Epidemiology

- **Pathology**: Study of disease
- **Pathogenesis**: Development of disease
- **Virulence**: Degree of pathogenicity.
- **Pathogen**: Pathogenic agents have special properties that allow them to invade the human body or produce toxins.
- **Infection**: Invasion and growth of pathogens in the body
- **Disease**: Abnormal state in which the body is not functioning normally. When infectious agent overcomes body’s defenses
The Normal Microbiota (Flora)

**Microbial antagonism** due to competition between microbes.

**Resident flora** = **Normal microbiota** (acquired at passage through birth canal, lactation, contact with mother)

Establish permanent colonies on/inside body without producing disease. Protect the host by

1. Occupying niches that pathogens might occupy (Competitive exclusion)
2. Producing acids
3. Producing bacteriocins
Nose
- *Staphylococcus aureus*
- *Staphylococcus epidermidis*
- *Corynebacterium* species

Throat
- *Streptococcus* species
- *Branhamella catarrhalis*
- *Corynebacterium* species
- *Haemophilus* species
- *Neisseria* species
- *Mycoplasma* species

Skin
- *Staphylococcus epidermidis*
- *Propionibacterium acnes*
- *Pityrosporum ovale*

Large intestine
- *Bacteroides fragilis*
- *Escherichia coli*
- *Proteus mirabilis*
- *Klebsiella* species
- *Lactobacillus* species
- *Streptococcus* species
- *Candida albicans*
- *Clostridium* species
- *Pseudomonas* species
- *Enterococcus* species

Mouth
- *Streptococcus* species
- *Fusobacterium* species
- *Actinomyces* species
- *Leptotrichia* species
- *Veillonella* species

Vagina
- *Lactobacillus* species
- *Streptococcus* species
- *Candida albicans*
- *Gardnerella vaginalis*

Urethra
- *Streptococcus* species
- *Mycobacterium* species
- *Escherichia coli*
- *Bacteroides* species
Transient Microbiota (Flora)

Certain microbes are present for various periods (days, weeks, or months) – then disappears.

**Dynamic nature of resident flora:** changes due to age, type of food consumed, Hormonal state, antibiotics

**Opportunistic pathogens** cause disease under special conditions (mutualistic relationship becomes parasitic)
Koch’s Postulates: Proof of Etiology of Infectious Diseases

1. The same pathogen must be present in every case of the disease

2. The pathogen must be isolated from the diseased host and grown in pure culture

3. The pathogen from the pure culture must cause the disease when it is inoculated into a healthy, susceptible lab animal

4. The pathogen must be isolated from the inoculated animal and must be shown to be the original microbe
Anthrax & Koch’s Postulates:

Postulate 1
The same microorganisms are present in every case of the disease.

Postulate 2
The microorganisms are isolated from the tissues of a dead animal, and a pure culture is prepared.

Postulate 3
Microorganisms from the pure culture are inoculated into a healthy, susceptible animal. The disease is reproduced.

Postulate 4
The identical microorganisms are isolated and recultivated from the tissue specimens of the experimental animal.
Exceptions to Koch’s Postulates

Modification of Koch’s postulates were necessary

1. To establish disease etiology for viruses and bacteria, which cannot be grown on artificial media

2. Some diseases, e.g.: pneumonia and nephritis, may be caused by a variety of microbes.

3. Some pathogens, such as *S. pyogenes*, cause several different diseases.

4. Certain pathogens, such as HIV, cause disease in humans only.
Classifying Infectious Diseases

- **Symptom**: A change in body function that is felt by a patient as a result of disease.

- **Sign**: A change in a body that can be measured or observed as a result of disease.

**Syndrome**: A specific group of signs and symptoms that accompany a disease.
Classifying Infectious Diseases

- **Communicable disease**: A disease that is spread from one host to another
- **Contagious disease**: A disease that is easily spread from one host to another
- **Noncommunicable disease**: A disease that is not transmitted from one host to another
Occurrence of a Disease

- **Incidence**: rate of new cases of a disease or Fraction of a population that contracts a disease during a specific time
- **Prevalence**: a proportion of disease found to be affecting a particular population or Fraction of a population having a specific disease at a given time
- **Sporadic disease**: Disease that occurs occasionally in a population
- **Endemic disease**: Disease constantly present in a population
- **Epidemic disease**: Disease acquired by many hosts in a given area in a short time
- **Pandemic disease**: Worldwide epidemic
Severity or Duration of a Disease

Scope of disease can be defined as

- **Acute**: Disease develops rapidly
- **Chronic**: Disease develops slowly
- **Subacute**: Symptoms between acute and chronic
- **Latent**: Disease with a period of no symptoms when the causative agent is inactive (Rubella)
Extent of Host Involvement

- **Toxemia**: Toxins in the blood
- **Viremia**: Viruses in the blood
- **Primary infection**: Acute infection that causes the initial illness
- **Secondary infection**: Opportunistic infection after a primary (predisposing) infection
- **Subclinical disease**: No noticeable signs or symptoms (inapparent infection)
Extent of Host Involvement: An Infection can be

- **Local**: limited to small area of body
- **Systemic**: spread throughout body via blood or lymph
- **Focal**: spread from local infection to specific areas (metastasis from focus).

**Sepsis**: Toxic inflammatory condition arising from spread of microbes or their toxins, from a focus

**Bacteremia**: Bacteria in the blood.

**Septicemia**: Growth of bacteria in the blood.
Secondary infection

Antibiotic treatment of bacterial infection also kills beneficial vaginal bacteria

Without the bacteria vaginal yeast grows unchecked
Patterns of Disease: Predisposing Factors

Variable susceptibility due to

- Genetics
- Gender
- Climate and weather
- Age
- Stress and fatigue,
- Lifestyle
- Chemotherapy
Disease Development and Stages

**Incubation period:** Time interval between initial infection and first appearance of signs and symptoms.

**Prodromal period:** Characterized by appearance of first mild signs and symptoms.

**Period of illness:** Disease at its height: all signs and symptoms apparent.

**Period of decline:** Signs and symptoms subside.

**Period of convalescence:** Body returns to prediseased state, health is restored.
The Course of Disease, as Typified by Measles

- Entrance of measles virus into child
- Rash appears at hairline and on face
- Rash fades from body

Period of illness

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Day 0
Day 10
Day 13
Day 16
Day 18
Day 21
The Spread of Infection:

Continual source of infectious agents is called **Reservoir**

- **Nonliving:** Soil, …..ect.
- **Human:** people with disease or asymptomatic carriers may have inapparent infections or latent diseases
- **Animal:** Pathogen for some other species lives and multiplies in reservoir.

**Zoonoses:** may be transmitted to humans.
Disease Transmissions

**Contact Transmission:**
- **Direct:** Close association between infected and susceptible host.
- **Indirect:** Spread by fomites.
- **Droplet:** Transmission via airborne droplets from saliva or mucus (coughing or sneezing)

**Airborne Transmission:** Pathogens carried on droplets for a distance greater than 1 meter

**Vehicle Transmission:** Water, food, air

**Vector Transmission:** **Arthropods** carry pathogens from one host to another
  - **Mechanical vector:** an animal vector not essential to the life cycle of the parasite.
  - **Biological vector:** an animal vector in which the pathogenic develops and multiplies before being transmitted to the next host.
Nosocomial (Hospital-Acquired) Infections

- Acquired as a result of a hospital stay.
- 5-15% of hospital patients acquire nosocomial infections.
- Aseptic techniques can prevent nosocomial infections.
- Hospital infection control staff members are responsible for overseeing the proper cleaning, storage, and handling of equipment and supplies.
Relative Frequency of Nosocomial Infections

Source: Data from CDC, National Nosocomial Infection Surveillance.
## Common Causes of Nosocomial Infections

<table>
<thead>
<tr>
<th></th>
<th>Percentage of Total Infections</th>
<th>Percentage Resistant to Antibiotics</th>
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</thead>
<tbody>
<tr>
<td>Coagulase-negative staphylococci</td>
<td>25%</td>
<td>89%</td>
</tr>
<tr>
<td><em>S. aureus</em></td>
<td>16%</td>
<td>80%</td>
</tr>
<tr>
<td><em>Enterococcus</em></td>
<td>10%</td>
<td>29%</td>
</tr>
<tr>
<td>Gram-negative rods</td>
<td>23%</td>
<td>5-32%</td>
</tr>
<tr>
<td><em>C. difficile</em></td>
<td>13%</td>
<td>None</td>
</tr>
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Epidemiology

- The study of where and when diseases occur (disease transmission, incidence, and frequency)

- Centers for Disease Control and Prevention (CDC)
  - Collects and analyzes epidemiological information in the United States
  - Publishes *Morbidity and Mortality Weekly Report*
- **Morbidity**: Incidence of a specific notifiable disease. (infections)
- **Mortality**: Deaths from notifiable diseases.
- **Morbidity rate**: Number of people affected in relation to total population in a given time period.
- **Mortality rate**: Number of deaths from a disease in relation to total population in a given time period.