Lecture 21: Epidemiology - Spread of infection, chain of transmission, patterns of infection

Infectious diseases follow a characteristic sequence of events
- **Predisposing factors** influence host susceptibility
  - Malnutrition is a major factor in susceptibility to a wide variety of infectious diseases, including tuberculosis
  - Gender, age, lifestyle and genetic factors may also help to determine susceptibility to infection
  - Interestingly, resistance to infection may vary with "state of mind", the basis for the discipline of **psychoneuroimmunology** (one of my favorite words!)
- Once a pathogen has overcome host resistance, an infectious disease typically follows a pattern characteristic of the disease, including periods of **incubation**, **illness**, **decline** and **convalescence** (Tortora et al. Figure 14.5)
  - The **incubation period** is the period between infection and the appearance of first signs and symptoms
  - During the **prodromal period**, mild symptoms may appear, but these are usually not specific to a particular infection
  - The **period of illness** is when acute signs and symptoms of the infectious disease occur
  - The **period of decline** indicates that the body’s defenses have begun to contain the infection
  - During the **period of convalescence**, the body clears the infection (except in persistent or latent infection) and returns to its previous state of resistance

For an infectious disease to perpetuate itself, it must have a **reservoir of infection** that provides the pathogenic microorganism with adequate conditions for survival and multiplication and an opportunity for transmission
- Many pathogens rely on **human reservoirs**, and do not multiply outside of human tissues
  - This is certainly the case for a majority of viral infections and for a number of bacteria
  - Human reservoirs may be **carriers**, not showing apparent symptoms of infection
- Some infectious diseases, called **zoonoses**, rely on **animal reservoirs**
  - Some strains of influenza, rabies, and Rocky Mountain spotted fever are example of zoonoses (Tortora et al., Table 14.2)
  - Transmission of zoonoses can occur through direct contact with the animal reservoir or through transmission by insect **vectors**
- Soil and water may serve as **nonliving reservoirs** for infectious microorganisms
  - **Clostridium botulinum**, which produces the toxin that causes botulism, is actually incapable of multiplying in humans
  - Water contaminated with human or animal feces serves as a reservoir for a number of pathogens, such as **Giardia lamblia**, the agent of giardiasis

**Transmission** of infectious diseases may be accomplished through a variety of routes
- **Contact transmission** is transmission more or less directly from a human reservoir to a susceptible host
  - **Direct contact transmission** refers to host-to-host transmission without an intermediate medium
    - By definition, all sexually transmitted diseases are transmitted by direct contact
    - Direct contact is also involved in transmission of a variety of viral diseases, including the common cold
  - **Indirect contact transmission** involves intermediate carriage of the infectious agent by an inanimate **fomite**
    - An important example is transmission of HIV between intravenous drug users through syringes contaminated with HIV
    - Inordinate fear of indirect contact transmission drives the market for items such as paper cup dispensers for the family bathroom
Droplet infection refers to contact transmission via droplets of respiratory secretions transmitted a short distance between hosts.

- Common vehicle transmission refers to transmission of a disease agent through a common nonliving reservoir.
  - A large number of gastrointestinal infections are spread by common vehicle transmission via the *fecal-oral route*.
  - An outbreak of infectious hepatitis associated with a restaurant is a classic example of common vehicle transmission.

- Airborne transmission refers to spread of infectious agents by *droplet nuclei* or dust at a distance of more than one meter from the reservoir to the susceptible host.

- Vector transmission involves transmission of an infection via *vectors* - animals that carry pathogens from one host to another.
  - Arthropods are the most important group of vectors (Tortora et al. Table 14.3).
  - Vectors may serve as agents of "mechanical transmission" when they serve as vehicles for carrying the agent; this is why everyone detests houseflies.
  - "Biological transmission", via arthropod bites, occurs for transmission of specific pathogens that rely on this mechanism for survival; infectious agents relying on biological transmission by vectors often multiply in the tissues of the vector.

- In addition to the mechanism of transmission, it is important to consider the *portals of exit* employed by pathogenic microorganisms to leave the infected host.
  - The respiratory tract is used as a portal of exit by many pathogens (e.g., Tortora et al., Figure 14.8; how many times have you seen this picture?)
  - Many pathogens exit the gastrointestinal tract via feces or saliva.
  - The urogenital tract serves as portal of exit for sexually transmitted diseases.

**Nosocomial infections** (which will be one of your preoccupations throughout your career) are infections acquired in a clinical setting.

- It is estimated that between 5% and 15% of all hospital patients acquire some type of nosocomial infection.
- The frequency of nosocomial infection is a consequence of the interaction of several factors (Tortora et al., Figure 14.9).
  - The hospital environment is a major reservoir for a variety of pathogens.
    - Most of these are opportunists (Tortora et al., Table 14.4) that are found as part of the human normal flora.
    - The hospital environment may select for strains of bacteria that are especially resistant to antibiotics because they harbor plasmids containing antibiotic-resistance genes.
  - Most hospital patients, by definition, are compromised hosts.
    - Burns, wounds, and invasive procedures provide opportunistic pathogens with access to tissues.
    - Both disease processes and therapeutic procedures (e.g., radiation therapy) may cause impairment of immunity, leading to increased susceptibility to infection.
  - Nosocomial infections may be transmitted patient-to-patient, through hospital staff, or by indirect routes.

- *Infection control* has become an administrative priority in most hospitals.