

Host - Pathogen Interaction

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I. What is a pathogen?

Pathogens are those organisms that live in other larger organisms which are capable of causing disease or damage to their hosts.

A. Microscopic organisms (microbes) are usually separated into pathogenic and non-pathogenic. About 100 microbes cause the majority of the disease in the world. Most microbes have evolved alongside their hosts. Not all microbes that live in other organisms cause disease.

B. Large Pathogens

Macroscopic organisms such as worms that cause disease.

II. Infection vs. Disease**Resolution of Infection**

Resolution of infection is usually from combined efforts of innate and acquired immune responses. Many infected individuals never have symptoms or clinical disease.

Immunocompetent versus Immunocompromised

Disease often results from weakened or slow immune responses (immunocompromised) which is unable to control the replication of pathogenic microbes. However, many pathogens are capable of eliciting disease in people with healthy immune systems (immunocompetent).

Co-evolution Host and Pathogen

Many hosts and parasites have co-evolved and have very carefully balanced equilibrium. Long-term infections provide ideal situation for continued transmission.

The host immune response has evolved to combat a wide array of invading pathogens.

Infectious agent wants host to stay healthy enough to spread to new host.

“Successful pathogens” have immune evasion mechanisms.

In order for pathogens to maintain a presence in a host population, they rapidly evolve characteristics that enable them to overcome the host defenses.

III. Biologic Response Gradient.

It is uncommon for a microbe to cause the same disease in all infected individuals.

Factors that influence the immune response to a pathogen.

1. Variation in the virulence of pathogen.

Genetic mutations allowing faster replication.

Mutations allowing for escape from immune system.

2. Spectral immune response.

Variation in the immune response between individuals.

Factors---MHC, age, sex, other infections, nutritional status, etc.

Location of infection and replication.

Where a pathogen lives is often part of how it evolved to better survive and or evade the immune responses. Location of replication can also make a difference in being detected by immune responses. Certain cell types cells or organs can be more difficult to immune response gets activated or not.

IV. Entry, Exit and Transmission.

Entry Sites of entry in body. ---Mouth (oral, digestive), respiratory, skin, blood, conjunctiva, urogenital, anal.

Exit Shedding----- many areas to exit body.
Amount--usually the more the better.

Transmission. Elaborate mechanisms for transmission. 3 factors.

1. The number of microorganisms shed.
2. Stability in the environment. Resist drying.
3. Number of microorganisms needed to infect new host.

Types of transmission

1. Respiratory or saliva spread.
2. Fecal-oral spread
3. Venereal spread.
4. Arthropod-borne vectors-mosquitoes, flies, etc.
Vector is another organism or object that helps in the transfer of infectious diseases.
5. Zoonoses--accidental infection from other animals.

Horizontal transmission person infecting unrelated person through contact.
All 5 types of transmission above are horizontal transmission.

Vertical transmission infection is transmitted from parents to offspring.

V. Types of Pathogens

These pathogens have very different life cycles and are classified according to phylogeny. Usually differentiated based on replication cycle, structure etc.

Bacteria

1. **Extracellular.** Live outside cells. Large enough to be seen by immune system both innate and adaptive. In a way very easy targets but also fast replicating.
Challenge of elimination before rampant replication.
2. **Intracellular.** Live inside cells. Many bacteria are capable of both intra/extracellular.
These bacteria have developed strategies to live inside endosomes, escape lysosomes, or live in cytoplasm.

Viruses

RNA or DNA containing viruses.
Many viruses live in mammalian and plant hosts very few actually cause disease.
Obligatory replication cycle inside cells. (Must use cell machinery for replication.)

Parasites

Protozoan. (Unicellular) Can live inside cells or extracellular.

Helminths. Parasitic worms---much larger.
Nematodes, Trematodes, Cestodes.

Fungi

Yeast. Unicellular fungi that can live in human mucosal tracts and skin.