Infection Control

Principles of Health Science
Shelley Westwood, RN, BSN
What is a microorganism??

- A small, living organism, not visible to the naked eye, must be viewed under microscope.
- Found everywhere in the environment, including on, and in, the human body.
- Normal flora of the body (microbes that live on us all the time) are beneficial in maintaining certain body processes—they are NONPATHOGENS.
- Microorganisms that cause infection and disease--PATHOGENS.
How do microorganisms grow?

• Most prefer a warm environment which makes body temperature ideal.
• Most prefer darkness, many are quickly killed by sunlight.
• A source of food and moisture is also needed.
• Organisms that require oxygen to live are called AEROBIC.
• Others live and grow in the absence of oxygen, these are called ANAEROBIC.
Classes of Microorganisms

- Bacteria
- Protozoa
- Fungi
- Rickettsiae
- Viruses
- Helminths
1\textsuperscript{st} class of microrganisms—\textbf{Bacteria}

- Simple, one-celled organisms that multiply rapidly.
- Classified by shape and arrangement.
- Antibiotics are used to kill bacteria; however, due to overuse and misuse of antibiotics, some strains of bacteria have become antibiotic-resistant.
- This means antibiotics are no longer effective against these strains of bacteria.
Classifications of bacteria

- Cocci
  - Diplococci
  - Streptococci
  - Staphylococci
- Bacilli
- Spirilla
Classifications of bacteria

- Cocci are round or spherical in shape.
Classifications of bacteria

- **Diplococci**—cocci bacteria that occur in pairs.
- Causes diseases such as gonorrhea, meningitis, and pneumonia.
Diplococci: Meningitis
Classifications of bacteria

- **Streptococci** -- cocci that occurs in chains.
- Common diseases are strep throat and rheumatic fever.
- *Streptococcus pyogenes*, also called flesh-eating strep or STREP A, causes necrotizing fasciitis that destroys tissues and can result in amputation and/or death.
Streptococci: STREP A
Streptococci: STREP A
Classifications of bacteria

- **Staphylococci**—cocci that occur in clusters or groups.
- Most common pyogenic (pus-producing) microorganisms.
- Cause infections such as boils, urinary tract infections (UTIs), wound infections, and toxic shock.
Staphyloccoci Infections
Bacilli

- Rod-shaped bacteria, can occur singly, in pairs, or in chains.
- Many contain flagella--thread-like projections similar to tails and allow the organisms to move.
- Have the ability to form spores, or thick-walled capsules, when conditions for growth are poor.
- In the spore form, bacilli are very difficult to kill.
- Diseases caused by different types of bacilli include tuberculosis, tetanus, pertussis (whooping cough), botulism, diphtheria, and typhoid.
Bacilli
Bacilli Infection: Tuberculosis

How TB disguises itself
A person may contract pulmonary tuberculosis from inhaling infected droplets from a cough or sneeze by an infected person.

TB has two phases: one latent, where the immune system keeps it in check, and one active, characterized by weeks of coughing, fever, weakness and loss of appetite. It's only contagious while active.

Latent TB hides within the lungs by forming balls of fibrous material and living immune cells. These balls develop their own blood supply. Referred to as granulomas, they can persist for many years without causing sickness.

Eventually though, the blood supply to these granulomas disintegrates. The granulomas collapse into the lungs, and the infectious bacilli are released into the airways, causing active disease.

Source: Science Magazine, May 14, 2010 ‘Tuberculosis: What we don’t know can and does hurt us,’ by David G. Russell, Clifton E. Barry III, and JoAnne L. Flynn

STEVE LOPEZ/Staff Artist
Bacilli Infection: Tuberculosis
Spirilla

- Bacteria that are spiral, or corkscrew, in shape.
- These include the comma-shaped vibrio and the corkscrew-shaped spirochete.
- Diseases caused by spirilla include syphilis and cholera.
Spirilla: Cholera

How cholera affects the body
Cholera is an acute intestinal infection that causes severe diarrhea, dehydration and, if not treated promptly, death.

How it spreads
- People ingest water or food contaminated with cholera bacteria
- In epidemic, feces of diseased person is source of contamination

Treatment
- Salt solution, intravenous fluids, antibiotics
- In unprepared communities, death rates can be as high as 50 percent

In the large intestine
1. Bacteria multiply rapidly
2. Toxin from bacteria penetrates cells of intestinal wall
3. Toxin prevents intestine from absorbing water from digested food; diarrhea, dehydration result

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Source: World Health Organization
Multidrug Resistant Bacteria

- When bacteria becomes resistant to several drugs.
- Also called “Superbugs.”
- Examples:
  - MRSA (Methicillin-resistant staphylococcus aureas): causes a severe staph infection that is difficult to treat because it is so resistant to many different antibiotics.
  - VRE (Vancomycin-resistant enterococcus): bacterium that is resistant to Vancomycin and many other drugs. No single antibiotic can eliminate VRE so many different combinations of drugs are used to treat this.
MRSA
Septicemia
2nd class of microorganisms-- **Protozoa**

- One-celled, animal-like organisms often found in decayed materials, animal or bird feces, insect bites, and contaminated water.
- Many contain flagella that allow them to move freely.
- Some are pathogenic and cause diseases such as malaria, amebic dysentry (intestinal infection), trichomonas, and African sleeping sickness.
Protozoa: Malaria

How Malaria Spreads

The malaria parasite depends on both humans and mosquitoes to carry out its deadly cycle of life.

1. Infected mosquito bites a human.
2. Parasite rapidly goes to liver within 30 minutes.
3. The parasite starts reproducing rapidly in liver. Some parasites lie dormant in the liver and become activated years after initial infections.
4. Gets into blood stream, attaches and enters red blood cells. Further reproduction occurs.
5. Infected red blood cells burst, infecting other blood cells.
6. This repeating cycle depletes the body of oxygen and also causes fever. The cycle coincides with malaria’s fever and chills.
7. After release, a dormant version of malaria travels through the host’s blood stream, waiting to be ingested by another mosquito to carry it to a new host.

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3rd class of microrganisms-- Fungi

- Simple, plant-like organisms that live on dead organic matter.
- 2 common forms that can be pathogenic are yeasts and molds.
- Antibiotics do not kill fungi, antifungal medications are available but can be very expensive, must be taken for a long time, and may cause liver damage.
- Common diseases are ringworm, athlete’s foot, histoplasmosis, yeast vaginitis, and thrush.
Fungi
Fungi Infection: Ringworm
4th class of microorganisms—Rickettsiae

- Parasitic organisms which means they cannot live outside the cells of another living organism.
- Commonly found in fleas, lice, ticks, mites, and are transmitted to humans by the bites of these insects.
- Cause diseases such as Typhus Fever and Rocky Mountain Spotted Fever.
- Antibiotics are effective against many different rickettsiae.
Rickettsiae Infection: Rocky Mountain Spotted Fever
5th class of microrganisms-- Viruses

- The smallest microorganisms, visible using only an electron microscope.
- Cannot reproduce unless inside another living cell.
- Spread from human to human by blood and body secretions.
- More difficult to kill because they are resistant to many disinfectants and are not affected by antibiotics.
- New and different viruses emerge constantly because viruses are prone to mutating and changing genetic information.
Viruses

- Cause many diseases including:
  - Common cold
  - Influenza
  - Measles
  - Mumps
  - Chicken Pox
  - Herpes
  - Warts
  - Polio
3 Viruses of Major Concern for Safety of Health Care Workers

- Hepatitis B
- Hepatitis C
- Acquired Immune Deficiency Syndrome
Hepatitis B

- Aka Serum Hepatitis.
- Caused by HBV virus.
- Affects the liver, can lead to destruction and scarring of liver cells.
- Transmitted by blood, serum, and other body secretions.
- Vaccine has been developed: Expensive and involves a series of 3 injections.
- Federal law mandates that employers must provide the vaccine at no cost to any health care worker at-risk for exposure, the worker may refuse in writing.
Hepatitis C

- Caused by HCV virus
- Transmitted by blood and blood-containing body fluids.
- Many have no symptoms while others feel like they have the flu.
- Can cause serious liver damage.
- Immunizations are being developed.
- Both HBV and HCV are VERY difficult to destroy, viruses can remain active in dried blood for several days!! EEK!!
- Health care worker must take every precaution to protect themselves!
Hepatitis

Risk factors:
- people who share needles
- health workers who are exposed to infected blood

Possible symptoms:
- pain in the upper right quadrant of abdomen
- nausea and vomiting
- loss of appetite
- jaundice
- fatigue
- itching
Acquired Immune Deficiency Syndrome

- Caused by the Human Immunodeficiency Virus (HIV)
- Suppresses the immune system
- An individual with AIDS cannot fight off many cancers and infections that would not affect a healthy person
- Presently there is no cure or vaccine available
HIV/AIDS
6th class of microorganisms-- Helminths

- Multi-cellular parasitic organisms, commonly called worms or flukes.
- Transmitted to humans when eggs or larvae are ingested by eating contaminated food, ingest meat contaminated with the worms, or get bitten by infected insects. Some worms can also penetrate the skin to enter the body.
Helminth examples:

- **Hookworms**: Attach to the small intestine and can affect the heart.
- **Ascariasis**: Live in the small intestine and can cause an obstruction.
- **Trichinella Spiralis**: Causes Trichinosis after eating raw or undercooked pork products.
- **Enterobiasis**: Commonly called Pinworms, affects many young children.
- **Taenia Solium**: or Pork Tapeworm, contracted by eating inadequately cooked pork.
Helminths
Types of Infection based on origin

- Pathogenic organisms cause infection and disease in different ways
  - **Endogenous**—infection originates within the body
    - Ex. metabolic disorders (diabetes), tumors, congenital abnormalities
  - **Exogenous**—infection originates outside the body
    - Ex. Pathogenic organisms invading body, trauma, temperature extremes
  - **Communicable**—A disease caused by pathogens that spreads easily.
    - Ex. Chicken pox, measles, mumps
  - **Nosocomial**—AKA. Hospital acquired infections
    - Ex. Often transmitted by healthcare workers. Staph, pseudomonas and enterococci
  - **Opportunistic**—occur when body defenses are weak, usually in immunocompromised people.
    - Ex. Kaposi’s sarcoma, candidiasis or pneumocystis jiroveci in AIDS pts
Chain of infection

- For disease to occur and spread from one person to another certain conditions must be met.
- These conditions are commonly called the Chain of Infection.
Aseptic technique

- Asepsis — the absence of disease-producing microorganisms or pathogens.
- Measures are needed to achieve asepsis.
  - **Medical asepsis** (clean technique)
  - **Surgical asepsis** (sterile technique)
- Sterile — free from all organisms both pathogenic and nonpathogenic.
- Contaminated — becoming unclean; organisms and pathogens are present.
- Aseptic technique — directed toward maintaining cleanliness and eliminating or preventing contamination.
Levels of aseptic control

- **Antisepsis or antiseptics**—prevent or inhibit growth of pathogenic organisms but are not effective against spores and viruses. Ex. alcohol and betadine

- **Disinfection**—process that destroys or kills pathogenic organisms. Not always effective against spores and viruses. Chemical disinfectants are used. Ex. bleach solution and zephirin

- **Sterilization**—process that destroys all microorganisms, both pathogenic and nonpathogenic, including spores and viruses. An **autoclave** is the most common piece of equipment used for sterilization.
What is PPE??

- “specialized clothing or equipment worn by an employee for protection against infectious materials”  (OSHA)
Regulations and Recommendations for PPE

- OSHA issues workplace health and safety regulations and specifies circumstances for which PPE is indicated.
- Employers must:
  - Provide appropriate PPE for employees
  - Ensure that PPE is disposed or reusable PPE is cleaned, laundered, repaired and stored after use
- CDC recommends when, what and how to use PPE
What types of PPE is used in Healthcare Settings?
What types of PPE is used in Healthcare Settings?

- Gloves – protect hands
- Gowns/aprons – protect skin and/or clothing
- Masks and respirators – protect mouth/nose
  - Respirators – protect respiratory tract from airborne infectious agents
- Goggles – protect eyes
- Face shields – protect face, mouth, nose, and eyes
What are the reasons why we would provide you different types of PPE?

- Type of exposure anticipated
  - Splash/spray versus touch
  - Category of isolation precautions
- Durability and appropriateness for the task
- Fit
Do’s and Don’ts of Glove Use

- Work from “clean to dirty”
- Limit opportunities for “touch contamination” - protect yourself, others, and the environment
- Don’t touch your face or adjust PPE with contaminated gloves
- Don’t touch environmental surfaces except as necessary during patient care
- Change gloves
  - During use if torn and when heavily soiled (even during use on the same patient)
  - After use on each patient
- Discard in appropriate receptacle
  - Never wash or reuse disposable gloves
Sequence* for Donning PPE

- Gown first
- Mask or respirator
- Goggles or face shield
- Gloves
- *Combination of PPE will affect sequence – be practical
What parts of your PPE are clean and dirty?

• Clean – inside, outside back, ties on head and back
  • Areas of PPE that are not likely to have been in contact with the infectious organism

• Dirty/Contaminated – outside front
  • Areas of PPE that have or are likely to have been in contact with body sites, materials, or environmental surfaces where the infectious organism may reside
Sequence for Removing PPE

• Gloves
• Goggles
• Gown
• Mask
Where do we remove PPE?

- At doorway, before leaving patient room or in anteroom*
- Remove respirator (special mask) outside room, after door has been closed*
- Ensure that hand hygiene facilities are available at the point needed, e.g., sink or alcohol-based hand rub
Standard Precautions

- Previously called Universal Precautions
- Assumes blood and body fluid of ANY patient could be infectious
- Recommends PPE and other infection control practices to prevent transmission in any healthcare setting
- Decisions about PPE use determined by type of clinical interaction with patient
What do we use when??

- Use **GLOVES**—when touching blood, body fluids, secretions, excretions, contaminated items; for touching mucus membranes and non-intact skin
- Use a **GOWN** during procedures and patient care activities when contact of clothing/ exposed skin with blood/ body fluids, secretions, or excretions is anticipated
- Use a **MASK & FACE SHIELD/GOGGLES** during patient care activities likely to generate splashes or sprays of blood, body fluids, secretions, or excretions
What Type of PPE Would *You* Wear?

- Giving a bed bath?
- Drawing blood from a vein?
- Cleaning an incontinent patient with diarrhea?
- Irrigating a wound?
- Taking vital signs?
- Suctioning oral secretions?
- Transporting a patient in a wheel chair?
- Responding to an emergency where blood is spurting?
What Type of PPE Would You Wear?

- Giving a bed bath?—Generally none
- Drawing blood from a vein?—Gloves
- Cleaning an incontinent patient with diarrhea?—Gloves, possibly a gown
- Irrigating a wound?—Gloves, mask, face shield & gown
- Taking vital signs?—Generally none
- Suctioning oral secretions?—Gloves, mask & face shield, possibly a gown
- Transporting a patient in a wheel chair?—Generally none
- Responding to an emergency where blood is spurting?—Gloves, mask & face shield & gown
Transmission Based Precautions (Isolation)

- Airborne
- Droplet
- Contact
Transmission Based Precautions (Isolation)

- **Airborne**
  - Tiny particles that stay in the air for an extended time.
  - Requires a respirator and negative pressure isolation room

- **Droplet**
  - Large droplet that live on surfaces
  - Must wear mask within 3 feet of patient

- **Contact**
  - Gown and gloves for contact with patient or environment of care (e.g., medical equipment, environmental surfaces)
Interventions for patients in isolation

• Contaminated items are bagged to remove them from the person’s room.
  • Leak-proof plastic bags are used.
  • Bag and transport linens, trash, equipment, and supplies following center policy.
  • **Double bagging** is not needed unless the outside of the bag is soiled.
• Use **biohazard specimen bags** to transport specimens to the laboratory.
• Procedures for transporting persons vary among centers and type of isolation
Bloodborne Pathogen Standard

- Regulation of OSHA to protect health team from exposure to blood and other potentially infectious materials (OPIM)
- HIV, HBV & HCV are bloodborne pathogens.
- The center must have an exposure control plan.
  - It identifies staff at risk
  - Includes actions to take for an exposure incident.
  - Staff at risk receive free training.
Preventive Measures

- Measures used to reduce the risk of exposure include:
  - Hepatitis B vaccinations
  - Engineering and work practice controls
  - Personal protective equipment (PPE)
  - Proper cleaning and decontamination of contaminated equipment
    - Decontaminate work surfaces with a proper disinfectant.
    - Use a brush and dustpan or tongs to clean up broken glass
Regulated Waste

- Anything soiled with liquid or semi-liquid blood or other potentially infection material, including sharps, must be discarded using special measures.
- Containers used for discarding regulated waste are closable, puncture-resistant, leak-proof, and color-coded in red and have the **BIOHAZARD** symbol.
- The center must be kept clean and sanitary.
- Special measures must be used with contaminated laundry.
What happens if someone is exposed to blood or another body fluid?

- Exposure Incidents
  - Any contact of the eye, mouth, other mucous membrane, non-intact skin with blood or OPIM, including parental contact (needles) must be reported at once!!
  - Confidentiality is important.
Hand Hygiene

• Required for Standard and Transmission Based Precautions

• When to perform…
  • Before and after patient contact
    – Immediately after removing PPE
    – If hands become visibly contaminated during PPE removal, wash hands before continuing to remove PPE

Wash hands with soap and water or use an alcohol-based hand rub

Ensure that hand hygiene facilities are available at the point needed, e.g., sink or alcohol-based hand rub
PPE Use in Healthcare Settings: Final Thoughts

- PPE is available to protect you from exposure to infectious agents in the healthcare workplace.
- Know what type of PPE is necessary for the duties you perform and use it correctly.