

Infectious Diseases

Infectious Diseases - Definitions

- Human disease can be caused by infectious agents, genetic defects, environmental factors, or a combination of these factors.
- The infectious disease process begins at the time of infection, when a pathogen enters a host and starts to reproduce.
- Many infectious agents, though, are killed by the body's numerous defenses before they can begin to reproduce.
- Further more, an infection may not necessarily produce disease; the infectious agent could be defeated quickly or it could hide somewhere in the body where it cannot be detected
- The rapidity of onset and severity of the disease caused by an infectious agent depends on the virulence of the pathogen.

Koch's Postulates

- Bacteria were discovered in 1675 by Antony van Leeuwenhoek
- 1876 , a German physician named Robert Koch first demonstrated that specific diseases are associated with particular microorganisms.
- Koch developed a set of criteria to show that anthrax, a disease of cattle, was caused by a specific bacterium, named *Bacillus anthracis*, and that tuberculosis was caused by a separate distinct bacterium.

Koch's Postulates

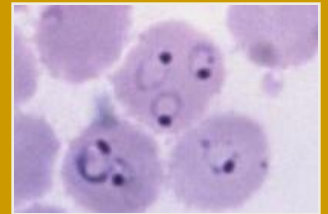
- Koch presented his discovery of *Mycobacterium tuberculosis* in a lecture in March of 1882. He brought his entire laboratory setup to the lecture hall and demonstrated his procedures for his audience, inviting them to check his findings themselves. His methods were so innovative that his criteria still are useful today in identifying disease-causing agents.
- Robert Koch was awarded the Nobel Prize in Physiology and Medicine in 1905 for his work in tuberculosis.

Koch's Postulates

- Koch developed four criteria to demonstrate that a specific disease is caused by a particular agent.
 1. The specific agent must be associated with every case of the disease.
 2. The agent must be isolated from a diseased host and grown in culture.
 3. When the culture-grown agent is introduced into a healthy susceptible host, the agent must cause the same disease.
 4. The same agent must again be isolated from the infected experimental host.

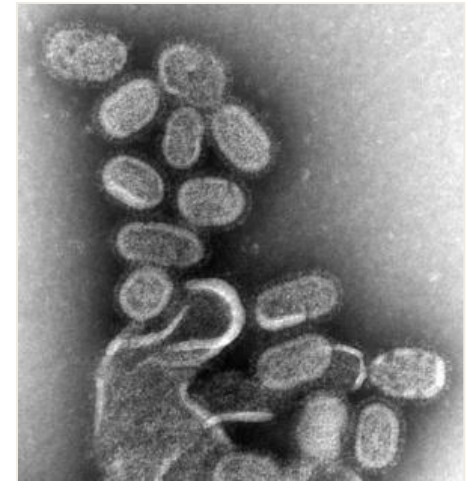
Infectious Disease Agents

- Most infectious agents that cause disease are microscopic in size and thus, are called microbes or microorganisms.
- Different groups of agents that cause disease are:
 - Bacteria
 - Viruses
 - Protozoa (Protists)
 - Fungi
 - Helminths (Animals)



Infectious Diseases Throughout History

- Infectious agents have probably always caused disease in humans.
- Smallpox has been described in ancient Egyptian and Chinese writings and may have been responsible for more deaths than all other infectious diseases combined.
- There is evidence that malaria and poliomyelitis have existed since ancient times.
- In the 14th Century, the bubonic plague, or Black Death, killed about 20 million people in Europe alone.



How Infectious Agents Cause Disease

- Production of poisons, such as toxins and enzymes, that destroy cells and tissues.
- Direct invasion and destruction of host cells.
- Triggering responses from the host's immune system leading to disease signs and symptoms.

Phases of Infectious Disease

- time between infection and the appearance of signs and symptoms.
- mild, nonspecific symptoms that signal onset of some diseases.
- a person experiences typical signs and symptoms of disease.
- subsidence of symptoms.
- symptoms have disappeared, tissues heal, and the body regains strength.

Phases of Infectious Disease

- Diseases caused by infectious agents usually run a standard course that is associated with different signs and symptoms. Before we describe these different phases of infectious diseases, we must first define the terms, “signs” and “symptoms.”
- Signs of an infectious disease are characteristics of a disease that can be observed by examining a patient. They include things such as fever, coughing, rash, vomiting, and diarrhea.
- Symptoms, on the other hand, can be felt only by the patient. They include pain, headache, and nausea.

Phases of Infectious Disease

- The time period from when a person first becomes infected until signs and symptoms become apparent is called the incubation period. During this phase, the person is not aware that he or she is infected, but he or she may already be contagious (capable of passing the agent on to others).
- The length of the incubation period is typical for a specific agent but can vary, depending on how virulent the agent is, the dose of infectious agent entering the body, and the route of infection (i.e., where the agent enters the body relative to the tissue it infects).
- In the prodromal phase, a person experiences mild, nonspecific symptoms. During this time, the agent is continuing to multiply and the person is contagious. This phase is absent in some diseases, which cause a person to feel ill suddenly, without any warning.

Phases of Infectious Disease

- The clinical phase (also called the invasive phase or acute phase) is the period in which typical disease signs and symptoms are evident. During this phase, there comes a time when symptoms reach their greatest intensity. Called the “acme,” this is the height of the battle between the pathogen that is invading and destroying tissue and the efforts of the body’s immune system to contain and obliterate the invader.

Phases of Infectious Disease

- Fever is usually a component of this phase, during which the patient is most contagious. Once the acme is reached, the number of infectious agents begins to drop and the signs and symptoms start to decrease. This is the decline phase, during which the body's activities gradually return to normal, the tissues heal, and the individual no longer experiences any symptoms.
- The recovery phase also is known as the convalescent phase. With some diseases, such as chickenpox, a person can still be contagious during recovery until the lesions are healed.

Phases of Infectious Disease

- From the pathogen's perspective, it is advantageous to induce the signs and symptoms of disease, such as coughing, sneezing, vomiting, and diarrhea, because these are ways that the infectious agent can be released from one host and spread to another. And although we do not enjoy feeling ill, these signs and symptoms are beneficial to us, in that they make us more likely to stay in bed and conserve energy to fight the pathogen and minimize the chance of spreading the disease to others.

Classification of Infectious Disease

- develops and runs its course quickly.
 - develops more slowly and is usually less severe, but may persist for a long, indefinite period of time.
 - characterized by periods of no symptoms between outbreaks of illness.
- confined to a specific area of the body.
 - a generalized illness that infects most of the body with pathogens distributed widely in tissues.
- initial infection in a previously healthy person.
 - infection that occurs in a person weakened by a primary infection.

Types of Infectious Disease

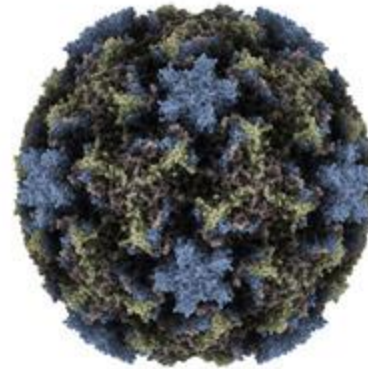
- Infectious diseases are classified by their duration and their location within the body, among other characteristics. “Acute,” “chronic,” and “latent” are terms used to describe the duration of a disease, how quickly the symptoms develop, and how long they last. The common cold is an acute disease; tuberculosis is a chronic disease; and herpes infections can produce latent infections with recurring attacks interspersed by periods with no symptoms (e.g. cold sores).
- “Local” and “systemic” refer to the location of a disease within the body. Pathogens that spread from a more localized site, enter the bloodstream and are carried to other tissues can produce a systemic infection.

Types of Infectious Disease

- “Primary” and “secondary” characterize the order of infection. A primary infection, usually an acute infection, occurs first in a previously healthy person. Sometimes, when a person is suffering from a primary infection and his or her immune system has been weakened by battling the primary infection, the person can succumb to a secondary infection caused by another agent. Thus, a person who has caught a cold due to a virus may then become ill with an ear infection caused by a bacterium because his/her immune system is incapable of fighting off another agent in its weakened state.

Influenza

Epidemic of 1918 killed 20-100 million people worldwide.



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Example of an Infectious Disease - Flu

- Acute contagious disease caused by the influenza virus.
- Respiratory tract infection, but symptoms felt throughout entire body.
- Epidemics occur seasonally with low fatality; more deadly pandemics occur several times each century.
- Highly changeable virus that can infect multiple species, including humans, pigs, and birds.
- Concern exists that current avian flu will lead to a new pandemic.

Transmission of Infectious Diseases

- Agents that cause infectious diseases can be transmitted in many ways.
 - Through the air
 - Through contaminated food or water
 - Through body fluids
 - By direct contact with contaminated objects
 - By animal vectors such as insects, birds, bats, etc.



Related Terms

- **Endemic/Enzootic:** The constant presence of a disease or infectious agent within a given geographic area.
- **Epidemic/Epizootic:** The occurrence in an area of a disease or illness in excess of what may be expected on the basis of past experience for a given population (in the case of a new disease, such as AIDS, any occurrence may be considered "epidemic").
- **Pandemic/Panzootic:** A worldwide epidemic affecting an exceptionally high proportion of the global population.

Example of an Infectious Disease - AIDS

- AIDS (Acquired Immune Deficiency Syndrome) is the disease caused by the virus called HIV (human immunodeficiency virus).
- HIV attacks cells of the immune system and destroys their ability to fight infection by other agents.
- HIV is spread through the direct exchange of body fluids.
- There is a long period of time from HIV infection to the onset of AIDS.
- Anti-HIV drugs prolong the length and quality of life, but there is no vaccine or cure for AIDS.

Reducing the Spread of Infectious Diseases

- Vaccines
- Antimicrobial drugs
- Good personal hygiene and sanitation
- Protection against mosquitoes
- Quarantine



Emerging Infectious Diseases

- Emerging diseases are those that have recently appeared within a population, or whose incidence or geographic range is increasing rapidly.
- Diseases can emerge or re-emerge due to:
 - appearance of a previously unknown agent.
 - evolution of a new infectious agent.
 - spread of an infectious agent to a new host.
 - spread of an infectious agent to new locations.
 - acquisition of resistance to anti-microbial drugs.
 - deliberate introduction into a population.

Emerging Infectious Diseases

- Emerging infectious diseases can be caused by both “new” and “old” pathogens.
- Diseases that recently appeared in a population, or whose range of hosts or geographic locations are rapidly expanding or threatening to expand in the near future are referred to as “emerging diseases.”
- Diseases whose incidence had significantly declined in the past, but have again reappeared are known as “re-emerging diseases.” Examples of emerging diseases are HIV, influenza, SARS, and Ebola.
- Tuberculosis is a disease that is re-emerging. “Old” pathogens are considered emerging if they are spreading to new species or new geographic locations.

Emerging Infectious Diseases

- Diseases sometimes emerge due to natural processes, such as the evolution of the infectious agent over time, but many emerging diseases result from human activities. These include population growth, migration from rural areas to cities, international air travel, blood transfusions, poverty, wars, and destructive ecological changes caused by economic development and land use.

Emerging Infectious Diseases

- Many emerging diseases arise when infectious agents in animals are passed to humans (referred to as zoonoses). This is occurring more and more as the human population grows and spreads into new geographical regions, resulting in increased contact with wild animal. It is not difficult to imagine a scenario in which a hunter in a remote area of Africa becomes infected with a “new” infectious agent and then travels to a village, where he infects other locals, one of whom boards a plane and infects his fellow passengers, who then travel to other parts of the world before any infection is detected. In this way, a disease could emerge quite rapidly.

Emerging Infectious Diseases

- For an emerging disease to become established, at least two events must occur: (1) the infectious agent must be introduced into a vulnerable population; and (2) the agent must have the ability to spread readily from person to person, cause disease, and sustain itself within the population. Both of these events have occurred with HIV. To date, only the first has happened with avian flu.

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Emerging Infectious Diseases

- Even diseases previously thought to have been under control can sometimes make a comeback. This can occur when an agent becomes resistant to the drugs, such as antibiotics, used to treat the disease. An infectious agent can mutate so that these drugs are no longer useful in combating the disease. Drug resistance is on the rise, in large part due to overuse and misuse of antibiotics and other drugs. Tuberculosis, for example, is becoming highly antibiotic-resistant. Malaria, too is becoming increasingly drug-resistant.

Emerging Infectious Diseases

- A frightening possibility is the emergence of an infectious disease due to its deliberate introduction into human or agricultural populations for terrorist purposes. Since the terrorist attacks of September 11, 2001, and the subsequent mailing of anthrax-laced letters, this threat is being taken very seriously. Agents considered most dangerous include those which cause anthrax, botulism, plague, and smallpox. Other potential agents classified as risks, albeit lower level ones, include West Nile virus, Salmonella, SARS, influenza, yellow fever, and drug-resistant tuberculosis.