M220 Lecture 28

Microorganisms and Disease

-Interactions Between Microbe and Host

1. Symbiosis-two organisms living together.
   a. Commensalism- two organisms living together where one is benefited and the other is neither harmed nor benefited. The normal skin flora represents this type of symbiotic relationship where the microorganism is benefited and the host is unaffected.
   b. Mutualism- two organisms living together where both gain benefit. The classic example would be the lichen. The algal component is photosynthetic and manufactures glucose, while the fungus provides root support and draws in minerals and water. The intestinal flora in the human gut also illustrates this type of symbiotic relationship. These bacteria gain nutrients from the intestines and also provide the human host with vitamin K and some of the B vitamins.
   c. Parasitism- one organism is benefited while the other is harmed.

2. Colonization by normal flora- the newborn is first colonized by microorganisms as it moves down the vaginal canal. Contact with air, water, food, soil and all exposures to the outside environment complete this process.

3. Infection- defined as microorganisms living in or on the body of the host. If the infectious agent causes harm and now exists as a parasite, the homeostatic balance of the host becomes altered. This is now referred to as a disease.

4. Infestation-macroscopic parasites in or on the body of the host. Examples include ticks, lice, fleas, tapeworms, flukes etc.

5. Disease- any departure from the healthy state (a shift away from normal homeostatic balance). This can be an altered physiologic state or an altered structural state. A disease can be non infectious or infectious. Examples of non infectious diseases include genetic, metabolic, nutritional, degenerative, immunologic and psychogenic diseases. Infectious diseases are caused by infectious agents such as bacteria, viruses, fungi etc. The traditional infectious bacterial disease starts with the incubation period. This represents a time prior to the first signs or appearance of infection. Next, we see the prodromal period. This represents the first signs of infection. Perhaps the first tickle in the throat or the subtle suggestion of a headache. The illness period follows where the classic signs and symptoms of the infectious agent are apparent. If the patient survives there is a decline period where the major symptoms go away. The convalescence period is a time where the patient recovers their strength and is restored to pre-disease health.
6. **Pathogen**—any agent capable of producing disease. **Pathogenicity** depends upon factors of both the host and the microorganism. It is the potential ability of the infectious agent to enter the host and cause disease. Microbial competition and mutual inhibition contribute to a normally balanced ecosystem in or on the body and may prevent invasion by pathogens. **Virulence** is the degree of pathogenicity as defined by the organism alone to produce disease. Two factors influence virulence. They are invasiveness and toxigenicity. More later.

Factors influencing pathogenicity

a. **Dose**—an increase in the numbers of organism will increase the probability of disease.

b. **Method of transmission (communicability)**
   1. **Vertical**—from parent to progeny. These are all directly transmitted.
   2. **Horizontal**—from one member of one species to another member of that species.
      a. **Direct contact**
         1. Venereal disease—gonorrhea, syphilis, trichomoniasis, AIDS etc.
         2. Nosocomial transmission—derived in hospital or clinical setting.
         3. Iatrogenic transmission—derived from a physician.
      b. **Indirect contact**
         1. **Air**—tuberculosis, pneumonia, flu, common cold etc.
         2. **Food**—Staphylococcal food poisoning, salmonellosis (causing gastroenteritis) etc.
         3. **Water**—Shigellosis, typhoid fever, cholera etc.
         4. **Arthropod borne**—mosquitoes, ticks, fleas, lice etc.
         5. **Fomites**—inanimate objects.

c. **Portal of entry**—the organism must gain access through the correct route. Presence of the organism does not necessarily result in disease. Eating *Clostridium tetani* spores will not cause tetanus. Placing these spores in an open wound however, will cause disease. *Mycobacterium tuberculosis* must gain access into the respiratory passages to cause tuberculosis. *Salmonella typhi* placed upon the skin is not problematic. This organism in the G. I. however, can cause typhoid fever.

Pathogenicity involves the interaction of the organism and the host together. The probability that an organism will cause disease within a host takes into account the microbial strengths (virulence) and the host strengths (resistant state or immune system of the host).

The factors that influence **virulence** are strictly related to the properties of the microbe. See handout on virulence.