

# Virulence and Pathogenicity

**Pathogen:** a parasitic organism that causes damage to, or disease in its host.

**Pathogenicity:** the ability to cause disease.

**Virulence:** the relative degree or intensity of pathogenicity.

Virulence is determined by the five following characteristics of the pathogen.

**Invasiveness:** the ability of the organism to spread to adjacent tissues or other tissues.

**Toxigenicity:** the ability of the organism to produce toxic products that cause disease and/or damage in the host.

**Infectivity:** the ability of the organism to establish a focal point of infection through growth.

**Pathogenic potential:** the degree that the pathogen causes morbid symptoms.

**Hypersensitivity:** host's innate sensitivity to pathogen.

# Determinants of Infectious Disease

To produce an infectious disease, a pathogen must be able to:

1. initially be transported to the host
2. adhere to, colonize or invade the host
3. grow, multiply, or complete its life cycle in the host
4. initially evade host defense mechanisms
5. damage the host by mechanical and/or chemical means

In the end it is – Numbers (of bacteria) that make you sick!

## **EXOTOXINS**

- ☞ usually synthesized by specific pathogens with plasmids bearing the exotoxin genes
- ☞ heat-labile proteins
- ☞ toxic in very small doses (microgram per kg)
- ☞ highly immunogenic
- ☞ associated with specific diseases, often given the name of the disease they produce; have specific mechanisms of action

## **ENDOTOXINS**

- ☞ lipid A region of the LPS in Gram-negative bacteria
- ☞ heat-stable LPS-lipoprotein complex
- ☞ toxic only at high doses (milligram per kg)
- ☞ weakly immunogenic
- ☞ generally similar, despite source, usually causing fever

## Adherence Factors in Gastrointestinal Disease

Definition: **Adhesins** are specialized molecules or structures on the pathogen's cell surface that bind to complementary or specific receptor sites on host cell surfaces.

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Adhesin	Description
fimbrial adhesins	Fimbriae are short filamentous structures that bind to host cell glycoproteins, initiating the attachment event
glycocalyx	Glycocalyx is a term that describes polysaccharides surrounding the bacterial cell wall. This structure aids in adherence to host tissue and may protect the pathogen from phagocytosis, a host defense mechanism.
lectins	Lectins are substances (proteins or glycoproteins) that bind specifically with carbohydrates

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## Other Virulence Factors related to Invasiveness

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Virulence Factor	Description
hyaluronidase	breaks down hyaluronic acid, a polysaccharide that functions as a tissue cement; enables organisms to spread from the focal point of infection
collagenase	breaks down the collagen network that supports tissues; dissolution of tissue enables organisms to spread from the focal point of infection
streptokinase	dissolves fibrin clots that have been formed by the host to “wall off” the microbial pathogen; fibrinolysis makes further invasion possible
coagulase	promotes fibrin clotting, which causes localization of the microbial pathogen rather than its spread

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## TYPES OF EXOTOXINS

- 1. Cytolytic toxins** - work by enzymatically attacking cell constituents, causing lysis of the cell.
- 2. A-B toxins** - consist of two subunits, A & B, that are linked by covalent bonds.
  - ☞ The B subunit binds to a cell surface receptor on the host.
  - ☞ A conformational change generates a pore through which the A subunit crosses the targeted host cell membrane.
- 3. Superantigens** - toxins that work by stimulating large numbers of immune response cells in the host.

