

# **Pathogenesis of Infectious Diseases**

**CLS 212: Medical Microbiology**

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# Definitions

- **Path-** means disease.
- **Pathogenesis**  
The steps or mechanisms involved in the development of a disease.
- **Infection**  
The presence and colonization of a pathogen in human body.
- **Infectious Disease**  
Is a disease caused by a pathogen.
- **Virulence**  
Is the degree of pathogenicity of an organism, i.e. the relative ability of a pathogen to cause disease.
- **Not all pathogens entering human body will cause disease because humans are protected by normal flora and the immune system.**

# Course of an Infectious Disease

There are 4 phases or periods in any infectious disease:

**1. The incubation period:**

The time between entry of the pathogen and the onset of symptoms.

**2. The prodromal period:**

The time when the person feels abnormal and weak.

**3. The period of illness:**

The time when the person feels typical symptoms associated with that specific disease.

**4. The convalescent period:**

The time when the person recovers from the infection but may develop permanent damage to the area of infection.

# Localized vs. Systemic Infection

## Localized Infection

The pathogen is only present at the original site of infection.

## Systemic Infection (Generalized)

The pathogen is carried to other parts of the body by blood, lymph, ..

# Acute, Subacute, and Chronic Disease

## Acute Disease

Rapid onset of disease and rapid recovery.

**e.g.** Influenza, measles,..

## Chronic Disease

Slow onset of disease and last a long time.

**e.g.** Tb, syphilis,..

## Subacute Disease

The disease with onset less than acute but more than chronic. **e.g.** bacterial endocarditis.

# Signs vs. Symptoms

## A Sign of a Disease

Evidence of disease found or seen by the doctor **e.g.** abnormal heart or breath sounds, blood pressure, LAB results, radiology, ..

## A Symptom of a Disease

Evidence of disease felt and explained by the patient **e.g.** headache, stomachache, pain, nausea, itching, ..

# Steps in the Pathogenesis of Infectious Diseases

1. Entry.
2. Attachment.
3. Colonization.
4. Invasion.
5. Immune response Inhibitors.
6. Toxins.

# **I- Ways of Pathogen Entry**

## **1. Penetration of Skin.**

e.g. Bilharzia

## **2. Through mucous membranes.**

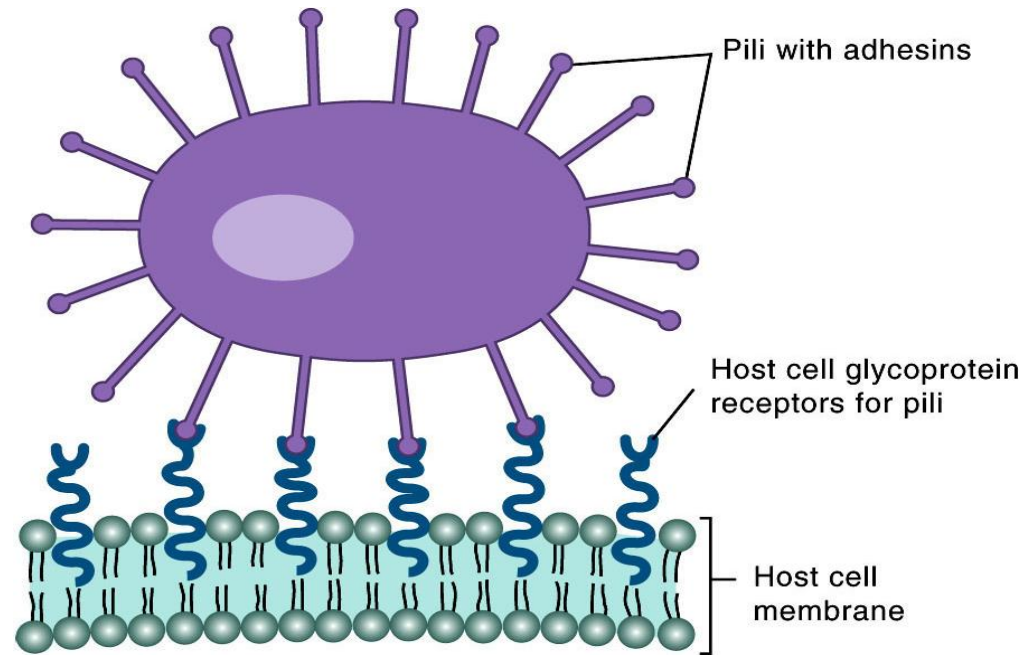
Ingestion (Gastrointestinal tract), Inhalation (Respiratory tract), introducing pathogen into Genitourinary tract or blood, or by insects.

e.g. E.coli, Malaria, ...



## II. Attachment (Adhesion)

- Microorganisms have macromolecules (proteins or carbohydrates) that promote attachment to tissue surfaces.
- Viruses and many bacteria must first bind to host cell surfaces.
- Prevents early clearance.
- Pathogens often bind host tissues via surface receptors. e.g. **pili in bacteria.**



- **Adhesins** have been shown to be important in a number of microorganisms
- *Streptococcus mutans*, a member of the normal oral flora, produces a polysaccharide, dextran, that enhances its attachment to teeth.



- Pathogenic strains of *Escherichia coli* have *pili* that aid in attachment to epithelial cells of the gastrointestinal tract or urinary tract

# III. Colonization

- Some virulent bacteria produce special proteins that allow them to colonize parts of the host body.
- Pathogens start multiplication and maintenance.
- Pathogens compete with normal flora for residence.
- Pathogens will resist body reactions e.g. Bile, stomach acid, skin secretions, IgA (mucosal antibodies).
- e.g.  
*Helicobacter pylori* is able to survive in the acidic environment of the human stomach by producing the enzyme **urease**.

## IV. Invasion

Some virulent bacteria produce proteins that either:

- a.** Disrupt host cell membranes or
- b.** Stimulate endocytosis into host cells.

*Endocytosis is the process by which cells absorb material (molecules such as proteins) from outside the cell by engulfing it with their cell membrane*

# V. Immune Response Inhibitors

- Many bacteria produce virulence factors that inhibit the host's immune system defenses.
- The polysaccharide capsule of *Streptococcus pneumoniae* inhibits phagocytosis of the bacterium by host immune cells.

# VI. Toxins

- Many virulence factors are proteins made by microorganisms that poison host cells and cause tissue damage.  
**e.g.** Bacteria that produce toxins are called toxigenic.

## Bacterial toxins



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graph TD; A[Bacterial toxins] --> B[Endotoxins]; A --> C[Exotoxins];
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**Endotoxins:** they are part of the outer membrane of the cell wall of bacteria  
-They are present **only** by Gram -ve bacteria  
- Death of the bacteria lead to the release of endotoxins.

**Exotoxins:** they are toxins produced by the bacteria to the surrounding tissue.  
-They are produced mostly by Gram +ve bacteria  
E.g. Diphtheria toxins

**Number of  
Invading Microbes**

**Portals of Entry**

Mucous membranes  
Respiratory tract  
Gastrointestinal tract  
Genitourinary tract  
Conjunctiva  
Skin  
Parenteral route

**Penetration or Evasion  
of Host Defenses**

Capsules  
Cell wall components  
Enzymes  
Cytoskeleton

**Damage to Host Cells/  
Cytopathic Effects**

Direct damage  
Toxins  
Exotoxins  
Endotoxins  
Hypersensitivity

**Adherence**

