - True
   - False

7. Use trained observers to monitor for correct PPE use and adherence to protocols for donning and doffing PPE when treating Ebola patients.
   - True
   - False

8. CDC recommends facilities use a powered air-purifying respirator (PAPR) or an N95 or higher respirator in the event of an unexpected aerosol-generating procedure.
   - True
   - False

9. “Office-based surgery” means any surgical or other invasive procedure, requiring general anesthesia, moderate sedation, or deep sedation, excluding liposuction procedures, where such surgical or other invasive procedure is performed by a licensee in a location other than a hospital.
   - True
   - False

10. Hepatitis B virus (HBV), hepatitis C virus (HCV) and human immunodeficiency virus (HIV) are the three most common bloodborne pathogens.
    - True
    - False