4. Infection Control

A. Introduction to Infection Control

1. **Healthcare associated infections** (HAI), previously called “nosocomial” infections.
   
   1) Infections caused by a wide variety of common and unusual bacteria, fungi and viruses during the course of receiving medical care.
   
   2) “Hospital acquired infections” if acquired in hospital.
   
   3) Acquired by 5-10% of hospitalized patients, resulting in increased cost of millions of dollars annually.
   
   4) Leading cause of patient deaths.
   
   5) Medicare and Medicaid no longer paying the costs, hospital must absorb the cost.

2. Center for Disease control (CDC), the Joint Commission, state regulatory agencies, and each health care institution are required to develop and implement infection control policies which include surveillance, reporting, isolation procedures, education and investigation of epidemics in the hospital.

3. Infection control department of the hospital hire nurses to perform this job and they in turn work very closely with the micro department.

B. Surveillance

1. Infection control program closely monitors the following:
   
   a. Patients at high risk of infection
   
   b. Patients with infections
   
   c. Personnel or patients exposed to communicable diseases, contaminated equipment, or hazardous reagents.
   
   d. Patients in certain areas of the hospital or in certain rooms.
   
   e. Patients in ambulatory settings: home or long-term care facilities.

2. Phlebotomists must be aware of these special circumstances:
   
   a. Take necessary precautions to avoid infecting yourself or the patient.
   
   b. Mentally prepare yourself to deal in a professional, humane manner with special patients.

3. Surveillance is also involved in classifying infections according to relevance rates and monitoring employee health including screening for diseases and offering immunizations.
C. Chain of Infection

1. Healthcare associated infections require the presence of a pathogenic organism.

2. The chain of infection must be completed and requires the following: pathogen, reservoir, portal of exit, mode of transmission, portal of entry and susceptible host.

3. **Pathogen**
   a. Some of the microorganisms that cause infection include
      1) Bacteria (Examples: *Streptococcus, E. Coli*)
      2) Viruses (Examples: Influenza, HIV)
      3) Fungi (Examples: Ringworm, *Candida*)
      4) Prions (Example: abnormal proteinaceous particle, causes diseases like Creutzfeldt-Jakob Disease, Mad Cow Disease)
      5) Protozoa (Examples: *Entamoeba, Giardia*)
      6) Worms (Examples: Tapeworms, *Trichinella*)

4. **Reservoir**
   a. In a normal environment few things are sterile. Inanimate objects as well as people and animals are colonized with microorganisms, many of which help with normal bodily functions.

   b. Even when an organism is pathogenic some are more pathogenic than others, i.e., only a few *Shigella* organisms need to be ingested to cause a diarrheal infection, whereas *Salmonella* requires large number of organisms to be ingested.

   c. Common reservoirs in the health care setting:
      1) People
      2) Contaminated needles or sharps
      3) IV catheters, Foley catheters, cardiac catheters
      4) Bronchoscope, respiratory therapy equipment
      5) Contaminated clothing
      6) Medical instruments used for surgery or diagnostic procedures are reusable but must be thoroughly sterilized.
      7) Some equipment such as tourniquets has a low risk of causing infection.
5. **Portal of Exit**
   a. The pathogen leaves the reservoir. Some of the methods include:
      1) Respiratory droplets created by a cough or sneeze
      2) Infectious Body Fluids includes blood, saliva, urine, feces, wound drainage

6. **Mode of transmission**
   a. Infections can be transmitted by direct contact, air, medical instruments, other objects or vectors.
   b. Direct contact infections such as Staph, chicken pox, hepatitis A, diarrheal diseases, can be avoided by proper hand washing.
   c. Airborne infections such as TB or Legionnaires disease may be transmitted by coughing, sneezing, shaking linen, sweeping or inadequate ventilation and can be prevented by using a mask.
   d. Invasive medical instruments, such as needles, must be used only once and discarded.
   e. Inanimate objects (fomites) such as toys, toilets, sinks, linens and water fountains may provide a means of transmission if contaminated.
   f. Vectors include mosquitoes, ticks, fleas and mites which can transmit infections such as plague, rabies, West Nile Virus and malaria.
   g. Stop mode of transmission through appropriate use of infection control procedures.

7. **Portal of Entry**
   a. Different pathogens require different portals of entry.
      1) Inhalation – Airborne pathogens come in contact with the mucous membranes of the respiratory system.
      2) Ingestion – Pathogens come in contact with the mucous membranes of the digestive system
      3) Injection – pathogens come in contact through a break in the skin, such as a needle stick, mosquito bite, animal bite, acne, cut, skin rash or chapped skin
      4) Other mucous membrane exposure - include pathogens that come in contact with the mucous membrane of the eyes, nose, mouth or genital area

8. **Susceptible host**
   a. Factors that affect susceptibility are: age, drugs, degree and nature of illness, and status of the host’s immune system.
b. Underlying diseases such as diabetes, AIDS, and cancer may change status of host and increase chance of infection.

c. Treatment of diseases such as chemotherapy, radiation and antibiotic therapy which may lower patient’s resistance to infections.

9. Must break the chain of infection by strict adherence to policies involving:
   a. Hand washing
   b. Proper waste disposal
   c. Appropriate laundry service and housekeeping
   d. Control of insects and rodents
   e. Use of disposable protective equipment and supplies
   f. Isolation techniques

10. Proper treatment of patient will speed recovery and reduce host susceptibility:
   a. Appropriate immunizations
   b. Transfusion
   c. Nutritional support
   d. Proper medications
   e. Physical exercise

D. OSHA Needlestick Safety and Prevention Act.

1. The Needlestick Safety and prevention Act mandated that the 1991 Bloodborne Pathogens Standard be revised to strengthen the requirements related to the use of safety-engineered sharp devices.

2. OSHA published the revised standard in the federal Register on January 18, 2001; it became effective April 18, 2001.

3. Requires employers to identify, evaluate and make use of effective safer devices.

4. For needle use it requires a built-in safety feature or mechanism that allows a single handed method of causing the needle to be permanently covered.

5. The law mandated that employers allow “front line” employees to evaluate and select the equipment they were most comfortable with.

6. Employers must maintain an injury log which will include the brand name of the device used which caused the injury.
E. Isolation Procedures

1. Isolation procedures vary and range from sterile rooms or wards to isolations procedures for one disease only.

2. *Isolation procedures* divide patients into two groups:
   a. Patients with communicable diseases.
   b. Patients who are extremely susceptible to infections.

3. *Isolation techniques* formally divided into two types: category-specific and disease-specific precautions.
   a. Category specific provided guidelines for dealing with infectious substances based on route of transmission (wound/drainage, enteric, respiratory, etc).
   b. Disease Specific Isolation Precautions included specific procedures for dealing with more than 150 diseases.

   a. Combined the earlier Universal Precautions and Body Substance Isolations (BSI) into a single set of safeguards (now known as the Standard Precautions) to be used on all patients.
      1) ‘Universal Precautions’ – designed to reduce the risk of transmission of bloodborne pathogens; - brought about the recommendations of wearing gloves when collecting or handling blood & body fluids and the use of face shields if blood splattering is a possibility. Introduced the concept that all patients should be considered infectious
      2) ‘BSI’ practices - based on the assumption that all body substances may carry infectious agents; - focused on isolation of potentially infectious moist body substances: blood, urine, saliva, feces, sputum, wound drainage, all other body fluids, non-intact skin and mucous membranes. Designed to reduce risk of transmission of microorganisms.
   b. Changes necessary to avoid inconsistent use of Universal Precautions and Body substance Isolation (BSI).
   c. The old categories of disease-specific precautions have been collapsed into three categories: airborne, droplet and contact.

F. Standard Precautions Review

1. Standard precautions includes the major features of Universal Precautions (*Blood and Body Fluid Precautions* – designed to reduce the risk of transmission of bloodborne pathogens) and applied them to all patients receiving care in hospitals, regardless of their diagnosis or presumed infection status.
2. Focus on applying a single set of precautions to be utilized for all non-intact skin, mucous membranes and potentially infectious moist body substances regardless of whether or not they contain visible blood.

3. Designed to reduce the risk of transmission of blood borne pathogens.

4. Applies to all patients receiving care in hospitals, regardless of diagnosis or presumed infection status.

5. Standard Precautions apply to:
   a. blood
   b. all body fluids, secretions (saliva, sputum), excretions (urine, feces) except sweat regardless of whether or not they contain visible blood.
   c. non-intact skin (wound drainage)
   d. mucous membranes

6. Procedures to follow for Standard Precautions include the following:
   a. Use appropriate barrier protection to prevent skin and mucous membrane exposure when contact with blood or body fluids is anticipated.
   b. Wash hands and contaminated surfaces and equipment immediately if contaminated with blood or body fluids and after removing gloves.
   c. Take the necessary precautions to prevent injuries caused by handling and disposing of needles, scalpels and other sharp instruments.
   d. Use of special equipment to protect from saliva exposure during resuscitation.
   e. Appropriate protection when exudative lesions or dermatitis is present.
   f. Pregnant health care workers must strictly adhere to infection control policies.
   g. Immunization of employees is required for infectious agents (measles, mumps, rubella) transmitted by air.

7. Three additional types of precautions may need to be taken when patients have infectious conditions or illnesses; these are called Transmission Based Precautions and include:
   a. **Airborne Precautions** for diseases transmitted by small droplets, less than 5 microns. These droplets can travel on air currents for long distances.
   b. **Droplet precautions** for diseases transmitted by large droplets, greater than 5 microns. These droplets usually only travel 3 – 4 feet.
   c. **Contact precautions** for disease transmitted by direct contact with the patient, i.e., wounds, skin infections, enteric infections, etc, or indirect contact with objects the patient has been in contact with.
d. There may be times when a patient requires more than 1 type of Transmission Based Precaution category.

8. Tuberculosis Isolation
   a. Indicated for patient with infections tuberculosis and is sometimes called AFB (Acid fast bacilli) isolation.
   b. Drug resistant TB is becoming more prevalent and the new guidelines emphasize the importance of wearing an appropriate mask that is fitted to the individual employee.
   c. OSHA requires the use of a National Institute for Occupational Safety and Health (NIOSHA) approved high efficiency particulate air (HEPA) respirator as a minimum level for HCWs entering AFB isolation rooms.

9. Protective or reverse isolation
   a. Protect patient who is highly susceptible to infection: severe burns, transplant patients
   b. All articles entering room must be sterile.
   c. Everyone entering the room must wear gown, gloves, and mask
   d. Used supplies can be removed from room.

G. OSHA Bloodborne Pathogens Standard for the Health Care Employer
   1. Employers must provide measures that will protect workers who can reasonably be anticipated to possible exposure to biological hazards.
      a. Mandatory training and compliance in the use of Standard Precautions.
      b. Employers must provide appropriate PPE.
      c. Engineering practice controls that isolate or remove blood-borne pathogen hazards, i.e., sharps containers.
      d. Work practice controls to reduce likelihood of exposure, i.e., no recapping of needles, no eating, drinking, smoking in clinical lab.
      e. Appropriate cleaning methods of contaminated surfaces.
      f. Provide free Hepatitis B (HBV) vaccine.
      g. Post-exposure follow up for employees exposed to HBV and HIV.
      h. Training and education information on blood borne pathogens available for employees at no cost and accessible during working hours.
      i. Labels and signs that warn of biological hazards and contaminated waste.
j. Establish an exposure control plan and update the plan annually.

2. Blood Borne Exposure Procedures
   a. Health care facilities must provide a confidential medical evaluation, treatment and follow up for any employee with a blood borne exposure incident.
   b. Immediately after an exposure incident the employee must:
      1) Apply appropriate first aid.
      2) Report the incident
      3) Be given appropriate medical evaluation, treatment and counseling.
   c. Medical evaluation involves the following steps and is kept confidential:
      1) HCWs blood is tested for HBV, HCV and HIV.
      2) Source individual tested for HBV, HCV and HIV, if permission is given.
      3) If source individual is HIV positive, or exposure is to an unknown specimen the HCW is counseled and evaluated for HIV infection immediately, 6 weeks, 12 weeks and 6 months. The type and timing of the follow up testing may vary with the type of exposure and the type of suspected pathogen. Follow the facilities protocol.
      4) Azidothymidine (AZT) therapy is provided to the exposed employee as soon as possible, preferably within 1-2 hours of exposure.
      5) If source individual refuses to consent to testing and is in a high-risk category, the exposed HCW is given hepatitis B immune globulin and HBV vaccination.
      6) The HCW is counseled to be alert for acute viral symptoms within 12 weeks of exposure.

H. Infection Control in Hospital Units
   1. Isolation for hospital outbreaks
      a. May dictate need for special precautions, isolation procedures or screening of employees.
      b. Examples: Staph outbreak in nursery, undiagnosed chicken pox, positive TB test on employee or inpatient.

   2. Infection control procedures in a nursery unit
      a. Infant’s immune system not developed and they have increased susceptibility to infection.
b. May pick up pathogens from mom, other babies or hospital personnel.
c. Hand washing procedure much stricter and must be adhered to.
d. Gloves must be worn.
e. Nursery usually provides gowns to be worn while in the nursery.
f. To decrease exposure each baby is assigned to one nurse.
g. Special case would be an infant whose mom has **active genital herpes**.
   1) Baby and mother are isolated.
   2) Must use gown and gloves.
   3) Remove contaminated articles by double bagging.

3. Infection control in a burn unit
   a. Use reverse isolation as the patient is highly susceptible to infection.
   b. Infection rate dramatically decreases if patient is in a completely closed environment.
      1) Bed surrounded by plastic curtain with sleeves, use sleeves to care for patient.
      2) Everything kept outside of curtain.
   c. If facility lacks the curtain, house patient in special room.
   d. Must use gown, gloves, double bagging of soiled articles and strict adherence to hand washing technique.
   e. Sterilize and disinfect room frequently.

4. Infection control in an intensive care of postoperative unit:
   a. Patients who are critically ill or have had surgery are more susceptible to infections.
   b. Some hospital ICUs are big open rooms with numerous patients for easy monitoring. The current standard of care is small, individual rooms opening to a nurse’s station.
   c. Patients with known infections are isolated according to infection.
   d. Strict hand washing, gowning and gloving policies are necessary.

5. Infection Control in a Dialysis Unit
a. Patients often immunosuppressed, increasing the risk of acquiring an infection, especially hepatitis.

b. Gown and gloves worn on unit.

c. Strict adherence to hand washing technique and glove use.

I. Infection control in the Clinical Laboratory

1. Surveillance performed primarily by microbiology personnel.
   a. Maintains lab records for surveillance purposes.
   b. Reports infectious agents, drug resistant microorganisms and outbreaks.
   c. Evaluates effectiveness and sterilization or decontamination procedures.

2. Acquisition of infections is prevented by:
   a. Prohibiting eating, and drinking, or mouth pipetting
   b. Proper hand washing at the appropriate times.
   c. Use of appropriate barrier protection such as gloves, protective clothing, and eye protection.
   d. Decontamination of work surfaces periodically during the day and prior to leaving.
   e. Proper disposal of sharps, including broken glass.
   f. Proper handling of equipment.

3. Phlebotomists play an important role in preventing the spread of infection during the blood collection process.
   a. Must use proper technique during blood collection.
   b. Must strictly adhere to infection control policies and procedures specifically appropriate use of gowns, gloves and masks.
       1) Pay close attention to posted signs which illustrate special PPE.
       2) Know how to put on and remove gown, gloves, and mask.
       3) Know where to dispose of the materials used in the patient room.
   c. One phlebotomist may collect specimens from 50 patients: the potential is there to spread infections all over the hospital.
J. Entering and Exiting patient’s rooms under Transmission Based Precautions

1. For all patients, follow **Standard Precautions**
   a. Wash hands or use hand sanitizer before and after patient contact. Follow facility protocols of how frequently hand sanitizers may be used before hands must be washed.
   b. Take only supplies needed into the room.
   c. Follow facility policy on tourniquet use. Some reuse tourniquet during rounds others have tourniquet in room or use disposable tourniquets.

2. For patients under **Airborne Precautions**
   a. In addition to Standard Precautions, use **respiratory protective equipment**. This type of equipment must be properly fitted. Request assistance as needed.
   b. Follow facility protocols and signage on door.

3. For patients under **Droplet Precautions**
   a. In addition to Standard Precautions, **wear a mask**
   b. Follow facility protocols and signage on door.

4. For patients under **Contact Precautions**
   a. In addition to Standard Precautions, **wear gloves and gown**
   b. Follow facility protocols and signage on door.

5. For patients under multiple Transmission Based Precautions, a combination of PPE will be necessary. Follow facility protocols and signage on door.

Example of Multiple Transmission Based Precautions: Patient with suspected or known Ebola virus

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Purpose: to help healthcare personnel follow standard, contact, and droplet precautions when caring for a PUI (patient under investigation) or a patient with confirmed EVD (Ebola virus disease).

Abstract of Key Points

1. CDC recommends the use of standard, contact and droplet precautions when caring for a patient under investigation (PUI) or with confirmed Ebola virus disease (EVD).
2. Implement appropriate additional infection control steps if PUI or EVD patient has other conditions or illness, such as tuberculosis or when a medical procedure would create aerosols.

3. Reminder that healthcare personnel can be exposed to Ebola virus by touching a patient’s body fluids (such as blood) contaminated medical supplies and equipment or contaminated environmental surfaces. Splashes to unprotected mucous membranes (eyes, nose, or mouth) are particularly hazardous. Procedures that increase environmental contamination with infectious material or create aerosols should be minimized.

K. Double bagging

1. All items in isolation removed by double bagging technique which requires 2 people to perform, one person in the room, one outside the room.
   a. Person outside holds clean, impermeable bag with ends of bag covering their hands.
   b. Person inside the room seals the bag and places into the clean bag.
   c. Person outside the room seals and labels with appropriate warnings
   d. The bag is disposed of in a designated container for biohazardous waste.

L. Prevention of Laboratory Acquired Infection

1. The occurrence of an infection from biohazardous specimen depends upon:
   a. The virulence of the infecting organism.
   b. The susceptibility of the host.

2. The following are possible routes of infection from collected specimens and, therefore, should be considered when collecting or processing specimens for laboratory assays.

   a. Skin contact
      1) Organisms may enter through abrasions, cuts or conjunctiva of eye.
      2) Avoid needles and never handle broken glass with hands.
      3) Wear PPE and cover all cuts appropriately.
      4) Avoid rubbing eyes or mouth.

   b. Ingestion
      1) Caused by failure to wash contaminated hands prior to eating, drinking or smoking.
      2) Comply with lab safety rules.
c. **Airborne**

1) Aerosols may be created by careless handling or centrifugation.
2) Popping stoppers off of vacuum tubes can create aerosols.
3) Use correct procedures for processing and separating patient specimens.

M. **Sterile Techniques for Phlebotomists**

1. **Responsibilities**
   a. Must realize bacteria and other microorganisms can be found everywhere.
   b. All hospital personnel are responsible for cleanliness, including:
   c. Maintain sterility when handling instrument or equipment that contacts the patient.
   d. Clean up small messes when noticed, or notify appropriate personnel in a timely fashion if you are unable to handle it.

2. **Site preparation**
   a. Use sterile supplies for skin and venipuncture.
   b. Rubbing alcohol (70% isopropyl) for routine destruction of organisms on the site.
   c. Blood cultures has more complex site preparation, requires sterile site.

3. **Disinfectants and antiseptics:**
   a. **Disinfectant**
      1) Is a chemical compound used to remove or kill pathogenic organisms, they are regulated the EPA.
      2) Is used on surfaces and instruments, but are too caustic for direct use on human skin.
   b. **Antiseptics**
      1) Antiseptics are chemicals used to inhibit the growth and development of microorganisms, but not necessarily kill them.
      2) May be used on human skin.
   c. Intermediate level disinfectants which are HIV-cidal or TB-cidal should be used to cleanse tourniquets and other contaminated articles.
References

CDC, Healthcare Infection Control Practices Advisory Committee (HICPAC):

http://www.cdc.gov/vhf/ebola/transmission/index.html