Biological Agents and Infection Control
What are Healthcare Associated Infections (HAI)

- As a healthcare worker, you must be continually aware of the potential for the spread of infection and learn how to keep you, your co-workers, and patients safe.
- The CDC defines HAI's as those that develop during hospitalization but are neither present nor incubating upon the patient’s admission to the hospital. They are generally infections that occur more than 48 to 72 hours after admission and within 10 days after hospital discharge.
What are Healthcare Associated Infections (HAI) cont.

- Healthcare facilities employ many types of invasive devices and procedures to treat patients and to help them recover. Infections can be associated with the devices used in medical procedures, such as catheters or ventilators.
- HAIs have a big impact on increased illness, death, and cost in healthcare.
Types of HAIs

- HAI s include central line-associated bloodstream infections, catheter-associated urinary tract infections, ventilator-associated pneumonia, and surgical site infections.
- Pathogens and infectious diseases that can potentially be acquired in healthcare settings include gastrointestinal illness, hospital-onset Clostridium difficile infections (C. difficile), and MRSA bacteremia (bloodstream infections).
Microorganisms

- A microorganism or microbe is an organism that is so small that it is microscopic or invisible to the naked eye. Microorganisms are typically single-celled and consist of bacteria, viruses, fungi, and protozoa.
- During the delivery of healthcare, patients are exposed to a variety of microorganisms from other patients, healthcare personnel, and visitors.
- The most common sources of infectious agents causing HAI are the individual patient, medical equipment, and/or devices, hospital environment, healthcare personnel, contaminated drugs, contaminated food, and contaminated patient care equipment.
The Chain of Infection

- In order to prevent the spread of infection, it is important to understand how the chain of infection works.
- The chain of infection consists of an infectious disease, a reservoir, a portal of exit, a mode of transmission, a portal of entry, and a susceptible host.
  - **Infectious Disease:** An infectious disease is any microorganism that can cause disease. Several factors contribute to whether an organism can cause an infection such as its ability to multiply and grow, its ability to enter tissue, and its ability to cause disease.
The Chain of Infection cont.

- **Reservoir:** A reservoir is where an infectious agent lives, grows, and multiplies. There are three types of reservoirs; human, animal, and environmental. Examples seen in the healthcare industry include, body fluids, respiratory secretions, and touch surfaces such as door handles or blood pressure cuffs.

- **Portal of Exit:** The term portal of exit refers to where the organisms leaves the reservoir, such as the respiratory tract, intestinal tract or rectum, urinary tract, or blood and other body fluids.

- **Modes of Transmission:** Modes of transmission is the term used to describe how an organism moves from one person to another by either direct or indirect transmission.
The Chain of Infection cont.

- **Portal of Entry:** The term portal of entry describes where an infectious disease enters the host’s body. A portal of entry must provide access to tissues in which the pathogen can multiply or a toxin can act. Common portals of entry include mucous membranes, skin, and blood. Often, infectious agents use the same portal to enter a new host that they 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. In contrast, many pathogens that cause gastroenteritis 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 utensil, and enter a new host through the mouth.

- **Susceptible Host:** The term susceptible host refers to the individual at risk for developing an infection from the disease.
Transmission

Transmission of infection within a healthcare setting requires three elements: a source of infecting microorganisms, a susceptible host, and a means of transmission for the microorganism to the host.

Patients have different degrees of susceptibility to microorganisms they are exposed to. Some people, who are exposed, will not become sick; some may become carriers, and some will develop an active infection.

Some patients such as those that are immunocompromised because of age (for example newborn or elderly patients), those with underlying diseases, severe illness, those taking immunosuppressive medications, or having just completed medical or surgical treatments are more vulnerable.
Transmission cont.

- Those hospitalized for prolonged periods of time are at higher risk for acquiring HAIs due to the increased opportunity for invasive devices to be used. These patients are likely suffering from an underlying condition which makes them more susceptible.

- According to the NIH, among patients and healthcare personnel, microorganisms are spread through four common routes of transmission:
  - Contact (direct and indirect)
  - Respiratory droplets
  - Airborne spread
  - And common vehicle
Standard Precautions

- Standard Precautions are a set of infection control practices that healthcare personnel use to reduce transmission of microorganisms in healthcare settings. They are the minimum infection prevention practices that apply to all patient care, regardless of suspected or confirmed infection status of the patient, in any setting where healthcare is delivered. These practices are designed to protect healthcare workers as well as preventing the spread of infections among patients.
- Standard Precautions include: hand hygiene, use of PPE, safe injection practices, safe handling of potentially contaminated equipment or surfaces in the patient environment, respiratory hygiene and cough etiquette.
Hand Hygiene

- Hand hygiene (handwashing with soap and water or use of an alcohol-based hand sanitizer) should be employed before and after patient contact and after contact with the immediate patient care environment.

- PPE should be used when exposure to blood, bodily fluids, excretions, secretions, mucous membranes, or non-intact skin is anticipated. PPE includes:
  - Gloves when hand contamination is anticipated.
  - Masks and eye protection when splashes may occur.
  - Gowns when soiling of clothes may occur.
Good hand hygiene is one of the most important ways to prevent the spread of infections. The practice of appropriate hand hygiene and glove usage is a major contributor to patient safety and reduction in HAIs.

However, according to the NIH, observational studies have found that on average, healthcare workers adhere to recommended hand hygiene procedures only 40% of the time.

**Handwashing:** Handwashing refers to washing hands with plain soap and water. Handwashing with soap and water remains a sensible strategy for hand hygiene in non-healthcare settings and is recommended by CDC and other experts.
Antiseptic Handwash: Antiseptic handwash refers to washing hands with water and soap or other detergents containing an antiseptic agent. Alcohol-based handrub refers to the alcohol-containing preparation applied to the hands to reduce the number of viable microorganisms.

Surgical Hand Hygiene or Antisepsis: Surgical hand hygiene or antisepsis refers to an antiseptic handwash or antiseptic handrub performed preoperatively by surgical personnel to eliminate transient and reduce resident hand flora. Antiseptic handrubs often have a long-lasting antimicrobial effect.
Hand Hygiene cont.

- A healthcare worker should use hand hygiene in the following circumstances:
  - Whenever hands are visibly dirty or contaminated.
  - Before:
    - Having contact with patients
    - Putting on gloves
    - Inserting any invasive device
    - Manipulating an invasive device
  - After:
    - Having contact with a patient’s skin
    - Having contact with bodily fluids or excretions, non-intact skin, wound dressings, or contaminated items
    - Having contact with inanimate objects near a patient
    - Removing gloves
Hand Hygiene cont.

- Alcohol-based hand rubs (foam or gel) kill more effectively and are quicker than handwashing with soap and water. They are also less damaging to skin than soap and water, resulting in less dryness and irritation.

- An alcohol-based hand rub is the preferred method for hand hygiene in all situations, except for when your hands are visibly dirty or contaminated.
The correct technique for washing your hands using soap and water is:

- Wet your hands with water
- Apply soap
- Rub your hands together for at least 15 seconds, covering all surfaces and focusing on fingertips and fingernails
- Rinse your hands under running water and dry them with a disposable towel
- Use the towel to turn off the faucet
The correct technique for practicing hand hygiene using a hand rub is:
- Apply the rub to the palm of one hand
- Rub your hands together, covering all surfaces, focusing in particular on fingertips and fingernails, until dry.

Hand lotions are important to prevent skin dryness and irritation. You should use only hospital-approved hand lotions. Other lotions may:
- Make hand hygiene less effective
- Cause breakdown of latex gloves
- Become contaminated with bacteria if dispensers are refilled
Hand Hygiene cont.

- Keep your natural fingernails short to about \( \frac{1}{4} \) inch
- Do not wear artificial nails when having direct contact with high-risk patients such as those in the intensive care unit (ICU) or operating room (OR).
Exposure to Bloodborne Pathogens

- As a healthcare worker, the nature of your everyday duties puts you at risk for being exposed to infection from bloodborne pathogens.
- Healthcare workers are at risk for occupational exposure to bloodborne pathogens, including:
  - Hepatitis B virus
  - Hepatitis C virus
  - Human immunodeficiency virus (HIV)
  - And more than 20 other pathogens
- Another common means of transmission is the patient’s blood coming in to contact with the clinician’s eyes, nose, mouth, or broken skin
According to NIOSH, more than 8 million U.S. healthcare workers in hospitals may be exposed to blood or other body fluids through the following types of contact:

- Skin injuries with contaminated sharp instruments such as needles and scalpels (82%)
- Contact with mucous membranes of the eyes, nose, or mouth (14%)
- Exposure of broken or abraded skin (3%)
- Human bites (1%)
Exposure to Bloodborne Pathogens cont.

- Prevention of occupational transmission of bloodborne pathogens requires a multipronged approach to reduce blood contact and skin injuries including improved engineering controls such as:
  - Safer medical devices
  - Work practices, for example, technique changes to reduce handling of sharps
  - The use of PPE
There are certain high risk practices and procedures capable of causing healthcare-acquired infection with bloodborne pathogens. These include:

- **Skin Exposures:** Skin exposures occur through handling, disassembly, disposal, or reprocessing of contaminated needles and other sharp objects.

- **Sharps Injuries:** Sharps injuries can occur when performing procedures where there is poor visualization, such as blind suturing, non-dominant hand opposing or next to a sharp, or performing procedures where bone splinters or metal fragments are produced.
Mucous Membranes: Mucous membranes and non-intact skin exposures are also a potential method for exposure to bloodborne pathogens. Direct blood or body fluid contact with the eyes, nose, mouth or other mucous membranes occurs through contact with contaminated hands, open skin lesions or dermatitis, or splashes or sprays of blood or body fluids that might occur during irrigation or suctioning.

Following safe injection practices is critical to prevent the percutaneous or skin exposure to bloodborne pathogens.
Cleaning

The creation and maintenance of a safe environment for patient care through application of infection control principles and practices for:

- **Cleaning**: is the removal of visible soil and foreign materials such as dirt, body fluids, and lubricants from objects and surfaces, and normally is accomplished manually or mechanically using water soaps, detergents, or enzymatic products, through washing or scrubbing the object or surface. Thorough cleaning is essential before high-level disinfection and sterilization because contaminants that remain on the surfaces of instruments interfere with the effectiveness of these processes.
Decontamination: involves the use of physical or chemical means to remove, inactivate, or destroy pathogens on a surface or item to the point where they are no longer capable of transmitting infectious particles. Decontamination removes pathogenic microorganisms from items so they are safe to handle, use, or discard.

Sterilization: involves the removal or destruction of all microorganisms and their spores. Sterilization describes a process that destroys or eliminates all forms of microbial life and is carried out in healthcare facilities by physical or chemical methods. Steam under pressure, dry heat, EtO gas, hydrogen peroxide gas, plasma, and liquid chemicals are the principal sterilizing agents used in healthcare facilities. When chemicals are used to destroy all forms of microbiologic life, they can be called chemical sterilants.
Disinfection: describes a process that eliminates many or all pathogenic microorganisms, except bacterial spores, on inanimate objects. In healthcare settings, objects usually are disinfected by liquid chemicals or wet pasteurization. Each of the various factors that affect the efficacy of disinfection can nullify or limit the efficacy of the process. Factors that affect the efficacy of both disinfection and sterilization include prior cleaning of the object, organic and inorganic load present, type and level of microbial contamination, concentration of and exposure time to the germicide, physical nature of the object (e.g., crevices, hinges, and lumens), presence of biofilms, temperature and pH of the disinfection process, and in some cases, relative humidity of the sterilization process (e.g., ethylene oxide).
Cleaning cont.

- Reusable medical devices (for example endoscopes) should be accompanied by instructions for cleaning and disinfection or sterilization as appropriate. Single-use devices are labeled by the manufacturer for only a single use and do not have reprocessing instructions.
- All reusable medical devices must be cleaned and maintained according to the manufacturer’s instructions to prevent patient-to-patient transmission of infectious agents.
- Spaulding’s Classification divides instruments and items for patient care into critical semi-critical, or non-critical items. Depending on the category, planning for disinfection or sterilization can be determined.
Critical Items: (e.g., surgical instruments) are objects that enter sterile tissue or the vascular system and must be sterile prior to use.

Semi-critical Items: (e.g., endoscopes used for upper endoscopy and colonoscopy) contact mucous membranes or non-intact skin and require, at a minimum, high-level disinfection prior to reuse.

Noncritical Items: (e.g., blood pressure cuffs) are those that may come in contact with intact skin but not mucous membranes and should undergo low or intermediate-level disinfection depending on the nature and degree of contamination. Environmental surfaces (e.g., floors, walls) are those that generally do not contact the patient during delivery of care. Cleaning may be all that is needed for the management of these surfaces but if disinfection is indicated, low-level disinfection is appropriate.
Respiratory Hygiene or Cough Etiquette is an element of Standard Precautions that highlights the need for prompt implementation of infection prevention measures at the first point of encounter with the facility (e.g., reception and triage areas).

This strategy is targeted primarily at patients and accompanying family members or friends with undiagnosed transmissible respiratory infections, and applies to any person with signs of illness including cough, congestion, rhinorrhea, or increased production of respiratory secretions when entering the facility.
Ensuring you are immune to vaccine-preventable diseases is an essential part of keeping yourself and your patients safe.

Obtaining the correct vaccines and keeping them up-to-date helps prevent transmission of vaccine-preventable diseases and eliminate unnecessary work restrictions.

As a healthcare worker, the Public Health Service’s Advisory Committee on Immunization Practices considers you to be at substantial risk for acquiring or transmitting hepatitis B, influenza, measles, mumps, rubella, pertussis, and varicella as a result of contact with patients or infected material from patients.
Since healthcare workers are at risk for exposure to and possible transmission of vaccine-preventable diseases, maintenance of immunity is an essential part of prevention and infection control programs.

In the event that you are exposed to HIV, immediate action is required. You must report your exposure to your employer, complete a full course of treatment, and attend the recommended follow-up appointments.