

# New York: Infection Control and Prevention

5 contact hours: \$30

This course is approved by the New York State Departments of Health and Education to meet the requirement for infection control training for all New York healthcare professionals.

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**Course Summary:** Infection control training for all NY healthcare professionals, including responsibility for adhering to accepted principles and monitoring the performance of all for whom one is responsible. Reviews the mechanisms of transmission along with strategies of prevention and control. Coverage of controls, PPE, and practices to protect both workers and healthcare settings.

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**Off-Label Use:** No off-label uses were discussed or recommended in this course.

**Criteria for Successful Completion:** 80% or higher on the post test, a completed evaluation form, and payment where required. No partial credit will be awarded.

This course will be reviewed every two years. It will be updated or discontinued on May 1, 2012.

## Accreditation Information

### Nursing

ATrain Education, Inc. is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation.

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ATrain Education, Inc. is an approved reviewer and provider by the Physical Therapy Board of California and an approved provider by the New York State Board for Physical Therapy.

### Occupational Therapy

ATrain Education, Inc. is an approved provider by the American Occupational Therapy Association. The following course information applies to occupational therapy professionals:

*Target Audience:* Occupational Therapists, OTAs

*Instructional Level:* Intermediate

*Content Focus:*

- Category 1 - Domain of OT, Client Factors
- Category 2 - Occupational Therapy Process, Outcomes

### Other Professions and Accreditations

See the ATrainCEU Accreditation page at <http://www.ATrainCeu.com/accreditation.php>.

## Instructions

1. Read the course material and then complete the following forms:
  - A. Answer Sheet
  - B. Evaluation Learning Activity
  - C. Registration Form
2. If you are not paying by credit card, prepare a check for the amount of the course made out to: *ATrain Education, Inc.*
3. Mail the completed forms and your payment to:  
ATrain Education, Inc  
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When we receive your forms and payment, we will mail (or email, at your request) your completion certificate. If you have any questions, please call or email [Info@ATrainCEU.com](mailto:Info@ATrainCEU.com).

## Course Objectives

When you finish this course, you will be able to:

- Relate the responsibility of healthcare professionals to adhere to scientifically accepted principles and practices of infection control and to monitor the performance of those for whom the professional is responsible.
- Describe the mechanisms of transmission of pathogens in the healthcare setting and strategies for prevention and control.
- Outline the use of engineering and work practice controls to reduce the opportunity for patient and healthcare worker exposure to potentially infectious material in all healthcare settings.
- Understand the selection and use of personal protective equipment to prevent patient and healthcare worker contact with potentially infectious material.
- Describe the proper use of infection control principles and practices for cleaning, disinfection, and sterilization in all healthcare settings.
- Understand the principles and practices designed to prevent and manage infectious and communicable diseases in healthcare workers.

## Healthcare-Associated Infections

**Healthcare-associated infections (HAIs)** are among the most common adverse events in healthcare. In addition to the personal consequences for patients, families, and their healthcare professionals, HAIs add to the skyrocketing costs of the nation’s healthcare system. New attention to HAIs, seen as both patient safety and public health problems, has underscored the need for systematic surveillance as part of a broad-based prevention and control strategy.

The American Recovery and Reinvestment Act of 2009 was designed to stimulate economic recovery in various ways, including strengthening healthcare infrastructure and reducing healthcare costs. Within the Recovery Act, \$50 million was authorized to support states in the prevention and reduction of HAIs. These funds are to be invested in efforts that support surveillance and research, improve quality for patients, encourage collaboration, train the workforce in HAI prevention, and measure outcomes.

A 2009 report from the Centers for Disease Control and Prevention (CDC) analyzed the impact of HAIs on direct hospital costs and suggested that the annual cost is more than \$30 billion per year (CDC, 2009). But HAIs have more than an economic impact—they also affect healthcare workers, patients, and their families. In 2002 the CDC estimated that more than 1.7 million HAIs occur in U.S. hospitals each year (Table 1), and they are associated with approximately 99,000 deaths.

**Table 1. Estimated Number of HAIs by Site of Infection**

Major site of infection	Estimated number of infections
All HAIs	1,737,125
Surgical site infection (SSI)	290,485
Central line–associated bloodstream infections (CLABSI)	92,011
Ventilator-associated pneumonia (VAP)	52,543
Catheter-associated urinary tract infection (CAUTI)	449,334
<i>Clostridium difficile</i> –associated disease (CDI)	178,000

Source: Klevins et al., 2002.

Using even the most conservative data, the number of HAIs far exceeds the number of cases of any currently notifiable disease. Deaths associated with HAIs in hospitals exceeded the number of deaths attributed to several of the ten leading causes of death reported in U.S. vital statistics (CDC, 2007). More people die in the United States from HAIs than from breast cancer, AIDS, and auto accidents combined.

The situation is no better outside the United States. A 2005 World Health Organization (WHO) survey conducted in 55 hospitals in fourteen countries revealed that 8.7 percent of hospital patients suffered from hospital-acquired infections. WHO estimates that in these countries, 5 to 10 percent of patients admitted to acute care hospitals acquire an infection that was not present on admission (WHO, 2005).

## Six Elements of Infection Control

In August 1992, New York State passed legislation establishing a requirement that certain healthcare professionals must receive training on infection control (IC) and barrier precautions every four years when they renew their license. Six elements of IC were identified in the New York State IC Training Syllabus. In August 2008, the legislature requiring certain changes be made to the training curriculum, the training process, and those requiring training (NYSDOH, 2009a). The six elements are spelled out in the following box and then explained further in the sections that follow.

### ELEMENT I

The responsibility to adhere to scientifically accepted principles and practices of infection control and to monitor the performance of those for whom the professional is responsible.

### ELEMENT II

Modes and mechanisms of transmission of pathogens organisms in the healthcare setting and strategies for prevention and control.

### ELEMENT III (updated guideline)

Use of engineering and work practice controls to reduce the opportunity for patient and healthcare worker exposure to potentially infectious material in all healthcare settings.

### ELEMENT IV

Selection and use of barriers and/or personal protective equipment for preventing patient and healthcare worker contact with potentially infectious material.

### ELEMENT V (updated guideline)

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

### ELEMENT VI

Prevention and management of infectious of communicable diseases in healthcare workers.

Source: NYCDOH, 2009a

## Element I

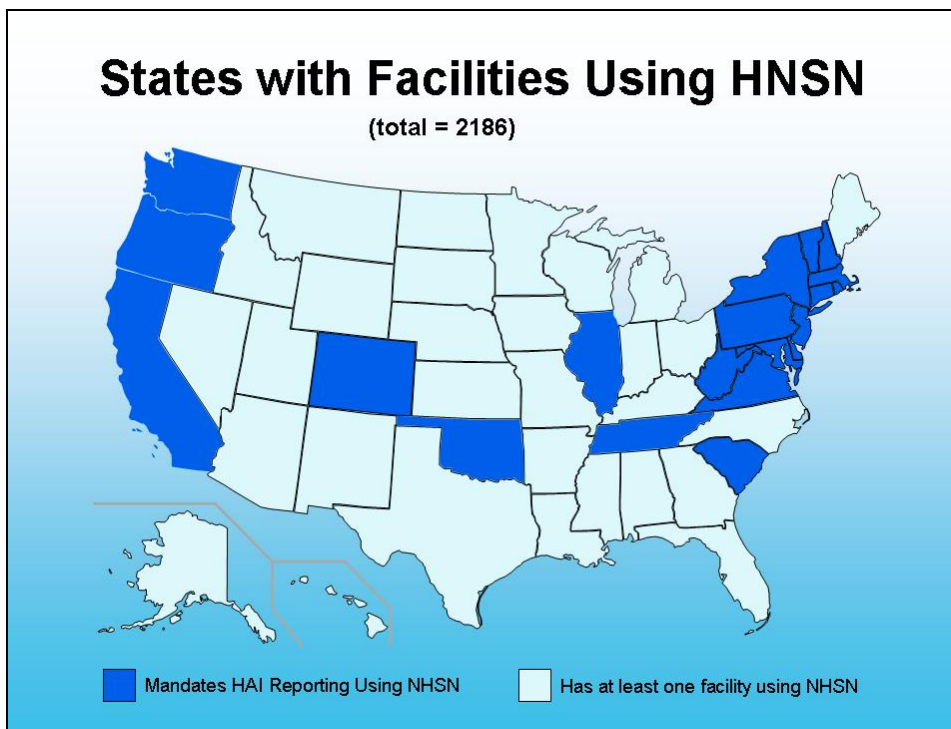
**The responsibility to adhere to scientifically accepted principles and practices of infection control and to monitor the performance of those for whom the professional is responsible.**

Until recently, infections were an expected consequence of hospitalization, and reliance on scientifically accepted information for infection prevention had not penetrated all corners of the healthcare system. However, as healthcare moves rapidly toward practices and procedures based on scientifically accepted, evidence-based principles, we are seeing a cultural shift in the management of HAIs. Twenty-five states, including New York, require public reporting of infection rates, although New York does not yet require reporting on two of the most troubling antibiotic-resistant infectious organisms, *Clostridium difficile* (*C. diff*) and methicillin-resistant *Staphylococcus aureus* (MRSA).

**Zero tolerance** has emerged as a guiding concept in the management of HAIs. The goal for all healthcare organizations—from hospitals to home care—is to reduce the number of HAIs to zero. In the past it was an accepted practice for hospitals to compare the success of their IC activities to national averages called **benchmarks**—if the hospital’s infection rates were comparable to these benchmarks their performance was acceptable.

In 2005, in an effort to get a handle on the magnitude of HAIs, New York State passed legislation requiring hospitals to report certain types of HAIs to the department of health (NYSDOH). As of 2009, New York, along with nineteen other states and more than 2,000 hospitals (out of a total of 7,569) throughout the United States, utilizes CDC’s National Healthcare Safety Network (NHSN) for their reporting.

**Figure 1. Hospitals using NHSN**



More than 2,000 hospitals and 19 states use the National Healthcare Safety Network for reporting HAIs. Source: CDC, 2009.

The 2005 legislation requires reporting colon and coronary-bypass surgical site infections and central line–associated bloodstream infections (CLABSIs) in adult, pediatric, and neonatal ICUs. In 2008 surgical site infections associated with hip replacements or revisions and CLABSIs in other critical care units were added to the mandatory reporting list. As part of this legislation, hospitals must:

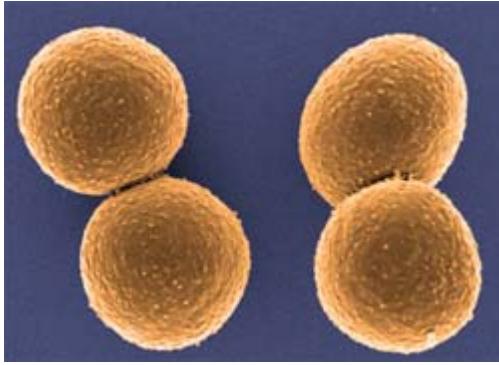
- Develop “reliable, valid, and useful” reporting systems
- Prevent the selected HAIs
- Use the HAI reporting system to evaluate risk factors and potential interventions
- Use the data to improve quality of care (NYSDOH, 2008a)

The transition of healthcare delivery from acute care hospitals to other healthcare settings (home care, ambulatory care, free-standing specialty care sites, and long-term care) has created a need for IC guidelines that can be applied in all settings. These guidelines must follow common principles of IC practice, yet be modified to reflect setting-specific needs. The emergence of new pathogens, concern for evolving pathogens, development of new therapies, and increasing concern for the threat of bio-weapons attacks has led to broader guidelines for infection control and prevention.

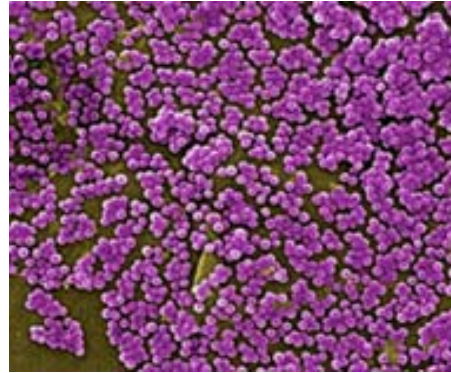
Scientific evidence is the primary source of guidance for IC practice. As the science of infection control has evolved, practices have been updated to reflect new findings. A number of factors contribute to this changing landscape: for example, germs evolve and mutate, and new diseases emerge. The recent H1N1 influenza outbreak is an example of a potentially deadly virus that emerged as a mix of human, swine, and bird viruses. Human immunodeficiency virus (HIV) is another well-known example of a disease that emerged in the late 1970s, prompting widespread and rapid changes in IC practices.

Antibiotic-resistant organisms have also changed the IC landscape. Methicillin-resistant *S. aureus*, *C. difficile*, and vancomycin-resistant enterococcus (VRE), among others, have become serious problems in healthcare facilities over the past two decades. The MRSA organism alone is responsible for more than 94,000 invasive infections and almost 19,000 deaths each year in the United States (Klevens et al., 2007).

Illustrating how widespread these organisms have become, a study done in a hospital in Tours, France, showed that 77 percent of blood pressure cuffs stored on nurses’ trolleys and 63 percent of individual cuffs were contaminated with MRSA. The same study showed that none of the cuffs cleaned with a disinfectant contained MRSA (McCaughey, 2008).



This colored electron micrograph shows isolated *S. aureus* bacteria that are resistant to many forms of antibiotics.  
Source: NIAID.



Scanning electron micrograph depicting numerous clumps of MRSA bacteria.  
Source: CDC.

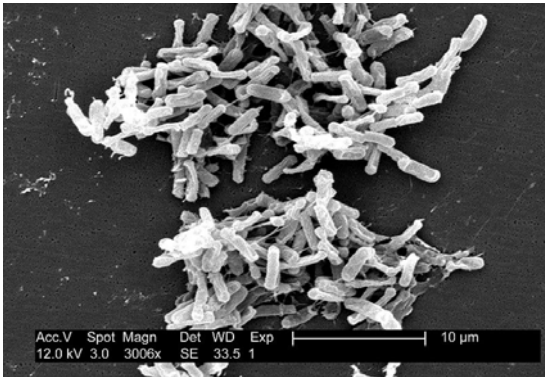
To understand how quickly disease-causing bacteria can develop resistance to antibiotics, take the example of *S. aureus*. Penicillin, introduced in the early 1940s, once kept staph bacteria at bay. By the late 1960s, more than 80 percent of staph bacteria were penicillin-resistant. Methicillin was introduced in 1961 to combat resistant staph bacteria, but reports of methicillin-resistant *S. aureus* (MRSA) rapidly followed. In 1974, 2 percent of the staph bacteria found in U.S. hospitals were methicillin-resistant. By 2002, that figure had jumped to 57.1 percent, according to CDC data.

Source: *Bad Bugs, No Drugs: As Antibiotic Discovery Stagnates, a Public Health Crisis Brews*. IDSA, 2004.

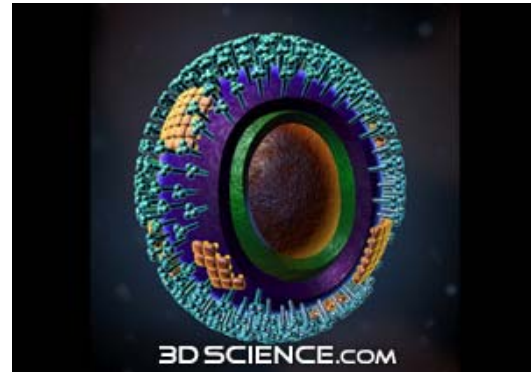
*Clostridium difficile* has also become more virulent, and hospital-associated outbreaks are causing increased deaths. In the general population, *C. difficile* is present in about 5 percent of people. The need to control outbreaks of *C. difficile* has focused new attention in the area of environmental cleaning. Because *C. difficile* causes watery diarrhea it can spread easily and rapidly in the healthcare setting, passing from person to person via clothing, equipment, and dirty hands.

Vancomycin-resistant enterococcus (VRE) is another antibiotic-resistant organism that has been associated with increased mortality and length of hospital stay. Many studies have shown that VRE can be readily found on cabinets, bedrails, equipment, and bedside tables and it is easily transmitted on the hands, gloves, and clothing of healthcare workers. Vancomycin-resistant enterococcus is also easily transmitted on equipment such as blood pressure cuffs, stethoscopes, pulse oximeters, IV poles, telephones, and infusion pumps. Aggressive environmental cleaning, screening of incoming patients for VRE and MRSA, isolation, and stringent barrier precautions have led to remarkable success in controlling and eliminating these organisms in hospitals in Denmark, Finland, and the Netherlands (Muto et al., 2003).

Even before the recent H1N1 outbreak, influenza has long been an area of focus for infection prevention. Although flu pandemics have occurred periodically for centuries, causing hundreds of thousands of deaths, we now have the scientific ability to identify an influenza epidemic as it is emerging. We also have the public health capability (vaccines, surveillance, education) to take action to minimize the impact of a flu outbreak. Addressing and controlling these emerging threats has become a priority for healthcare organizations.



Scanning electron micrograph of *Clostridium difficile* bacteria from a stool sample. Source: CDC/Lois S. Wiggs (PHIL #6260), 2004.



An illustration of the influenza virus microorganism. Source: Zygote Media.

## Laws, Regulations, and Infection Prevention

**Law** is a broad term that refers to legally binding rules of conduct adopted by a legislative or other government body at the international, federal, state, or local level. The most common laws are statutes enacted by a legislature. A **regulation** is an official policy issued by an agency of the executive branch in response to statutory authority. Regulations have binding legal force and are intended to implement the administrative policies of an agency. Regulations govern professional conduct and establish what conduct is or is not acceptable for those regulated by the agency (Pain and Policies Research Group, 2008).

Legal issues first began to impact IC practices at the beginning of the AIDS epidemic in early 1980s. The need to protect healthcare workers from bloodborne exposures resulted in the publication of the Bloodborne Pathogens Standard by the Occupational Safety and Health Administration (OSHA) in 1991. The OSHA Standard requires employers whose employees have exposure to blood to provide safe work practices, education, and barriers to exposure. The standards were later amended to cover the safe use of sharps.

Part of the OSHA Bloodborne Pathogens Standard is the requirement that every healthcare worker who may have contact with body fluids on the job must receive specific annual education. This education includes instruction in the basics of infection control and prevention, bloodborne pathogens training, and instruction in modes of transmission, needlestick precautions, and contact precautions.

Since 1991 other laws and regulations have been enacted, some at the federal and some at the state level. The Conditions of Participation, published by the Centers for Medicare and Medicaid Services (CMS) is an important source of legal guidance for the infection control community. The Conditions of Participation must be met for a hospital to receive Medicare funding, which is typically about half their income for most facilities. Inspection for compliance with the Conditions of Participation is generally carried out by survey teams from either the Joint Commission or the American Osteopathic Association (AOA). Validation surveys may also be made by state health department staff.

## Standards of Professional Conduct

In New York State it is a violation of professional conduct to fail to use scientifically accepted infection prevention techniques appropriate to each profession. This includes techniques for the cleaning and sterilization or disinfection of instruments, devices, materials and work surfaces; utilization of protective garb; use of covers for contamination-prone equipment; and the handling of sharp instruments. Title 10 of the Rules and Regulations of New York also mandates that health professionals are responsible for monitoring the IC practices of all licensed and unlicensed workers for whom they are responsible.

For physicians, registered physicians assistants, and specialist assistants, the definition of unprofessional conduct includes the failure to use scientifically accepted IC practices to prevent transmission of disease pathogens from patient to patient, and professional to patient. Scientifically accepted prevention techniques include:

- **Wear appropriate protective gloves at all times** when touching blood, saliva, other body fluids or secretions, mucous membranes, non-intact skin, blood-soiled items or bodily fluid-soiled items, contaminated surfaces, and sterile body areas, and during instrument cleaning and decontamination procedures
- **Discard gloves used following treatment of a patient** and change to new gloves if torn or damaged during treatment of a patient; wash hands and don new gloves prior to performing services for another patient; and wash hands and other skin surfaces immediately if contaminated with blood or other body fluids
- **Wear appropriate masks, gowns, or aprons, and protective eyewear or chin-length plastic face shields** whenever splashing or spattering of blood or other body fluids is likely to occur
- **Sterilize equipment and devices** that enter the patient's vascular system or other normally sterile areas of the body
- **Sterilize equipment and devices** that touch intact mucous membranes but do not penetrate the patient's body or use high-level disinfection for equipment and devices which cannot be sterilized prior to use for a patient
- **Use appropriate agents**, including but not limited to detergents for cleaning all equipment and devices prior a sterilization or disinfection
- **Clean, by the use of appropriate agents**, including but not limited to detergents, equipment and devices which do not touch the patient or that only touch the intact skin of the patient
- **Maintain equipment and devices used for sterilization** according to the manufacturer's instructions
- **Adequately monitor the performance of all personnel**, licensed or unlicensed, for whom the licensee is responsible regarding infection control techniques
- **Place disposable used syringes, needles, scalpel blades, and other sharp instruments in appropriate puncture-resistant containers for disposal**; and place reusable needles, scalpel blades, and other sharp instruments in appropriate puncture-resistant containers until appropriately cleaned and sterilized
- **Maintain appropriate ventilation devices** to minimize the need for emergency mouth-to-mouth resuscitation

- **Refrain from all direct patient care and handling of patient care equipment when the healthcare professional has exudative lesions or weeping dermatitis** and the condition has not been medically evaluated and determined to be safe or capable of being safely protected against in providing direct patient care or in handling patient care equipment
- **Place all specimens of blood and body fluids in well-constructed containers with secure lids** to prevent leaking; and cleaning any spill of blood or other body fluid with an appropriate detergent and appropriate chemical germicide (NYSED, 2006)

Reporting of suspected or confirmed communicable diseases is mandated under the New York State Sanitary Code (10NYCRR 2.10). Although physicians have primary responsibility for reporting, school nurses, laboratory directors, infection control practitioners, daycare center directors, healthcare facilities, state institutions, and any other individuals/locations providing healthcare services are also required to report communicable diseases.

Reports should be made to the local health department in the county in which the patient resides and need to be submitted within 24 hours of diagnosis. However, some diseases require prompt action and should be reported immediately to local health departments by phone. A list of diseases and information on proper reporting can be found under Communicable Disease Reporting Requirements on the New York State Department of Health (NYSDOH) website.

Any single case of a reportable condition or an increase over baseline incidence of any condition is required to be reported by a facility licensed under Article 28 of the Public Health Law (10NYCRR 702.4). The facility should report the case to the NYSDOH electronically through the Nosocomial Outbreak Reporting Application (NORA), by fax to the Regional Epidemiology Program central office, or by phone to the regional epidemiologist in the facility's region. Urgent matters should be directed by phone to the regional epidemiologist. General questions and infection control guidance may be directed to the regional epidemiologist or to the Regional Epidemiology Program central office.

### **Professional Misconduct**

In 2008 New York passed legislation that enhances the state's ability to investigate potential cases of physician misconduct and increases medical student and medical resident training in infection control. The legislation also requires the reporting of suspected disease transmission in office-based surgery practices. The bill requires the state to publicize charges served on a physician in any discipline proceeding and authorizes the state to release information about any public health threat revealed during an investigation.

The 2008 legislation provides that a physician's failure to respond to records requests from state or local health departments constitutes "professional medical misconduct." It requires that medical students take the same courses in infection-control practices as those offered for physicians, physicians' assistants, and specialist assistants.

## Element II

### Modes and mechanisms of transmission of pathogens organisms in the healthcare setting and strategies for prevention and control.

It is becoming increasingly clear that transmission of infections in healthcare settings is largely preventable through the use of evidence-based IC guidelines. The concept of the chain of infection has provided the basis for our understanding of transmission of pathogens as well as identifying practices and procedures for the prevention of healthcare-associated infections.

A **healthcare-associated infection (HAI)** is defined as a localized or systemic condition that (1) results from an adverse reaction to the presence of an infectious agent or its toxin, (2) occurs during a hospital admission, (3) has no evidence of the infection being present or incubating at admission, and (4) meets body site-specific criteria (CDC, 2007).

### The Chain of Infection

We have all seen infections spread through a family, classroom, or office; this situation can be described using a concept called the **chain of infection** (Figure 2). It is a process that begins when (1) an infectious agent or pathogen (2) leaves its reservoir, source, or host through (3) a portal of exit, (4) is conveyed by some mode of transmission, (5) enters the host through an appropriate portal of entry, and (6) infects a susceptible host. The concept of a chain of infection is essential to our understanding of why we do what we do to prevent infection. If any link of the chain of infection is broken, the spread of infection can be prevented.

**Figure 2. The Chain of Infection**

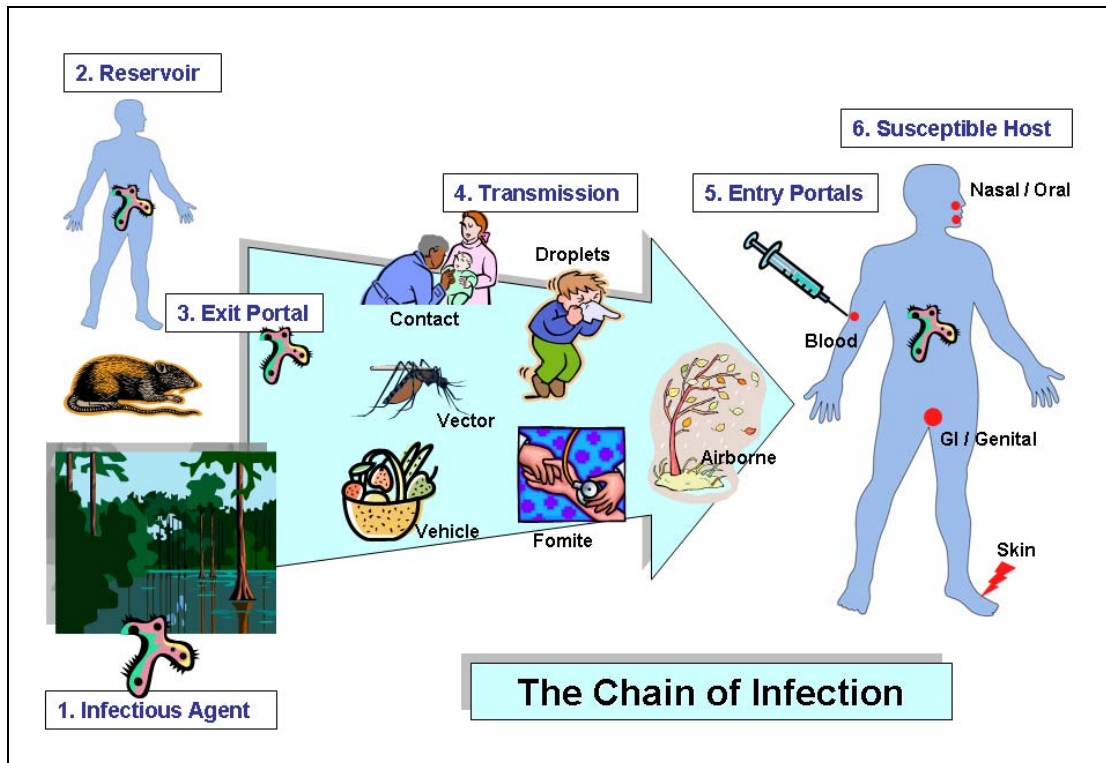


Illustration courtesy of Toni Thompson.

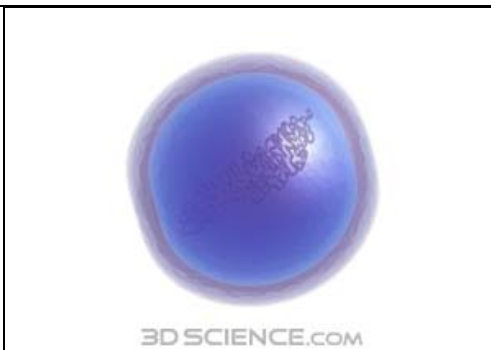
## Infectious Agents or Pathogens

Infectious agents or pathogens are the biological microorganisms or “germs”—bacteria, viruses, fungi, and protozoa—that can cause disease or illness in its host. The word **pathogen** is derived from Greek and means “that which produces suffering.” Although pathogens are common in the environment, most are not harmful to people. All pathogens vary in infectivity and virulence, and to cause disease an **infectious dose** is required. Creating an environment with no pathogens is not a realistic goal outside of highly specialized laboratories.

### Bacteria

Bacteria are single-celled organisms, the vast majority of which are harmless or even beneficial. Our bodies contain bacteria, called **normal flora**, that protect us from infection by providing competition to pathogens. Normal flora usually do not cause disease unless balance is disturbed or the bacteria get into a part of the body that cannot tolerate them. Antibiotics are effective against many bacterial infections although, as already noted, the overuse or misuse of antibiotics has produced strains of bacteria that are resistant to them.

Pathogenic bacteria contribute to a number of globally prevalent diseases. Examples include pneumonia, tuberculosis, bacterial meningitis, group A and group B streptococcus, *Haemophilus influenzae*, methicillin-resistant *Staphylococcus aureus*, *Neisseria meningitidis*, and *Streptococcus pneumoniae*.



A representation of a generic coccus, which is a bacterium with a spherical shape. As cocci join with other cells to form groups, classification can become more specific. For example, chains of cocci bacteria form streptococcus, while clusters form staphylococcus. Source: Zygote Media.



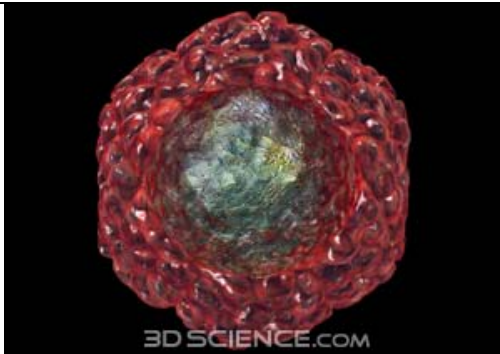
This image depicts a group of typical bacilli. **Bacillus** can refer to any rod-shaped bacterium, or can be more specific to *Bacillus*, which is a gram-positive and rod-shaped genus. Source: Zygote Media.

## Viruses

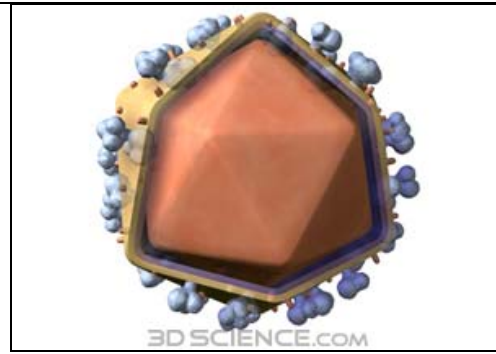
Viruses are true parasites in that they can only reproduce inside the host cell. More than five thousand types of viruses have been described since the first was discovered in 1899. Viruses are about a hundred times smaller than bacteria and, like bacteria, not all viruses cause disease.

Viruses spread in many different ways—via certain insects, by droplets from coughing and sneezing, through fecal contamination, in contaminated food and water, via contact with blood, and through sexual contact. Examples of diseases caused by viruses include influenza, chickenpox, West Nile fever, and HIV.

Antibiotics are not effective against viruses. Vaccines, however, have been successful in eliminating or controlling some viral disease—including smallpox, polio, measles, mumps, and rubella—that have killed millions of people throughout the world. Anti-viral medications for some illnesses have varying degrees of effectiveness.



This image of the West Nile Virus shows the characteristic rough and furrowed surface with no protein arms projecting from it, as so many viruses have. Source: Zygote Media.



HIV is a retrovirus, whose genetic content is stored in RNA, which is copied into the DNA of the host upon infection. Source: Zygote Media.

## Fungi

Fungi are very common, but only a few cause diseases in humans. Some fungal infections are life-threatening in certain susceptible patients. Fungal infections can be superficial (limited to the surface of the skin and hair), cutaneous (extending into the epidermis, nails, and hair), or subcutaneous (extending into the dermis, subcutaneous tissues, muscle, and fascia). Fungal infections can also be systemic—originating mostly in the lungs and spreading to multiple organs. There are several classes of antifungal medications, although fungal and human cells are similar on the molecular level, so antifungal drugs can have mild to serious side effects.



Athlete's foot, yeast infections, and candidemia (yeast growing in the blood) are examples of diseases caused by fungi. A fungus that survives well in air, dust, and moisture in healthcare facilities is *Aspergillus spp.*, a ubiquitous, aerobic fungus that is present in soil, water, and decaying vegetation. Site renovation and construction can disturb *Aspergillus*-contaminated dust and produce bursts of airborne fungal spores, which have been associated with clusters of HAIs in immunocompromised patients. Absorbent building materials such as wallboard are an ideal substrate for the proliferation of this organism if they become and remain wet. Patient-care items, devices, and equipment can become contaminated with *Aspergillus spp.* spores and serve as sources of infection (CDC, 2003).

Other opportunistic fungi that are occasionally linked with HAIs are members of the order *Mucorales* and molds such as *Fusarium* and *Penicillium*. Many of these fungi can proliferate in moist environments, for example in water-damaged wood and building materials. Some fungi, such as *Fusarium* and *Pseudoallescheria*, can be airborne. As with aspergillosis, a major risk factor for disease caused by any of these pathogens is the host's severe immunosuppression from either underlying disease or immunosuppressive therapy.

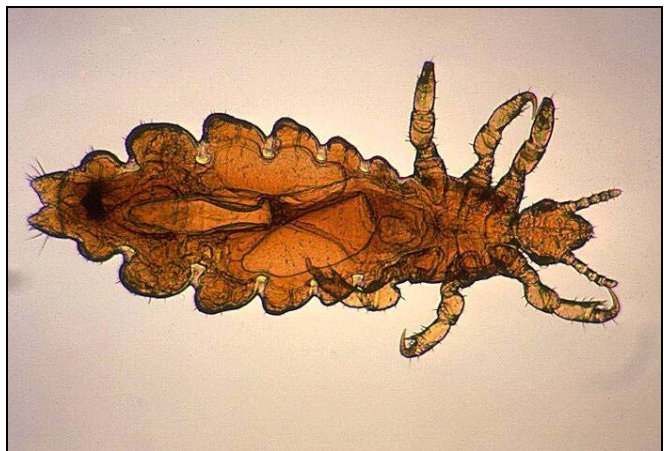
**Parasites**

Parasites are usually larger organisms that exploit a host by living on the skin, inside the gut, or in tissues. The life of a parasite is precarious because the host usually does everything it can to destroy the parasite. Parasites are dependent upon the host for survival and employ a number of strategies to move from host to host. They can be transmitted by direct contact, as with lice or scabies, or wait in the external environment until there is contact with the host (ticks, leeches).

Helminthes are a class of parasites that live inside the body and include roundworms, tapeworms, and flukes. They infect humans principally through ingestion of fertilized eggs or when the larvae penetrate the skin or mucous membranes. Still other parasites live in the blood of the host and are transmitted when an insect bites, ingests infected blood, and then transmits the parasite by biting a new host.



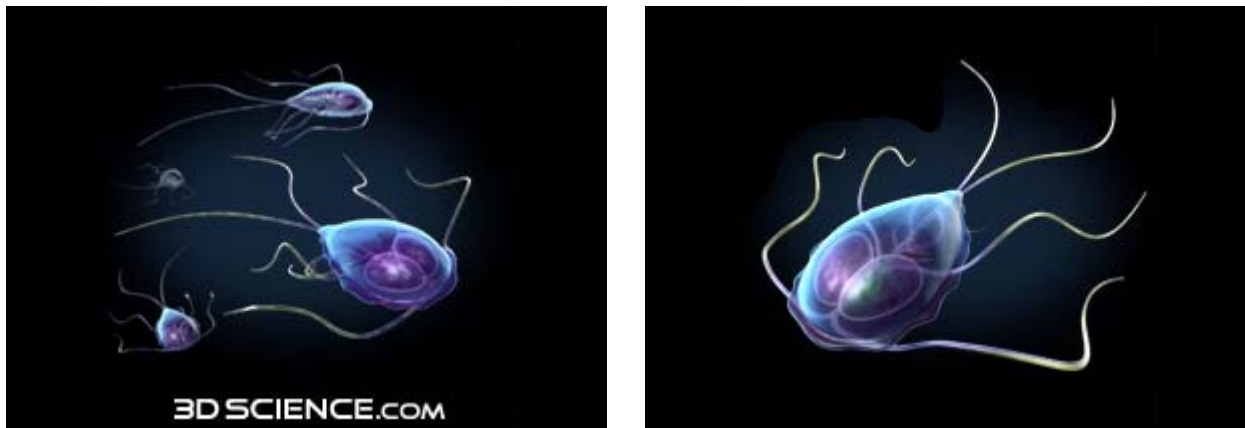
The parasitic roundworm *Ascaris lumbricoides*. As many as one-quarter of the world's population is infected with *Ascaris*. Source: CDC.



*Pediculus humanus var capitis*, also know as head louse. Source: CDC, PHIL.

## Protozoa

Protozoa are single- or multi-celled microorganisms that are larger than bacteria. They have traditionally been classified by their means of propulsion: flagella, amoeboid, sporozoan, or ciliate. They may be transmitted in soil, via water, by direct contact, or by an insect such as a mosquito. Examples of diseases caused by protozoa include malaria and giardia. Protozoa are less common than the other types of organisms in the United States and can be treated with specific medications.



These images depict Giardia trophozoites in a variety of positions. Giardia stick closely to the lining of the small intestine in the hosts they infect and cause mild to severe diarrhea. Giardia have a characteristic teardrop shape, two nuclei in the anterior end and a number of flagella used for movement. Source: Zygote Media.

## Reservoirs

Reservoirs are where the germs live and grow. For healthcare workers and patients a general rule is: **If an area is wet, it is probably a reservoir.** Surprisingly, reservoirs can be complex and difficult to identify. The CDC defines a **reservoir** as “one or more epidemiologically connected populations or environments in which the pathogen can be permanently maintained and from which infection is transmitted to the defined target population” (Haydon et al., 2002).

Although many emerging diseases of human, domestic animal, and wildlife populations are assumed to be maintained in reservoir hosts, these reservoirs are rarely identified. Sometimes there is agreement as to where an infectious organism resides and a specific public health action is taken. For example, approximately one million pigs were slaughtered in Malaysia in 1999 to control Nipah virus; several million chickens were slaughtered in Hong Kong in 1998 and 2001 to prevent a projected pandemic of Influenza A virus; and several million cows were slaughtered in Britain to curtail the epidemic of bovine spongiform encephalopathy.

In other instances the role of reservoirs is less clear; for example, the reservoirs that harbor emerging deadly viruses such as Ebola and Marburg are unknown. Incomplete understanding of reservoirs has hampered control of many diseases in Africa, such as Ebola virus infection, Buruli ulcer, and rabies (Haydon et al., 2002).

In humans, the reservoir and the susceptible host can be the same person and can cause disease if the person's normal flora gets into the wrong part of the body. For example, oral flora getting into the lungs can cause aspiration pneumonia, skin flora contaminating an IV site can cause a site or bloodstream infection, and fecal flora contaminating the urinary tract can cause a urinary tract infection (UTI). This is why care must be taken to avoid carrying germs between different body sites of the same patient. The most effective prevention technique is to change gloves and do hand hygiene when going from a contaminated area to a cleaner area.

In healthcare facilities, activities aimed at eliminating reservoirs include:

- Treating people who are ill
- Handling and disposing of body fluids carefully
- Using sterile water in respiratory equipment
- Drying equipment before storing it
- Handling food safely and cooking meat thoroughly
- Monitoring soil and contaminated water in sensitive areas of the hospital and washing hands carefully after contact with either
- Vaccinating people
- Encouraging ill workers to stay home

Infection control practices should be followed in all settings where healthcare is delivered, including home care, although the relative risk of acquiring an infection may differ. In acute care, a patient's risk for an HAI is related not only to the severity of illness and exposure to invasive interventions and devices but also to environmental risks, including exposure to other patients and inanimate reservoirs or pathogens. In home care, the rationale and strategy for use of precautions differ from those applied in hospitals. In most cases, the use of gowns, gloves, and masks in the care of homebound patients is recommended to protect the healthcare provider, not the patient. Caregivers in the home may need to use masks only when caring for patients with pulmonary tuberculosis (CDC, 2001).

Home care patients known to have a multidrug-resistant organism should be cared for through use of appropriate barriers. Although these organisms may not be a risk to providers, they may be transmitted to other homecare patients through inanimate objects or hands. Reusable equipment such as stethoscopes and blood pressure cuffs should remain in the home. If practical, such patients should be seen as the last appointment of the day. If this is not possible, visits should be scheduled to avoid seeing at-risk patients—such as patients requiring wound care—after seeing a patient with multidrug-resistant organisms (CDC, 2001).

### **Portals of Exit: How Pathogens Leave the Body**

A pathogen leaves its reservoir or host through a portal of exit. The portal of exit usually corresponds to the site where the pathogen is located. For example, influenza viruses and *M. tuberculosis* exit from the respiratory tract, cholera exits its host in feces, and *Sarcoptes scabiei* in scabies skin lesions. Some bloodborne pathogens can exit by crossing the placenta from mother to fetus (rubella, syphilis, and toxoplasmosis), while others exit through cuts in the skin or needles (hepatitis B) or blood-sucking insects (malaria) (DHHS, n.d.).

The portal of exit is the link of the chain over which we have the *least* control. Any break in the skin—such as natural anatomical openings or draining lesions—may be a portal of exit from a host. Any body fluid may carry infectious agents out of the body. Some bacteria (such as MRSA) live on the patient’s skin, so even dry skin contact may serve as the portal of exit.

Activities aimed at eliminating portals of exit in healthcare facilities include:

- Covering coughs and sneezes with a tissue
- Handling body fluids with gloves—followed by hand hygiene
- Keeping draining wounds covered with a dressing
- Staying home from work when you have wet lesions or weeping dermatitis

### Means of Transmission

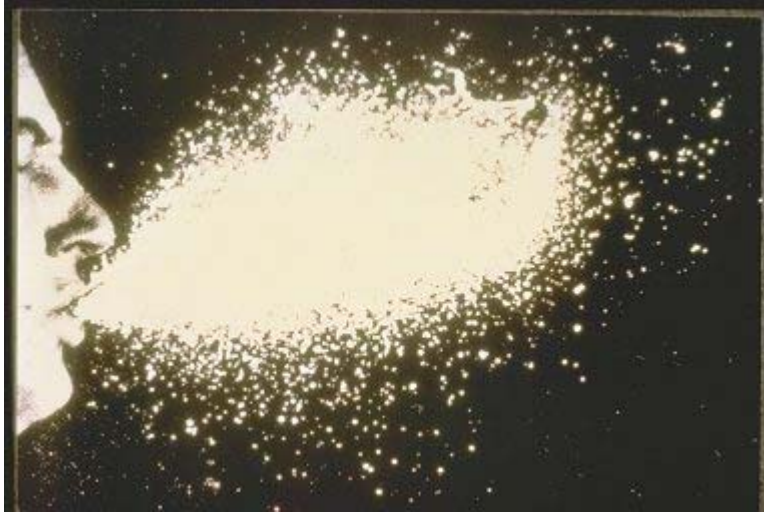
Very few germs can fly—almost all have to be carried from one place to another. **The means of transmission is the weakest link in the chain of infection, and it is the only link we can hope to eliminate entirely.** Most infection control efforts are aimed at preventing the transport of germs from the reservoir to the susceptible host. Both Standard and Contact Precautions are designed to interrupt the means of transmission.

The most common means of transport in the healthcare setting are the hands of the caregivers and items that move patient to patient (Table 2). Items moving between patients should be cleaned after each use to avoid indirect contact transmission of pathogens. Because it addresses the weakest link in the chain of transmission, **hand hygiene is still the single most important procedure for preventing the spread of infection.**

**Table 2. Common Means of Transport**

Type of Contact	Example
Direct	Person-to-person transmission of pathogens through touching, biting, kissing, or sexual intercourse
Indirect	Involves an intermediate person or item between the portal of exit and the portal of entry to the next person (unwashed hands, soiled blood pressure cuffs, doorknobs)
Fomites	Soiled objects, such as used gloves, pens, bed rails, used tissues, and soiled laundry

Transmission of germs can also occur via droplet or airborne routes. **Droplet transmission** is a common means for easily spread infections such as colds, influenza, whooping cough (pertussis), and some forms of meningitis. Droplets are produced when the infected person coughs, sneezes, or speaks. Droplets can travel about 3 to 6 feet before drying out or falling to the ground. Droplet Precautions are designed to interrupt this means of transmission, and respiratory hygiene practices recommend that they be used when caring for any person with active respiratory symptoms.



How influenza travels through the air when someone coughs.  
Source: CDC.

**Airborne transmission** occurs with only a few infections—those caused by organisms that can survive the drying of respiratory droplets. When the droplets evaporate, they leave behind droplet nuclei, which are so tiny they remain suspended in the air. Diseases transmitted by the airborne route include tuberculosis, chickenpox, measles, severe acute respiratory syndrome (SARS), and smallpox. Airborne Precautions are designed to interrupt this means of transmission.

Means of transmission that are not common in hospitals include:

- Common-source vehicles such as contaminated food, water, milk, or IV fluid. In hospitals, these products are obtained only from safe and approved sources to prevent contamination.
- Vector-borne transmission by an animal carrier such as a rat or mosquito that carries the pathogen from reservoir to host. Hospitals maintain their environment so that vector-borne transmission is not likely to occur.

Activities aimed at eliminating the means of transmission in healthcare facilities include:

- Hand hygiene
- Wearing gloves to minimize contamination of hands and discarding them after each patient
- Maintaining Contact, Droplet and Airborne Precautions as indicated
- Cleaning, disinfection, or sterilization of equipment used by more than one patient
- Cleaning of the environment, especially high-touch surfaces
- Maintaining directional air flow

### **Animate Transmission**

Infectious agents transmitted during healthcare derive primarily from human sources. Human reservoirs include patients, healthcare personnel, and household members and other visitors. These **source 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 (Siegel, 2007).

### **Inanimate Transmission**

An agent or pathogen can be indirectly transmitted from a reservoir to a susceptible host on inanimate objects. Cleaning and disinfection are important practices to ensure that medical equipment surfaces do not serve as reservoirs for infectious pathogens. Hands of healthcare 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 (Siegel, 2007).

Patient-care devices such as electronic thermometers, glucose monitoring devices, stethoscopes, blood pressure cuffs and other devices may transmit pathogens if they are contaminated with blood or bodily fluids or are shared between patients without cleaning and disinfecting between patients. Shared toys may become a vehicle for transmitting respiratory viruses (eg, respiratory syncytial virus) or pathogenic bacteria (eg, *Pseudomonas aeruginosa*) among pediatric patients (Siegel, 2007).

Instruments such as endoscopes or surgical instruments that are inadequately cleaned between patients before disinfection or sterilization 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 (Siegel, 2007).

The potential also exists for soiled garments to transfer infectious agents to successive patients. A 2007 study in a Maryland teaching hospital revealed that 27 percent of the white coats worn by 109 doctors and other medical professionals were colonized with *S. aureus* and 6 percent were colonized with MRSA. In a follow-up questionnaire, 65 percent of the healthcare workers reported they had last washed their white coat more than a week ago and nearly 16 percent had last washed their coat more than 30 days ago (Treakle, 2006).

### **Portals of Entry: How Pathogens Are Introduced**

The portal of entry refers to the manner in which a pathogen enters a susceptible host. The portal of entry must provide access to tissues in which the pathogen can multiply or a toxin can act. Often, the infectious agent uses the same portal to enter the new host that it used to exit the source host. For example, influenza virus exits the respiratory tract of the source host and enters the respiratory tract of the new host.

Other pathogens follow a so-called fecal-oral route because they exit the source host in feces, are carried on inadequately washed hands to a vehicle such as food, water, or utensils, and enter a new host through the mouth. Other portals of entry include skin, mucous membranes, and blood (DHHS, n.d.).

Pathogens cannot cause illness until they gain entry into the body, and, in general, they cannot enter through intact skin. They may gain entry through an anatomical opening, a skin break caused by illness or accident, or an opening created during a medical procedure, such as a surgical wound or an IV site. Preventing or eliminating portals of entry, where possible, and protecting portals that cannot be eliminated is a must for both patients and healthcare personnel.

Examples of portals of entry include:

- Mouth, nose, eyes, and other anatomical openings
- Rash or dermatitis
- Insect bites
- Injuries, from microscopic to major
- Surgical wounds
- Intravenous sites
- Anatomical openings with tubes in place
- Needle-puncture injuries

Activities aimed at protecting or eliminating portals of entry in healthcare facilities include:

- Use of septic surgical technique
- Application of dressings on surgical wounds
- Use of IV site dressings and proper care
- Elimination of tubes as soon as possible
- Use of masks, goggles, and face shields
- Protecting your skin to prevent holes (such as dermatitis)
- Keeping unwashed hands and objects away from the mouth
- Use of actions and devices to prevent needlesticks

## Susceptible Host

The final link in the chain of infection is the susceptible host. Most of the factors that influence infection and the occurrence and severity of disease are related to the host, although agent and environmental factors also play a role (Table 3). However, characteristics of the host-agent interaction—such as pathogenicity, virulence, and antigenicity—are also important. The infectious dose, mechanism of disease production, and route of exposure are also factors.

**Table 3. Factors That Influence the Outcome of an Exposure**

<b>Host factors</b>	<ul style="list-style-type: none"> <li>• Extremes of age</li> <li>• Underlying disease</li> <li>• HIV/AIDS</li> <li>• Malignancy</li> <li>• Transplants</li> <li>• Medications that alter normal flora such as antimicrobial agents, gastric acid suppressants, corticosteroids, anti-rejection drugs, antineoplastic agents, and immunosuppressive drugs</li> <li>• Surgical procedures</li> <li>• Radiation therapy</li> <li>• Indwelling devices such as urinary catheters, endotracheal tubes, central venous and arterial catheters and synthetic implants</li> </ul>
<b>Agent factors</b>	<ul style="list-style-type: none"> <li>• Infectivity</li> <li>• Pathogenicity</li> <li>• Virulence</li> <li>• Size of inoculum</li> <li>• Route of exposure</li> <li>• Duration of exposure</li> <li>• The ability of a pathogen to maintain infectivity over that distance</li> </ul>
<b>Environmental factors</b>	<ul style="list-style-type: none"> <li>• Contamination of environment and equipment</li> <li>• Temperature and humidity</li> </ul>

Some persons exposed to pathogenic microorganisms never develop symptomatic disease while others become severely ill and even die. Those who are extremely old or young, are already ill, have holes in their skin, have invasive devices in place, or are immunocompromised are more susceptible. Still others progress from colonization to symptomatic disease either immediately following exposure or after a period of asymptomatic colonization.

Susceptibility can be reduced in several ways. For some diseases there are effective vaccines and some diseases produce lasting immunity after illness. We have better resistance to disease when we are well rested, well fed, and relatively stress-free. People with healthy immune systems are often able to resist infection even when bacteria do invade.

The healthy body has numerous protective structures and systems that support resistance to infection. These include intact skin, blood circulation bringing white blood cells and nutrients to the tissues, antibodies to previously encountered infectious agents, the inflammatory response, stomach acid, and a robust community of normal flora, which provides competition to invading pathogens. A person with these defense mechanisms intact is said to be **immunocompetent**.

Immune compromise varies in severity and can be temporary or long term. A person who is sick in bed for a few days may be mildly compromised, while a person with a chronic illness such as diabetes is probably moderately and chronically compromised. Someone receiving chemotherapy or a transplant patient may be severely immunocompromised.

Extra care should be taken to protect a person who is immunocompromised. Nutritional status should be closely monitored to support immune competence. The care should be tailored to the specific needs and situation of the patient. Both the very young and very old need extra protection from infection. Any indwelling device (IV catheters, urinary catheters, etc.) increases susceptibility. To reduce the risk of infections associated with these devices, the device should be discontinued as soon as the patient no longer needs it.

Infections are sometimes more related to host factors than to the infectious agent. For example, a person who is well rested may resist the virus that makes the over-tired person sick. Some organisms are widely found but only cause disease in a **susceptible host**—such as the person recently treated with antibiotics who then develops a yeast infection. Examples of susceptible hosts include people who:

- Are already ill
- Have invasive devices or tubes in place
- Are malnourished
- Are very old or very young
- Are tired or under high stress
- Have skin breaks such as surgical wounds or IV sites
- Are undergoing steroid therapy or treatment for cancer
- Have HIV infection
- Are well and healthy! (None of us are immune to all disease.)

Activities aimed at protecting or eliminating susceptible hosts in healthcare facilities include:

- Preventing exposure of both patients and staff
- Removal of invasive devices as soon as they are no longer needed
- Maintaining good nutrition
- Maintaining good skin condition
- Covering skin breaks
- Vaccinating people against illnesses to which they may be exposed
- Encouraging rest and balance in our lives

## Prevention Strategies

Since 1991, when OSHA first issued its Bloodborne Pathogens Standard to protect healthcare personnel from blood exposure, the focus of regulatory and legislative activity has been on implementing a hierarchy of prevention and control measures. A central tenet is to **consider all patients to be potentially infected with a bloodborne pathogen**. For organisms other than bloodborne pathogens, early identification and prompt isolation are critical. Other prevention strategies include sharps safety, isolation precautions, Standard Precautions, hand hygiene, environmental control measures, vaccination of healthcare workers, post-exposure prophylaxis, and training and education in infection prevention.

## Sharps

There has been increased focus on removing sharps hazards through the development and use of engineering controls. In November 2000, the Federal Needlestick Safety and Prevention Act authorized OSHA's revision of its Bloodborne Pathogens Standard to require the use of safety-engineered sharp devices (Figure 3). The CDC has provided guidance on the design, implementation, and evaluation of a comprehensive sharps injury prevention program. This includes 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 (Seigel, 2007).

**Figure 3. Examples of sharps with safety features exposed and covered**



Source: CDC.

## Isolation

When a patient is known or thought to have a contagious disease, **isolation precautions** are used. They are stopped either when a patient is found not to have an infectious disease or when the patient is no longer infectious. Signs detailing the isolation precautions should be posted outside the hospital door and on the patient’s chart. Strict isolation applies to rare diseases (such as rabies or Ebola virus) that spread through the air or by contact with infectious material.

## Standard Precautions

Because patients with bloodborne infections can be asymptomatic or unaware they are infected, Universal Precautions were based on the concept that all blood and bodily fluids that might be contaminated with blood should be treated as infectious. The relevance of Universal Precautions to other aspects of disease transmission was recognized, and in 1996, the CDC expanded the concept and changed the term to Standard Precautions. **Because Standard Precautions is broader than Universal Precautions, CDC recommends Standard Precautions for the care of all patients**, regardless of their diagnosis or presumed infection status.

Standard Precautions integrate and expand the elements of Universal Precautions into a standard of care designed to protect healthcare personnel and patients from pathogens that can be spread by blood or any other bodily fluid, excretion, or secretion. Standard Precautions apply to contact with (1) blood, (2) all body fluids, secretions, and excretions (except sweat), regardless of whether they contain blood, (3) non-intact skin, and (4) 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.

Standard Precautions protect both staff and patients from infection and ensure that the right precautions are used with known and unknown carriers of diseases, as well as with blood and bodily fluids. Correct use of Standard Precautions with every patient protects healthcare workers from the unknown carriers of those diseases (Table 4).

**Table 4. Correct Use of Standard Precautions**

<b>Always</b>	<ul style="list-style-type: none"> <li>• Use good hand hygiene.</li> <li>• Use gloves for contact with blood, body fluids, non-intact skin (including rash), mucous membranes, used equipment, linen, and trash.</li> <li>• Use a gown any time your clothing is soiled and if a patient has uncontained body substances.</li> <li>• Use a mask and eye protection if you may be splashed—your glasses do not count.</li> <li>• Change gloves if they become heavily soiled or if you must go from a dirtier area to a cleaner one.</li> </ul>
<b>Never</b>	<ul style="list-style-type: none"> <li>• Wear artificial fingernails—check your facility’s policy for details.</li> <li>• Touch a second patient with the same pair of gloves.</li> <li>• Re-use gowns, even for repeated contacts with the same patient.</li> <li>• Contaminate the environment with dirty gloves.</li> <li>• Wear gloves in the hall unless you can say why you are wearing them.</li> </ul>

## Hand Hygiene

The chain of infection makes it clear why hand hygiene is critical. For generations, handwashing with soap and water has been considered a measure of personal hygiene. The concept of cleansing hands with an antiseptic agent probably emerged in the early nineteenth century. As early as 1822, a French pharmacist demonstrated that solutions containing chlorides of lime or soda could eradicate the foul odors associated with human corpses and that such solutions could be used as disinfectants and antiseptics. In a paper published in 1825 this pharmacist stated that physicians and other persons attending patients with contagious diseases would benefit from moistening their hands with a liquid chloride solution (MMWR, 2002).

Despite the simplicity and effectiveness of hand hygiene in preventing the spread of infectious disease, adherence to hand hygiene practice remains unacceptably low throughout the world. Adherence varies among professional categories of healthcare workers and between hospital departments but is usually estimated as less than 50 percent (Pittet, 2001).

For healthcare workers, strict adherence to hand hygiene guidelines protects both the patient and the worker. Hand hygiene should be done when you first come on duty, before you touch your first patient or clean equipment, and before and after every patient contact, including after touching intact skin. In addition, perform hand hygiene:

- After contact with any body fluids, including your own
- Before any clean or invasive procedure
- Before putting on sterile gloves
- Each time you remove your gloves
- When leaving an isolation room
- When going from a dirtier to a cleaner part of the patient
- When your hands feel or look dirty
- After contact with contaminated things or environments, such as charts
- After handling used equipment or linen
- After using the bathroom
- Before contact with any portal of entry, your patient's or your own
- Before and after eating

If you can see dirt on your hands—whether from blood, body fluid, or from the earth—wash your hands with soap and water, which physically removes the dirt from your hands. Washing with soap and water does *not* kill germs. Alcohol products kill most germs including viruses, but they do *not* remove dirt and debris from your hands. If you use alcohol, choose a hand hygiene product that contains alcohol as part of its overall formulary—plain alcohol should not be used because it evaporates too quickly to provide enough contact time to kill germs. Follow these guidelines for proper hand hygiene:

- Wet your hands before applying soap to minimize skin irritation.
- Use friction on all surfaces to loosen dirt and germs.
- Scrub for at least 15 seconds (*Row, Row, Row Your Boat*, twice).
- Use a comfortable water temperature—water hot enough to kill germs would injure your skin.
- Use alcohol products on dry skin only.
- Use one squirt of alcohol gel or foam, and rub until hands are completely dry—do not wipe off with a paper towel.

For routine hand hygiene, alcohol products are preferred. They are better than soap and water because they kill germs more effectively, leave skin in better condition, and are quicker and easier so are used more frequently.



Source: CDC Hand Hygiene Training.

When dealing with diarrhea that may be infectious, use soap and water. *Clostridium difficile* is a spore-forming organism and the spores are not killed by alcohol products. Norovirus is another organism not killed well by alcohol products. Because alcohol products are effective antimicrobial agents, the CDC does not specify an antimicrobial soap for routine hand hygiene. Antimicrobial soaps are often more irritating to the skin, are more expensive, and tend to build up in the environment. “Plain” soap removes germs from the hands as well as an antimicrobial product.



To see a video of hand washing technique on YouTube, go to YouTube.com and search for "Put Your Hands Together CDC." Link: [http://www.youtube.com/watch?v=ZIDqcmY\\_EV8](http://www.youtube.com/watch?v=ZIDqcmY_EV8). Source: CDCTV.

## Environmental Control Measures

*[The following section is derived from CDC (2003).]*

Microorganisms are present in great numbers in moist, organic environments, but some can persist under dry conditions. Although microbiologically contaminated surfaces can serve as reservoirs of potential pathogens, these surfaces generally are not directly associated with transmission of infections to either staff or patients. The transfer of a microorganism from an environmental surface to a patient is largely via hand contact with the surface. Although hand hygiene is important to minimize the impact of this transfer, cleaning and disinfecting environmental surfaces is fundamental in reducing their potential contribution to the incidence of HAIs.

### Environmental Cleaning

All work areas must be maintained in a clean and sanitary condition. The employer is required to determine and implement a written schedule for cleaning and disinfection based on the location within the facility, type of surface to be cleaned, type of soil present, and tasks or procedures being performed. All equipment, environmental and working surfaces must be properly cleaned and disinfected after contact with blood or other infectious material. Contaminated broken glassware must be removed using mechanical means, like a brush and dustpan or vacuum cleaner.

Chemical germicides and disinfectants used at recommended dilutions must be used to decontaminate environmental surfaces. Consult the Environmental Protection Agency (EPA) lists of registered sterilants, tuberculocidal disinfectants, and antimicrobials with HIV/HBV efficacy claims to ensure that the disinfectant is appropriate. Specimens of blood or other potentially infectious materials (OPIM) must be placed in a closeable, labeled, or color-coded leakproof container before being stored or transported.

## Laundry

OSHA defines contaminated laundry as “laundry which has been soiled with blood or other potentially infectious materials or may contain sharps.” Contaminated textiles and fabrics often contain high numbers of microorganisms from body substances, including blood, skin, stool, urine, vomitus, and other body tissues and fluids. Disease transmission attributed to healthcare laundry has involved contaminated fabrics that were handled inappropriately (eg, the shaking of soiled linens). Bacteria, viruses, fungi, and ectoparasites such as scabies presumably have been transmitted from contaminated textiles and fabrics to workers either via direct contact or via aerosols of contaminated lint generated from sorting and handling contaminated textiles.

Fabrics, textiles, and clothing used in healthcare settings are disinfected during laundering and generally rendered free of vegetative pathogens (hygienically clean), but they are not sterile. The antimicrobial action of the laundering process results from a combination of mechanical, thermal, and chemical factors. Dilution and agitation in water remove substantial quantities of microorganisms. Soaps and detergents function to suspend soils and also exhibit some microbicidal properties. Hot water provides an effective means of destroying microorganisms. Chlorine bleach is an economical, broad-spectrum chemical germicide that enhances the effectiveness of the laundering process.

Laundry that is or may be soiled with blood or other potentially infectious material, or may contain contaminated sharps, must be treated as though contaminated. Contaminated laundry must be bagged at the location where it was used, and should not be sorted or rinsed in patient-care areas. It must be placed and transported in bags that are labeled or color-coded (red-bagged).

Laundry workers must wear protective gloves and other appropriate personal protective clothing when handling potentially contaminated laundry. All contaminated laundry must be cleaned or laundered so that any infectious agents are destroyed.

Infectious material may be present on the clothing of healthcare workers. In a study examining the microbial contamination of medical students' white coats, the students perceived the coats as “clean” as long as the garments were not visibly contaminated with body substances, even after wearing the coats for several weeks. The heaviest bacterial load was found on the sleeves and the pockets of these garments; the organisms most frequently isolated were *Staphylococcus aureus*, diphtheroids, and *Acinetobacter spp.*

## Appropriate Ventilation

Engineering controls to contain or prevent the spread of airborne contaminants center on local exhaust ventilation, general ventilation, and air cleaning. General ventilation encompasses: (a) dilution and removal of contaminants via well-mixed air distribution of filtered air; (b) directing contaminants toward exhaust registers and grilles via uniform, non-mixed airflow patterns; (c) pressurization of individual spaces relative to all other spaces; and (d) pressurization of buildings relative to the outdoors and other attached buildings.

## Waste Management

The most practical approach to medical waste management is to identify wastes that represent a sufficient potential risk of causing infection during handling and disposal and for which some precautions are likely prudent. Healthcare facility medical wastes targeted for handling and disposal precautions include microbiology laboratory waste, pathology and anatomy waste, blood specimens from clinics and laboratories, blood products, and other body-fluid specimens.

Although any item that has had contact with blood, exudates, or secretions may be potentially infective, treating all such waste as infective is neither practical nor necessary. Federal, state, and local guidelines and regulations specify the categories of medical waste that are subject to regulation and outline the requirements associated with treatment and disposal. The categorization of these wastes has generated the term **regulated medical waste**, which is defined as any of the following:

- Liquid or semi-liquid blood or other potentially infectious materials (OPIM)
- Contaminated items that would release blood or OPIM in a liquid or semi-liquid state, if compressed
- Items that are caked with dried blood or OPIM and are capable of releasing these materials during handling
- Contaminated sharps
- Pathological and microbiological wastes containing blood or OPIM

Medical wastes require careful disposal and containment before collection and consolidation for treatment. OSHA has dictated initial measures for discarding regulated medical-waste items. These measures are designed to protect the workers who generate medical wastes and who manage the wastes from point of generation to disposal. A single, leak-resistant biohazard bag is usually adequate for containment of regulated medical wastes, provided the bag is sturdy and the waste can be discarded without contaminating the bag's exterior. The contamination or puncturing of the bag requires placement into a second biohazard bag. All bags should be securely closed for disposal.

Puncture-resistant containers located at the point of use are utilized for discarded slides or tubes with small amounts of blood, scalpel blades, needles and syringes, and unused sterile sharps. To prevent needlestick injuries, needles and other contaminated sharps should not be recapped, purposefully bent, or broken by hand.

Transporting and storing regulated medical wastes within the healthcare facility while awaiting terminal treatment is often necessary. Both federal and state regulations address the safe transport and storage of on- and off-site regulated medical wastes. Healthcare facilities are instructed to dispose of medical wastes regularly to avoid accumulation.

Medical wastes requiring storage should be kept in labeled, leakproof, puncture-resistant containers under conditions that minimize or prevent foul odors. The storage area should be well ventilated and be inaccessible to pests. Any facility that generates regulated medical wastes should have a regulated medical waste management plan to ensure health and environmental safety as per federal, state, and local regulations (CDC, 2003).

## Vaccination

All employees with occupational exposure to blood or OPIM must be offered hepatitis B vaccination after receiving required training and within 10 days of initial assignment. The vaccine must be provided free of charge. Serologic testing after vaccination (to ensure that the shots were effective) is recommended for all persons with ongoing exposure to sharp medical devices. The provision of employer-supplied hepatitis B vaccination may be delayed until after probable exposure for employees whose sole exposure risk is the provision of first aid.

## Pre-and Post-Exposure Prophylaxis

An **occupational exposure** is defined as a percutaneous injury or contact of mucous membrane or non-intact skin with blood, tissue, or OPIM. The risk of infection varies case by case. Factors influencing the risk of infection include:

- Whether the exposure was from a hollow-bore needle or other sharp instrument
- Whether the exposure was to non-intact skin or mucus membranes
- The amount of blood that was involved
- The amount of virus present in the source's blood

As soon as safely possible following a potential exposure, wash the affected area with soap and water. Application of antiseptics should not be a substitute for washing. It is recommended that any potentially contaminated clothing be removed as soon as possible. It is also recommended that you familiarize yourself with existing protocols and the location of emergency eyewash or showers and other stations within your facility. If there is exposure to the eyes, nose, or mouth, flush thoroughly with water, saline, or sterile irrigants. The risk of contracting HIV through this type of exposure is estimated to be 0.09 percent.

If a sharps injury occurs, wash the exposed area with soap and water. Do not "milk" or squeeze the wound. There is no evidence that shows using antiseptics (like hydrogen peroxide) will reduce the risk of transmission for any bloodborne pathogens; however, the use of antiseptics is not contraindicated. In the event that the wound needs suturing, emergency treatment should be obtained. The risk of contracting HIV from this type of exposure is estimated to be 0.3 percent.

Post-exposure prophylaxis (PEP) provides anti-HIV medications to someone who has had a substantial exposure, usually to blood. PEP has been the standard of care for occupationally exposed healthcare workers with substantial exposures since 1996. Animal models suggest that cellular HIV infection happens within 2 days of exposure to HIV and the virus in blood is detectable within 5 days. Therefore, PEP should be started as soon as possible—within hours, not days—after exposure and continued for 28 days. However, PEP for HIV does not provide prevention of other bloodborne diseases like HBV or HCV.

Hepatitis B PEP for susceptible persons would include administration of hepatitis B immune globulin and HBV vaccine. This should occur as soon as possible and no later than 7 days post-exposure.

The benefit of the use of antiviral agents to prevent HCV infection is unknown and antiviral are not currently approved by the Federal Drug Administration (FDA)—approved for prophylaxis. Because of the frequent advances in treatment, doses and medications are not listed here. Post-exposure prophylaxis can only be obtained from a licensed healthcare provider. Your facility may have recommendations and a chain of command in place for you to obtain PEP. After evaluation of the exposure route and other risk factors, certain anti-HIV medications may be prescribed. The national bloodborne pathogen hotline provides 24-hour consultation for clinicians who have been exposed on the job.

Post-exposure prophylaxis is not as simple as swallowing one pill. The medications must be started as soon as possible and continued for 28 days. Many people experience significant side effects. It is essential to report occupational exposure to the department at your workplace that is responsible for managing exposure. If post-exposure treatment is recommended, it should be started as soon as possible. In rural areas, police, firefighters, and other at-risk emergency providers should identify a 24-hour source for PEP.

### **Training and Education of Healthcare Workers**

All new employees, or employees being transferred into jobs involving tasks or activities with potential exposure to blood or OPIM, must receive bloodborne pathogen training before assignment to tasks where an occupational exposure may occur. Training is to include information on the hazards associated with blood and other potentially infectious material, the protective measures to be taken to minimize the risk of occupational exposure, and information on the appropriate actions to take if an exposure occurs. Retraining is required annually, or when changes in procedures or tasks affecting occupational exposure occur. Employees must be provided access to a qualified trainer during the training session to respond as questions arise.

## Element III (updated guideline)

**The use of engineering and work practice controls to reduce the opportunity for patient and healthcare worker exposure to potentially infectious material should be standard practice in all healthcare settings, not only in hospitals. Facilities are required to address and manage high-risk practices and procedures capable of causing healthcare-acquired infections (HAIs) from bloodborne pathogens.**

Engineering and work practice controls are designed to manage percutaneous, mucous membrane/non-intact skin, and parenteral exposures. **Percutaneous** (through the skin) **exposures** can occur during handling, disassembly, disposal, and reprocessing of contaminated needles and other sharp objects. For example, manipulating contaminated needles and other sharp objects by hand, removing scalpel blades from holders, and removing needles from syringes can lead to a percutaneous injury.

Delaying or improperly disposing of sharps, leaving contaminated needles or sharp objects on counters or workspaces, or disposing of sharps in non-puncture-resistant receptacles can lead to injury. Recapping contaminated needles and other sharp objects using a two-handed technique is a common cause of injury. Percutaneous exposures can also occur when performing procedures where there is poor visualization—such as blind suturing, non-dominant hand positioned opposed or next to a sharp, and performing procedures where bone spicules or metal fragments are produced.

**Mucous membrane/non-intact skin exposures** occur when there is direct blood or body fluids contact with the eyes, nose, mouth, or other mucous membranes. This can occur via contact with contaminated hands, contact with open skin lesions/dermatitis, and from splashes or sprays of blood or body fluids (eg, during irrigation or suctioning).

*Parenteral* refers to a route of transmission or administration that involves piercing mucous membranes or the skin barrier through such events as needlesticks, human bites, cuts, and abrasions. A **parenteral exposure** occurs as a result of injection with infectious material, which can occur during administration of parenteral medication, sharing of blood monitoring devices such as glucometers, hemoglobinometers, lancets, and lancet platforms/pens, and infusion of contaminated blood products or fluids.

According to OSHA, nurses sustain the most needlestick injuries and as many as one-third of all sharps injuries occur during disposal. The CDC estimates that 62 to 88 percent of sharps injuries can be prevented simply by using safer medical devices.

### Engineering and Work Practice Controls

*[The following information is taken from the OSHA Bloodborne Pathogens Standard, 1910.1030.]*

**Engineering controls** such as sharps disposal containers, self-sheathing needles, and safer medical devices (sharps with engineered sharps injury protections and needleless systems) isolate or remove the bloodborne pathogens hazard from the workplace. **Work practice controls** reduce the likelihood of exposure by altering the manner in which a task is performed (eg, prohibiting recapping of needles by a two-handed technique). Engineering and work practice controls are intended to eliminate or minimize employee exposure. They must be examined and maintained or replaced on a regular schedule to ensure their effectiveness.

As part of their responsibility for providing a safe workplace, employers must provide handwashing facilities that are readily accessible to employees. If it is not feasible to provide handwashing facilities, the employer must provide antiseptic hand cleanser and clean cloth or paper towels, or antiseptic towelettes. When antiseptic hand cleansers or towelettes are used, hands should be washed with soap and running water as soon as possible.

Contaminated needles and other contaminated sharps should not be bent, recapped, or removed unless the employer can demonstrate that there is no alternative or that such action is required by a specific procedure. Shearing or breaking of contaminated needles is prohibited. Such bending, recapping or needle removal must be accomplished through the use of a mechanical device or a one-handed technique.

Immediately, or as soon as possible after use, contaminated reusable sharps must be placed in appropriate containers until properly reprocessed. These containers must be:

- Puncture resistant
- Labeled or color-coded in accordance with this standard
- Leakproof on the sides and bottom
- Maintained in accordance with OSHA requirements for reusable sharps

Eating, drinking, smoking, applying cosmetics or lip balm, and handling contact lenses are prohibited in work areas where there is a reasonable likelihood of occupational exposure. Food and drink should not be kept in refrigerators, freezers, shelves, cabinets, or on countertops or benchtops where blood or OPIM are present.

All procedures involving blood or other potentially infectious materials must be performed in such a manner as to minimize splashing, spraying, spattering, and generation of droplets of these substances. Mouth pipetting or suctioning of blood or OPIM is prohibited.

Specimens of blood or other potentially infectious materials must be placed in a container that prevents leakage during collection, handling, processing, storage, transport, or shipping. The container must be labeled or color-coded according to OSHA guidelines. When a facility utilizes Standard Precautions in the handling of all specimens, the labeling or color-coding of specimens is not necessary provided containers are recognizable as containing specimens, although this exemption only applies while such specimens or containers remain within the facility. Labeling or color-coding is required when such specimens or containers leave the facility.

If outside contamination of the primary container occurs, the primary container must be placed within a second container that prevents leakage during handling, processing, storage, transport, or shipping, and is labeled or color-coded according to the requirements of this standard. If the specimen could puncture the primary container, the primary container shall be placed within a secondary container that is puncture-resistant in addition to the above characteristics.

Equipment that may become contaminated with blood or other potentially infectious materials must be examined before servicing or shipping and be decontaminated as necessary, unless the employer can demonstrate that decontamination of such equipment or portions of such equipment is not feasible. A readily observable label must be attached to the equipment stating which portions remain contaminated.

The employer must ensure that this information is conveyed to all affected employees, the servicing representative, and the manufacturer before handling, servicing, or shipping, so that appropriate precautions will be taken.

Use splatter shields on medical equipment associated with risk-prone procedures (eg, locking centrifuge lids). Gloves used for the task of sorting laundry should be of sufficient thickness to minimize sharps injuries. Of all the categories comprising regulated medical waste, microbiologic wastes such as untreated cultures, stocks, and amplified microbial populations pose the greatest potential for infectious disease transmission, while sharps pose the greatest risk for injuries (CDC, 2003).

#### **General Practices for the Workplace**

- Use proper hand hygiene, including the appropriate circumstances in which alcohol-based hand sanitizers and soap-and-water handwashing should be used.
- Use proper procedures for cleaning of blood and bodily fluid spills, including initial removal of bulk material followed by disinfection with an appropriate disinfectant.
- Practice proper handling and disposal of blood and bodily fluids, including contaminated patient care items.
- Select, don, doff, and dispose of PPE as trained.
- Protect work surfaces in direct proximity to patient procedure treatment areas with appropriate barriers to prevent instruments from becoming contaminated with bloodborne pathogens.
- Prevent percutaneous exposures by avoiding unnecessary use of needles and other sharp objects.
- Use care in the handling and disposing of needles and other sharp objects.

Always activate safety features—do not circumvent them. Modify procedures if necessary to avoid injury. For example:

- Use forceps, suture holders, or other instruments for suturing.
- Avoid holding tissue with fingers when suturing or cutting.
- Avoid leaving exposed sharps of any kind on patient procedure or treatment work surfaces.
- Use appropriate safety devices whenever available.

## Safe Injection Practices

Safe injection practices are designed to prevent disease transmission from patient to patient and healthcare worker to patient. The absence of visible blood or signs of contamination in a used syringe, IV tubing, multi-dose medication vial, or blood glucose monitoring device does *not* mean the item is free from potentially infectious agents. Bacteria and other microbes can be present without clouding or other visible evidence of contamination. All used injection supplies and materials are potentially contaminated and should be discarded.

Many cases reported to the CDC in which a bloodborne pathogen was transmitted as a result of improper injection practices have common themes and findings. Often aseptic technique and Standard Precautions were not carefully followed. In many cases infection control programs were lacking or responsibilities were unclear. Lack of recognition of an IC breach led to prolonged transmission and a growing number of infected patients. In all cases, investigations were time-consuming and costly and required the notification, testing, and counseling of hundreds and sometimes thousands of patients.

To ensure safe injection practices, providers should use aseptic technique throughout all aspects of injection preparation and administration. Medications should be drawn up in a designated "clean" medication area that is not adjacent to areas where potentially contaminated items are placed. In addition:

- Use a new sterile syringe and needle to draw up medications while preventing contact between the injection materials and the non-sterile environment.
- Practice proper hand hygiene before handling medications.
- Disinfect the rubber septum of a medication vial with alcohol prior to piercing it if has already been opened.
- Discard medication vials upon expiration or any time there are concerns regarding the sterility of the medication.

Never leave a needle or other device inserted into a medication vial septum, IV bag, or bottle for multiple uses. This provides a direct route for microorganisms to enter the vial and contaminate the fluid. Medications should never be administered from the same syringe to more than one patient, even if the needle is changed. Never use the same syringe or needle to administer IV medications to more than one patient, even if the medication is administered into the IV tubing, regardless of the distance from the IV insertion site.

Keep in mind that all of the infusion components from the infusate to the patient's catheter are a single interconnected unit. All of the components are directly or indirectly exposed to the patient's blood and cannot be used for another patient. Syringes and needles that intersect through any port in the IV system also become contaminated and cannot be used for another patient or used to re-enter a non-patient-specific multi-dose vial. Separation from the patient's IV by distance, gravity or positive infusion pressure does not ensure that small amounts of blood are not present in these items.

Dedicate vials of medication to a single patient. Never enter a vial with a syringe or needle that has been used for a patient if the same medication vial might be used for another patient. Medications packaged as single-use must never be used for more than one patient. Never combine leftover contents for later use. Medications packaged as multi-use should be assigned to a single patient whenever possible. Never use bags or bottles of IV solution as a common source of supply for more than one patient.

Peripheral capillary blood monitoring devices packaged for single-patient use should never be used on more than one patient. Restrict use of peripheral capillary blood sampling devices to individual patients. Never reuse lancets. Consider selecting single-use lancets that permanently retract upon puncture. Whenever possible evaluate and select safer devices to prevent sharps injuries.

In surgical and obstetrical settings where the use of exposed sharps cannot be avoided, work-practice controls are an important adjunct for preventing blood exposures, including percutaneous injuries. Operating room controls include:

- Using instruments, rather than fingers, to grasp needles, retract tissue, and load/unload needles and scalpels
- Giving verbal announcements when passing sharps
- Avoiding hand-to-hand passage of sharp instruments by using a basin or neutral zone
- Using alternative cutting methods such as blunt electrocautery and laser devices when appropriate
- Substituting endoscopic surgery for open surgery when possible
- Using round-tipped scalpel blades instead of sharp-tipped blades (CDC, 2004)

The use of blunt suture needles, an engineering control, is also shown to reduce injuries in this setting. These measures help protect both the healthcare provider and the patient from exposure to the other's blood (CDC, 2004).

### **Evaluation/Surveillance of Exposure Incidents**

Employers must identify those at risk for exposure and what devices cause exposure. **All** sharp devices can cause injury and disease transmission if not used and disposed of properly. For example, hollow-bore needles have a higher disease transmission risk, while butterfly-type IV catheters, devices with recoil action, and blood glucose monitoring devices (lancet platforms/pens) have a higher injury rate.

## Areas or Settings Where Exposures Occur

Sharps injuries don't just occur in hospitals and labs—they can occur in other healthcare settings, such as nursing homes, clinics, emergency care services, and private homes. Although it is estimated that more than 350,000 sharps injuries occur each year in the United States, the CDC estimates 50 percent or more of healthcare personnel do not report occupational percutaneous injuries (CDC, 2008b). Six sharps devices are responsible for nearly 80 percent of all injuries. These are:

- Disposable syringes (30%)
- Suture needles (20%)
- Winged steel needles (12%)
- Scalpel blades (8%)
- Intravenous (IV) catheter stylets (5%)
- Phlebotomy needles (3%)

Devices requiring manipulation or disassembly after use (such as needles attached to IV tubing, winged steel needles, and IV catheter stylets) are associated with a higher rate of injury than the hypodermic needle or syringe. Injuries from hollow-bore needles, especially those used for blood collection or IV catheter insertion, are of particular concern. These devices are likely to contain residual blood and are associated with an increased risk for HIV transmission. Overall, hollow-bore needles are responsible for 56 percent of all sharps injuries (CDC, 2008b).

The largest percentage (39%) of sharps injuries occur on inpatient units, particularly medical floors and intensive care units. The operating room is the second most common environment in which sharps injuries occur, accounting for 27 percent of injuries overall. Injuries most often occur:

- After use and before disposal of a sharp device (40%)
- During use of a sharp device on a patient (41%)
- During or after disposal (15%) (CDC, 2008b)

Although nurses sustain the highest number of percutaneous injuries, other patient-care providers, laboratory staff, and support personnel are also at risk. Nurses are the predominant occupational group injured by needles and other sharps, in part because they are the largest segment of the workforce at most hospitals (CDC, 2008b).

## Element IV

### **Selection and use of barriers and/or personal protective equipment (PPE) for preventing patient and healthcare worker contact with potentially infectious material.**

The OSHA regulations require use of PPE in healthcare settings to protect personnel from exposure to bloodborne pathogens and tuberculosis. Under OSHA's General Duty Clause, PPE is also required for any potential infectious disease exposure. Employers must provide their employees with appropriate PPE and ensure its proper disposal. If reusable, it must be properly cleaned or laundered, repaired, and stored after use (CDC, 2004b).

#### **Selecting PPE**

Selection of PPE—particularly the combination of more than one type of protective equipment—is determined by the category of the patient's isolation precautions and the type of anticipated exposure. Touch, splashes or sprays, or large volumes of blood or bodily fluids might penetrate protective clothing. Anticipated exposure will affect whether PPE needs to be fluid resistant, fluid proof, or neither. When selecting protective equipment, consider its durability and appropriateness for the task (CDC, 2004b).

Procedures that generate splashes or sprays of blood, body fluids, secretions, or excretions—such as 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 bodily fluid exposures are likely to occur is mandated by the OSHA Bloodborne Pathogens Standard. Use sterile barriers for invasive procedures and masks for the prevention of droplet contamination.

#### **Types of PPE/Barriers**

**Personal protective equipment (PPE)** is “specialized clothing or equipment worn by an employee for protection against infectious materials.” In addition to the familiar gloves and gowns, PPE includes a variety of barriers and respirators used alone or in combination to protect skin, mucous membranes, and airways from contact with infectious agents. The selection of PPE is based on the nature of the patient interaction and the likely mode of transmission (CDC, 2007).

#### **Gloves**

Gloves protect both patients and healthcare personnel from exposure to infectious material that may be carried on their hands. Gloves used in the healthcare setting are subject to FDA evaluation and clearance. Nonsterile disposable medical gloves made of latex, vinyl, or nitrile should be available for routine patient care. Use gloves when:

- Anticipating direct contact with blood or body fluids, mucous membranes, non-intact skin, and other potentially infectious material
- Engaging in direct contact with patients who are colonized or infected with pathogens transmitted by the contact route, such as VRE or MRSA
- Handling or touching visibly or potentially contaminated patient care equipment and environmental surfaces (CDC, 2007)

In the non-surgical setting, the selection of glove type is based on the task to be performed, anticipated contact with chemicals and chemotherapeutic agents, latex sensitivity, sizing, and facility policies for creating a latex-free environment. For contact with blood and body fluids, a single pair of gloves generally provides adequate barrier protection (CDC, 2007).

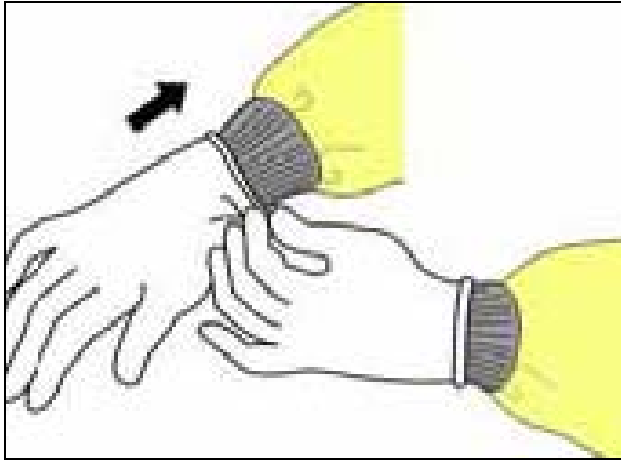
There is considerable variability among gloves. Both the quality of the manufacturing process and type of material influence their effectiveness. While there is little difference in the barrier properties of unused intact gloves, studies have repeatedly shown that vinyl gloves have higher failure rates 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. Heavier, reusable utility gloves should be used for non-patient care activities, such as handling or cleaning contaminated equipment or surfaces (CDC, 2007).

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 directly needed for patient care. It may be necessary to change gloves during the care of a single patient to prevent cross-contamination of body sites. It also may be necessary to change gloves if the patient interaction involves touching portable computer keyboards or other mobile equipment that is transported from room to room (CDC, 2007).

Gloves should be discarded between patients to prevent transmission of infectious material. They should never be washed and reused because microorganisms cannot be removed reliably from glove surfaces and continued glove integrity cannot be ensured. Glove reuse has been associated with transmission of MRSA and gram-negative bacilli (CDC, 2007).

When gloves are worn in combination with other PPE, put them on last. Gloves that fit snugly around the wrist are preferred for use with an isolation gown because they will cover the gown cuff and provide a more reliable continuous barrier for the arms, wrists, and hands (Figure 4). Gloves that are removed properly will prevent hand contamination. Hand hygiene following glove removal further ensures that the hands will not carry potentially infectious material that might have penetrated through unrecognized tears or that could contaminate the hands during glove removal (CDC, 2007).

**Figure 4. Proper procedure for donning gloves**

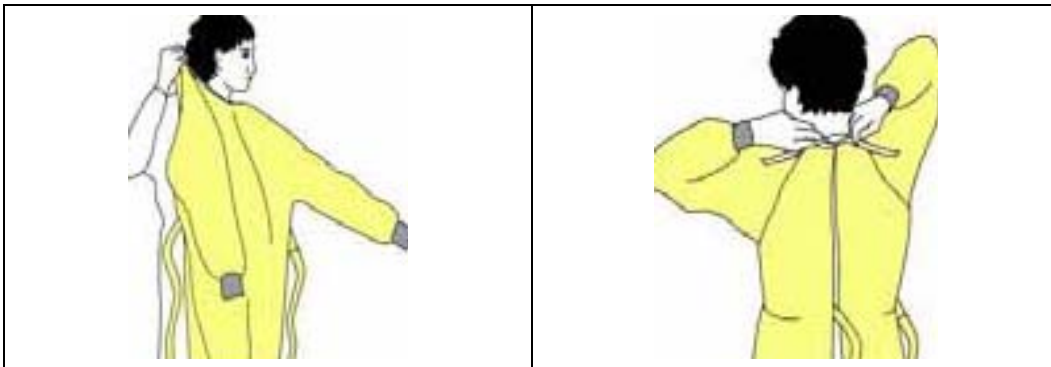


Extend gloves over isolation gown cuffs to provide a more reliable and continuous barrier for the arms, wrists, and hands. Source: CDC.

### Cover Garb

Isolation gowns are intended to protect your arms and exposed body areas and prevent contamination of clothing with blood, body fluids, and other potentially infectious material (Figure 5). The 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 bodily fluid penetration of the barrier. Clinical and laboratory coats or jackets worn over personal clothing for comfort or purposes of identity are not considered PPE (CDC, 2007).

**Figure 5. Donning an isolation gown**



How to don an isolation gown. Source: CDC.

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. Several gown sizes should be available in a healthcare facility to ensure appropriate coverage for staff members.

Isolation gowns should be removed 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. 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 (CDC, 2007).

## Masks

Masks are used for three primary purposes in healthcare settings: (1) to protect you from contact with infectious material from patients, eg, respiratory secretions and sprays of blood or bodily fluids; (2) to protect patients from exposure to infectious agents carried in your mouth or nose when you are engaged in procedures requiring sterile technique, and (3) for coughing patients, to limit potential dissemination of infectious respiratory secretions from the patient to others (CDC, 2007).

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. Masks should not be confused with particulate respirators that are used to prevent inhalation of small particles that may contain infectious agents transmitted via the airborne route (CDC, 2007).

Two mask types are available for use in healthcare settings: surgical masks procedure or isolation masks. No studies have been published that compare mask types to determine whether one mask type provides better protection than another. Since procedure/isolation masks are not regulated by the FDA, there may be more variability in quality and performance than with surgical masks. Masks come in various shapes (molded and non-molded), sizes, filtration efficiency, and method of attachment (ties, elastic, ear loops) (Figure 6). Different types of masks may be needed to meet individual healthcare personnel needs (CDC, 2007).

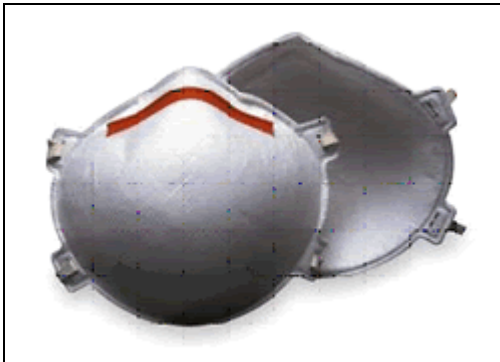
**Figure 6. A surgical mask with ties**



Source: CDC.

There are nine types of disposable particulate respirators (Figure 7), also known as air-purifying respirators because they protect by filtering particles out of the air as you breathe. These respirators protect only against particles—not gases or vapors. Since airborne biological agents such as bacteria or viruses are particles, they can be filtered by particulate respirators. An N-95 respirator (Figure 7) is an example of a particulate respirator; it must be fit-tested as required by OSHA to verify a good seal. Facial hair may interfere with a good seal, requiring use of a positive-pressure respirator which does not require a seal.

**Figure 7. An N-95 respirator**



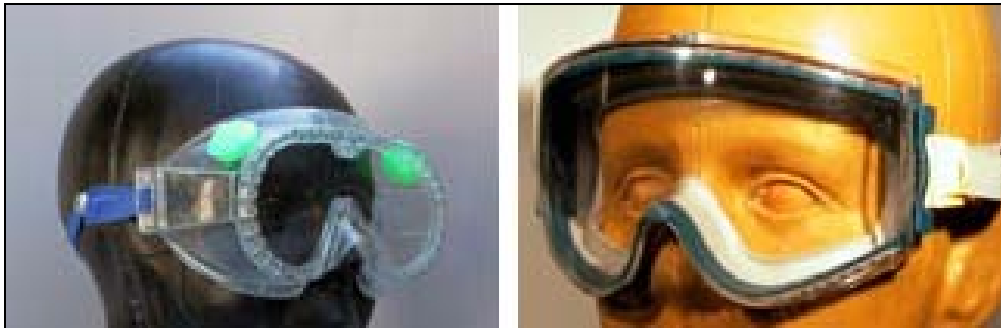
Source: CDC.

### Face Shields and Goggles

The eye protection chosen for specific work situations—for example, 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. Eye protection must be comfortable, allow for sufficient peripheral vision, and be adjustable to ensure a secure fit (CDC, 2007).

Indirectly vented goggles with a manufacturer’s anti-fog coating may provide the most reliable practical eye protection from splashes, sprays, and respiratory droplets from multiple angles. Newer styles of goggles may provide better indirect airflow properties to reduce fogging, as well as better peripheral vision and more size options for fitting goggles to various workers. Many styles of goggles fit adequately over prescription glasses with minimal gaps. While effective as eye protection, goggles do not provide splash or spray protection to other parts of the face (CDC, 2007).

**Figure 8. Safety Goggles**



Goggles for splash or fine dust protection should have indirect venting. Source: CDC.

As compared with goggles, a face shield can provide protection to other facial areas in addition to the eyes. Face shields extending from chin to crown provide better face and eye protection from splashes and sprays; face shields that wrap around the sides may reduce splashes around the edge of the shield. Removal of a face shield, goggles and mask can be performed safely after gloves have been removed and hand hygiene performed. The ties, ear pieces, and/or headband used to secure the equipment to the head are considered “clean” and therefore safe to touch with bare hands. The front of a mask, goggles, or face shield is considered contaminated (CDC, 2007).

## Application of PPE

Personal protective equipment must fit the individual user, and it is up to the employer to ensure that all PPE are available in sizes appropriate for the workforce to be protected. Gloves should fit the user’s hands comfortably—they should not be too loose or too tight. They also should not tear or damage easily. If contamination of the arms can be anticipated, a gown should be selected. Gowns should fully cover the torso, fit comfortably over the body, and have long sleeves that fit snugly at the wrist.

Masks should fit snugly and fully cover the nose and mouth to prevent fluid penetration. For this reason, masks that have a flexible nose piece and can be secured to the head with string ties or elastic are preferable. Goggles provide barrier protection for the eyes and should fit snugly over and around the eyes or personal prescription lenses. Personal prescription lenses do not provide optimal eye protection and should not be used as a substitute for goggles.

Before you use a respirator, your employer is required to have you medically evaluated to determine that it is safe for you to wear a respirator, to fit test you for the appropriate respirator size and type, and to train you on how and when to use a respirator. **You** are responsible for fit checking your respirator before use to make sure it has a proper seal.

In addition to providing employees with appropriate PPE, employers are responsible for its proper disposal. If protective equipment is reusable it must be properly cleaned or laundered, repaired, and stored after use. Many types of PPE, such as latex gloves and disposable gowns are used once and then discarded in an appropriate receptacle. Other types of PPE, such as cloth gowns or reusable heavy duty latex or nitrile gloves, can be cleaned and reused. If goggles or face shields are reusable, they must be placed in a designated receptacle for subsequent reprocessing. If they are not reusable they may be discarded in a waste receptacle.

PPE is a potential source of cross-contamination if not changed between patients. To avoid cross-contamination:

- Don PPE before contact with the patient, generally before entering the room
- Use carefully—don’t spread contamination
- Remove and discard carefully, either at the doorway or immediately outside the patient room
- Remove respirator outside the room
- Immediately perform hand hygiene

The use of personal protective equipment is not a substitute for safe work practices. Avoid contaminating yourself by keeping your hands away from your face and not touching or adjusting PPE. Also, remove your gloves if they become torn and perform hand hygiene before putting on a new pair of gloves. Avoid spreading contamination by limiting surfaces and items touched with contaminated gloves.

## Element V (updated guideline)

**Creation and maintenance of a safe environment for patient care in all healthcare settings through application of infection control principles and practices for cleaning, disinfection, and sterilization.** (updated guideline)

Application of accepted infection control principles helps maintain a safe environment for both patients and healthcare workers. This includes proper use of Standard Precautions and an understanding ability to apply proper techniques for cleaning, disinfection, sterilization, and reprocessing of medical equipment.

### Standard Precautions

The use of **Standard Precautions** is recommended by CDC for the care of all patients, regardless of their diagnosis or presumed infection status. Standard Precautions evolved from the Universal Precautions first recommended in 1987 by CDC as a response to the risk of transmission of HIV to healthcare workers from patients whose infection status was unknown.

Universal Precautions was based on the concept that all blood and body fluids might be contaminated with blood and should be treated as infectious because patients with bloodborne infections can be asymptomatic or unaware of their infectious status. In 1996, having recognized the relevance of Universal Precautions to other aspects of disease transmission, CDC expanded their recommendations and changed the term to Standard Precautions.

Standard Precautions are a standard of care designed to protect healthcare personnel and patients from pathogens that can be spread by blood or any other bodily fluid, excretion, or secretion. Correct use of Standard Precautions protects staff and patients from infection and ensures that the right precautions are used with both known and unknown carriers of diseases, with both blood and body fluids. Standard Precautions apply to contact with:

- Blood
- All bodily fluids, secretions, and excretions (except sweat), regardless of whether they contain blood
- Non-intact 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.

### Sterilization and Disinfection

In the United States, nearly 50 million surgical procedures and even more invasive medical procedures—including more than 5 million gastrointestinal endoscopies—are performed each year. Each procedure involves contact by a medical device or surgical instrument with a patient's sterile tissue or mucous membranes. A major risk of all such procedures is the introduction of pathogens that can lead to infection. Failure to properly disinfect or sterilize equipment carries not only risk associated with breach of host barriers but also risk for person-to-person transmission and transmission of environmental pathogens such as *Pseudomonas aeruginosa* (Rutala et al., 2008).

Because sterilization of all patient-care items is not necessary, healthcare policies must identify—primarily on the basis of the items' intended use—whether cleaning, disinfection, or sterilization is indicated. Multiple studies in many countries have documented lack of compliance with established guidelines for disinfection and sterilization. Failure to comply with scientifically based guidelines has led to numerous outbreaks (Rutala et al., 2008).

**Sterilization** is a process that destroys or eliminates all forms of microbial life and is carried out in healthcare facilities by physical or chemical methods. *Sterile* and *non-sterile* are absolute concepts—black and white with no gray. If a sterile item is touched by anything non-sterile, the formerly sterile item is no longer sterile.

**Disinfection** is a process that eliminates many or all pathogenic microorganisms, except bacterial spores, on inanimate objects. In healthcare settings, objects are usually disinfected using liquid chemicals or wet pasteurization. When selecting a disinfectant, consider its properties (Table 5). There are two levels of disinfection:

- **High-level disinfection**—used to clean patient-care equipment that touches mucous membranes
- **Low-level disinfection**—used to clean the hospital environment or items that touch intact skin

**Cleaning** is the removal of visible soil (organic and inorganic material) from objects and surfaces; normally it 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. **Decontamination** removes pathogenic microorganisms from objects so they are safe to handle, use, or discard (Rutala et al., 2008).

Products for sterilization and disinfection are licensed for the appropriate use by the FDA. Always be sure the product you plan to use is licensed for the intended purpose. And always use the lowest level of product that will do the job, since all disinfectants are toxic by their nature.

**Table 5. Properties of an Ideal Disinfectant**

<b>Characteristics</b>	<b>Properties</b>
Broad spectrum	Wide antimicrobial spectrum.
Action	Fast acting—produces a rapid kill.
Compatibility	Active in the presence of organic matter such as blood, sputum, and feces—compatible with soaps, detergents, and other chemicals encountered in use.
Toxicity	Should be nontoxic and not be harmful to the user or patient.
Corrosiveness	Should not corrode instruments and metallic surfaces or cause deterioration of cloth, rubber, plastics, and other materials.
Residual effect	Should leave an antimicrobial film on treated surfaces.
Ease of use	Easy to use with clear label directions.
Odor	Should have a pleasant odor or no odor to facilitate its routine use.
Cost	Economical—not prohibitively high in cost.
Solubility	Soluble in water.
Stability	Stable in concentrate and use-dilution.
Cleaning properties	Should have good cleaning properties.
Environmentally friendly	Should not damage the environment on disposal.
Source: Rutala, 2008.	

## Key Practices for Infection Control

*[The information in this section is derived from the NYSDOH (2008b).]*

Key practices for infection control and prevention include establishing infection control policies and procedures, proper handling of sharps, medications, and solutions, use of aseptic technique, fulfilling infection prevention training requirements, and correct reprocessing of medical equipment

### Infection Control Policies and Procedures

Healthcare facilities are responsible for establishing and maintaining written infection control policies and procedures and implementing them according to published guidelines. They must ensure that these policies and procedures are reviewed and updated regularly and that staff members are familiar with them.

## Sharps

Healthcare workers must follow proper technique when using and handling needles, cannulae, and syringes. Whenever possible, use sharps with engineered sharps injury protections—for example, non-needle sharp or needle devices with a built-in safety features or mechanisms that effectively reduce the risk of an exposure incident. Do not disable or circumvent the safety feature on devices.

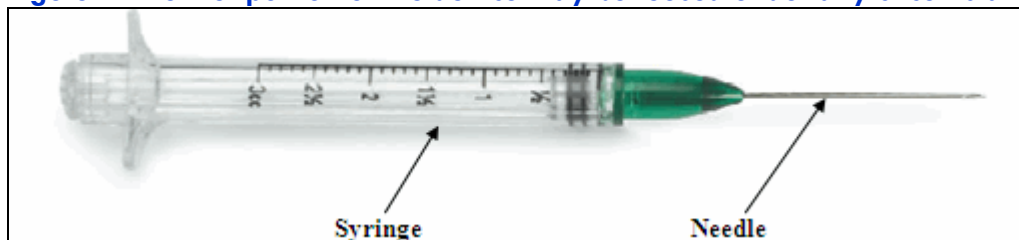
Needles, cannulae and syringes are sterile, single-use items—any use will result in these items being contaminated. They are contaminated once they are used to enter or connect to any component of a patient’s intravenous infusion set. After use, immediately dispose of all needles and syringes into a leak-proof, puncture-resistant, closable container. Develop policies and procedures to prevent sharps injuries among staff and review regularly.

## Medications and Solutions

A pathogen can be indirectly transmitted through contaminated medications and injection equipment. For this reason, medications and solutions must be properly handled whether they are single or multidose. To prevent cross-contamination, preparation and disposing of medications should be handled in areas designated for that purpose.

The reuse of needles or syringes and the misuse of medication vials are serious threats to public health. Healthcare providers should never reuse a needle or syringe, either from one patient to another or to withdraw medicine from a vial. Both needle and syringe must be discarded once they have been used. It is not safe to change the needle and reuse the syringe—reuse of needles or syringes to access medication can result in contamination of the medicine with infectious material that can be spread to others when the medicine is used again (CDC, 2008e).

**Figure 9. Neither portion of the device may be reused under any circumstances.**



Source: CDC.

## Single-Dose Vials

A single-use vial is 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 clean needle and clean syringe. Use single-dose vials for parenteral medications whenever possible. Do not administer medications from single-dose vials or ampules to multiple patients or combine leftover contents for later (CDC, 2008e).

## Multidose Vials

A multidose vial is a small sealed container holding more than one dose of medication, vaccine or fluid. The advantages of multidose vials include being able to adjust dosage of medication easily, less waste of left-over medication, cost savings in packaging, and ease of use. For the medication to remain sterile and safe for use between patients, a new sterile needle and syringe must be used every time the vial is entered.

CDC has investigated many outbreaks associated with syringe reuse and other lapses in recommended infection control practices. For example, in 2008 CDC investigated a Las Vegas endoscopy clinic and identified six cases of HCV infection among patients who had undergone procedures at the clinic in the 35 to 90 days prior to onset of symptoms. On investigation of the clinic, officials observed practices that had the potential to transmit HCV. On the basis of these findings, CDC and the Southern Nevada Health District notified 40,000 patients who had potentially been exposed to HCV and other infectious diseases through that clinic (CDC, 2008f).

A recent review of HBV and HCV outbreak information in 12 outpatient clinics, 16 hemodialysis centers, and 15 long-term care facilities revealed that 448 people became infected with HBV or HCV between 1998 and 2008 as a result of poor infection control practices or failure to use aseptic technique (Thompson et al., 2009).

To prevent these sorts of breaches, **minimize the use of multidose vials whenever possible**. If multidose vials must be used always use aseptic technique. Use a new needle or cannula and a new syringe to access the multidose vial. Do not keep the vials in the immediate patient treatment area. Do not use bags or bottles of IV solution as a common source of medication or fluid for multiple patients. Use infusion sets (ie, intravenous bags, tubing and connectors) for one patient only and dispose appropriately after use.

## Aseptic Technique

Aseptic technique involves the handling, preparation, and storage of medications in a manner that prevents microbial contamination. It also applies to the handling of all supplies used for injections and infusions, including syringes, needles, and IV tubing. To avoid contamination, medications should be drawn in a clean medication preparation area. Any item that may have come in contact with blood or bodily fluids should be kept separate from medications. Incorrect practices that have resulted in transmission of hepatitis C or hepatitis B virus include using:

- The same syringe to administer medication to more than one patient, even if the needle was changed
- The same medication vial for more than one patient, and accessing the vial with a syringe that has already been used to administer medication to a patient
- A common bag of saline or other IV fluid for more than one patient, and accessing the bag with a syringe that has already been used to flush a patient's catheter

In addition to strictly adhering to aseptic technique, ensure that all staff perform proper hand hygiene before and after gloving, between patients, and whenever hands are soiled. Avoid cross contamination with soiled gloves. Provide adequate soap and water, disposable paper towels, and waterless alcohol-based hand rubs throughout all medical facilities.

## Infection Control Training

Healthcare professionals must fulfill all federal and state requirements for infection control training and must complete bloodborne pathogen control training regularly. All licensed healthcare professionals in New York State (physicians, physician assistants, special assistants, registered professional nurses, licensed practical nurses, podiatrists, optometrists, dentists, and dental hygienists) are required to receive training on infection control and barrier precautions every four years through a NYS-approved provider. Documentation of appropriate training must be maintained both by the course provider and course participant (NYSDOH, 2008b).

## Reprocessing Reusable Medical Equipment

The NYSDOH (2008b) requires that healthcare facilities follow manufacturer's recommendations for proper cleaning, disinfection, and sterilization of all reusable equipment. In addition:

- Designate staff responsible for maintaining proper reprocessing procedures.
- Ensure designated staff members are properly trained in reprocessing each piece of equipment.
- Follow FDA guidelines for reprocessing equipment designated for single use.
- Maintain a log of all equipment reprocessing.

Instruments, medical devices, and equipment should be managed and reprocessed according to recommended and appropriate methods regardless of a patient's diagnosis except for cases of suspected prion disease. Special procedures are required for handling brain, spinal, or nerve tissue from patients with known or suspected prion disease (such as Creutzfeldt-Jakob disease). Consultation with infection control experts before performing procedures on such patients is recommended.

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. Potential for contamination is dependent upon:

- Type of device or environmental surface
- Potential for external or internal contamination
- Frequency of hand contact with device or surface
- Potential for contamination with body substances or environmental sources of microorganisms
- Level of contamination

Reprocessing of medical equipment involves several steps: (1) pre-cleaning, (2) cleaning, and (3) disinfection or sterilization. **Pre-cleaning**, which removes soil, debris, and lubricants from internal and external surfaces should be done as soon as possible after use. **Cleaning** can be done either manually (scrubbing with brushes) or mechanically using automated washers.

Equipment used for cleaning must be used appropriately and cleaning solutions must be changed according to the manufacturer's guidelines. Once cleaning is completed, equipment must be disinfected or sterilized depending on the intended use of the item. Disinfection requires sufficient contact time with chemical solution, while sterilization requires sufficient exposure time to heat, chemicals, or gases.

**Critical items**, instruments and medical devices, require sterilization. Critical items are those items that enter sterile spaces—they must be sterile. Critical items confer a high risk for infection if they are contaminated with any microorganism. This category includes surgical instruments, cardiac and urinary catheters, implants, and ultrasound probes used in sterile body cavities (Rutala et al., 2008).

**Semi-critical items** are those items that touch intact mucous membranes—they must receive high-level disinfection, which kills all microbial life except spores. This category includes respiratory therapy and anesthesia equipment, some endoscopes, laryngoscope blades, esophageal manometry probes, cystoscopes, anorectal manometry catheters, and diaphragm fitting rings (Rutala et al., 2008).

**Non-critical items** are those items that touch intact skin but not mucous membranes. Intact skin acts as an effective barrier to most microorganisms; therefore, the sterility of items coming in contact with intact skin is "not critical." Examples of noncritical patient-care items are bedpans, blood pressure cuffs, crutches, and computers. In contrast to critical and some semi-critical items, most non-critical reusable items may be decontaminated where they are used and do not need to be transported to a central processing area (Rutala et al., 2008).

### ***Factors That Contribute to Contamination During Reprocessing***

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, disinfection, or sterilization
- Contamination of disinfectant or rinse solutions
- Improper packaging, storage, and handling
- Inadequate or inaccurate record keeping of reprocessing requirements

Differing levels of disinfection and sterilization methods and agents are based on the area of professional practice, setting, and scope of responsibilities. Professionals who practice in settings where handling, cleaning, and reprocessing is performed elsewhere should understand core infection control concepts and principles. A thorough understanding of Standard Precautions, personal protective equipment, and principles of cleaning, disinfection, and sterilization are essential.

Designation and physical separation of patient care areas from cleaning and reprocessing areas is strongly recommended by NYSDOH. Each medical facility must determine appropriate reprocessing practices and select appropriate methods, taking into consideration:

- Antimicrobial efficacy
- Time constraints and requirements for various methods
- Compatibility of equipment and materials
- Toxicity
- Residual effect (the product's antimicrobial effect when used repeatedly over a number of days)
- Ease of use
- Stability (concentration, potency, efficacy of use, and effect of organic material)
- Odor
- Cost
- Monitoring requirements

### **Single-Use Devices**

A single-use device (SUD) is a device that is intended for one use or on a single patient during a single procedure. An unused SUD is referred to as an **original** device. A **reprocessed** SUD is an original device that has previously been used on a patient and has been subjected to additional processing and manufacturing for the purpose of an additional single use on a patient (FDA, 2006). Approximately 20 to 30 percent of U.S. hospitals report that they reuse at least one type of SUD.

The reprocessing of certain SUDs is permitted in the United States under the Federal Food, Drug, and Cosmetic Act. In 2002 the Medical Device User Fee and Modernization Act established regulations requiring that all reprocessed SUDs be clearly labelled as "reprocessed" and contain the name of the reprocessor. The act also directed the FDA to increase its oversight of these devices by identifying reprocessed SUDs that should not be marketed unless the reprocessing company first provided data demonstrating effective cleaning, sterilization, and functional performance (GAO, 2008).

Concerns have repeatedly been raised about the potential risks of infection from reprocessed SUDs or their failure to function properly, and their use has been controversial for more than two decades. The American public has expressed increasing concern regarding the risk of infection and injury when reusing medical devices intended and labeled for single use (Rutala et al., 2008). Reprocessing of SUDs is banned in France and strongly discouraged in Great Britain and other countries in Europe. The Department of Veterans Affairs, which operates one of the largest healthcare systems in the United States, prohibits their use entirely (GAO, 2008).

## Element VI

### Prevention and management of infectious or communicable diseases in healthcare workers.

Healthcare personnel are all paid and unpaid persons working in healthcare settings who have the potential for exposure to infectious materials, including body substances, contaminated medical supplies and equipment, contaminated environmental surfaces, or contaminated air. These personnel include those involved in direct patient care, students and trainees, contractual staff, and personnel not directly involved in patient care but potentially exposed to infectious agents (CDC, 1998).

#### Strategies to Protect Healthcare Workers

Protecting healthcare workers should be an integral part of a healthcare organization's general program for infection control and prevention. The objectives usually include:

- Educating personnel about the principles of IC and stressing individual responsibility for IC.
- Collaborating with the IC department in monitoring and investigating potentially harmful infectious exposures and outbreaks among personnel.
- Providing care to personnel for work-related illnesses or exposures.
- Identifying work-related infection risks and instituting appropriate preventive measures.
- Containing costs by preventing infectious diseases that result in absenteeism and disability (CDC, 1998)

#### Pre-Employment and Periodic Health Assessments

The NYSDOH requires that all healthcare workers in New York be medically evaluated prior to employment in hospitals and diagnostic and treatment centers. The evaluation must include screening for tuberculosis and other common communicable diseases. The medical evaluation should determine immunization status and include a history of any conditions that might predispose personnel to acquiring or transmitting communicable diseases. This information will assist in decisions about immunizations or post-exposure management.

#### Tuberculosis Screening

Tuberculosis (TB) screening may be done with any approved test to detect *M. tuberculosis* infection, such as the tuberculin skin test (TST) or one of the whole blood interferon-gamma release assays (IGRAs) approved by the FDA. Workers in hospitals and diagnostic and treatment centers must also be screened annually for TB using a tuberculin skin test (PPD). Employees found to have active TB may not return to work until clinically determined to be non-infectious (NYSDOH, 2009b).

For employees who work in non-clinical, off-site locations, annual TB screening is not required. However, in all cases in which staff is exempted from the requirement of an annual PPD, the provider must document the specific settings and work titles that have been exempted in written occupational health protocols that must be maintained on file at the facility (NYSDOH, 2009b).

## Mumps, Measles, and Rubella

[The information in the following sections is derived from the NYSDOH (2007).]

All those who work in healthcare facilities are required to be immune to measles and rubella, according to NYS regulations, which also “recommend” that healthcare personnel be immune to mumps. Those born in 1957 or later can be considered immune to measles, mumps, or rubella only if they have documentation of either:

- Laboratory evidence of measles, mumps, or rubella immunity (those who have an "indeterminate" or "equivocal" level of immunity upon testing should be considered susceptible); or
- Two doses of live measles and mumps vaccines administered on or after the first birthday and separated by at least 28 days, and at least one dose of live rubella vaccine administered on or after the first birthday.

Birth before 1957 is not considered evidence of immunity against rubella according to NYS regulations. Those born before 1957 must have either laboratory evidence of rubella immunity or one dose of live rubella vaccine administered on or after the first birthday. In addition, it is recommended that a dose of measles, mumps, and rubella (MMR) vaccine be given to unvaccinated healthcare personnel born before 1957 who do not have a history of measles and mumps diagnosed by a physician, nurse practitioner, or a physician's assistant, or laboratory evidence of measles and mumps immunity.

For unvaccinated healthcare workers born before 1957 who do not have other evidence of mumps immunity (eg, mumps diagnosed by a physician, nurse practitioner, or a physician's assistant, or laboratory evidence of mumps), consider giving 1 dose on a routine basis and strongly consider giving a second dose during a mumps outbreak.

## Hepatitis B

In accordance with the OSHA regulation CPL 2-2.69, healthcare personnel who perform tasks that may involve exposure to blood or bodily fluids should receive a three-dose series of hepatitis B vaccine at 0, 1, and 6-month intervals. They should be tested for hepatitis B surface antibody (anti-HBs) to document immunity 1 to 2 months after receiving the third dose.

If the level of anti-HBs is at least 10 mIU/mL (positive) after three immunizations, the patient is immune. No further serologic testing or vaccination is recommended. If the level of anti-HBs is negative after three immunizations, the patient is considered **unprotected** against hepatitis B virus infection. The recommendation is to revaccinate with a three-dose series. Retest anti-HBs levels 1 to 2 months after the third dose. If anti-HBs is positive, the patient is immune—no further testing or vaccination is recommended. If anti-HBs is negative following 6 doses of vaccine, the patient is a non-responder.

**Non-responders** should be considered susceptible to HBV and counseled regarding precautions to prevent HBV infection and the need to obtain hepatitis B immune globulin (HBIG) prophylaxis for any known or probable parenteral exposure to hepatitis B surface antigen (HBsAg)-positive blood. It is also possible that non-responders are persons who are HBsAg positive, and testing should be considered. Those found to be HBsAg positive should be counseled and receive a medical evaluation.

**Note:** Anti-HBs testing is not recommended routinely for previously vaccinated healthcare personnel who were not tested 1 to 2 months after their original vaccine series. These individuals should be tested for anti-HBs when they have an exposure to blood or body fluids. If found to be anti-HBs negative, individuals should be treated as if susceptible.

Studies indicate that immunologic memory remains intact for at least twenty years among healthy vaccinated individuals who initiated hepatitis B vaccination after 6 months of age. The vaccine confers long-term protection against clinical illness and chronic hepatitis B virus infection. Cellular immunity appears to persist even though antibody levels might become low or decline below detectable levels.

## Influenza A

The standard of care in New York State is that all healthcare personnel should receive an annual influenza vaccination. In addition, Public Health Law Article 21A, the Long-term Care Resident and Employee Immunization Act, requires that all long-term care facilities, adult homes, adult daycare facilities, and enriched housing programs offer influenza vaccine to all employees and residents. There are two types of influenza vaccine available:

- Trivalent inactivated vaccine (TIV): May be given by injection to any healthcare personnel.
- Live attenuated influenza vaccine (LAIV, or FluMist): May be given by nasal spray to all non-pregnant healthy healthcare personnel age 49 years and younger.

Groups that should be targeted for influenza vaccine include all personnel (including volunteers) in hospitals, outpatient, long-term care facilities, and home-health settings who have any patient contact. Trivalent inactivated vaccine should be used rather than LAIV for healthcare personnel who are in close contact with severely immunosuppressed persons (eg, stem cell transplant patients) when those patients require a protective environment.

## Other Recommended or Mandated Requirements

The NYSDOH recommended that all healthcare personnel be vaccinated with one dose of Tdap (tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis) to protect themselves, their patients, other healthcare workers, and the community against tetanus, diphtheria, and pertussis. Priority should be given to vaccination of healthcare personnel who have direct contact with infants less than 12 months of age.

NYSDOH also recommended that all healthcare personnel be immune to varicella. Evidence of immunity includes documentation of two doses of varicella vaccine given at least 28 days apart, history of varicella disease (chickenpox) or herpes zoster based on physician diagnosis, laboratory evidence of immunity, or laboratory confirmation of disease.

Symptoms such as fever, cough, rash, lesions, draining wounds, vomiting, and diarrhea require immediate evaluation, with treatment as needed. Healthcare personnel should have limited contact with patients and other susceptible individuals and should not return to work until they are non-infectious (NYSDOH, 2007).

## Occupational Health Prevention and Control Strategies

Healthcare workers must be informed of the possible health effects of exposure to infectious agents such as hepatitis B and C, HIV, and chemicals such as ethylene oxide (EtO) and formaldehyde. The information should be consistent with OSHA requirements and identify the areas and tasks in which potential exists for exposure (Rutala et al., 2008).

Healthcare workers must receive training in the selection and proper use of PPE, and employers must ensure that workers wear appropriate PPE to prevent exposure to infectious agents or chemicals. The employer is responsible for making such equipment and training available to their employees. Healthcare facilities must establish a program for monitoring occupational exposure to regulated chemicals that adheres to state and federal regulations. Healthcare workers with weeping dermatitis of hands must be excluded from direct contact with patient-care equipment (Rutala et al., 2008).

## Bloodborne Pathogen Transmission to Healthcare Workers

As noted earlier, it was the need to protect healthcare workers from bloodborne exposures that resulted in OSHA's publication in 1991 of the Bloodborne Pathogens Standard. The Standard requires employers whose employees have exposure to blood to provide safe work practices, education, and barriers to exposure. The Standard was later amended to add requirements for the safe use of sharps devices.

Part of the OSHA Bloodborne Pathogens Standard is the requirement that every healthcare worker who may have contact with body fluids on the job must receive specific annual education. This education includes:

- Instruction in the basics of infection control and prevention
- Bloodborne pathogens training
- Instruction in modes of transmission, needlestick precautions, and contact precautions

Important factors that influence the overall risk for occupational exposures to bloodborne pathogens include the number of infected individuals in the patient population and the type and number of blood contacts. Most exposures do not result in infection. Following a specific exposure, the risk of infection may vary, depending upon the:

- Pathogen involved
- Type of exposure
- Amount of blood involved in the exposure
- Amount of virus in the patient's blood at the time of exposure (CDC, 2003b)

## Hepatitis B Virus (HBV)

For a susceptible person, the risk from a single needlestick or cut exposure to HBV-infected blood ranges from 6 to 30 percent and depends on the hepatitis Be antigen (HBeAg) status of the source individual. Hepatitis B surface antigen (HBsAg)-positive individuals who are also HBeAg-positive have more virus in their blood and are more likely to transmit HBV than those who are HBeAg-negative. While there is a risk for HBV infection from exposures of mucous membranes or non-intact skin, there is no known risk for HBV infection from exposure to intact skin (CDC, 2003b).

Testing for HBsAg is now recommended for:

- Persons born in geographic regions with HBsAg prevalence of  $\geq 2$  percent
- U.S. born persons not vaccinated as infants whose parents were born in geographic regions with HBsAg prevalence of  $\geq 8$  percent
- Injection-drug users
- Men who have sex with men
- Persons with elevated ALT/AST (liver enzymes) of unknown etiology
- Persons with selected medical conditions who require immunosuppressive therapy (CDC, 2008c)

Testing continues to be recommended for:

- Pregnant women
- Infants born to HBsAg-positive mothers
- Household contacts and sex partners of HBV-infected persons
- Persons who are the source of blood or bodily fluid exposures that might warrant postexposure prophylaxis (eg, needlestick injury to a healthcare worker)
- Persons infected with HIV (CDC, 2008c)

## Hepatitis C Virus (HCV)

Hepatitis C is transmitted primarily through percutaneous exposure to infected blood. The average risk for infection after a needlestick or cut exposure to HCV-infected blood is approximately 1.8 percent. The risk following a blood exposure to the eye, nose, or mouth is unknown, but is believed to be very small; however, HCV infection from blood splash to the eye has been reported. There also has been a report of HCV transmission that may have resulted from exposure to non-intact skin, but no known risk from exposure to intact skin (CDC, 2003b).

All patients suspected of having HCV infection should be tested for antibody to HCV using an enzyme immunoassay test (EIA). The NYSDOH does not have specific guidelines for the management of occupational exposures to HCV but recommends that healthcare workers follow the guidelines published for hepatitis B and HIV. These include IC training, strict enforcement of IC standards, and protecting workers from infection through the use of engineering and work practice controls.

## HIV

The average risk of HIV infection after a needlestick or cut exposure to HIV-infected blood is 0.3 percent. Stated another way, 99.7 percent of needlestick or cut exposures do not lead to infection. The risk after exposure of the eye, nose, or mouth to HIV-infected blood is estimated to be, on average, 0.1 percent. The risk after exposure of non-intact skin to HIV-infected blood is estimated to be less than 0.1 percent. A small amount of blood on intact skin probably poses no risk at all. There have been no documented cases of HIV transmission due to an exposure involving a small amount of blood on intact skin (a few drops of blood on skin for a short period of time) (CDC, 2003b).

## Tuberculosis

Every year, more than 9 million people develop TB and nearly 2 million people die from the disease. Tuberculosis is a bacterial infection caused by *Mycobacterium tuberculosis* and is spread in airborne droplets when people with the disease cough or sneeze. Most people with healthy immune systems infected with *M. tuberculosis* never become ill. However, the bacteria remain dormant within the body and can cause tuberculosis years later if host immunity declines.

The **symptoms of tuberculosis** include a persistent cough, weight loss, and night sweats. Diagnostic tests for the disease include chest x-rays, the tuberculin skin test, and sputum cultures. Tuberculosis can usually be cured by taking several powerful antibiotics daily for several months (Escombe et al., 2008).

The person who is most likely to transmit tuberculosis is the person who has not been diagnosed—the unknown carrier. Active TB does have symptoms, which depend on where in the body the TB bacteria are growing. Tubercular disease in the lungs may cause symptoms such as a bad cough that lasts three weeks or longer, pain in the chest, or coughing up blood or sputum (phlegm from deep inside the lungs). Other symptoms of active TB disease are weakness or fatigue, weight loss, no appetite, chills, fever, or sweating at night (CDC, 2008a).

Because tuberculosis is the primary disease transmitted by a true airborne route, and because it is the undiagnosed person who is most likely to transmit disease, the CDC recommends a three-level hierarchy of controls: administrative, environmental, and respiratory protection controls.

**Administrative controls** specify who is in charge of the facility's TB control program, including critical infrastructure such as laboratories as well as other services needed to maintain an effective program. A key component is having a plan to ensure prompt detection, airborne precautions, and treatment of persons who have suspected or confirmed TB disease. Diagnose, isolate, and treat to prevent exposing others. **Environmental controls** are responsible for containing the source of exposure, primarily by the use of Airborne Infection Isolation (AII) rooms that provide negative-pressure ventilation.

**Respiratory controls** address the protection of people who must be protected from contaminated air when they enter the All room. Most facilities provide N-95 respirators, which must be fit-tested. Some facilities exclusively use powered air-purifying respirators (PAPRs, see Figure 9) for all staff, which do not require fit testing. Check your facility’s policies for what respiratory protection is made available for visitors.

**Figure 10. Powered air-purifying respirator hood.**



Source: OSHA.

Tuberculosis infectiousness usually declines within weeks of beginning treatment. The patient must show clear clinical improvement before isolation is discontinued because the patient with resistant organisms remains infectious if initial treatment is not effective. Airborne Precautions for tuberculosis may be discontinued when both of the following criteria have been met: (1) clinical improvement, and (2) three consecutive sputum smears negative for acid-fast bacilli (TB germs) collected on separate days. For current guidelines, consult *CDC Guidelines for Preventing the Transmission of Mycobacterium tuberculosis in Health-Care Settings*.

Multidrug-resistant TB (MDR-TB) and extensively drug-resistant tuberculosis (XDR-TB) have become widespread and are highly infectious. Treatment of drug-resistant TB is much more difficult than normal tuberculosis, requiring even more antibiotics, and for long periods, up to two years and beyond. In addition, because HIV weakens the immune system, HIV-positive people are much more likely to develop active tuberculosis (and to die from the disease, which speeds the development of AIDS) than people with a healthy immune system (Escombe et al., 2008).

## NYS Guidelines for Post-Exposure Prophylaxis

Organizations in New York State that employ health professionals or other persons who are at risk for occupational exposure to blood, body fluids, or OPIM are generally required to establish policies and procedures that guide the management of such exposures. Private employers subject to OSHA must conform to the OSHA Bloodborne Pathogen Standard, and public employers are subject to Public Employee Safety and Health Bureau (PESH) regulations. OSHA and PESH standards are identical regarding occupational exposure to bloodborne pathogens (HIVGuidelines.org, 2008).

These regulations require that a management plan be in place. The employer should ensure that any employee who sustains an occupational exposure has access to post-exposure services within 1 to 2 hours of a reported event. Services must be available 24 hours a day, every day. Organizations that do not have on-site occupational health services are encouraged to form agreements or contracts with another facility, emergency department, or private practitioner for such services (HIVGuidelines.org, 2008).

Post-exposure services for exposures to all bloodborne pathogens include but are not limited to:

- Post-exposure evaluation and follow-up post-exposure vaccinations
- A full course of post-exposure prophylaxis medications, at no cost to the employee
- Care provided under the supervision of a licensed physician or other licensed healthcare professional
- The performance of laboratory tests by an accredited laboratory
- Supportive counseling (HIVGuidelines.org, 2008)

Federal law requires covered employers to ensure that all medical evaluations and procedures, vaccines, and post-exposure prophylaxis are made available to the employee within a reasonable time and place and are made available at no cost to the employee.

Both New York State's PESH regulations and OSHA's Bloodborne Pathogen Standard make the covered employer responsible for all costs associated with an exposure incident. **An employer may not require the employee to pay any out-of-pocket expenses**, such as requiring the employee to use workers' compensation if prepayment is required, or compelling an employee to use health insurance (unless the employer pays all premiums and deductible costs associated with their employee's health insurance). In addition to the services listed above, NYS Guidelines, "HIV Prophylaxis Following Occupational Exposure," state that, when establishing plans for providing PEP for exposures to HIV, the employer must ensure that:

- PEP will be made available within 1 to 2 hours of exposure, ideally within 1 hour.
- A "starter kit" or three-day supply of the PEP will be made available to the employee.
- A mechanism is in place to provide the balance of the PEP medications needed to complete the four-week regimen to the employee at no cost. (HIVGuidelines.org, 2008)

The post-exposure management of other common diseases is shown in Table 6.

**Table 6. Postexposure Management of Common Diseases**

Disease	Postexposure prophylaxis
Varicella	Varicella vaccine is recommended for use in person without evidence of varicella immunity after exposure to varicella. The vaccine is 70–100% effective if given within 72 hours of exposure. It is not effective if given more than 5 days after exposure but will produce immunity if the exposure did not cause infection.
Rubella	Neither rubella vaccine nor immune globulin is effective for postexposure prophylaxis of rubella. Vaccination after exposure is not harmful and may possibly avert later disease.
Measles	Live measles vaccine provides permanent protection and may prevent disease if given within 72 hours of exposure. Immune globulin (IG) may prevent or modify disease and provide temporary protection if given within 6 days of exposure.
Pertussis	Erythromycin, a macrolide antibiotic, has been the antimicrobial of choice for treatment or postexposure prophylaxis of pertussis. It is usually administered in 4 divided daily doses for 14 days. A course of appropriate antibiotics can be administered to close contacts within 3 weeks of exposure, especially in high-risk settings.
Mumps	Neither mumps immune globulin nor immune globulin (IG) is effective postexposure prophylaxis. Vaccination after exposure is not harmful and may possibly avert later disease.
Source: CDC, 2008d.	

### Workers Infected with HIV or Other Bloodborne Pathogens

New York State Department of Health policy on HIV testing of healthcare workers ensures that public protection is a primary consideration and that healthcare personnel are afforded appropriate and equitable treatment. The DOH has established a uniform process and criteria for evaluating HIV/HBV-infected healthcare workers to determine if practice limitations are warranted (NYSDOH, 2005).

The evaluation of a healthcare worker should be based on the premise that HIV or HBV infection alone is not sufficient justification to limit a healthcare worker’s professional duties. The determination of whether an individual poses a significant risk to patients—which warrants job modification, limitation, or restriction—requires a case-by-case evaluation that considers the multiple factors that can influence risk. Periodic re-evaluation of an HIV-infected healthcare worker may be appropriate if physical or mental functioning changes due to disease progression (NYSDOH, 2005).

Factors that may have a bearing on the ability of healthcare workers, including those with bloodborne infections, to provide quality health care include:

- Physical or mental conditions that may interfere with the worker's ability to perform assigned tasks or regular duties
- Lack of compliance with established guidelines to prevent transmission of disease
- Documentation or evidence of previous transmission of bloodborne pathogens
- The appropriateness of techniques as related to performance of procedures
- Any health condition that would pose a significant risk to others (NYSDOH, 2005)

### **Expert Bloodborne Pathogen Workforce Review Panels**

In 1992 the NYSDOH established a voluntary evaluation process to provide guidance to HIV/HBV-infected healthcare workers who seek consultation. Access to state-appointed panel review is available to infected healthcare workers who perform procedures that might increase the risk of worker-to-patient blood exposure. State panels function as a primary evaluation resource for practitioners who are not affiliated with institutions, or as a second opinion for workers affiliated with health facilities who have been evaluated by their institutions (NYSDOH, 2005).

Each panel includes a public health official, an infectious disease expert, and an expert in IC or epidemiology. In addition, an individual from the infected practitioner's area of practice and the individual's private physician may be asked to serve as members of the panel. The purpose of such panels is to provide timely advice and consultation on an individual's risk of bloodborne disease transmission through his or her professional practice, and to recommend practice limitations, modifications, or restrictions where the evidence suggests there is a significant risk to patients (NYSDOH, 2005).

All citizens, including HIV-infected healthcare workers, are entitled to protections under the New York State HIV Confidentiality Law. Such workers are not required to disclose their HIV status to patients or employers. Healthcare facilities are under no obligation under New York law to disclose to patients the status of an infected healthcare worker in their employ. Disclosure—without the consent of the worker—would likely violate New York's HIV Confidentiality Law (NYSDOH, 2005).

Notification of patients that they were exposed to the blood of a healthcare worker should be based on documentation of an injury to a worker that could have resulted in the worker's blood coming into direct contact with a patient's bloodstream or mucous membranes. In such circumstances, the patient should be advised to receive testing for potential HIV or HBV exposure. The DOH will be available to assist hospitals in determining if a significant risk of exposure to bloodborne pathogens warrants notification to patients (NYSDOH, 2005).

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## Resources

New York State Department of Health  
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518 473 4439

## Glossary

**Barrier:** A material object that separates a person from a hazard.

**Contamination:** The presence of microorganisms on inanimate objects (clothing, surgical instruments) or in substances (water, food, milk).

**Cleaning:** The removal of all foreign material (soil, organic debris) from objects.

**Common vehicle:** Contaminated material, product, or substance that serves as an intermediate means by which an infectious agent is transported to two or more susceptible hosts.

**Communicable disease:** An illness due to a specific infectious agent which arises through transmission of that agent from an infected person, animal, or inanimate reservoir to a susceptible host.

**Engineering controls:** Equipment, devices, or instruments that remove or isolate a hazard.

**Decontamination:** The process of removing disease-producing microorganisms and rendering the object safe for handling.

**Disinfection:** A process that results in the elimination of many or all pathogenic microorganisms on inanimate objects with the exception of bacterial endospores.

**High-level disinfection:** Kills bacteria, mycobacteria (TB), fungi, viruses, and some bacterial spores.

**Infectious disease:** A clinically manifest disease of man or animal resulting from an infection.

**Intermediate-level disinfection:** Kills bacteria, mycobacteria (TB), most fungi, and most viruses—does not kill resistant bacterial spores.

**Low-level disinfection:** Kills most bacteria, some fungi and some viruses. Will not kill bacterial spores and is less active against some gram-negative rods (pseudomonas) and mycobacteria.

**Pathogens or infectious agent:** A biological agent capable of causing disease.

**Occupational health strategies:** As applied to infection control, a set of activities intended to assess, prevent, and control infections and communicable diseases in healthcare workers.

**Personal protective equipment (PPE):** Specialized clothing or equipment worn by a healthcare worker (HCW) for protection against a hazard.

**Reservoir:** Any person, animal, arthropod, plant, soil or substance (or combination of these) in which an infectious agent normally lives and multiplies, on which it depends primarily for survival, and where it reproduces itself in such manner that it can be transmitted to a susceptible host.

**Sterilization:** A process that completely eliminates or destroys all forms of microbial life.

**Susceptible Host:** A person or animal lacking effective resistance to a particular infectious agent.

**Transmission:** Any mechanism by which a pathogen is spread by a source or reservoir to a person.

**Work practice controls:** Controls that reduce or eliminate the likelihood of exposure by altering the manner in which a task is performed.

## Post Test

Use the Answer Sheet following the test to record your answers.

1. The number of U.S. deaths caused by healthcare-associated infections (HAIs):
  - a. Is about the same as those caused by AIDS.
  - b. Is very small due to antibiotic therapy and strict infection control practices.
  - c. Exceeds the number of deaths from breast cancer, AIDS, and auto accidents combined.
  - d. Is equal to the number of deaths caused by breast cancer.
2. A guiding concept that has emerged in the management of HAIs is:
  - a. Comparison of a hospital's infection rates to national averages called benchmarks
  - b. That HAIs are an expected consequence of hospitalization and should be treated aggressively when they occur
  - c. Zero tolerance, which has the goal of reducing the number of HAIs to zero
  - d. Reduction of HAI levels below national averages for hospitals of similar sizes and populations
3. The need to control outbreaks of *C. difficile* has focused new attention on:
  - a. Fit testing of masks for all hospital employees who have patient contact.
  - b. Development of new drugs to treat antibiotic-resistant bacteria.
  - c. Isolation of patients with cough and fever.
  - d. Environmental cleaning.
4. Conditions of Participation:
  - a. Are part of the OSHA Bloodborne Pathogens Standard.
  - b. Is a voluntary program to assist hospitals with infection control measures.
  - c. Must be met for a hospital to receive Medicare funding.
  - d. Spell out infection prevention techniques appropriate to each profession.
5. Failure by specified healthcare professionals to monitor infection control techniques of all personnel, licensed or unlicensed, for whom they are responsible is considered to be:
  - a. Unprofessional conduct.
  - b. Inappropriate conduct.
  - c. A medical error.
  - d. Medical malpractice.
6. An HAI is defined as a localized or systemic condition that:
  - a. Requires admission to a hospital.
  - b. Shows no evidence of being present, or incubating, prior to hospital admission.
  - c. Occurs following discharge from a hospital.
  - d. Is acquired while in a hospital and results in the death of a patient.
7. All links of the chain of infection must be broken in order to prevent the spread of infection.
  - a. True
  - b. False
8. Bacteria that protect us from infection by providing competition to harmful bacteria are called:
  - a. Pathogens.
  - b. Fomites.
  - c. Vectors.
  - d. Normal flora.

9. Viruses:
- Are not true parasites and are able to reproduce outside the host cell indefinitely.
  - Are about the same size as bacteria.
  - Can be treated with antibiotics.
  - Have been successfully eliminated or controlled with vaccines in some cases.
10. Normal flora in one part of the human body can never pose a danger of infection in another part of the same body.
- True
  - False
11. The portal of exit:
- Is the link in the chain of infection over which we have the most control.
  - Usually is different from the site where the pathogen is located.
  - Can never be from dry skin contact because infectious agents need a moist environment in which to live.
  - Usually corresponds to the site where the pathogen is located.
12. The means of transmission in the chain of infection is:
- The only link that we cannot completely eliminate.
  - The link targeted by both Standard and Universal Precautions.
  - Through vectors such as mosquitos in tuberculosis and SARS.
  - Is often through contaminated IV fluid in hospitals.
13. When a pathogen is transmitted to a susceptible host from a contaminated object it is called:
- Animate transmission.
  - A portal of entry.
  - Inanimate transmission.
  - The chain of infection.
14. The Bloodborne Pathogens Standard:
- Was formulated by OSHA to protect healthcare personnel from blood exposure.
  - Requires the isolation of all immunocompromised patients.
  - Requires testing of any patient suspected of having a bloodborne disease upon admission to the hospital.
  - Encourages the earliest possible removal of catheters or other invasive medical equipment.
15. The Federal Needlestick Safety and Prevention Act:
- Addresses the prevention of sharps injuries and other blood exposures during surgical and other invasive procedures.
  - Requires the use of safety-engineered sharp devices and measures to handle the devices to prevent injuries before and after their use.
  - Provides free sterile syringes to IV drug users to prevent the spread of bloodborne diseases in the community.
  - Requires all healthcare personnel to receive the hepatitis vaccine.

16. Standard Precautions:
  - a. Has been replaced by the broader Universal Precautions.
  - b. Applies to all blood, bodily fluids, secretions, and excretions, including sweat.
  - c. Does not apply to saliva.
  - d. Are recommended by CDC for care of all patients, regardless of their diagnosis or presumed infection status.
17. Handwashing:
  - a. With antimicrobial soap and water is best for routine hand hygiene.
  - b. Should be followed by an alcohol-based rub with hands still wet to kill any remaining bacteria.
  - c. Should be done with soap and water when dealing with diarrhea that may be infectious.
  - d. Is not necessary after removing gloves.
18. Laundry that is soiled with blood or other potentially infectious material:
  - a. Should be rinsed in the patient-care area and then placed and transported in bags that are labeled or color-coded.
  - b. May be placed in regular laundry bags because all laundry is treated with Standard Precautions.
  - c. Must be bagged at the location where it was used, then placed and transported in bags that are labeled or color-coded.
  - d. Should be discarded.
19. OSHA has dictated initial measures for discarding regulated medical waste. These measures include:
  - a. Double- bagging all regulated medical waste in leak-resistant biohazard bags.
  - b. Puncture-resistant containers at the point of use for discarded slides or tubes with small amounts of blood, scalpel blades, needles, and syringes.
  - c. Treatment of all items that have had contact with blood, exudates, or secretions as regulated medical waste.
  - d. Recapping of all needles to prevent accidental needle sticks to those who must dispose of contaminated sharps.
20. Following an occupational exposure blood or OPIM:
  - a. Antiseptics can be applied to a puncture site instead of washing the area.
  - b. The wound should be “milked” or squeezed to make it bleed and remove any virus that may be under the skin.
  - c. Post-exposure prophylaxis (PEP) must be started within 7 days.
  - d. The exposed area in a sharps injury should be washed with soap and water.
21. Work practice controls:
  - a. Reduce likelihood of exposure by altering the way in which a task is performed.
  - b. Mandate recordkeeping of all practices and procedures as they are performed.
  - c. Are sometimes known as engineering controls.
  - d. Generally recommend two-handed recapping of needles.

22. To ensure safe injection practices:
  - a. Use aseptic technique wherever possible.
  - b. Draw medications only in areas restricted to visitors.
  - c. To ensure long life of medication vials, always disinfect the rubber septum.
  - d. Practice proper hand hygiene before handling medications.
23. Evaluation and surveillance of exposure incidents:
  - a. Is monitored by the local department of health on a monthly basis.
  - b. Is the responsibility of the employer.
  - c. Excludes sharps because their safe use is the responsibility of the employee.
  - d. Is monitored by the Joint Commission both locally and nationally.
24. The largest percentage of sharps injuries occur:
  - a. In the operating room.
  - b. In the emergency room.
  - c. In ICU and on medical floors.
  - d. En route from patient to patient.
25. Selection of personal protective equipment is determined by:
  - a. Personal comfort and fit.
  - b. Anticipated exposure.
  - c. Size available.
  - d. Ability to work without impediment.
26. Selection of gloves in a non-surgical setting is based on:
  - a. Adequate barrier protection.
  - b. Condition of the healthcare worker's hands.
  - c. Availability.
  - d. Ease of donning and removing.
27. Isolation gowns should be removed:
  - a. At bedside when examination or procedure is completed.
  - b. And disposed of in the nearest trash container.
  - c. Before leaving the patient care area to prevent contamination outside the room.
  - d. And carefully folded with the exterior exposed for easy identification.
28. Surgical masks differ from others in that:
  - a. They are more expensive and more durable.
  - b. They are color-coded and come in a variety of patterns.
  - c. They are required to have fluid-resistant properties.
  - d. They must cover the hair as well as the face.
29. Face shields differ from goggles in that:
  - a. They decrease peripheral vision.
  - b. They give superior protection to the eyes.
  - c. They tend to fog up.
  - d. They give better protection from splashes and sprays.

30. Your employer is responsible for providing PPE that fits properly, but you are responsible for:
- Ensuring that there is an adequate supply for your own needs.
  - Fit checking your respirator to make sure it has a proper seal.
  - Declining the employer-supplied goggles if you wear personal prescription lenses.
  - Tying your face mask so that it can be removed quickly with one hand.
31. Standard Precautions:
- Spell out the procedures for initial patient workups.
  - Were replaced by Universal Precautions in 1987 when healthcare workers were threatened by HIV-infection.
  - Were initiated by CDC to manage hospital compliance for accreditation purposes.
  - Replaced Universal Precautions in 1996 because they cover all aspects of disease transmission.
32. Sterilization destroys all form of microbial life, while disinfection:
- Requires extended periods of time to clean inanimate objects.
  - Is used on inanimate objects to eliminate most microbes excepting bacterial spores.
  - Can be used to clean the hospital environment but not patient-care equipment.
  - Can be accomplished safely only if wearing PPE.
33. Healthcare workers are responsible for making themselves familiar with updates to infection control policies on a regular basis.
- True
  - False
34. Items that must be sterile and single-use include:
- Masks and goggles.
  - Needles, cannulae, and syringes.
  - Gowns and gloves.
  - Respirators.
35. A needle or a syringe may be safely reused:
- Only after thorough cleaning with chlorine bleach.
  - One time, if absolutely necessary.
  - Never.
  - Many times if proper procedures are followed.
36. Multidose vials:
- Should be avoided in acute-care hospitals.
  - Are known to be difficult to use.
  - Put patients at risk because they may be nonsterile.
  - Offer the advantage of less waste and cost savings when used safely.
37. Aseptic technique:
- Applies to all supplies used for injection or infusion.
  - Spells out the rules for common use of syringes when needles have been changed.
  - Allows patients to share a common bag of saline under some conditions.
  - Requires clean gloves as a substitute for hand washing.

38. All licensed healthcare professionals in New York State must complete training on infection control and barrier precautions:
  - a. Every two years.
  - b. Every three years.
  - c. Every four years.
  - d. Every five years.
39. Reprocessing of reusable medical equipment requires these steps:
  - a. Sorting, transporting, and restoring.
  - b. Pre-cleaning, cleaning, and disinfection or sterilization.
  - c. Disinfection, reconditioning, and restoring.
  - d. Sterilization and packaging under all circumstances.
40. When equipment cleaning is performed elsewhere:
  - a. Transporting must be done in sealed vehicles.
  - b. Sufficient time must be allowed for proper disinfection.
  - c. Preparation for transport must be done by licensed professionals.
  - d. Staff still need to understand core infection control concepts related to the items sent out.
41. Concerns continue to be raised about the potential risks of infection from reprocessed single-use devices despite attempts to regulate them.
  - a. True
  - b. False
42. The NYSDOH requires tuberculosis screening for healthcare workers:
  - a. Before employment in hospitals and diagnostic and treatment centers.
  - b. After completion of each year of practice.
  - c. Exclusively by whole-blood interferon–gamma release assays (IGRAs).
  - d. informally, as needed.
43. People born before 1957 are presumed by NYSDOH to be immune to rubella.
  - a. True
  - b. False
44. Studies indicate that immunity to hepatitis B remains intact among healthy individuals vaccinated after 6 months of age for a period of:
  - a. 20 years.
  - b. 15 years.
  - c. 10 years.
  - d. 5 years.
45. Live attenuated influenza vaccine (LAIV):
  - a. May be given via nasal spray to any healthcare personnel.
  - b. is not recommended for people over 49 years of age.
  - c. Is always given via injection.
  - d. Is safe for pregnant women.

46. Following a specific exposure to a bloodborne pathogen, the risk of infection varies, depending on:
- Your age and gender.
  - The patient's white blood count.
  - The pathogen involved.
  - Your history of vaccinations.
47. Although risk is very small, HCV infection has been reported following exposure to:
- A blood splash to the eye.
  - Intact skin.
  - Sputum.
  - Non-intact skin.
48. The symptoms of tuberculosis include persistent cough and:
- Rash and fever.
  - Weight loss and depression.
  - Night sweats and weight loss.
  - Fever and chills.
49. Any employee who sustains an occupational exposure to bloodborne pathogens should have access to post-exposure services:
- Within 10 minutes of a reported event.
  - Within 1 to 2 hours of a reported event.
  - Within 24 hours of a reported event.
  - Before the end of the shift.
50. Determining whether an exposed healthcare worker poses a significant risk to patients:
- Follows precise guidelines spelled out by New York State DOH policy.
  - Is evaluated on a case by case basis.
  - Varies depending on the professional's level of practice.
  - Necessarily includes assessment of mental status.
51. HIV-infected healthcare workers are not required to disclose their HIV status to patients or employers.
- True
  - False

(Answer sheet on next page)

# Answer Sheet

## New York Infection Control and Prevention

Name (Please print your name): \_\_\_\_\_

Date: \_\_\_\_\_

Passing score is 80%

1. \_\_\_\_\_
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50. \_\_\_\_\_
51. \_\_\_\_\_

## Course Evaluation

Please use this scale for your course evaluation. Items with asterisks (\*) are required.

- 5 = Strongly agree
- 4 = Agree
- 3 = Neutral
- 2 = Disagree
- 1 = Strongly disagree

\*1. Upon completion of the course, I was able to:

a. Relate the responsibility of healthcare professionals to adhere to scientifically accepted principles and practices of infection control and to monitor the performance of those for whom the professional is responsible.

5  4  3  2  1

b. Describe the mechanisms of transmission of pathogens in the healthcare setting and strategies for prevention and control.

5  4  3  2  1

c. Outline the use of engineering and work practice controls to reduce the opportunity for patient and healthcare worker exposure to potentially infectious material in all healthcare settings.

5  4  3  2  1

d. Understand the selection and use of personal protective equipment to prevent patient and healthcare worker contact with potentially infectious material.

5  4  3  2  1

e. Describe the proper use of infection control principles and practices for cleaning, disinfection, and sterilization in all healthcare settings.

5  4  3  2  1

f. Understand the principles and practices designed to prevent and manage infectious and communicable diseases in healthcare workers.

5  4  3  2  1

\*2. The course was written in a way that facilitated my learning.

5  4  3  2  1

\*3. This course was free from commercial bias.

5  4  3  2  1

\*4. The course met my continuing education needs.

5  4  3  2  1

\*5. The material presented was supported by evidence.

5  4  3  2  1

\*6. The author avoided the use of anecdotal information as the main source of material.

5  4  3  2  1

\*7. The course was free of product promotion.

Yes  No\*\*

\*\* If you answered no, please answer #8.

8. Was product promotion the sole purpose of the presentation?

Yes  No

\* 9. It took me 60 minutes per contact hour to complete the course, test, and evaluation.

Yes  No\*\*

\*\* If your answer was no, how long did it take?

\_\_\_\_\_



## Registration Information

Please answer all of the following questions (\*required).

\* Name: \_\_\_\_\_

\* Address: \_\_\_\_\_

\* City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

\* Phone: \_\_\_\_\_

\* Professional Designation: \_\_\_\_\_

\* License Number and State: \_\_\_\_\_

Please email my certificate:  Yes  No

Email (required if you want your certificate sent by email): \_\_\_\_\_

(If you request an email certificate we will **not** send a copy of the certificate by US Mail.)

### Payment Options

You may pay by credit card or by check.

Fill out this section only if you are **paying by credit card**.

5 contact hours: \$30

### Credit card information:

Name \_\_\_\_\_

Address (if different from above): \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

Card type:  Visa  MC  American Express  Discover

Card number \_\_\_\_\_ CVS # \_\_\_\_\_

Expiration date \_\_\_\_\_

### Test Completion and Mailing Instructions

1. Complete all forms:

- Answer Sheet
- Evaluation Learning Activity
- Registration Form (this page)

2. If you are **paying by check**, prepare a check for \$30 made out to ATrain Education, Inc.

3. Mail the completed forms and your payment to:

ATrain Education, Inc  
5171 Ridgewood Rd  
Willits, CA 95490

When we receive your forms and payment, we will mail (or email, if you request it) your certificate of completion. If you have any questions or concerns, please call or contact us at Sharon@ATrainCEU.com. And thanks for taking the ATrain!