

Infection

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Infection

- Infection is the invasion of a host organism's bodily tissues by disease-causing organisms, their multiplication, and the reaction of host tissues to these organisms and the toxins they produce. Infections are caused by microorganisms such as viruses, prions, bacteria, and Viroids, and larger organisms like parasites and fungi.



Definitions

Disease and Infectious Disease

Disease

Any deviation from a condition of good health and well-being

Infectious Disease

A disease condition caused by the presence or growth of infectious microorganisms or parasites

Pathogenicity and Virulence

- **Pathogenicity**
 - The ability of a microbe to cause disease
 - This term is often used to describe or compare species
- **Virulence**
 - The degree of pathogenicity in a microorganism
 - This term is often used to describe or compare strains within a species

Acute infection vs. chronic infection

- **Acute Infection**

- An infection characterized by sudden onset, rapid progression, and often with severe symptoms

- **Chronic Infection**

- An infection characterized by delayed onset and slow progression

Causative Agents Effecting Humans

- Bacteria
- Viruses
- Fungi
- Protozoa
- Helminths
- Prions



Definitions

Primary infection vs. secondary infection

- **Primary Infection**
 - An infection that develops in an otherwise healthy individual
- **Secondary Infection**
 - An infection that develops in an individual who is already infected with a different pathogen

Localized infection vs. systemic infection

- **Localized Infection**
 - An infection that is restricted to a specific location or region within the body of the host
- **Systemic Infection**
 - An infection that has spread to several regions or areas in the body of the host

Clinical infection vs. subclinical infection

- **Clinical Infection**
 - An infection with obvious observable or detectable symptoms
- **Subclinical Infection**
 - An infection with few or no obvious symptoms

- **Opportunistic infection**

- An infection caused by microorganisms that are commonly found in the host's environment This term is often used to refer to infections caused by organisms in the normal flora



Epidemiology

- The study of the transmission of disease

Communicable Disease

- A disease that can be transmitted from one individual to another

Contagious Disease

- A communicable disease that is easily spread from one individual to another

Noncommunicable Disease

- A disease that is not transmitted from one individual to other individual

Endemic Disease

- A disease condition that is normally found in a certain percentage of a population

Epidemic Disease

- A disease condition present in a greater than usual percentage of a specific population

Pandemic Disease

- An epidemic affecting a large geographical area; often on a global scale

Reservoir of Infection

- The source of an infectious agent

Carrier

- An individual who carries an infectious agent without manifesting symptoms, yet who can transmit the agent to another individual

Fomites

- Any inanimate object capable of being an intermediate in the indirect transmission of an infectious agent

Animal Vectors

- An animal (non human) that can transmit an infectious agent to humans
- **Two types: mechanical and biological**
 - Biological animal vectors: The infectious agent must incubate in the animal host as part of the agent's developmental cycle; eg, the transmission of malaria by infected mosquitoes
 - Mechanical animal vectors: The infectious agent is physically transmitted by the animal vector, but the agent does not incubate or grow in the animal; eg, the transmission of bacteria sticking to the feet of flies

Reservoir

- **Definition:**
 - **place in which an infectious agent can survive but may or may not multiply**
- **Common reservoirs**
 - **humans**
 - **animals**
 - **equipment**
 - **medication/intravenous**

Human Reservoirs



- Persons with **acute** or **subclinical** illness
- Carriers
 - during incubation
 - convalescent carriers
 - chronic carriers
 - intermittent carriers

Nature of Microorganisms

- Microorganisms (microbes) are small, living organisms that are not visible to the naked eye.
- Pathogens (germs) are microorganisms that cause disease.
- Non-pathogens are microorganisms that do not cause disease; can be beneficial.

- **At times, a microorganism that is beneficial in one body system can become pathogenic when it is present in another body system.**
 - **Escherichia coli (E. coli) bacteria:**
 - **Large intestine: beneficial, part of the natural flora.**
 - **Urinary system: causes an infection.**

Non-pathogens

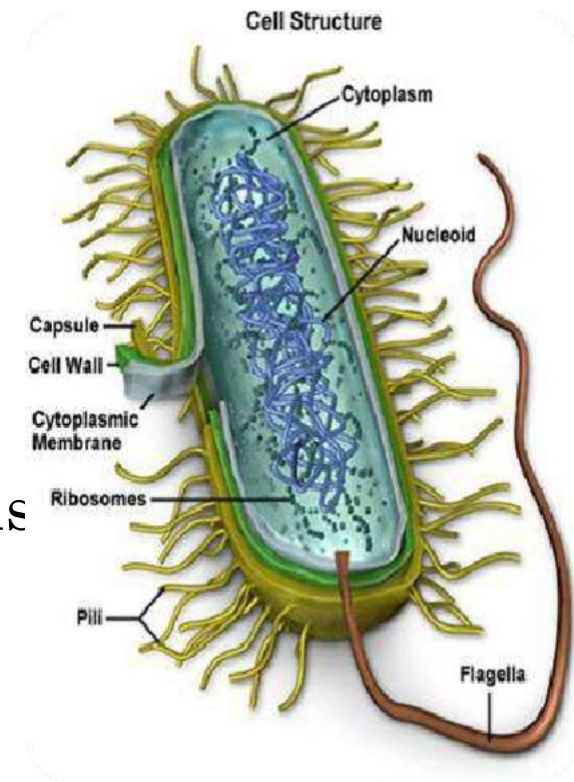
- Some microorganisms can be beneficial in other kinds of environments:
 - Support the production of bread, cheese, yogurt, beer, and several other foods and beverages.
 - Contribute to the health of soil for farming.
 - Aid in purifying water.



Types of Microorganisms

- **Bacteria**

- Simple, one-celled microorganisms that are classified according to their shape and arrangement.
- Cause diseases such as strep throat, pneumonia, meningitis and tuberculosis.



- Bacteria, cont. . . .
 - Antibiotics are used to kill bacteria – however some strains have become resistant.
 - Less than 1% of bacteria are harmful.
 - There are more bacteria in our mouths than humans living on the planet.

Types of Bacteria

- Streptococci (chains)
- Staphylococci (clusters)
- Diplococci (pairs)
- Micrococci (tiny)
- Flagellated forms (tails)
- Bacilli (rod-shaped)
- Vibrio's
- Spirillum (spiral)
- Spirochetes (comma)

Types of Microorganisms

- **Fungi**

- A plantlike organism that lives on dead organic matter.
- Yeasts and molds can be pathogenic.
- Cause conditions such as ringworm, athlete's foot, yeast infections, and thrush.
- Antibiotics do not kill fungi. Antifungal medications are available, but expensive and may

Types of Microorganisms

□ Protozoa

One-celled animal like organisms often found in decayed materials and contaminated water.

- Many contain flagella which allow them to move freely.
- Cause diseases such as malaria, trichomonas, and amebic dysentery.

Types of Microorganisms

- Rickettsia
 - Parasites that live inside the cells of other living organisms.
 - Commonly found in fleas, lice, ticks, and mites and are transmitted to humans by the bites of these insects.
 - Cause diseases such as Rocky Mountain spotted fever and typhus fever.
 - Antibiotics are effective against many different rickettsia.

Types of Microorganisms

- Viruses
 - Smallest of all microorganisms – visible only using an electron microscope.
 - Cannot reproduce unless they are inside another living cell.
 - Spread by contact with blood and other body fluids.
 - Difficult to destroy. Not affected by antibiotics.
 - Associated with diseases such as the common cold, chicken pox, herpes, hepatitis B, measles, warts, polio, influenza, and AIDS.

Viruses

- Three viruses are of major concern to the health care worker:
 - Hepatitis B – leads to destruction and scarring of liver cells. Vaccine is available.
 - Hepatitis C – also causes serious liver damage. No vaccine. Often misdiagnosed as the flu.
 - AIDS/HIV – suppresses the immune system. No cure and no vaccine.

Factors that influence microbial growth

- Following factors influence microbial growth:
 - Temperature
 - pH, or the values used in chemistry to express the degrees of acidity or alkalinity of a substance
 - Darkness
 - Food
 - Moisture
 - Oxygen

Factors that influence microbial growth

- Aerobic microbes – live only in the presence of oxygen.
- Anaerobic microbes – grow best in the absence of oxygen.

Causing an infection

- Pathogenic microorganisms cause infection and disease in different ways.
 - Produce poisons (toxins) which harm the body. Ex: Tetanus.
 - Allergic reaction in the body causing runny nose, watery eyes, sneezing.
 - Attack and destroy the living cells they invade. Ex: Malaria (rbc's).

Causing an infection

- Endogenous – disease originates within the body. Ex: metabolic disorders, congenital abnormalities, tumors.
- Exogenous – disease originates outside the body. Ex: chemical agents, electrical shock, trauma.
- Nosocomial – acquired by an individual in a health care facility (workers to patient).
 - Many are antibiotic resistant, life-threatening.
- Opportunistic – occur when the body's defenses are weak. Ex: pneumonia in AIDS.

Spread of Infectious Diseases

- Respiratory droplets
- Fecal-oral
- Direct contact with people or objects (especially by germs on hands)
- Body fluids: blood, urine, and saliva
- Insects

Means of transmission

- Common Vehicle (Food, blood)
- Vector-borne
- **Droplet**
- **Airborne**
- **Contact**
 - Direct Contact
 - Indirect Contact (Objects)

Causing an infection

- In order for disease to occur and spread from one individual to another, certain conditions must be met.
- If any one condition is not met, the transmission of the disease will not happen.
- Pathogens are everywhere and preventing their transmission is a continuous process.

Chain of infection

Chain of infection contains six elements. If broken, infection will not occur.



Chain of infection

- Infectious Agent – pathogen such as a bacteria or virus.
- Reservoir – a place the pathogen can live.
 - Examples: human body, animals, the environment, fomites.
 - Fomites are objects contaminated with infectious material that contains pathogens.
 - Ex: doorknobs, bedpans, linens, instruments

Chain of infection

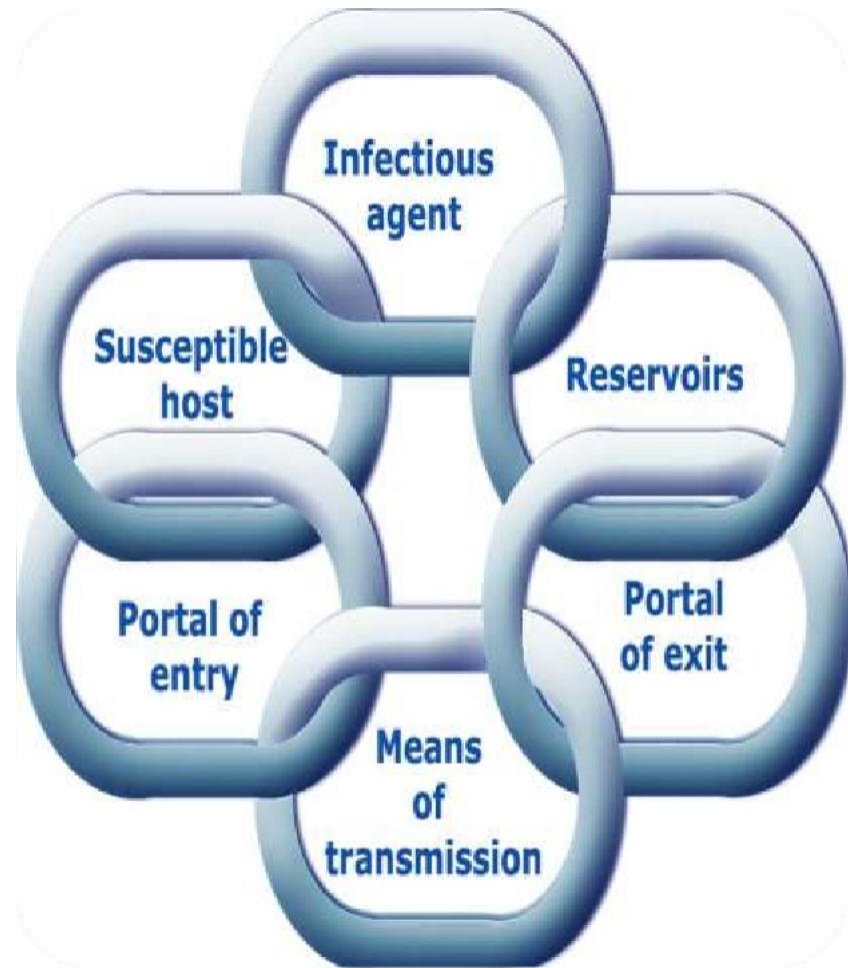
- reservoir in which it has been growing.
 - Urine
 - Feces
 - Saliva
 - Respiratory tract
 - Skin
 - Blood
 - Gastrointestinal tract
 - Mucous discharge
 - Tears

Chain of infection

- Mode of Transmission – way in which it can be transmitted to another reservoir or host where it can live.
 - Can be through direct contact or airborne droplet.
 - Contaminated hands are one of the most common sources of direct transmissions.
 - Hand washing is one of the most effective means of preventing the spread of pathogens.

Chain of infection

- **Portal of Entry** – way to enter the new reservoir or host.
 - **Respiratory tract, mucous membranes, and gastrointestinal tract are common.**
 - **Damaged**



Chain of infection

Susceptible Host – one that is capable of being infected.

- Microorganisms must be present in large enough quantity to be virulent.
- The host must be susceptible.
- Individuals with an immunity to certain pathogens will not be susceptible.

Body defenses

Defense mechanisms are intact and the immune system is functioning, a human can frequently fight off the causative agent and not contract the disease.

- Mucous membranes (traps pathogens)
- Cilia (propel pathogens out of respiratory tract)
- Coughing and sneezing
- Hydrochloric acid (stomach)
- Tears in the eyes (contain bactericidal chemicals)
- Fever
- Inflammation (wbc's destroy pathogens)
- Immune response (produce antibodies)

Signs & symptoms of infection

- Redness
- Swelling
- Tenderness
- Warmth
- Drainage
- Red streaks leading away from wound

Virulence factors and toxins

- **Enzymatic Virulence Factors**

- **Examples:**

- Coagulase (*Staphylococcus aureus*)
- Streptokinase (*Streptococcus pyogenes*)
- Hyaluronidase (Many pathogens)
- Collagenase (Many pathogens)
- Leukocidin (Many pathogens)
- Hemolysin

Virulence factors and toxins

- **Adhesion Factors**
 - **Examples:**
- Protein A (*Staphylococcus aureus*)
 - Protein M (*Streptococcus pyogenes*)

Virulence factors and toxins

- Exotoxins

- A type of bacterial toxin with the following properties:
 - May be produced by either gram-positive or gram-negative bacteria
 - Is secreted by the bacteria
 - The action of the exotoxin does not necessarily require the presence of the bacteria in the host
 - Most exotoxins are peptide or protein
 - Most exotoxins are heat sensitive (exception: enterotoxin of *Staphylococcus aureus*)

Virulence factors and toxins

- Exotoxins (cont.)
 - Classes of exotoxins: Neurotoxic, cytotoxic, or enterotoxic exotoxins
 - Neurotoxins: Interfere with proper synaptic transmissions in neurons
 - Cytotoxins: Inhibit specific cellular activities, such as protein synthesis
 - Enterotoxins: Interfere with water reabsorption in the large intestine; irritate the lining of the gastrointestinal tract

Impact of infectious diseases

- Economic
 - Loss of revenue for the family
 - Loss of productivity for the employer
- Contagion
 - Other children in child care
 - Families
 - Caregivers/teachers and their families
- Disruption
 - Alternative caregivers
 - Other colleagues filling in for missing parent at work
- Health care
 - Many office visits to get “sick notes”
 - Inappropriate use of antibiotics
 - Added responsibility of administering medication in child care

Impact of Infectious Diseases

- **All members of society are affected**

The annual direct & indirect medical cost
of **INFECTIOUS DISEASES:**

\$120 BILLION

=

15%

of all U.S.
healthcare
expenditures

(NIAID 2000)

MOST VULNERABLE TO INFECTION?

- Young infants
- Children with special health care needs
 - **Equipment in their bodies (catheters, g-tubes)**
- Children with impaired immune systems
- Pregnant women

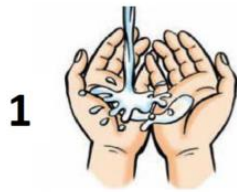


Why Are Children More Vulnerable to Infectious Diseases?



Hand washing still continues to be best option to prevent infections.

HANDWASHING



1

UNDER RUNNING WATER
WET HANDS



2

APPLY SOAP AND RUB PALMS
TOGETHER TO ENSURE
COMPLETE COVERAGE



3

SPREAD THE LATHER
OVER THE BACK OF
THE HANDS



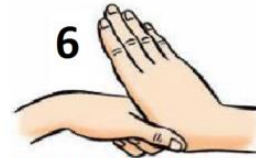
4

MAKE SURE THE SOAP
GETS IN BETWEEN THE
FINGERS



5

GRIP THE FINGERS
ON EACH HAND



6

PAY PARTICULAR ATTENTION
TO THE THUMBS



7

PRESS FINGERTIPS INTO
THE PALM OF EACH
HAND



8

DRY THOROUGHLY WITH
A CLEAN TOWEL

