NY: Infection Control and Prevention, including Sepsis (120)

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Contact hours: 5

Course price: $29

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New York: Infection Control and Prevention is approved by the New York State Department of Education (provider #IC166) and the New York State Department of Health (provider #TP02076) for all healthcare professionals. Approval expires July 31, 2027.

Course Summary

Infection control training for all New York 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, including sepsis. Coverage of controls, PPE, and practices to protect both patients and workers.

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

Course Objectives

When you finish this course you will be able to:

1. Summarize the most prevalent risk factors for healthcare-associated infections (HAIs) and their related sites of infection.
   Identify and explain the seven elements of infection control presented in the New York State Infection Control Syllabus, including sepsis.
2. Recall and explain each of the six links in the Chain of Infection.
3. Describe prevention strategies in terms of Standard and Universal Precautions, Transmission-Based Precautions, Contact Precautions, Droplet Precautions, and Airborne Precautions.
4. Explain both the importance and practice of hand hygiene in preventing HAIs.
5. Discuss safe injection practices and sharps disposal as they relate to both patient and worker health.
   Outline the use of engineering and work practice controls to reduce the opportunity for exposure to potentially infectious material.
6. Demonstrate the selection and use of personal protective equipment (PPE).
7. Define the principles and practices for cleaning, disinfection, and sterilization.
8. State the scope and prevalence of the sepsis in the United States and New York State.
9. Describe New York state Sepsis Improvement Initiative and Rory Staunton’s law.
10. Discuss the most common causes of sepsis.
11. State the signs and symptoms of sepsis and the importance of early recognition.
12. Define severe sepsis and septic shock.
13. Understand the basic principles of treatment and the need for rapid evaluation and management of sepsis.
14. Educate patients and families on methods for preventing infections and illnesses that can lead to sepsis and on identifying the signs and symptoms of severe infections and when to seek care.

Healthcare-Associated Infections (HAIs)

A healthcare-associated infection (HAI) is an infection acquired as a result of treatment for another condition while in a healthcare setting. In accordance with Public Health Law 2819, New York State has been tracking HAIs since 2007 and reporting them each year. This law was created to provide the public with fair, accurate, and reliable HAI data to compare hospital infection rates and to support quality improvement and infection prevention activities in hospitals (NYSDOH, 2013). Reports from 2007 through 2012 may be found at this source.

In addition to the personal consequences for patients, families, and professionals, HAIs add to the skyrocketing costs of the nation's healthcare system. A 2009 report from the Centers for Disease Control and Prevention (CDC) estimated the annual medical costs of HAIs in U.S. hospitals to be between $28 and $45 billion (CDC, 2009).

The CDC healthcare-associated infection (HAI) Prevalence Survey provides an updated national estimate of the overall problem of HAIs in U.S. hospitals. Based on a large sample of acute care hospitals, the survey found that on any given day about 1 in 25 hospital patients has at least one healthcare-associated infection. There were an estimated 722,000 HAIs in U.S acute care hospitals in 2011. About 75,000 hospital patients with HAIs died during their hospitalizations (CDC, 2014).

More than half of all HAIs occurred outside the intensive care unit. According to the Centers for Disease Control and Prevention (CDC), healthcare-associated infections are one of the top ten leading causes of death in the United States. The CDC estimates that there are 1.7 million healthcare-associated infections in American hospitals each year, with 99,000 associated deaths (CDC, 2014).

HAIs can be acquired anywhere healthcare is delivered, including inpatient acute care hospitals, outpatient settings such as ambulatory surgical centers and end-stage renal disease centers, as well as long-term care facilities such as nursing homes and rehabilitation centers. HAIs may be caused by any infectious agent, including bacteria, fungi, and viruses, as well as other less common types of pathogens (USDHHS, 2014).

HAIs are associated with a variety of risk factors, including:

- The use of indwelling medical devices such as bloodstream, endotracheal, and urinary catheters
- Surgical procedures
- Injections

- Contamination of the healthcare environment
- Transmission of communicable diseases between patients and healthcare workers
- Overuse or improper use of antibiotics (USDHHS, 2014)

HAIs are a significant cause of morbidity and mortality. Most HAIs are of the following four types:

- Urinary tract infections
- Surgical site infections
- Bloodstream infections
- Pneumonia (USDHHS, 2014)

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. To address this need, the American Recovery and Reinvestment Act (P.L. 111-5) of 2009 provided $50 million to support states in the prevention and reduction of HAIs (ARRA, 2009). These funds have supported surveillance and research, improved quality, encouraged collaboration, and trained healthcare workers in HAI prevention and in measurement of outcomes.

The Centers for Medicare and Medicaid Services (CMS) have increased scrutiny of practices and implemented financial incentives for prevention of HAIs. Media and public attention are also increasing. In 2011 the CMS implemented a new requirement that all hospitals nationwide receiving payment from CMS provide information on specific HAIs, using standardized reporting. Then in April 2011 the Obama administration launched a public/private program called Partnership for Patients, designed to make hospital care safer, more reliable, and less costly by:

- Keeping hospital patients from getting injured, or sicker. The goal is, by the end of 2013, to decrease instances of patients acquiring preventable conditions while in hospitals by 40% compared to 2010.
- Helping patients heal without complication. By the end of 2013, to decrease preventable complications during a transition from one care setting to another, so that the number of patients who must be re-admitted to the hospital is reduced by 20% compared to 2010. (CMS, 2011)

Reports are not yet available. More than 300 hospitals, consumer and patient organizations, employers, unions, and health plans in New York are participating in the Partnership for Patients program.

Seven Elements of Infection Control

In 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. Then in 2008 the legislature required certain changes be made to the training curriculum, the training process, and those requiring training. In 2018, a seventh element (sepsis awareness and education) was added. The seven elements are spelled out in the following box and then explained 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 or communicable diseases in healthcare workers.

ELEMENT VII (added in 2018)
Sepsis awareness and education.
Source: NYSDOH, 2017.

Element I: Scientifically Accepted Principles

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.

Scientific evidence is the primary source of guidance for infection control practice and, as the science 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 H1N1 influenza outbreak of 2009 is an example of a potentially deadly virus that emerged as a mix of human, swine, and bird viruses. Human immunodeficiency virus (HIV) is a well-known example of an infection that emerged in the late 1970s, prompting widespread and rapid changes in IC practices.

The transition of healthcare delivery from acute care hospitals to other settings (home, ambulatory, free-standing specialty, and long-term care sites) has created a need for IC guidelines that can be applied in all settings. These guidelines must follow common principles, 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 biological weapons has led to broader guidelines for infection control and prevention.

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 based on evidence-based principles, we are seeing a cultural shift in the prevention of HAIs.

In the past it was 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. **Zero tolerance** has now 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 2005 the Legislature passed Public Health Law 2819, requiring hospitals to report certain selected hospital-acquired infections (HAIs) to the New York State Department of Health. The legislation provided an initial pilot phase year (2007) to:

- Develop the reporting system
- Train hospitals on its use

- Standardize definitions, methods of surveillance and reporting
- Audit and validate the hospitals' infection data
- Modify the system to ensure that the hospital-identified infection rates would be fair, accurate, and reliable

In June 2008 the Department issued the pilot year report for 2007. Subsequent annual reports have followed. The sixth annual report, entitled *Hospital-Acquired Infections, New York State 2012,* provides hospital-acquired infection rates statewide and by individual hospital for 2012 (NYSDOH, 2013). Annual hospital-specific infection data are available at this link.

The infections selected for reporting in 2012 include colon surgical site infections, hip replacement surgical site infections, coronary artery bypass graft surgical site infections, abdominal hysterectomy surgical site infections, central line-associated bloodstream infections in intensive care units (adult, pediatric and neonatal intensive care units), and *Clostridium difficile* infection rates occurring on admission and during a patient's hospital stay. The report also contains updated information on infection control resources in NYS hospitals and describes progress of HAI prevention projects supported by the Department (NYSDOH, 2013).

Hospitals report to NYS using the CDC's National Healthcare Safety Network (NHSN). This secure web-based system allows hospitals, NYS, and federal agencies to monitor the same data concurrently. NHSN is used by almost all hospitals in the United States. All participants use the same surveillance definitions. In 2012, all 175 NYS acute care hospitals (excluding Veterans Affairs, critical access, psychiatric, and long-term acute care hospitals) reported HAI data. The following table summarizes the types of HAIs that NYS hospitals were required to report in 2012, along with the total number of infections reported and the infection rates (NYSDOH, 2013).

Hospital-Acquired Infections, New York State Hospitals, 2012		
Type of infection	Number	Rate
Hospital-onset *Clostridium difficile* infections (CDIs) among inpatients	9,945	8.3 per 10,000 patient days
Surgical site infections (SSI) following		
▪ Colon surgery	836	5.1 per 100 procedures
▪ Abdominal hysterectomy surgery	415	2.2 per 100 procedures
▪ Hip replacement or revision surgery	311	1.1 per 100 procedures
▪ Coronary artery bypass graft (CABG) - chest site	223	2.1 per 100 procedures
▪ CABG - donor site	58	0.6 per 100 procedures
Central line-associated blood stream infections (CLABSI) among patients in intensive care units	735	1.2 per 1,000 line days
Total	12,523	

Source: NYSDOH, 2013.

Hospitals have continuous access to their own data and can compare their rates to national levels and monitor trends over time. In addition, the NYSDOH has *continuous* access to the data reported by the hospitals for consistent real-time surveillance, identification of trends, and provision of technical assistance as needed. The collected data are made available to the public annually, giving the public the ability to review hospitals' performance for these particular procedures and helping to guide their medical decisions (NYSDOH, 2010).

Currently, HAI reports rates are identified by hospital and by region for the following:

Surgical site infections (SSIs)

- Colon
- Coronary artery bypass graft (CABG)
- Hip replacement/revision
- Abdominal hysterectomy

Central line-associated bloodstream infections (CLABSIs)

- Adult

- Pediatric
- Neonatal intensive care units (NICUs)

Clostridium difficile (C. Difficile) (NYSDOH, 2013)

NYSDOH entered into a data use agreement with CDC beginning in July 2013. This agreement gives NYSDOH the ability to use non-mandated NHSN data for quality improvement purposes. Examples of these data include catheter-associated urinary tract infections (CAUTI) and methicillin-resistant *Staphylococcus aureus* infections, which are reported to NHSN by almost all NYS hospitals as part of the CMS Hospital Inpatient Quality Reporting Program. As staffing levels allow, NYSDOH will evaluate the burden of other non-mandated HAIs (NYSDOH, 2013).

NYSDOH will continue to conduct medical record audits to verify appropriate use of surveillance definitions and accurate reporting by hospitals. Variation in audit coverage and thoroughness across the states currently results in inequitable comparison of hospital and state average rates. NYSDOH will continue to discuss audit methodology with CDC and CMS, as the stakeholders hopefully converge on a fair and efficient audit process (NYSDOH, 2013).

Laws and Regulations

Both regulations and science impact infection control practice. Whichever is stricter must be followed. Regulation is often more specific than science.

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 acceptable conduct for those regulated by the agency.

Legal issues first began to impact IC practices at the beginning of the AIDS epidemic in the 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.

The OSHA Bloodborne Pathogens Standard requires 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 (OSHA, 2012).

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 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.

Infection Control Policies and Procedures

[The information in this section is derived from OSHA, 2012 and NYSDOH, 2010, 2013.]

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.

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.

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.

Under New York State's standards, unprofessional conduct applies to the professions of: acupuncture, athletic training, audiology, certified dental assisting, chiropractic, creative arts therapy, dental hygiene, dentistry, dietetics/nutrition, licensed practical nursing, marriage and family therapy, massage therapy, medicine, mental health counseling, midwifery, occupational therapy, ophthalmic dispensing, optometry, pharmacy, physical therapist assistant, physical therapy, physician assistant, podiatry, psychoanalysis, psychology, registered professional nursing, respiratory therapy, respiratory therapy technician, social work, specialist assistant, occupational therapy assistant, and speech-language pathology.

There are exceptions for cases involving those professions licensed, certified, or registered pursuant to the provisions of Article 131 or 131-B of the Education Law, in which a statement of charges of professional misconduct was not served on or before July 26, 1991, the effective date of Chapter 606 of the Laws of 1991.

All licensed healthcare professionals in New York State are required to receive training on infection control and barrier precautions every four years through an NYS-approved provider. Documentation of appropriate training must be maintained both by the course provider and course participant.

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 that 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 you have 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 bodily fluids in well-constructed containers with secure lids** to prevent leaking; and clean any spill of blood or other bodily fluid with an appropriate detergent and appropriate chemical germicide (NYSED, 2011)

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, IC practitioners, daycare center directors, healthcare facilities, state institutions, and any others 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 IC guidance may be directed to the regional epidemiologist or to the regional epidemiology program central office.

Professional Misconduct

In 2011 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 (NYSED, 2012).

The 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 IC practices as those offered for physicians, physicians' assistants, and specialist assistants (NYSED, 2012).

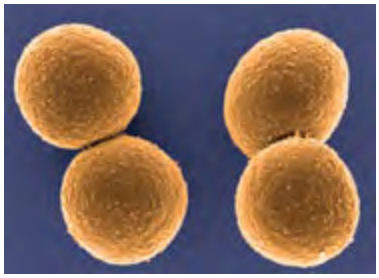
Element II: Mechanisms of Transmission

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

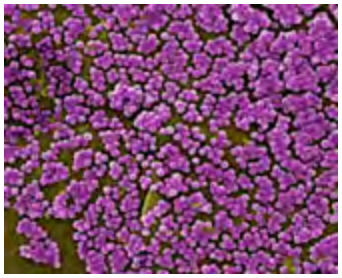
It is becoming increasingly clear that transmission of infections in healthcare settings is largely preventable through the use of evidence-based IC guidelines. The concept of the chain of infection provides the basis for understanding the transmission of pathogens as well as identifying practices and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

For the purposes of NHSN surveillance in the acute care setting, a **healthcare-associated infection (HAI)** is a localized or systemic condition resulting from an adverse reaction to the presence of an infectious agent(s) or its toxin(s) that was *not present on admission* to the acute care facility (CDC, 2014).

Antibiotic-resistant organisms have changed the infection control landscape. Methicillin-resistant *S. aureus* (MRSA), *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).



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.

Bad Bugs, No Drugs

In 2004 the Infectious Diseases Society of America (IDSA) raised the alarm about the dramatic increase in drug-resistant bacteria and the diminishing supply of new antibiotics in its landmark *Bad Bugs, No Drugs* report.

The Society has pursued multiple approaches, including legislation, to strengthen federal leadership, public health efforts, research, data collection, surveillance, appropriate use strategies, and efforts to fix the anemic drug pipeline.

In 2010 IDSA launched its 10 by 20 Initiative, calling for political leaders, regulators, manufacturers, etc., to work together to create an infrastructure capable of developing 10 new systemic antibiotics by 2020. Only one 10 x 20 antibiotic has been approved to date.

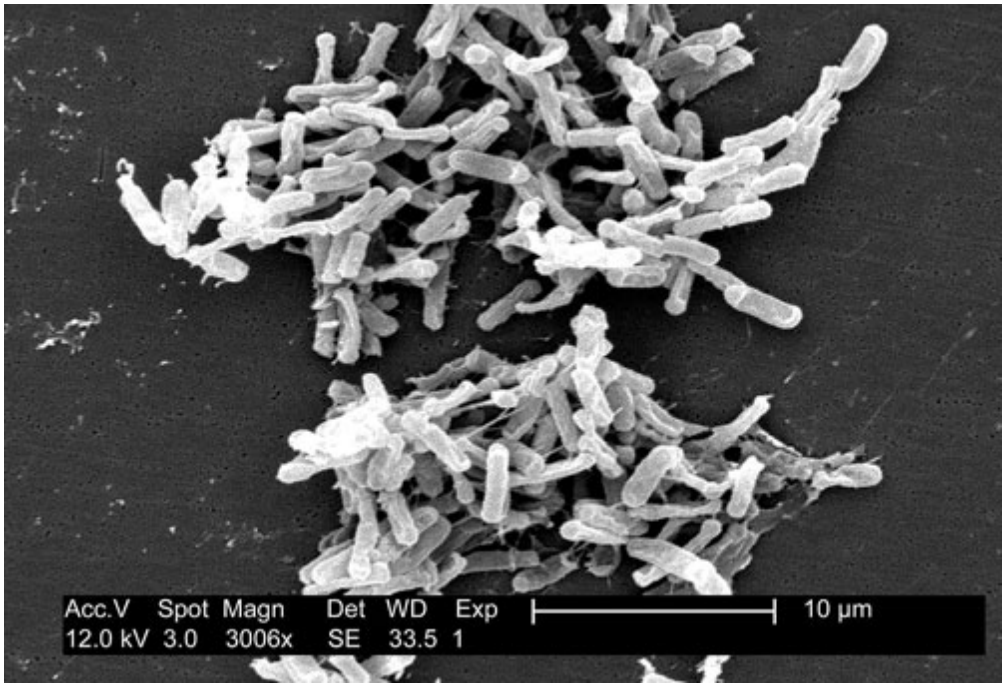
Source: IDSA, 2014.

Muto and colleagues (2003), in a ground-breaking document for the Society for Healthcare Epidemiology of America, published the SHEA guideline for preventing nosocomial transmission of multidrug-resistant strains of *Staphylococcus aureus* and Enterococcus.

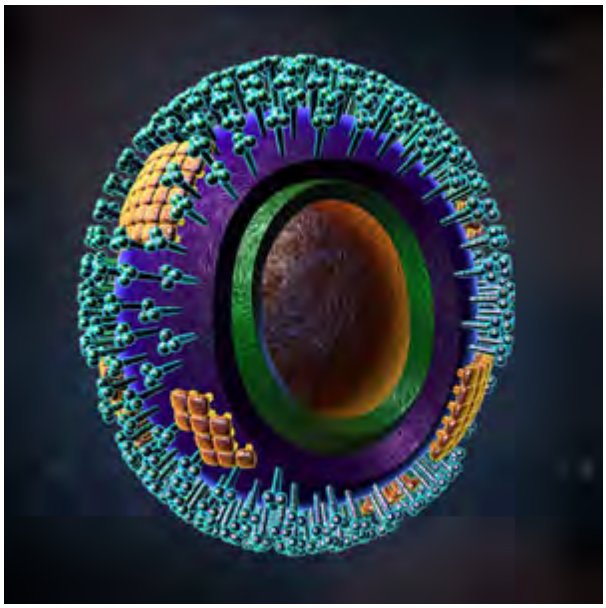
While most types of HAIs are declining, one, caused by the germ *Clostridium difficile*, remains at historically high levels. *Clostridium difficile* causes diarrhea linked to 14,000 American deaths each year (CDC, 2013). Those most at risk are people, especially older adults, who take antibiotics *and also get* medical care. *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% of the population. 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, bed rails, equipment, and bedside tables and it is easily transmitted on the hands and gloves 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 H1N1 outbreak of 2009, influenza had 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 ability to identify an influenza epidemic as it is emerging. We also have the public health capability to take action (vaccines, surveillance, education) to minimize the impact of a flu outbreak. Addressing and controlling these emerging threats has become a priority for healthcare organizations. (See ATrain's course, *Influenza: Fighting Complacency*, which is updated every year.)



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

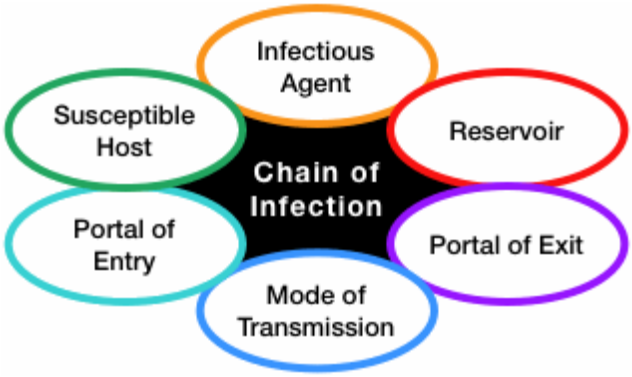

An illustration of the influenza virus micro-organism. Source: Illustration provided by 3DScience.com.

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** (see figure below). 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 now-infected susceptible host becomes a new reservoir and the whole process starts over.

The concept of a chain of infection is essential to our understanding of why we do what we do to prevent infection. If any **one** link of the chain of infection can be broken, the spread of infection can be prevented.

The Chain of Infection



Infectious Agents (Pathogens)

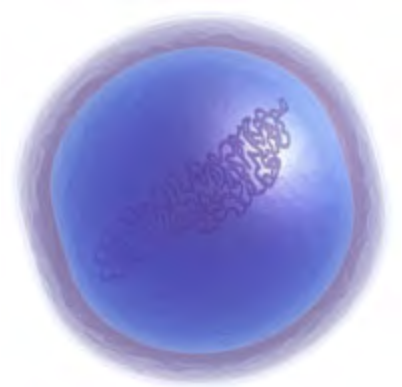
Infectious agents are the microorganisms or "germs"—bacteria, viruses, fungi, and protozoa—that can cause disease or illness in their hosts. Some microorganisms are *pathogens*, a word derived from the Greek, meaning "that which produces suffering." Although microorganisms are common in the environment, most are not harmful to people.

Pathogens vary in infectivity and virulence, and to cause disease an **infectious dose** (a sufficient number of organisms) 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, including pneumonia, tuberculosis, and bacterial meningitis. Pathogenic bacteria include group A and group B streptococcus, *Haemophilus influenzae*, *Staphylococcus aureus*, including MRSA, *Clostridium difficile*, *Neisseria meningitidis*, and *Streptococcus pneumoniae*.



A coccus is a bacterium with a spherical shape. Chains of cocci indicate streptococcus, while clusters indicate staphylococcus. Source: Illustration provided by 3DScience.com.

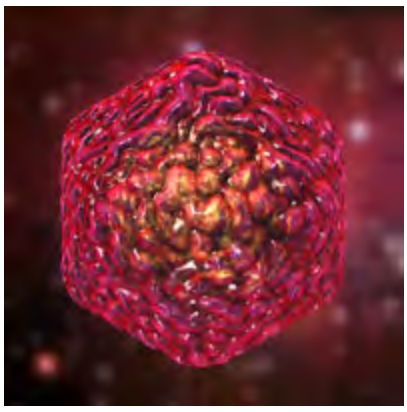
Bacillus can refer to any rod-shaped bacterium, or can be more specific to *Bacillus*, which is a gram-positive and rod-shaped genus. Source: Illustration provided by 3DScience.com.

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—by direct or indirect contact (soiled hands or articles), by droplets from coughing and sneezing, by contact with blood, sexual contact, by fecal contamination, by contaminated food and water, or via certain insects. 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.

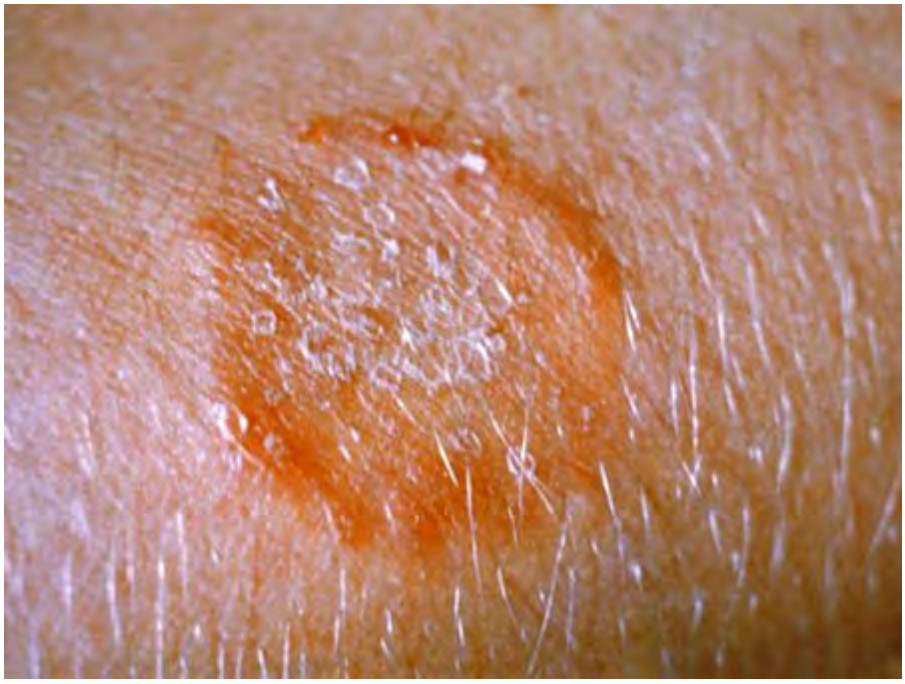


This image of the West Nile Virus shows the characteristic rough and furrowed surface with no protein arms projecting from it, as so many viruses have. Source: Illustration provided by 3DScience.com.

HIV is a retrovirus, whose genetic content is stored in RNA, which is copied into the DNA of the host upon infection. Source: Illustration provided by 3DScience.com.

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 subcutaneus (extending into the dermis, subcutaneous tissues, muscle, and fascia). Fungal infections can also be systemic, often originating 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.



An example of a fungal infection called ringworm (no worm is involved). Source: CDC.

One 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 can 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 growth medium for 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).

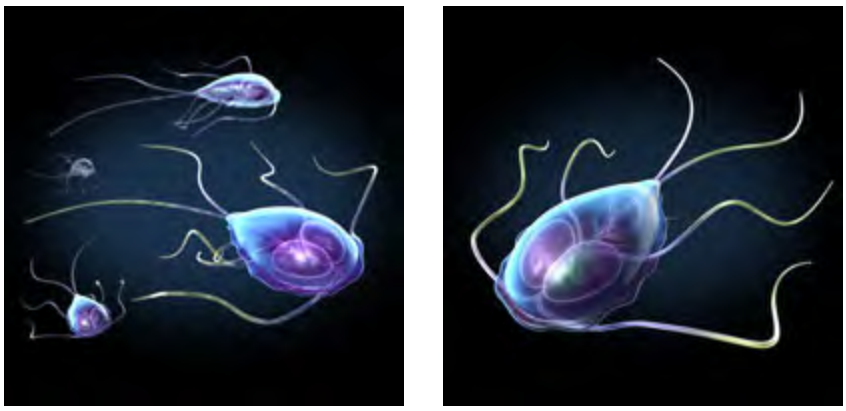
Other opportunistic fungi that are occasionally linked with HAIs are members of the order *Mucorales* and molds such as *Fusarium* and *Penicillium*. Many of these fungi can proliferate in moist environments—for example, in water-damaged wood and building materials. Some fungi, such as *Fusarium* and *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.

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. Malaria is a protozoan that lives in the blood of the host and is transmitted when an insect bites, ingests infected blood, and then transmits it by biting a new host.

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. Source: Illustration provided by 3DScience.com.

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.

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

Pediculus humanus var capitis, also known as head louse. Source: Wikipedia.

Reservoirs

Reservoirs are the places where the germs live and grow. A general rule: If an area stays wet, it is probably a reservoir. The most common reservoirs in healthcare facilities are people, who may be sick or healthy.

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).

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., 2014).

Although many emerging diseases of human, domestic animal, and wildlife populations are assumed to be maintained in reservoir hosts, these reservoirs may not be 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 identity 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, Buruli ulcer, and rabies (Haydon et al., 2014).

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 risks 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 respiratory protection only when caring for patients with pulmonary tuberculosis (Haydon et al., 2014).

Home care patients known to have a multidrug-resistant organism should be cared for using appropriate barriers. Although these organisms may not be a risk to providers, they may be transmitted to other home care 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 (Haydon et al., 2014).

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 (eg, rubella, syphilis, toxoplasmosis), while others exit through cuts in the skin or needles (hepatitis B) or blood-sucking insects (malaria) (CDC, 2014a).

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 anatomic 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

Did You Know. . .

> 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.

All types of precautions (standard, contact, droplet, and airborne) are designed to interrupt the means of transmission. These are reviewed later under "Prevention Strategies." Direct and indirect contact are the most common means of transmission in the healthcare setting —from the hands of the caregivers and items that move patient to patient. 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.**

Items moving between patients should be cleaned after each use to avoid indirect contact transmission of pathogens.

Common Means of Transmission	
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. Microorganisms may be carried by unwashed hands or soiled objects, called *fomites*. Any soiled object, such as blood-pressure cuffs, pens, bed rails, used tissues, soiled laundry, or doorknobs, may be a fomite.

Indirect Transmission

An agent or pathogen can be indirectly transmitted from a reservoir to a susceptible host by inanimate objects or contaminated environment. Cleaning and disinfection are important practices to ensure that medical equipment surfaces do not serve as means of transmission for infectious pathogens. Hands of healthcare personnel may transmit pathogens after touching an infected or colonized body site on a 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. Shared toys may become a vehicle for transmitting respiratory viruses (eg, respiratory syncytial virus) or pathogenic bacteria (e.g., *Pseudomonas aeruginosa)* among pediatric patients (Siegel, 2007).

Toys used by young children should be washable. A system should ensure that they are washed and dried routinely. Older children should wash hands before and after using shared toys or equipment.

Instruments (e.g., endoscopes, 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).

Airborne Transmission

Transmission of germs can also occur through the airvia droplet or airborne routes. **Droplet transmission** is common, easily spreadinginfections 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.

This photograph captures a sneeze in progress, revealing the plume of salivary droplets as they are expelled in a large cone-shaped array from this man's open mouth, thereby dramatically illustrating the reason for covering your mouth when coughing or sneezing in order to protect others from germ exposure. 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 Standard, 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

Portals of Entry: How Pathogens Are Introduced

The portal of entry refers to the location through 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.

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 anatomic 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 anatomic openings
- Rash or dermatitis
- Insect bites
- Injuries, from microscopic to major
- Surgical wounds
- Intravenous sites
- Any location, whether anatomic or created, with a tube in place
- Needle-puncture injuries

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

- Use of aseptic 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 needle sticks

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 below). However, characteristics of the host-agent interaction—such as pathogenicity, virulence, and antigenicity—are important. The infectious dose, mechanism of disease production, and route of exposure are also factors.

Factors That Influence the Outcome of an Exposure	
Host factors	▪ Extremes of age ▪ Underlying disease ▪ HIV/AIDS ▪ Malignancy ▪ Transplants ▪ Medications that alter normal flora, such as antimicrobial agents, gastric acid suppressants, corticosteroids, anti-rejection drugs, antineoplastic agents, and immunosuppressive drugs ▪ Surgical procedures ▪ Radiation therapy ▪ Indwelling devices such as urinary catheters, endotracheal tubes, central venous and arterial catheters, and synthetic implants
Agent factors	▪ Infectivity ▪ Pathogenicity ▪ Virulence ▪ Size of inoculum ▪ Route of exposure ▪ Duration of exposure ▪ The ability of a pathogen to maintain infectivity over that distance
Environmental factors	▪ Contamination of environment and equipment ▪ Availability of means of transmission ▪ Temperature and humidity

Some people 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 (e.g., IV catheters, urinary catheters) 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! (No one is immune to all disease.)

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

- Preventing exposure of both patients and staff to communicable disease
- 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

Both science and regulation address prevention of HAIs. The CDC provides the chief authority for science. Regulations may be federal, state, or local.

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**.

The federal OSHA Bloodborne Pathogens Standard requires that each employer having employees with occupational exposure to blood or other potentially infections material (OPIM) shall establish a written exposure control plan designed to eliminate or minimize employee exposure. Among other things, this plan must address:

- Standard/Universal Precautions, including hand hygiene (Element II)
- Engineering and work practice controls (See Element III.)
- Personal protective equipment (PPE) (See Element IV.)
- Housekeeping, laundry, regulated waste (See Element V.)
- Contaminated sharps and equipment (See Element III.)
- Hepatitis B vaccination and exposure followup (See element VI.)
- Employee communication and education (See Element VI.)
- Recordkeeping

The Exposure Control Plan must be available to employees. Many of the educational requirements are addressed in this course, but it does not cover employer-specific requirements such as how to report an exposure and it does not take the place of an employer-specific Exposure Control Plan.

The complete federal Bloodborne Pathogens Standard is available at the OSHA website.

Standard and Universal Precautions

Universal Precautions were originally developed by OSHA to protect healthcare workers from bloodborne pathogens, such as HIV, Hepatitis B (HBV), and hepatitis C (HCV). Universal Precautions were developed for use with all patients because those with bloodborne infections may be asymptomatic or unaware of their infectious status. Universal Precautions continue to be required by the OSHA Bloodborne Pathogens Standard.

Universal Precautions requires avoidance of contact with blood or OPIM. OSHA defines OPIM, or "other potentially infectious materials," as (1) the following human body fluids: semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate between body fluids; (2) any unfixed tissue or organ (other than intact skin) from a human (living or dead); and (3) HIV-containing cell or tissue cultures, organ cultures, and HIV- or HBV-containing culture medium or other solutions; and blood, organs, or other tissues from experimental animals infected with HIV or HBV.

Because the focus of Universal Precautions was narrow (protect healthcare workers from bloodborne pathogens), the CDC was led to develop Standard Precautions, which include all of Universal Precautions and more.

Standard Precautions protect patients and healthcare workers from many bacterial and viral infections, including bloodborne pathogens. When we use Standard Precautions, we are in full compliance with Universal Precautions.

Standard Precautions tell us to avoid contact with:

- Blood and all body fluids from all patients. Any body fluid may carry microorganisms.
- Mucous membranes
- Non-intact skin (abrasions, dermatitis, rash)

Standard Precautions, as described by the CDC, requires all of the following:

- Assume that every person is potentially infected or colonized.

- Perform hand hygiene correctly and routinely.
- Use personal protective equipment (PPE) (see Element IV). Note that mask, eye protection, and gown may be required for care of a patient on Standard Precautions. Supplies must be readily available.
- Use safe injection practices to protect patients and workers—Elements II and III.
- Clean patient-care equipment and the environment as described in Element V.
- Implement respiratory hygiene in all areas where people with respiratory symptoms may be seen.

Respiratory hygiene was incorporated into Standard Precautions by the CDC in 2007, to:

- Educate healthcare personnel on the importance of source control measures to prevent droplet and fomite transmission of respiratory infection. Cover the portal of exit!
- Put these measures in place beginning at the point of initial encounter in the healthcare setting.
- Apply them to both patients and accompanying individuals.
- Post signs at entrances and other key locations asking people with respiratory symptoms to cover their mouths and noses when coughing or sneezing, to dispose of tissues and do hand hygiene. Signs in several languages are available from the CDC.
- Provide tissues, waste receptacles, and hand hygiene materials.
- Offer a simple mask to coughing patients.
- Encourage coughing patients to stay at least 3 feet away from others.

Correct Use of Standard Precautions	
Always	▪ Use good hand hygiene. ▪ Use gloves for contact with blood, body fluids, non-intact skin (including rash), mucous membranes, used equipment, linen, and trash. ▪ Use a gown any time your clothing may become soiled and if a patient has uncontained body substances. ▪ Use a mask and eye protection if you may be splashed. OSHA-compliant eye protection must have solid side shields. ▪ Change gloves if they become heavily soiled or if you must go from a dirtier area to a cleaner one.
Never	▪ Wear artificial fingernails—check your facility's policy for details. ▪ Touch a second patient with the same pair of gloves. ▪ Re-use gowns, even for repeated contacts with the same patient. ▪ Contaminate the environment with dirty gloves. ▪ Wear gloves in the hall unless you can say why you are wearing them.

Transmission-Based Precautions

The CDC also recommends, for patients with certain infections, use of transmission-based precautions, *in addition to* Standard Precautions. Standard Precautions are used with all patients and do not require a sign on the door. Patients being cared for using Contact, Droplet, or Airborne Precautions will have a sign on the door in most facilities. Note that the sign on the door may not specify the patient's diagnosis for reasons of privacy.

Precautions may vary between facilities. Refer to your facility's policies for details. Details for all types of precautions may be found in the CDC Guideline for Isolation Precautions, 2007. The list of diseases requiring transmission-based precautions and the duration of those precautions may be found in Appendix A of that guideline (CDC, 2010).

Facilities should have policies for transport of the patient outside the room, addressing each type of transmission-based precautions.

Contact Precautions

The following are CDC recommendations for acute care facilities. Other types of facilities should develop policies based on these guidelines:

- Hand hygiene is critical in the care of patients.
- Visitors must perform hand hygiene on leaving the room.
- Use a single-patient room if possible; consult with IC staff if not possible.
- Wear gloves to enter the room. Change gloves as specified by Standard Precautions.
- Wear a gown to enter the room.
- Use single-patient equipment, left in the room, as possible.
- Disinfect any equipment that must leave the room.
- Clean and disinfect these rooms at least daily.

Supplies needed include:

- Gloves
- Gowns
- Disinfectant for removed equipment
- Trash container for discarded PEP
- Single-patient use equipment

Contact Precautions are often used to care for patients with Methicillin-resistant *Staphylococcus aureus*, *C. difficile*, wounds with uncontained drainage, and a number of other infections.

Droplet Precautions

The following are CDC recommendations for acute care facilities. Other types of facilities should develop policies based on these guidelines:

- Use a single-patient room if possible; consult with IC staff if not possible.
- Maintain at least 3 feet separation between the patient and others.
- If two patients must share a room, draw the privacy curtain between them.
- Hand hygiene must be done as specified for Standard Precautions.
- Staff should wear a simple mask to enter the room.
- Supplies needed (beyond Standard Precautions) are limited to simple masks.

Droplet Precautions are used to provide care to patients with influenza, pertussis, some types of meningitis, undiagnosed respiratory infections, and several other diseases.

Airborne Precautions

Airborne Precautions are the ***only*** type that require:

- Airborne infection isolation room—AIIR—a negative pressure isolation room
- N-95 respirator or PAPR.
- Supplies needed (beyond Standard Precautions) are limited to the appropriate respiratory protection.

AIIRs have very specific requirements and are often available only in acute care facilities. If a disease requiring Airborne Precautions is suspected and an AIIR is not available, place a simple mask on the patient and place him/her in a separate room with its door closed while transfer to a facility with an available AIIR is arranged. Non-acute care settings should have well known policies for identifying and managing such patients.

If patients must come out of the AIIR, put a simple mask on them; a tight-fitting respirator may not be tolerated and is not indicated.

Airborne Precautions are used for patients known or suspected of having:

- Tuberculosis, active pulmonary or rule-out
- Chickenpox
- Measles
- Disseminated herpes zoster (shingles of more than one dermatome)
- SARS
- Smallpox

Tuberculosis

Every year, more than 9 million people worldwide develop tuberculosis (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 person who is most likely to transmit tuberculosis is the person who has not been diagnosed—the unknown carrier. Identification without delay of the person with active tuberculosis is critical so that isolation and treatment can prevent transmission to others.

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 3 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, 2005).

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.

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.

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 provided to contain 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 AII room. Most facilities provide N-95 respirators (see Module 6), which must be fit-tested. Some facilities exclusively use powered air-purifying respirators (PAPRs, see image at right) for all staff; they do not require fit testing. Check your facility's policies for what respiratory protection is made available for visitors.

Powered Air-Purifying Respirator Hood (PAPR)

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).

Each of the three sputum specimens should be collected in eight 24-hour intervals and at least one specimen should be an early morning specimen.

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 more common 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 2 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).

Hand Hygiene

The term **hand hygiene** includes both the use of an alcohol-based hand rub and washing with soap and water.

The chain of infection makes it clear why hand hygiene is critical. For generations, handwashing with soap and water has been the standard 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 (CDC, 2002).

CDC's 2002 Guidelines for Hand Hygiene brought a major change in hand hygiene practices. While washing with soap and water is still required in some situations, now the use of an alcohol-based hand rub is preferred for routine use.

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. Although measuring hand hygiene adherence is not a simple task, an oft-cited study by Pittet (2001) noted that adherence varies among professional categories of healthcare workers and between hospital departments but is usually estimated as less than 50%.

CDC (2002) has described observed and self-reported factors that influence adherence to hand hygiene practices.

Observed risk factors for poor adherence

- Physician (rather than nurse)
- Nursing assistant (rather than nurse)
- Male gender
- Working in intensive care unit
- Working during the week (rather than weekend)
- Wearing gowns/glove
- Automated sink
- Activities with high risk of cross contamination
- High number of hand hygiene opportunities per hour of patient care

Self-reported factors for poor adherence

- Handwashing agents cause irritation and dryness
- Sinks inconveniently located
- Lack of soap and paper towels
- Too busy
- Understaffing or overcrowding
- Patient needs take priority
- Hand hygiene interferes with patient/healthcare worker relationship
- Low risk of acquiring infection from patient
- Believing that wearing gloves means hand hygiene is unnecessary
- Lack of knowledge
- Forgetfulness
- Lack of role model
- Skepticism about need for hand hygiene
- Disagreement with recommendations
- Lack of scientific data to back up need for hand hygiene

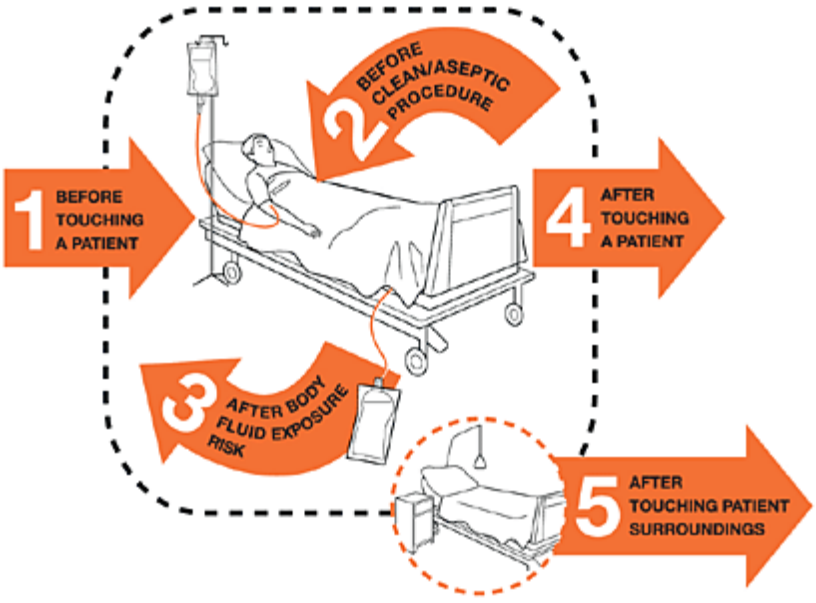
For healthcare workers, adherence to hand hygiene guidelines protects both the patient and the worker. Hand hygiene should be done when:

- You first come on duty
- Before you touch your first patient or clean equipment

- Before and after every patient contact, including after touching intact skin
- Before any clean or invasive procedure
- Before putting on sterile gloves
- Before contact with any portal of entry, your patient's or your own
- After contact with any body fluids, including your own
- After unprotected contact with mucous membranes or non-intact skin
- 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 and after eating
- Before going off duty

My 5 Moments for Hand Hygiene

The **My 5 Moments for Hand Hygiene** approach defines the key moments when healthcare workers should perform hand hygiene. This evidence-based, field-tested, user-centered approach is designed to be easy to learn, logical, and applicable in a wide range of settings (Sax, 2007).



Choosing Alcohol Sanitizer or Soap and Water

If you can see dirt on your hands—whether from blood, body fluid, or other visible soiling—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 hand rubs do 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; plain alcohol should not be used because it evaporates too quickly to provide enough contact time to kill germs.

How to do hand hygiene right:

- If using soap, wet your hands first 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 hand rubs on dry skin only.
- Use one measured amount of alcohol sanitizer, 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 do kill germs
- They leave skin in better condition
- They are quicker and easier, so are used more frequently

When dealing with diarrhea that may be infectious, use soap and water. Both *Clostridium difficile* and norovirus cause diarrhea and neither is effectively killed by alcohol-based hand rubs.

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.

Hand Washing Video

Click here or on the image to view the video. Source: CDC.

Safe Injection Practices: Protecting Patients

[This section derived largely from NYSDOH, 2011.]

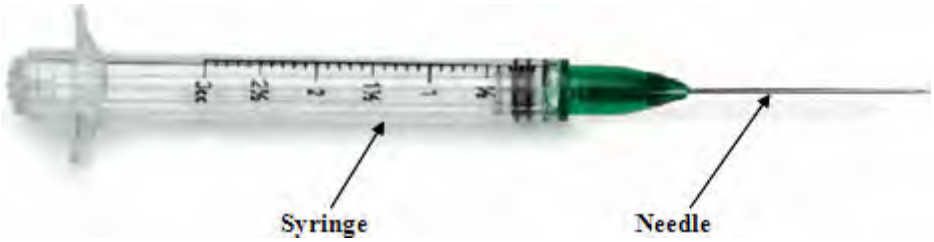
Needles, cannulae, and syringes are sterile, single-use items—any use will result in these items being contaminated. They are contaminated once they are used to enter or connect to any component of a patient's intravenous infusion set. After use, immediately dispose of all needles and syringes into a leak-proof, puncture-resistant, closable container. Develop policies and procedures to prevent sharps injuries among staff and review them 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, 2011).

Injectable Device



Neither portion of the injectable device may be reused under any circumstances. Source: CDC.

Single-Use 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 ampoules to multiple patients or combine leftover contents for later (CDC, 2011).

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.

A 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 (i.e., 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 up 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.

Preventing Disease Transmission

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, multidose 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 or 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 for each patient. Prevent 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.
- 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 nonpatient-specific multidose 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 2012 FDA, NIOSH, and OSHA issued a joint safety communication. This document strongly encourages healthcare professionals to use blunt-tip suture needles as an alternative to standard suture needles when suturing fascia and muscle to decrease the risk of needlestick injury (CDC, 2014b).

Element III: Engineering and Work Practice Controls

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. (updated guideline)

[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 hazard* from the workplace.

Work practice controls reduce the likelihood of exposure by altering the manner in which a task is performed (e.g., 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. Engineering controls usually involve an object, such as a safer chemical, syringe with engineered safety protection, sharps container, or splash guard. Work practice controls reduce risk by altering the way a task is performed. Work practice controls tell how to do the job safely, and should be described in written procedures. Engineering and work practice controls are designed to reduce risk of percutaneous, mucous membrane/non-intact skin or parenteral exposures of workers.

Percutaneous (through the skin) **exposures** can occur during handling, disassembly, disposal, and reprocessing of contaminated needles and other sharp objects, or via human bites, cuts, and abrasions.

Activities that risk percutaneous exposures include manipulating contaminated needles and other sharp objects by hand, removing scalpel blades from holders, and removing needles from syringes.

Delaying or improperly disposing of sharps, leaving contaminated needles or sharp objects on counters or workspaces, or disposing of sharps in nonpuncture-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 (e.g., 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% of sharps injuries can be prevented simply by using safer medical devices (OSHA, 2012).

Sharps Safety: Protecting Healthcare Workers

[This section is derived from CDC, 2008.]

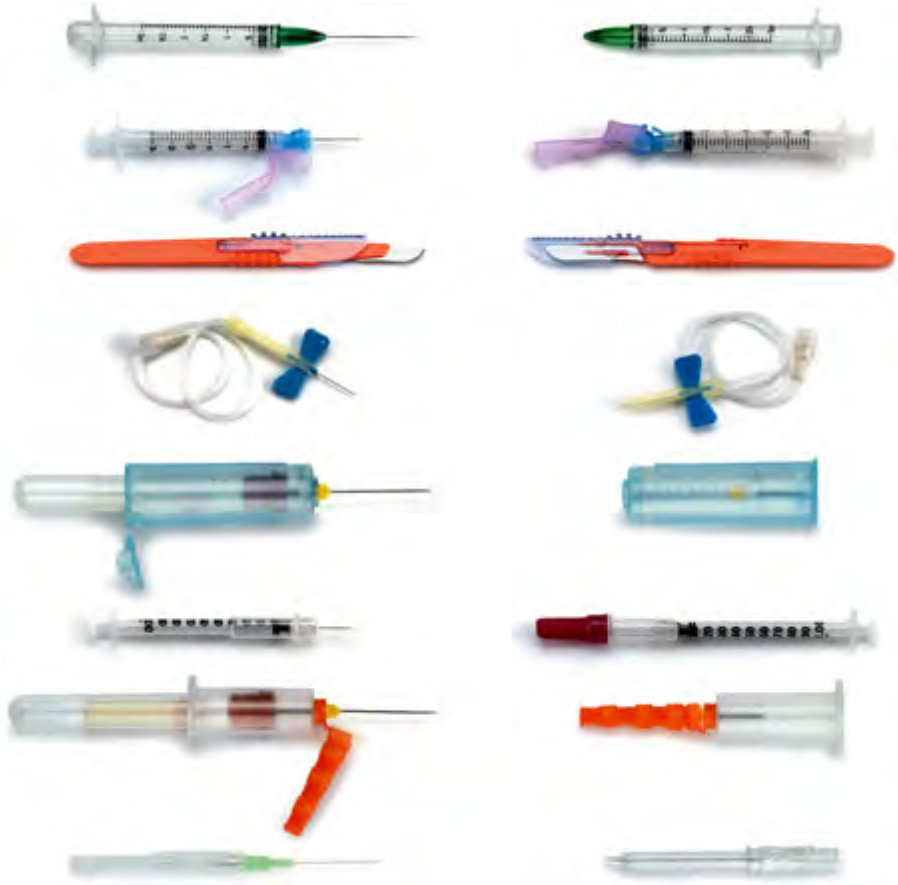
There has been increased focus on removing sharps hazards through the development and use of engineering controls. In November 2000 the Federal Needlestick Safety and Prevention Act authorized OSHA’s revision of its Bloodborne Pathogens Standard to require the use of safety-engineered sharp devices (see below). 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.

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 built-in safety features or mechanisms that effectively reduce the risk of an exposure incident.

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.

Sharps with Safety Features Exposed (left) and Covered (right)



Source: CDC.

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. These measures help protect both the healthcare provider and the patient from exposure to the other's blood.

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

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.

Work Practice Controls: How to Do the Job Safely

[This section is taken largely from OSHA, 2012.]

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. Any required manipulation must be accomplished through the use of a mechanical device or a one-handed technique. Shearing or breaking of contaminated needles is prohibited.

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 bench tops where blood or OPIM are present. It may be useful to designate areas to be kept free of body fluids (no specimens or gloves) where drinks may be permitted.

All procedures involving blood or OPIM 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 OPIM 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 (e.g., locking centrifuge lids). Gloves used for the task of sorting laundry should be of sufficient thickness to minimize sharps injuries.

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, put on, take off, 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.

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% or more of healthcare personnel do not report occupational percutaneous injuries (CDC, 2008). Six sharps devices are responsible for nearly 80% 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% of all sharps injuries (CDC, 2008).

The largest percentage (39%) of sharps injuries occur on inpatient units, particularly medical floors and intensive care units (ICUs). The operating room is the second most common environment in which sharps injuries occur, accounting for 27% 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, 2008)

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, 2008).

Element IV: Personal Protective Equipment

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

[This section is taken from OSHA, 2012, 1991 and CDC, 2004.]

Personal protective equipment (PPE) includes barriers such as gloves, gowns, masks, goggles, and face shields. They protect patients and workers from exposure to bloodborne pathogens on the job. Use of PPE is part of Standard Precautions, used with **all** patients, and is required by OSHA.

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.

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.

Procedures that generate splashes or sprays of blood, body fluids, secretions, or excretions —such as open 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.

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.

Gloves

Wear gloves:

- When contact with blood, body fluid, mucous membranes or non-intact skin is anticipated
- When performing vascular access procedures
- For contact with contaminated items or surfaces (OSHA)

Always change gloves between patients!

- Always do hand hygiene following removal of gloves, in case of:
  - Unsuspected holes in the gloves
  - Contamination of the hands during glove removal

Gloves used in the healthcare setting are subject to FDA evaluation and clearance. Nonsterile disposable medical gloves made of latex or nitrile should be available for routine patient care.

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.

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 are indicated for non-patient care activities, such as handling or cleaning contaminated equipment or surfaces.

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

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.

Gloves **must be changed** 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.

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 can cover the gown cuff and provide a more reliable continuous barrier for the arms, wrists, and hands. 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.

Cover Garb: Gowns and Lab Coats

Wear a gown or fluid-resistant lab coat whenever soiling of skin or clothing is anticipated. Remember that a gown may be needed during the care of a patient on Standard Precautions.

Gowns are intended to protect your arms and exposed body areas and prevent contamination of clothing with blood, body fluids, and OPIM. The type of gown is chosen 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.

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.

Gowns should be removed before leaving the patient care area to prevent possible contamination of the environment outside the patient's room. 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 to contain contamination. **Do not reuse gowns**.

Masks

Masks by themselves are used for three primary purposes in healthcare settings: (1) to protect workers from contact with infectious material from patients, e.g., respiratory secretions; (2) to protect patients from exposure to infectious agents carried in the workers' mouths or noses when they are engaged in procedures requiring sterile technique, and (3) to put on coughing patients, to limit potential dissemination of infectious respiratory secretions from the patient to others, as part of Respiratory Hygiene.

A mask may be worn without eye protection, but eye protection must be worn with a mask (OSHA). Masks should not be confused with respirators that are used to prevent inhalation of small particles that may contain infectious agents transmitted via the airborne route.

When Airborne Precautions are used, a respirator is required. It may be an N-95 respirator, which requires fit testing, or a positive air-purifying respirator (PAPR), which does not require fit testing. These are discussed in Element II in the section on tuberculosis.

An N-95 Respirator

Note N-95 identifier in horizontal box at the bottom of the text. Source: 3M, 2014.

There are many types of disposable particulate respirators, 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 biologic agents such as bacteria or viruses are particles, they can be filtered by particulate respirators. An N-95 respirator 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 that does not require a seal.

Face Shields and Goggles

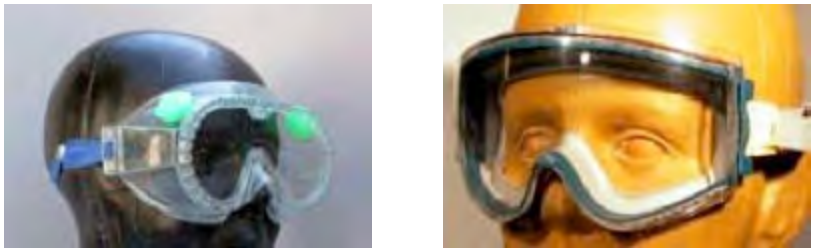
Masks in combination with eye protection devices, such as goggles or glasses with solid side shields, or chin-length face shields, shall be worn whenever splashes, spatter, or droplets of blood or OPIM may be generated and eye, nose, or mouth contamination can be reasonably anticipated (OSHA).

Note: A mask always accompanies eye protection unless a face shield is used.

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.

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 (see below). 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.

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 forehead 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.

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 be easily damaged. 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 snuggly at the wrist.

Masks should fit snuggly 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 snuggly 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. Goggles with prescription lenses are available.

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 **every** 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. Avoid touching the environment with soiled gloves.
- 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: Cleaning, Disinfection, and Sterilization

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 and ability to apply proper techniques for cleaning, disinfection, sterilization, and reprocessing of medical equipment.

Environmental Control Measures

[This section is taken from OSHA, 2012, 1991.]

Microorganisms are present in great numbers in moist, organic environments, and some can persist under dry conditions. Contaminated surfaces have been associated with transmission of infections—especially *C. diff*, norovirus, and MRSA.

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 OPIM. Contaminated broken glassware must be removed using mechanical means, like a brush and dustpan or vacuum cleaner.

Chemical germicides and disinfectants 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.

Laundry

OSHA defines contaminated laundry as "laundry that 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 (e.g., 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 OPIM, 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.

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.

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 other spaces; and (d) pressurization of buildings relative to the outdoors and other attached buildings.

Waste Management

Both science and regulation address the management of waste from healthcare. In addition to complying with regulation, 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.

Although any item that has had contact with blood, exudates, or secretions may carry pathogens, 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
- Pathologic and microbiologic 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, red, 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. If the outside of the primary bag is contaminated or punctured, it must be placed into a second biohazard bag. All bags should be securely closed for disposal.

Puncture-resistant containers located at the point of use are used to discard sharps, including needles and syringes, scalpel blades, unused sterile sharps, and discarded slides or tubes with small amounts of blood. 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 **required** 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.

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.

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 (Rutala et al., 2008).

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. 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 (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 (Rutala et al., 2008).

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).

Reprocessing Reusable Medical Equipment

The NYSDOH (2011, 2008) 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 ***at least*** 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 is 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 (NYSDOH, 2011, 2008)

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, 2013). Approximately twenty to thirty 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 labeled 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, 2009).

Many sources have repeatedly warned 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, 2009).

Element VI: Protecting Healthcare Workers

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

[This section is taken from OSHA, 2011, 1991.]

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.

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 infection control and stressing individual responsibility for infection control
- 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

Infection Control Training

New York State requires that healthcare professionals fulfill all federal and state requirements for infection control training and must repeat 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, 2010a).

The federal government, through OSHA, requires that all new employees, or employees being transferred into jobs involving potential exposure to blood or OPIM, must receive bloodborne pathogen training before assignment to tasks where an occupational exposure may occur. 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 (NYSDOH, 2010a).

The training program shall contain at a minimum the following elements:

- An accessible copy of the regulatory text of the OSHA Bloodborne Pathogens Standard and an explanation of its contents
- A general explanation of the epidemiology and symptoms of bloodborne diseases
- An explanation of the modes of transmission of bloodborne pathogens
- An explanation of the employer's exposure control plan and the means by which the employee can obtain a copy of the written plan
- An explanation of the appropriate methods for recognizing tasks and other activities that may involve exposure to blood and OPIM
- An explanation of the use and limitations of methods that will prevent or reduce exposure including appropriate engineering controls, work practices, and personal protective equipment
- Information on the types, proper use, location, removal, handling, decontamination and disposal of personal protective equipment
- An explanation of the basis for selection of personal protective equipment
- Information on the hepatitis B vaccine, including information on its efficacy, safety, method of administration, the benefits of being vaccinated, and that the vaccine and

vaccination will be offered free of charge

- Information on the appropriate actions to take and persons to contact in an emergency involving blood or other potentially infectious materials
- An explanation of the procedure to follow if an exposure incident occurs, including the method of reporting the incident and the medical followup that will be made available
- Information on the post-exposure evaluation and followup that the employer is required to provide for the employee following an exposure incident
- An explanation of the signs and labels and/or color coding required
- An opportunity for interactive questions and answers with the person conducting the training session (NYSDOH, 2010a).

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).

Assessments and Vaccines

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 (NYSDOH, 2010a).

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.

Annual TB screening of employees must be performed in hospitals and diagnostic and treatment centers in New York State. If previously negative, the TST or QuantiFERON-TB test (QFT) should be performed. If previously positive, a screen for symptoms should be performed and the employee evaluated as appropriate. Routine annual follow-up chest x-rays are not required. All screening activities should be documented in the employee health record (NYSDOH, 2009).

An employee who is found to be a converter (defined as an individual with a >10 mm increase in the size of TST induration, or with a positive IGRA, after establishing a prior negative baseline TB screening test) must be assessed for active TB disease (clinical evaluation and chest x-ray examination). If active TB disease is suspected or diagnosed, the employee should not return to work until TB disease has been ruled out. If an employee is found to have active TB disease, the employee may not return to work until clinically determined to be noninfectious. Clusters of TST or IGRA conversions or active TB disease in an employee must be reported to the local and state health departments (NYSDOH, 2009).

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, 2009).

Mumps, Measles, and Rubella

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

All those who work in healthcare facilities are required to be immune to measles and rubella, according to NYS regulations, which also recommends 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 (e.g., 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 Virus (HBV)

Testing for HBsAg is recommended ***only*** for persons who are the source of blood or bodily fluid exposures that might warrant post-exposure prophylaxis, such as needlestick injury to a healthcare worker or exposure of a patient to a worker's blood.

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. 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.

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.

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.

Hepatitis C Virus (HCV)

Hepatitis C is transmitted primarily through percutaneous exposure to infected blood. 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.

Influenza

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 (NYSDOH, 2014), 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 (e.g., stem cell transplant patients) when those patients require a protective environment (NYSDOH, 2014).

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, 2014).

Element VII: Sepsis Awareness and Education

Scope of the Problem: Sepsis Prevalence and Mortality

Sepsis is the body’s extreme response to an infection. It is a life-threatening medical emergency that requires early recognition and intervention. Sepsis is a condition caused by an over-reactive immune response to an infection and is a major cause of death globally. Normally, when bacteria or other microbes enter the human body, the immune system efficiently destroys the invaders. In sepsis, the immune system goes into overdrive, and the chemicals it releases into the blood to combat the infection trigger widespread inflammation that can ravage the entire body (Recknagel et al., 2012).

Severe sepsis is unfortunately common, expensive, and frequently fatal. More than 1.5 million cases of sepsis occur annually in the United States, and its incidence continues to rise. It has been estimated that between 15% and 30% of these people die (NIGMS, 2018). This means about 250,000 people die from sepsis each year in the United State (CDC, 2018a). Most sepsis cases are community-acquired: 7 in 10 patients with sepsis had recently used healthcare services or had chronic conditions requiring frequent medical care.

In New York State, severe sepsis and septic shock impacts approximately 50,000 patients each year, and on average almost 30% of patients will die from this syndrome. In addition, many more may experience lifelong impairments as a result of the broad impact that sepsis can have on organ and tissue function (NYSDOH, 2017).

NYS Sepsis Improvement Initiative and Rory Staunton's Law

In 2017 New York State Governor Andrew Cuomo signed into law amendments to Public Health Law § 239 and Education Law § 6505, directing approved infection control continuing education providers to add sepsis education and identification material to their mandated NYS Infection Control courses.

The purpose of these changes to education and health law is to establish a sepsis awareness, prevention, and education program within the Department of Education that will educate students, parents, and school personnel about sepsis awareness. In addition, the new guidelines are intended to help healthcare providers recognize early signs of sepsis in children and adults and initiate rapid treatment protocols.

Rory's Regulations

In May 2013, New York State became the first state to issue sepsis regulations, collectively known as "Rory's Regulations," mandating that all New York hospitals adopt, develop, and implement best practices for the early detection and timely treatment of sepsis (ASTHO, 2017). These regulations (10 NYCRR 405.2 and 405.4) were enacted after the death of Rory Staunton, a 12-year-old boy whose sepsis stemmed from an infected scrape, which was initially treated as a virus. Rory's parents set up a foundation to push for standard sepsis care in all states. The regulations require hospitals in New York State to adopt evidence-based protocols to ensure early diagnosis and treatment of sepsis.

Hospital Regulations

Beginning in 2014 each acute care hospital in New York State that provides care to patients with sepsis is required by amendment of Title 10 of the New York State Codes, Rules and Regulations (Sections 405.2 and 405.4) to develop and implement evidence-informed sepsis protocols that describe their approach to both early recognition and treatment of sepsis patients (NYSDOH, 2017).

This law requires hospitals to:

- Implement an evidence-based process, which should include suitable training, resources, and equipment for healthcare providers, for quickly recognizing and treating sepsis in adults and children
- Collect sepsis data to improve the quality of care and provide this data to the state annually
- Implement Parents' Bill of Rights to ensure that parents and primary care providers receive vital information about children's care. Some components include:
  - Allowing parents or guardians to stay with pediatric patients at all times
  - Reviewing medical tests with the patient or the patient's parent or guardian before discharging a child patient (CDC, 2017)

Hospitals are required to report data to the New York State Department of Health, which is used to calculate each hospital's performance on key measures of early treatment and protocol use. Hospitals are also required to submit sufficient clinical information on each patient with sepsis to allow the DOH to develop a methodology to evaluate "risk adjusted" mortality rates for each hospital. Risk adjustment permits comparison of hospital performance and takes into consideration the different mix of demographic and comorbidity attributes, including sepsis severity, of patients cared for within each hospital (NYSDOH, 2017).

Although these regulations are new, the New York State DOH reports that between 2014 and 2016 the use of protocols for sepsis care in adults increased from approximately 74% to nearly 85%. Mortality decreased during this period from 30% to 25% (Hershey & Kahn, 2017).

Causes of Sepsis

Sepsis does not arise on its own. It stems from another medical condition, such as an infection in the lungs, urinary tract, skin, abdomen, or other part of the body. Invasive medical procedures like the insertion of a vascular catheter can introduce bacteria into the bloodstream and bring on the condition (NIGMS, 2018).

Many different types of microbes can cause sepsis, including bacteria, fungi, and viruses, but bacteria are the most common culprits. Severe cases often result from a body-wide infection that spreads through the bloodstream, but sepsis can also stem from a localized infection (NIGMS, 2018). Once a septic reaction is triggered, the resulting damage is widespread, extensive, and life-threatening.

Originally sepsis was described as a disease specifically related to Gram-negative bacteria. This is because sepsis was thought to be a response to endotoxin—a molecule felt to be relatively specific for Gram-negative bacteria. In fact, some of the original studies of sepsis showed that Gram-negative bacteria were among the most common causes of sepsis. This resulted in a number of trials that focused on Gram-negative therapies, and even highly specific therapies for endotoxin, which were felt to be potentially useful treatments for sepsis. It is now recognized that sepsis can be caused by any bacteria, as well as from fungal and viral organisms.

While bacterial causes of sepsis have increased, fungal causes of sepsis have grown at an even more rapid pace. This may represent a general increase in hospital-acquired cases of sepsis, or it may reflect effective treatment of bacterial infections, which then allowed fungal infections to grow without competition (Martin, 2012).

Development of Sepsis Following Infection

In a classic systemic infection, the body's immune response is self-limiting: the immune forces are called into action, the battle is fought, and the army retires. Sepsis begins like a typical infection and often presents with the signs of a classic systemic infection—fever, tachycardia, tachypnea, and an elevated white blood cell count. However, in sepsis the natural checks and balances fail. Instead of tapering off and disappearing, the inflammatory forces spread beyond the infected region.

The immune response begins as pro-inflammatory signal molecules enter the bloodstream in large numbers. As they travel through the vascular system, these molecules cause dilation and leaking of the endothelium that lines the blood vessels. The usual orderly movement of oxygen, nutrients, and fluids through the capillary walls is disrupted and organs become hypoxic (starved of oxygen).

If the sepsis continues, organ hypoxia and damage becomes organ failure, and at this point the condition is called **severe sepsis**. Severe sepsis increases the likelihood that the patient will die. When the organ system that fails is the circulatory system, the arterial wall muscles can no longer contract sufficiently to maintain adequate blood pressure. Now the patient is in **septic shock**, and the chance of surviving declines further (Shapiro et al., 2010).

The systemic collapse that occurs in sepsis is called **systemic inflammatory response syndrome (SIRS**). SIRS can be triggered by a variety of causes, including noninfectious causes such as pancreatitis, trauma, or burns. When it is triggered by an infection, SIRS is called *sepsis* and, unlike other types of SIRS, sepsis must be treated with antibiotics to remove or control the primary source of the infection.

Although any infection can trigger sepsis, to develop sepsis, a microbial infection is necessary but not sufficient: it appears that a patient also needs a pre-existing susceptibility. Support for this idea can be seen in large surveys of ICU patients. These surveys found that "approximately 70% to 80% of the cases of severe sepsis in adults occurred in individuals who were already hospitalized for other reasons" (Munford & Suffredini, 2009).

Sites and Sources of Infection

The likelihood that a local infection will progress to sepsis varies according to its source and location. For example, pulmonary or abdominal infections are 8 times more likely to develop into sepsis than are urinary tract infections (Munford, 2008). The most common sites of infection that lead to sepsis are:

- Lungs
- Abdomen
- Kidney
- Bloodstream (Mayo Clinic, 2018)

Populations at Increased Risk

Anyone at any age can get sepsis, but it is more common in infants, older adults, and those who are chronically ill or immune-suppressed. About 2 of every 3 patients who develop sepsis already have another significant illness. People with chronic health conditions such as diabetes, cancer, kidney and liver disease, suppressed immune systems, and patients with implanted devices or endotracheal tubes are at increased risk of developing sepsis (Neviere, 2013).

The increasing number of sepsis cases in the United States may be due to:

- An aging population
- The increased longevity of people with chronic diseases
- Greater use of invasive procedures which introduce microorganisms into the body
- Broader use of immunosuppressive drugs, chemotherapy, and transplantation

- The spread of antibiotic-resistant organisms
- Improved clinical awareness and diagnosis of sepsis (NIGMS, 2018)

Early Recognition of Sepsis: Signs and Symptoms

Early recognition of sepsis is the responsibility of all healthcare providers. The challenge is to pick out the signs of sepsis from among the other abnormalities plaguing a patient. To make sepsis easier to identify, there has been an effort to standardize its definition despite its wide range of presentations.

Three Definitions

In 1991 the American College of Chest Physicians and the Society of Critical Care Medicine issued the first consensus definition of sepsis in an effort to standardize its terminology. It characterized **sepsis** as an abnormal response to infection called "systemic inflammatory response syndrome" (SIRS) (Cortés-Puch & Hartog, 2016).

From mild to severe, *sepsis* was defined as:

- Infection
- SIRS
- Sepsis
- Severe sepsis
- Septic shock
- Multiple organ dysfunction syndrome (MODS)

This intentionally broad definition described the common early clinical manifestations seen in septic patients: fever, mental status changes, tachypnea, tachycardia, hypotension, leukocytosis, thrombocytopenia, and coagulation abnormalities were considered for inclusion in the definition (Balk, 2014). In 2001 the definition was expanded to include a number of additional general, inflammatory, hemodynamic, and organ dysfunction variables.

In 2016 an international task force revised the definition of **sepsis** as a "dysregulated" host response causing life-threatening organ dysfunction that is associated with the acute change of at least 2 points in the sequential organ failure assessment (SOFA) score (Cortés-Puch & Hartog, 2016).

New sepsis criteria were advocated as "Sepsis-3" in 2017, which redefined **sepsis** as infection complicated by one or more organ dysfunctions. Organ system dysfunctions are assessed with an increase in the Sequential Organ Failure Assessment (SOFA) score by 2 or more points. This definition of sepsis is only applied to adult population (Kawasaki, 2017).

Classic Signs and Symptoms

Classic signs and symptoms of a systemic infection that may be associated with sepsis in persons with confirmed or suspected infection can include:

- Fever
- Tachypnea
- Tachycardia
- High white blood cell count

The severity of the septic reaction should also produce other warning signs, such as:

- Hot, flushed skin
- Newly altered mental status
- Hypotension
- Widened pulse pressure*
- Elevated blood lactate level
- Thrombocytopenia

* **Pulse pressure** is the difference between the systolic and the diastolic blood pressure values.

People who are elderly, immunocompromised, or neutropenic (have an abnormally low levels of white blood cells) are the most likely to develop a septic response to an infection. Because of our aging population and because medical care is increasing the longevity of immunocompromised patients, the cases of sepsis are increasing in the United States (CDC, 2018b).

Signs and Symptoms in Older Adults

The incidence of sepsis increases with age due to increasing comorbidity, exposure to instrumentation, institutionalization, immune-senescence, and malnutrition. The outcome of older patients with sepsis is worse compared to younger patients and is associated with higher healthcare costs (Warmerdam et al., 2017).

Septic patients often have a fever, sometimes with chills and sometimes with an abrupt onset. However, the majority of septic patients are elderly, and this demographic brings with it a caution about using fever to recognize sepsis. Older adults develop fevers less readily than younger patients, and sepsis in older adults can present without fever, with only a modest fever, or with hypothermia (Jui, 2010).

To improve early sepsis recognition and outcomes in older patients, the quality of emergency department (ED) sepsis care is critically important. Atypical symptom presentation, including delirium, malaise, and functional decline, and the absence of classical symptoms such as fever, tachycardia, and hypoxemia may result in poor sepsis recognition, thus delaying treatment. As a result, older patients may present to the ED with more acute potentially reversible sepsis-related organ dysfunction, especially because older patients have a higher risk for deterioration due to less physiological reserve (Warmerdam et al., 2017).

Poor sepsis recognition may also affect the quality of care of older patients in the ED, which has a large impact on mortality. In a recent study, implementing a Surviving Sepsis Campaign–based quality improvement program, in patients who were hospitalized with a suspected infection, full compliance with recommended quality performance measures was associated with a large reduction of in-hospital mortality. Unfortunately, full bundle compliance* was achieved in only approximately 40% of the patients. Previous studies suggest that this may be even worse in older patients, due to the aforementioned poor sepsis recognition (Warmerdam et al., 2017).

***Bundle**: A bundle is a selected set of elements of care that, when implemented as a group, have an effect on outcomes beyond implementing the individual elements alone. Each hospital's sepsis protocol may be customized, but it must meet the standards created by the hour-1 bundle. Enhancing reliability of the hour-1 bundle allows teams to focus on aspects of the changes they are implementing. The aim is to create a reliable system that reduces the odds for both death and morbidity from sepsis (Surviving Sepsis Campaign, 2018).

Signs and Symptoms in Children

Sepsis is one of the leading causes of mortality among children worldwide. It is a life-threatening condition that affects many children regardless of underlying healthcare issues. Although demographic data does not clearly show it, many children who are reported to die from other underlying conditions actually die directly from sepsis (Kawasaki, 2017).

The management of pediatric sepsis was comprehensively advocated through systematic review process in the **Surviving Sepsis Campaign guidelines (SSCG)** 2008 and 2012. Unfortunately, many recommendations and suggestions were still based on low-quality evidence and expert consensus, and sometimes only on evidence in *adult* sepsis. Furthermore, the latest version of SSCG did not include a specific description of the management of pediatric sepsis (Kawasaki, 2017).

Consensus guidelines emphasize basic principles of goal-directed resuscitation, prompt antimicrobial administration, and supportive care of organ dysfunction in pediatric sepsis. However, few large clinical trials have addressed the management of critically ill children with severe sepsis. Consequently, debate remains about the optimal approach to both basic and adjuvant therapies. For example, vasoactive strategies, immune stimulation, and plasma exchange would all benefit from further evaluation in rigorous pediatric trials (Weiss et al., 2015).

Signs and symptoms of **neonatal sepsis** include:

- Body temperature changes
- Breathing problems
- Diarrhea
- Low blood sugar
- Reduced movements
- Reduced sucking
- Seizures
- Slow heart rate
- Swollen belly
- Vomiting
- Yellow skin and whites of the eyes (jaundice)

Signs of **sepsis in children** include:

- High fever (above 100.4 degrees)
- General illness or a previous injury, such as a scrape or cut
- Shortness of breath
- Very rapid heart beat
- Drop in, or no, urine output

Severe Sepsis and Septic Shock

Severe sepsis can develop if sepsis continues, leading to organ hypoxia and organ failure. Severe sepsis increases the likelihood that the patient will die. When the organ system that fails is the circulatory system, the arterial wall muscles can no longer contract sufficiently to maintain adequate blood pressure. Now the patient is in septic shock, and the chance of surviving declines further (Shapiro et al., 2010).

Severe sepsis and septic shock are unfortunately common, complicated and deadly conditions within the same pathophysiologic spectrum. If a clinician believes that a patient is exhibiting SIRS secondary to infection, that patient has sepsis. If that same patient has signs or symptoms of organ dysfunction, then that patient has severe sepsis. Septic shock is then characterized by overall tissue hypoperfusion, tissue hypoxia, or general hypotension that fails to respond to fluid resuscitation (Tannehill, 2012).

Severe Sepsis (Sepsis Syndrome)

Severe sepsis, or sepsis syndrome, is present when the patient has progressed to a stage in which one or more organs or organ systems begin to fail. The Surviving Sepsis Campaign no longer uses the term *severe sepsis* but simply *sepsis*.

Sepsis is considered severe when a patient has one of the following clinical problems:

- Cardiovascular system dysfunction
- Acute respiratory distress syndrome (ARDS)
- Dysfunction of two or more other organs or systems

Septic shock is acute circulatory failure with refractory (difficult to reverse) hypotension that is unexplainable by other causes. The term *shock* describes a condition in which many tissues throughout the body become hypoxic due to poor perfusion. In shock, normal homeostatic mechanisms are either not functioning or not adequate to deliver enough oxygen to tissues. If it is not reversed, shock leads to organ failure and death. Septic shock is a form of distributive shock. In septic shock, there is hypotension and vasodilation that cannot be reversed by giving adequate fluids. When the hypotension of septic shock does not respond to vasopressors, the condition is called refractory septic shock (Munford & Suffredini, 2009).

Septic shock presents with hypotension, oliguria, abnormal mental status (restlessness, confusion, lethargy, or coma), and metabolic acidosis due to an increased concentration of lactate in the blood. When the shock is septic, it can also present with tachycardia, tachypnea, fever, and a high white blood cell count (Gaieski, 2013). A key sign in sepsis is hypotension that cannot be reversed with fluids alone.

The hypotension of shock may be absolute, with a systolic blood pressure <90 mm Hg. Alternately, the hypotension of shock may be relative and take the form of a drop in systolic blood pressure >40 mm Hg; in this situation, hypertensive people can be in shock although their presenting blood pressures are within the normal range. When a person is in shock, vasopressors are frequently needed to maintain adequate perfusion of tissues.

For a patient in shock, diagnostic tests, a physical examination, and a medical history should not delay procedures that will stabilize the patient's circulation and respiration. Instead, data should be collected while the patient is being resuscitated. It is important to know the patient's blood and serum chemistry values, so resuscitators need to draw blood samples.

Initial tests include a complete blood count with a differential, basic blood chemistries, liver function tests, coagulation studies, cardiac enzymes, blood gases, lactate levels, blood type with cross match, and toxicology screening (Shapiro et al., 2010). Two sets of blood cultures should be drawn with the initial labs and prior to administration of antibiotics.

Did You Know . . .

To optimize a patient's chance of survival, sepsis must be treated rapidly and efficiently. Every hour of delay in treatment reduces the average patient's survival by 8%.

Principles of Sepsis Treatment

The initial step in the treatment of sepsis is to stop the infection, protect the vital organs, and prevent a drop in blood pressure. International clinical practice guidelines and the Centers for Medicare and Medicaid Services (CMS) recommend the prompt identification of sepsis and treatment with broad-spectrum antibiotic agents and intravenous fluids (Seymour et al., 2017).

More seriously affected patients might need a breathing tube, kidney dialysis, or surgery to remove an infection. Despite years of research, scientists have not yet developed a medicine that specifically targets the aggressive immune response seen with sepsis (NIGMS, 2018). Prompt diagnosis and treatment are critical for optimal outcomes; there is increased morbidity/mortality with delayed recognition and response.

New York Codes, Rules, and Regulations parts 405.2 and 405.4 require all sepsis protocols to include receipt of the following care within 3 hours:

- Obtaining of a blood culture before the administration of antibiotics
- Measurement of the serum lactate level
- Administration of broad-spectrum antibiotics (Seymour et al., 2017)

Protocols also require a 6-hour bundle, consisting of:

- Administration of a bolus of 30 ml of intravenous fluids per kilogram of body weight in patients with hypotension or a serum lactate level of 4.0 mmol or more per liter

- Initiation of vasopressors for refractory hypotension
- Re-measurement of the serum lactate level within 6 hours after the initiation of the protocol (Seymour et al., 2017)

Diagnostic modalities include blood cultures and other testing to identify source and site or infection and organ dysfunction. Treatment includes administration of appropriate IV antimicrobial therapy, with source identification and de-escalation of antibiotics as soon as feasible. These recommendations are supported by preclinical and observational studies suggesting that early treatment with antibiotics and intravenous fluids could reduce the number of avoidable deaths (Seymour et al., 2017).

Patient Education and Infection Prevention

Healthcare providers can help patients and family members protect themselves against sepsis by teaching the signs and symptoms of sepsis and the importance of prompt and early treatment.

Sepsis is a medical emergency. A person with sepsis should look ill and should seek immediate care for worsening infection and signs and symptoms. Time matters. Call your doctor or go to the emergency department immediately if you suspect sepsis.

- It’s important that you ask, “Could this be sepsis?”
- If you are continuing to feel worse or not getting better in the days after surgery, ask your doctor about sepsis.
- If you have an infection and don’t get better or start feeling worse, ask your doctor, “Could this infection be leading to sepsis?”

Infection prevention is a critical part of preventing sepsis. This includes proper hand hygiene, wound care, and vaccination. Be aware that children and older adults, as well as immunocompromised people and those with chronic illnesses, are at higher risk for contracting sepsis than the general population.

Warning signs and symptoms of sepsis include:

- Altered mental state, confusion
- Shortness of breath
- Fever
- Clammy or sweaty skin
- Extreme pain or discomfort
- High heart rate

Talk to your doctor or nurse about steps you can take to prevent infections. Some steps include taking good care of chronic conditions and getting recommended vaccines.

- Know the symptoms of sepsis.
- Practice good hygiene, such as handwashing, and keeping cuts clean until healed.
- **Act fast**. Get medical care **immediately** when an infection is not getting better or if it gets worse.

Always remember, sepsis is a medical emergency. Time matters. Giving relevant history and information to healthcare providers can help with early identification and treatment of sepsis, leading to improved outcomes.

The Need for Sepsis Awareness: Dana's Story

In December 2011, a lack of awareness of sepsis—a disease responsible for more American deaths each year than breast cancer, prostate cancer, and AIDS combined—nearly cost me my life. It began with a little bump on my shoulder one afternoon. I did not know that within 24 hours that small bump would develop into life-threatening septic shock and soon I would find myself in the ICU.

The seemingly insignificant little bump became swollen and I developed symptoms that felt like the worst flu of my life. When my husband discovered my temperature was over 104 degrees, he rushed me to the emergency room, just on a hunch that this was not an ordinary flu.

He had never heard of sepsis, and I had heard the word, but thought it was a rare, largely obsolete disease. I had no idea of the symptoms and certainly no idea it could be happening to me. When I arrived at the hospital, I was the sickest I had ever been in my life. My temperature was soaring, my blood pressure was falling, and my arm was in excruciating pain. I soon learned the bump on my arm actually was a skin infection, which had led to cellulitis.

The doctors acted quickly and I was soon admitted to the ICU, where I vacillated between life and death. I was cognizant enough to worry whether I would make it out of the hospital and home again to my two small children, and if so, whether all my limbs would be coming home with me.

After several terrifying, agonizing days, I began to recover, transitioning first out of the ICU and then out of the hospital. I went home to begin what would be a deceptively arduous recovery. Having survived and avoided severe complications like amputations, I expected my recovery would be swift, but it was not. Weeks turned to months, even years, before I began to feel like "myself" again. I did not know then that post-sepsis or post-ICU syndrome exists and can affect many sepsis and ICU patients. Today, nearly three years later, I have much of my strength back, although some of the physical and (of course) the emotional impacts still linger.

As difficult as my recovery was, I am lucky to be alive. I am lucky that the doctors and nurses at my hospital were aware of sepsis. They saved my life. Others—who either do not make the fortunate decision to seek emergency medical care, or whose symptoms are overlooked or misdiagnosed—are not as lucky.

But surviving sepsis should not be a matter of luck. The public and medical professionals alike must be aware of sepsis. We must know the name of this deadly disease, and we must know the symptoms. By being aware and suspecting sepsis, we will be able to save more lives—which just might be our own, or those of our loved ones. The CDC's efforts to increase sepsis awareness and improve treatment will result in fewer lives lost to this sudden, swift and often-fatal disease.

Source: CDC Safe Healthcare Blog September 11, 2014.
https://blogs.cdc.gov/safehealthcare/sepsis-awareness/

Occupational Exposure to Bloodborne Pathogens

The need to protect healthcare workers from bloodborne exposures 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. As noted earlier, the Standard was later amended to add requirements for the safe use of sharps devices (OSHA, 2012, 1991).

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

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

If a sharps injury occurs, as soon as safely possible,

- Wash the affected area with soap and water.
- Do not "milk" or squeeze the wound.
- Application of antiseptics should not be a substitute for washing. There is no evidence that using antiseptics (like hydrogen peroxide) will reduce the risk of transmission for any bloodborne pathogens; however, the use of antiseptics is not contraindicated.
- The risk of contracting HIV from a sharps injury is estimated to be 0.3%.

If there is exposure to the eyes, nose, or mouth,

- Flush thoroughly with water, saline, or sterile irrigants.
- Remove any potentially contaminated clothing as soon as possible.
- Familiarize yourself with existing protocols and the location of emergency eyewash or showers and other stations within your facility in advance of need.
- The risk of contracting HIV through this type of exposure is estimated to be 0.09%. (CDC, 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 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. These regulations require that a management plan be in place (NYSDOH, 2012).

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 required to form agreements or contracts with another facility, emergency department, or private practitioner for such services (NYSDOH, 2012).

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

- Post-exposure evaluation and followup post-exposure medications and/or vaccinations, as indicated
- 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 (NYSDOH 2012)

The National Needlestick Hotline is available 24 hours per day at 888 448 4911, without cost, for consultation by treating providers. Documentation of consultation may be prudent if PEP is being considered.

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 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 3-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 4-week regimen to the employee at no cost. (NYSDOH, 2012)

Post-exposure prophylaxis (PEP) provides 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 against HIV should be started as soon as possible—within hours, not days—after exposure and continued for 28 days if indicated. 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.

For a susceptible person, the risk from a single needlestick or cut exposure to HBV-infected blood ranges from 6% to 30% 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, 2014b).

The average risk of HIV infection after a needlestick or cut exposure to HlV-infected blood is 0.3%. Stated another way, 99.7% 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%. The risk after exposure of non-intact skin to HlV-infected blood is estimated to be less than 0.1%. 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, 2014b).

The average risk for infection after a needlestick or cut exposure to HCV-infected blood is approximately 1.8%. 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, 2014b).

As of January 2014 there is no approved PEP against HCV. The benefit of the use of antiviral agents to prevent HCV infection is unknown and antivirals are not currently approved by the Federal Drug Administration (FDA) 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 medications may be prescribed. The national bloodborne pathogen hotline provides 24-hour consultation for clinicians who have been exposed on the job; it is available 24 hours per day at 888 448 4911, without cost.

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.

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. They have issued a risk questionnaire, to be found in this source.

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, 2011).

Factors that may have a bearing on the ability of healthcare workers, including those with bloodborne infections, to provide quality healthcare 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, 2011)

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, 2011 rev.).

Each panel includes a public health official, an infectious disease expert, and an expert in infection control 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 individuals' risk of bloodborne disease transmission through their professional practice, and to recommend practice limitations, modifications, or restrictions where the evidence suggests there is a significant risk to patients (NYSDOH, 2011 rev.).

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, 2011 rev.).

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, 2011 rev.).

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Post Test: NY IC (120)

Use the answer sheet following the test to record your answers.

1. Common risk factors for HAIs include:

    a. Improper use of antibiotics.
    b. Air-conditioned facilities.
    c. Outpatient treatments.
    d. Uncontrolled visitation by families and friends.

2. Most HAIs are of the following types:

    a. Bloodstream, surgical site, migraines, and pneumonia.
    b. Surgical site, pneumonia, decubitus ulcer, and urinary tract.
    c. Bloodstream, surgical site, pneumonia, and urinary tract.
    d. Bloodstream, pneumonia, urinary tract, and deep vein thrombosis.

3. Which one of the following is not an Element of Infection Control under NYS law?:

    a. Wearing personal protective equipment when appropriate.
    b. Use of engineering and work practice controls.
    c. Applying the Elements to cleaning, disinfection, and sterilization.
    d. Restricting visitors except in the ICU.

4. Hospitals currently measure their infection control practices by:

    a. Benchmarks.
    b. Zero tolerance.
    c. Patient population statistics.
    d. Funding considerations.

5. Taking a leadership position in systematic reporting, NYS has utilized the CDC’s National Healthcare Safety Network (NHSN) and has access to HAI data:

    a. Annually.
    b. Monthly.
    c. Weekly.
    d. Continually.

6. New York State mandates that all health professionals take responsibility for monitoring IC practices:

a. For their own patients.
b. For patients and visitors to the facility.
c. For all licensed and unlicensed workers for whom they are responsible.
d. For themselves only.

7. In recent years, antibiotic-resistant organisms have included all but:

a. *H. pyloris.*
b. *C. difficile.*
c. VRE.
d. *S. aureus.*

8. Which of the following is **not** a link in the Chain of Infection?:

a. Pathogenic micro-organism.
b. Reservoir.
c. Means of attachment.
d. Host susceptibility.

9. Bacteria are single-celled organisms that include cocci and bacilli, which are distinguished by:

a. Size.
b. Shape.
c. Color.
d. Luminosity.

10. Viruses are about 100 times smaller than bacteria, and they:

a. Are more susceptible to antibiotics than modern-day bacteria.
b. Can reproduce both inside and outside a host cell.
c. Can only be spread by direct contact.
d. Typically have tiny protein arms projecting from their surfaces.

11. Most fungi are harmless, but some are life-threatening. Among those causing trouble is *Aspergillus spp.*, which:

a. May be dispersed by site renovation and construction.

b. Is found in asparagus and other produce served to patients.

c. Is an anaerobic fungus that thrives where oxygen is in use.

d. Contaminates primarily the clothing and bedding of the patient.

12. A reservoir is a place where germs live and grow. The most common reservoirs in healthcare facilities are:

a. Patient call buttons.

b. People.

c. Bathrooms.

d. IV stands.

13. A pathogen leaves its reservoir or host through a:

a. Mode of Transmission.

b. Portal of entrance.

c. Portal of exit.

d. Natural anatomical opening.

14. The indirect means of transmission of a pathogen:

a. May be accomplished through kissing or biting.

b. Occurs only through airborne particles.

c. Can be through sexual intercourse.

d. Involves an intermediate person or item.

15. The portal of entry, the location through which a pathogen enters a susceptible host:

a. Can be the same in the new host as the portal of exit in the source host.

b. Is not important because any portal can admit a pathogen that causes illness.

c. May be through broken skin unless the break was surgical in origin.

d. Must be the same in the new host as the portal of exit in the source host.

16. Factors that influence the outcome of an exposure in a susceptible host include:

a. Socioeconomic level.

b. Extremes of age.

c. Living conditions.

d. Educational level.

17. A central tenet of the OSHA Bloodborne Pathogens Standard is:

a. Take all Precautions and proceed with confidence.
b. Use Universal Precautions rather than Standard Precautions.
c. Consider all patients to be potentially infected with a bloodborne pathogen.
d. Consider all patients to be noninfected until there is evidence to the contrary.

18. When adopting transmission-based precautions including Contact, Droplet, or Airborne Precautions:

a. Refer to your facility's policies for details.
b. Follow the CDC Guideline for Isolation Precautions first and foremost.
c. Post a sign on the patient's door stating diagnosis and Precautions being followed.
d. Never transport the patient outside of the room.

19. Airborne Precautions are the only type that require a negative pressure isolation room.:

a. True
b. False

20. Because tuberculosis is the most common disease transmitted by a true airborne route, the CDC recommends three levels of TB controls:

a. Environmental, airborne, and respiratory protection controls.
b. Droplet, airborne, and administrative controls.
c. Administrative, environmental, and respiratory protection controls.
d. Droplet, airborne, and respiratory protection controls.

21. To achieve hand hygiene, the recommended technique is:

a. Soap and water.
b. Alcohol-based rub.
c. Pure alcohol.
d. Alcohol-based rub followed by a water rinse.

22. My 5 Moments of Hand Hygiene include all but one of the following:

a. After greeting the patient.

b. Before clean or aseptic procedures.

c. After touching patient surroundings.

d. Before touching a patient.

23. Alcohol hand rubs:

a. Kill bacteria but not viruses.

b. Are preferred to everything but plain alcohol.

c. Do not remove dirt and debris from your hands.

d. Are preferred to everything but soap and water.

24. To do hand hygiene correctly, you should use friction for at least:

a. 5 seconds.

b. 10 seconds.

c. 15 seconds.

d. 30 seconds.

25. With regard to the reuse of needles and syringes:

a. The syringe may be reused but the needle may not.

b. Neither the needle nor the syringe may ever be reused.

c. Needles may be reused if they are properly disinfected.

d. Syringes may be reused if they are properly disinfected.

26. Aseptic technique to ensure safe injection practices includes:

a. Disinfecting the rubber septum of a medication vial with soap and water.

b. Use a new or properly disinfected syringe and needle to draw up medications.

c. Placing medication prep areas next to lunchrooms for greatest cleanliness.

d. Practice proper hand hygiene before handling medications.

27. Work practice controls reduce the likelihood of exposure by altering the manner in which a task is performed, while engineering controls:

a. Isolate or remove the hazard.

b. Address hazards from heating and air conditioning systems.

c. Have to do with optimal layout of facilities to ensure hygienic conditions.

d. Relate to methods engineered to produce better environments for patients.

28. Following sharps safety procedures in obstetrical and surgical settings entails:

a. Passing sharps quietly and quickly while maintaining eye contact with the recipient.
b. Using instruments rather than fingers to grasp tissue.
c. Passing instruments hand to hand for greater confidence.
d. Choosing open surgery for its greater visual field and accuracy.

29. Contaminated needles may only be broken to indicate they are used if there is no sharps container available.:

a. True
b. False

30. Which sharps device is responsible for the most injuries in the workplace?:

a. IV catheter stylets.
b. Phlebotomy needles.
c. Disposable syringes.
d. Suture needles.

31. Personal protective equipment (PPE) provided by the employer for protection against infectious materials ordinarily includes all but:

a. Gowns and lab coats.
b. Gloves.
c. Masks, face shields, and goggles.
d. Wetsuits.

32. All work areas must be maintained in a clean and sanitary condition. This function is called:

a. Environmental cleaning.
b. Protective cleaning.
c. Facility cleaning.
d. Housekeeping.

33. Healthcare facility medical wastes targeted for handling and disposal precautions include:

a. Restroom trash.

b. Blood products.

c. Cafeteria waste.

d. Staff wastebaskets.

34. High-level disinfection is used to clean:

a. Items that touch the skin.

b. Items that come into the facility from outdoors.

c. Items that touch mucous membranes.

d. The hospital environment.

35. OSHA requires that all new employees or transfers:

a. Take an examination to determine whether they understand the Chain of Infection.

b. Receive bloodborne pathogen training if occupational exposure may occur.

c. Be retrained every five years on bloodborne pathogens.

d. Take a one-time course in environmental cleaning.

36. The NYS Department of Health requires all New York healthcare workers to:

a. Be medically evaluated prior to employment in hospitals and treatment centers.

b. Reveal a history of HIV infection.

c. State any physical or mental disability.

d. Demonstrate a level of physical fitness suitable to the job.

37. Sepsis is:

a. Caused by poor nutrition.

b. The body’s extreme response to an infection.

c. Not common in New York State.

d. An infectious disease caused by rat bites.

38. The New York State Sepsis Improvement Initiative requires hospitals to:

a. Eliminate sepsis infections entirely by 2020.

b. Prevent parents from staying with pediatric patients.

c. Implement an evidence-based process for recognizing and treating sepsis in adults and children.

d. Observe, but do not immediately treat, patients with suspected sepsis.

39. Sepsis is a disease:

a. Specifically related to Gram-negative bacteria.

b. That is rarely associated with fungal infections.

c. That is related to a highly specific Gram-negative endotoxin.

d. That can be caused by bacteria, fungi, and viruses.

40. The increasing number of sepsis cases in the United States may be due to:

a. Greater use of invasive procedures which introduce microorganisms into the body.

b. Lack of availability of antibiotics.

c. Increase in the use of illegal intravenous drugs.

d. Decreased clinical awareness and diagnosis of sepsis.

41. Classic signs and symptoms of sepsis include:

a. Slight fever, low blood sugar, low white blood count.

b. No fever, decreased blood lactate level, low white blood count, and narrowed pulse pressure.

c. Fever, tachypnea, tachycardia, and high white blood cell count.

d. Fever, cough, low blood sugar, and hyper alertness.

42. Older patients suffering from sepsis can present with atypical symptoms. This can include:

a. Combativeness, nausea, and diarrhea.

b. The absence of classical symptoms such as fever, tachycardia, and hypoxemia.

c. Low blood sugar, jaundice, and hyper alertness.

d. Hyperactivity, intention tremor, and one-sided weakness.

43. Septic shock is:

a. Acute circulatory failure with refractory hypotension that is unexplainable by other causes.

b. A type of pneumonia usually caused by a viral infection.

c. Very treatable is antibiotics are administered within 3 days of infection onset.

d. Almost never fatal.

44. The initial step in the treatment of sepsis is:

a. Restrict fluids and provide supportive care.

b. Wait for a blood culture to determine the causative organism.

c. Observe for worsening symptoms.

d. To stop the infection, protect the vital organs, and prevent a drop in blood pressure.

45. Patient education is a key factor in the prevention of sepsis. Key points can include:

a. Any fever above 104 degrees can be treated at home with fluids and a cool towel.

b. Older adults rarely contract sepsis.

c. Sepsis is a medical emergency.

d. Children experiencing sepsis may have a very low body temperature.

46. OSHA and NYS Public Employee Safety and Health Bureau (PESH) standards require that employers provide access to post exposure services within:

a. 15 minutes

b. 30 minutes

c. 45 minutes

d. 1 to 2 hours

47. HIV or HBV infection alone is sufficient to limit a healthcare worker’s professional duties.:

a. True

b. False

Answer Sheet

NY: Infection Control and Prevention, including Sepsis (120)

Name (Please print your name): _____

Date: _____

Passing score is 80%

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Course Evaluation: NY IC (120)

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

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

a. Summarize the most prevalent risk factors for healthcare-associated infections (HAIs) and their related sites of infection.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

b. Identify and explain the seven elements of infection control presented in the New York State Infection Control Syllabus, including sepsis.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

c. Recall and explain each of the six links in the Chain of Infection.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

d. Describe prevention strategies in terms of Standard and Universal Precautions, Transmission-Based Precautions, Contact Precautions, Droplet Precautions, and Airborne Precautions.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

e. Explain both the importance and practice of hand hygiene in preventing HAIs.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

f. Discuss safe injection practices and sharps disposal as they relate to both patient and worker health.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

g. Outline the use of engineering and work practice controls to reduce the opportunity for exposure to potentially infectious material.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

h. Demonstrate the selection and use of personal protective equipment (PPE).

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

i. Define the principles and practices for cleaning, disinfection, and sterilization.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

j. State the scope and prevalence of the sepsis in the United States and New York State.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

k. Describe New York state Sepsis Improvement Initiative and Rory Staunton’s law.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

l. Discuss the most common causes of sepsis.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

m. State the signs and symptoms of sepsis and the importance of early recognition.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

n. Define severe sepsis and septic shock.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

o. Understand the basic principles of treatment and the need for rapid evaluation and management of sepsis.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

p. Educate patients and families on methods for preventing infections and illnesses that can lead to sepsis and on identifying the signs and symptoms of severe infections and when to seek care.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

* The author(s) are knowledgeable about the subject matter.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

* The author(s) cited evidence that supported the material presented.

5 4 3 2 1

* This course contained no discriminatory or prejudicial language.

Yes No

* The course was free of commercial bias and product promotion.

Yes No

* As a result of what you have learned, do you intend to make any changes in your practice?

Yes No

If you answered Yes above, what changes do you intend to make? If you answered No, please explain why.

* Do you intend to return to ATrain for your ongoing CE needs?

- Yes, within the next 30 days.
- Yes, during my next renewal cycle.
- Maybe, not sure.
- No, I only needed this one course.

* Would you recommend ATrain Education to a friend, co-worker, or colleague?

- Yes, definitely.
- Possibly.
- No, not at this time.

* What is your overall satsfaction with this learning activity?

5 4 3 2 1

* Navigating the ATrain Education website was:

- Easy.
- Somewhat easy.
- Not at all easy.

* How long did it take you to complete this course, posttest, and course evaluation?

- 60 minutes (or more) per contact hour
- 50-59 minutes per contact hour
- 40-49 minutes per contact hour
- 30-39 minutes per contact hour
- Less than 30 minutes per contact hour

I heard about ATrain Education from:

- Government or Department of Health website.
- State board or professional association.
- Searching the Internet.
- A friend.
- An advertisement.
- I am a returning customer.
- My employer.
- Other
- Social Media (FB, Twitter, LinkedIn, etc)

Please let us know your age group to help us meet your professional needs.

- 18 to 30
- 31 to 45
- 46+

I completed this course on:

- ○ My own or a friend's computer.
- ○ A computer at work.
- ○ A library computer.
- ○ A tablet.
- ○ A cellphone.
- ○ A paper copy of the course.

Please enter your comments or suggestions here: _____

_____

_____

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Registration Form: NY IC (120)

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

* Name: _____

* Email: _____

* Address: _____

* City: _____ * State: _____ * Zip: _____

* Country: _____

* Phone: _____

* Professional Credentials/Designations:

_____

* License Number and State: _____

* Please email my certificate:

○ Yes ○ No

(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: $29

Credit card information

* Name: _____

Address (if different from above): _____

* City: _____ * State: _____ * Zip: _____

* Card type:

○ Visa ○ Master Card ○ American Express ○ Discover

* Card number: _____

* CVS#: _____

* Expiration date: _____