

Infectious Diseases and Microbial Agents

OBJECTIVES/RATIONALE

An infection is an organism's response to disease-causing microorganisms. It results when pathogens enter and multiply in the body. The student will identify the main classes of pathogenic organisms and common diseases associated with each pathogen.

TEKS: 121.15 (c) 4(A-E), 5A-D), (A-D), 7 (A-D)

TAKS ELA 1, 4
Science 1, 2

KEY POINTS

POWER POINT: *We Are Not Alone!*

I. An Introduction:

A. We Are Not Alone!

- We are outnumbered.
- On the average human, there are about 100 trillion microscopic beings.
- As long as they stay in balance and where they belong, they do us no harm.
- Many of them provide some important service for human survival.
- *opportunists*

B. Facts:

- Microorganisms cannot be seen without a microscope—with the exception of some intestinal parasites.
- Some of these organisms cause infection and illness.
- Other are “good” organisms that help keep a balance in the environment and in the body.

III. Good vs. Bad Microbes

A. microbes that cause disease (germs) are referred to as *pathogens*
nonpathogens

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These organisms are referred to as *opportunistic pathogens*

87% - Beneficial Microbes
10% - Opportunists
03% - Pathogens

IV. Opportunistic infections

A. When is the “right time” for opportunistic pathogenic invasion?

- When host's resistance is low
- When otherwise harmless microbes gain entry to organ system where it can multiply and do harm

- B. Usually opportunistic pathogens live on and in the healthy human body (on skin, in mouth, in intestine).
- Since many of these microbes are potentially pathogenic, they can cause disease if they gain entrance to bloodstream, or internal organs such as the bladder.
 - Other times microbes become pathogenic when they leave their normal environment in the body and move into other areas, i.e. the *E. coli*

- **warm** temperatures (98.6° F)
- Most organisms prefer a **dark area** to grow and reproduce (many are killed quickly by sunlight)
- All need food to survive—some live on dead matter or tissues, and others use living matter (parasites)
- All organisms need **moisture**
Human body is the ideal supplier of all requirements of microorganisms.

VI. Main Classes of Pathogenic Microbes

A. Bacteria – one-celled microorganisms

- Prokaryotic cells
- Pathogenic bacteria contain cell-damaging proteins that cause infection; these proteins come in two forms:
 - endotoxins – released when the bacterial cell wall decomposes. (these endotoxins cause fever and aren't affected by antibiotics)
 - exotoxins – released during cell growth.
- Bacteria are classified by shape and arrangement:
 - Bacteria that are round or spherical in shape are called
 - When they occur in pairs they are called _____ (cause diseases such as gonorrhea, meningitis, and pneumonia)
 - Cocci that occur in chains are called _____ (cause strept throat and rheumatic fever)
 - Cocci that occur in clusters are called _____ (cause pus-producing microbes that cause infections such as boil, wound infections, and toxic shock)
 - Bacteria that are rod-shaped are called
 - bacilli can occur in pairs or in chains
 - many bacilli contain flagella (threadlike projections similar to tails) which allow them to move
 - some bacilli have the ability to form spores (thick-walled capsules) when conditions for growth are poor; in spore form, bacilli are extremely difficult to kill
 - diseases caused by bacilli include: tuberculosis, tetanus, pertusis (whooping cough), botulism, diphtheria, and typhoid
 - Bacteria that are spiral or corkscrew-shaped are called _____ - diseases caused by spirilla include syphilis and cholera
- chlamydia and rickettsia are specific types of bacteria
 - they are smaller than conventional bacterial but larger than viruses
 - chlamydia cause a variety of infections including: conjunctivitis, chlamydial urethritis and cervicitis,
 - rickettsia causes forms of typhus including Rocky Mountain spotted fever

B. Protozoa & Helminths –animal-like, single-celled organisms that may form colonies

- Most species are found in such aquatic habitats as oceans, lakes, rivers, and ponds.

- b. Protozoa obtain their food by ingesting bacteria, waste products of other organisms, algae, or other protozoa.
 - c. Most protozoan species are motile, either by flagella, cilia, or amoeboid motion
 - d. Some are pathogenic and cause diseases such as: malaria, amebic dysentery, trichomonas, African sleeping sickness, leishmaniasis, and toxoplasmosis.
 - e. A helminth, commonly known as a parasitic “worm,” usually of the intestines.
 - f. Helminths are more complex than protozoa
 - g. Adult helminths are visible without a microscope.
 - h. Helminth infections are associated with unsanitary conditions, overcrowding, and warm climates.
- C. Fungi – a diverse group of organisms that obtain food by absorbing nutrients from an external source.
- a. Thousands of different types of fungi grow on and absorb food from substances such as soil, wood, decaying organic matter, or living plants and other organisms.
 - b. A number of fungi cause diseases in humans and other vertebrates. In general, these fungal infections, or mycoses, develop slowly, recur more frequently than bacterial infections, and do not produce a lasting immunity in the body.
 - c. A mycosis is classified in one of two groups, depending on the part of the body that is infected.
 - i. A dermatomycosis is an infection of the skin, hair, or nails, such as ringworm or athlete’s foot - these infections rarely progress to the internal organs. Most respond well to medication, although treatment may take several weeks.
 - ii. A systemic mycosis, which is an infection of the entire body, is typically more serious and can be fatal for individuals whose immune system has been weakened by diseases such as acquired immunodeficiency syndrome (AIDS) or cancer.
 - d. Fungal infections are typically spread by spores that enter the body through inhalation or through an opening in the skin.
 - e. Some infections are passed from animals to humans or between humans.
 - f. A few drugs are effective in treating systemic infections, but because treatment may last for several months to years to prevent relapse of the infection, these drugs often cause toxic side effects.
 - g. Some fungi are external parasites of humans, causing skin conditions such as ringworm, athlete's foot, and jock itch.
 - h. Other fungi invade internal tissues; examples include yeast that infect the genital tract and several fungi species that cause a type of pneumonia.
- D. Viruses – microscopic genetic parasites that may contain genetic material such as DNA.
- a. Viruses are not considered free-living, since they cannot reproduce outside of a living cell; they have evolved to transmit their genetic information from one cell to another for the purpose of replication.
 - b. Viral infections generally occur when normal inflammatory and immune responses fail.
 - i. It develops in a host cell and hides there.
 - ii. Viruses need this host cell in order to replicate.
 - c. Viruses often damage or kill the cells that they infect.
 - d. A few viruses stimulate cells to grow uncontrollably and produce cancers.
 - e. Although many infectious diseases, such as the common cold, are caused by viruses, there are no cures for these illnesses - the difficulty in developing antiviral therapies stems from the large number of variant viruses that can cause the same disease, as well as the inability of drugs to disable a virus without harming healthy cells.
 - f. Diseases caused by viruses includes: mumps, measles, influenza, rabies, hepatitis, poliomyelitis, smallpox, AIDS, and certain types of cancer.

VII. How Pathogens Are Spread: The Chain of Infection

The analogous model used to understand the infection process is the chain of infection, a circle of links, each representing a component in the cycle. Each link *must* be present and in sequential order for an infection to occur.

- A. First, there must be an **infectious agent** (pathogen) such as bacterium, virus, fungus, or protozoan.
- B. Second, the causative agent must find a **reservoir** where it can live (inside human or animal, the environment, objects contaminated with infectious material)
- C. Third, the pathogen must then have a **portal of exit** (a way to escape from the reservoir in which it has been growing). In the human body, pathogens can leave the body through urine, feces, saliva, blood, tears, mucous discharge, sexual secretions, and draining wounds.
- D. Forth, when the pathogen leaves the reservoir, it must have a **mode of transmission** to another reservoir or host where it can live. Transmission of pathogens occurs in different ways:
 - a. **Direct person-to-person** –direct contact with body secretion containing the pathogen; contaminated hands are one of the most common sources of direct transmission; other direct contact includes kissing, sexual contact
 - b. **Indirect contact** – occurs when pathogens are transmitted from contaminated substances such a food, air, soil, insects, feces, clothing, instruments, and equipment.
 - i. Examples include: touching contaminated objects and spreading pathogen to hands, being bitten by insect carrying pathogen
 - c. **Airborne** – occurs when one breathes in droplets carrying airborne infections; coughing and sneezing projects droplets into the air. Droplets cling to hair, cloths, and objects.
- E. Fifth, there must be a **portal of entry** (way to enter new reservoir or host) Pathogens may enter the body through breaks in the skin, breaks in the mucous membrane, through the respiratory tract, the digestive tract, the genitourinary tract, and the circulatory system.
- F. Sixth, the new host must be a **susceptible host**. This happens when large numbers of pathogens invade the body or when the body's defenses are weak.

VIII. Breaking the chain of infection

- C. Because many healthcare professionals come into direct contact with a number of patients, they must practice techniques to break the chain of infection.
- D. Two important practices are:
 - a. medical asepsis – keeping the environment as free from infectious organisms as possible - aseptic techniques include: hand washing, gowning & masking, separating clean from contaminated materials, providing patient information about appropriate hygienic practices
 - b. universal precautions – help control contamination from blood borne viruses such as HIV and hepatitis - protective measures include: wearing gloves, gown, facial mask, and/or goggles.

VIII. Emerging Infectious Diseases

- A. Among diseases new to science are AIDS, Ebola hemorrhagic fever, Legionnaires' disease, and Lyme disease.
 - a. AIDS has been the most deadly of all the new diseases, but even it has not taken as high a toll as malaria, tuberculosis, and other diseases that have been around for centuries.
 - b. Some newly identified disease-causing agents for diseases that have been recognized for a long time include Human T-lymphotropic, which can cause some cases of non-Hodgkin's lymphoma, a type of cancer originating in the lymphatic system; and hairy-cell leukemia, a rare type of cancer of the blood.
- B. Environmental changes may be responsible for some new diseases.

- a. It has been speculated that the viruses for some of the lethal hemorrhagic fevers that have surfaced in Africa, (e.g. Ebola and Marburg disease), have long existed in certain feral animals.
 - b. As populations have trespassed into wilderness areas they have come into contact with the infected animals, and the viruses have jumped from their customary animal host to a new human host, with deadly consequences.
- G. Besides new diseases, pathogens change, or mutate, giving rise to new, virulent strains.
- a. Influenza viruses are among those that mutate frequently, which explains why flu shots are given annually, and why epidemics of influenza sporadically arise.
- H. Problems have occurred when mutations in infectious agents result in resistance to medicines that previously were effective treatments.
- a. The bacteria that caused bronchitis, meningitis, tuberculosis, and pneumonia are among many that have developed strains that are now resistant to at least some antibiotics.
 - b. Physicians have fewer options for treating these resistant diseases and preventing their spread.
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- I. Complete a Case Study over an infectious disease caused by an agent in each of the classes of pathogenic microbes.
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MATERIALS NEEDED

<http://216.239.53.100/search?q=cache:cTtsvgmtFzEC:www.gphealthsmart.com/teaching/gradesK-3pdf/page19.pdf+glow+germ&hl=en&ie=UTF-8> - cute lesson plan on cross contamination—could be used with teaching activity

<http://faculty.ccc.edu/tr-infectioncontrol/chain.htm> - nice site for chain of infection

<http://www.healthsystem.virginia.edu/internet/infection-control/pppartners.cfm> - good article on antibiotic resistance for enrichment reading

<http://news.bbc.co.uk/1/hi/scotland/2009028.stm> - New Superbug Found In Hospital; good but scary

Quiz Key

Successful completion of Infectious Disease Quiz.

For reinforcement, the student will outline essential points over one of the following: a specific microbial infection, antibiotic resistant diseases, nosocomial diseases, treating systemic fungal infections.

For enrichment, the student will research and report on emerging or reemerging diseases. Present using multimedia technology.

REFLECTIONS

Pathology Report

Disease

Alternate names

Definition

Etiology

Signs & Symptoms

Diagnostic Tests

Treatment

Complications

Prognosis

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