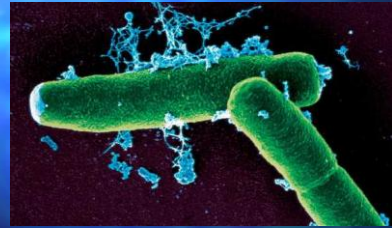


The Nature of Infectious Disease

Denise Michaelsen
Chetek-Weyerhaeuser High School
Chetek, WI

I. What is an Infectious Disease?



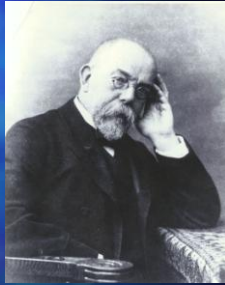
Colored scanning, electron micrograph of anthrax bacteria (*Bacillus anthracis*), the cause of the disease anthrax in humans and livestock.
Retrieved from http://as.dl.ac.uk/Annual_Reports/AnRep01_02/amhrax.htm

- A. Pathogen: Disease producing agents such as bacteria, protozoans, fungi, viruses and prions.
- B. Not all microorganisms are pathogenic – some part of our normal flora.
 - 1. Respiratory tract, digestive and reproductive tract and skin.
- C. Infectious disease: Any disease caused by the presence of pathogens.
 - 2. Smallpox, cold sores, rabies, strep throat, athletes foot, influenza, tetanus, botulism (food poisoning).

II. Determining What Causes a Disease.

- A. Not all disease is caused by pathogens.
 - 1. Genetics – Hemophilia, cystic fibrosis, sickle-cell anemia
 - 2. Aging – Osteoarthritis
 - 3. Deficiencies – Rickets (vitamin D), osteoporosis (calcium)
- B. $\frac{1}{2}$ all human diseases are infectious.

Robert Koch



Retrieved from http://www.ncornell.edu/faculty/jeje/S/hi_ofilms/Koch.jpg

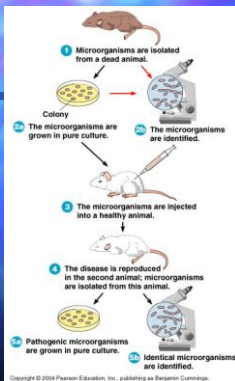
C. First pathogen identified

1. Robert Koch in 1876. Was looking for the cause of anthrax. Found rod shaped bacterium in the blood of cattle that died from anthrax.

D. Koch's Postulates

1. Pathogen must be found in the host of every case.
2. Pathogen must be isolated and grown in a culture with no other organisms.
3. When pathogen is placed in a healthy host it must cause the disease.
4. Pathogen must then be isolated from the new host and be shown to be the original pathogen.

Koch's Postulates



Retrieved from http://diverse.hunter.cuny.edu/~weijiang/Images/14-03_koch_1.jpg

E. Exceptions to Koch's Postulates

1. Some pathogens cannot be grown in an artificial medium – e.g. STD syphilis
2. Viral pathogens also cannot be grown in a medium – must be in living tissue.



Treponema pallidum
The bacterium that causes syphilis

Retrieved from www.freeinfosociety.com/~/syphilis1.jpg

III. The Spread of Infectious Diseases

- A. For disease to continue and spread there must be a continual source – living organism or an inanimate object.
- B. Reservoirs of pathogens
 1. People can be a reservoir of pathogens – harboring them without even knowing it – called carriers.
 2. Transmit them either directly or indirectly.
 3. During incubation period pathogens can be spread before the person begins to experience any symptoms.



Mary Mallon in a hospital bed. She was forcibly quarantined as a carrier of typhoid fever in 1907 for three years and then again from 1915 until her death in 1938.

Retrieved from <http://www.pbs.org/wgbh/nova/typhoid/letter.html>

- a. Mary Mallon, a.k.a. "Typhoid Mary"
- b. First known "healthy" carrier of typhoid fever.
- c. Emigrated from Ireland and worked as a cook in the New York area.
- d. Human carrier – healthy person who has survived, but bacteria still reside in the gallbladder.
- e. Bacteria are passed into feces and urine and poor hygiene leads to the introduction in food and water.
- f. Mary is thought to have give typhoid fever to 47 people, three of whom died.

- 4. Animals can be reservoirs for microorganisms that cause disease in humans.
 - a. Influenza and rabies.
- 5. Soil and water are the major nonliving reservoirs.



Rabies is an acute viral infection transmitted to humans by a bite or by the exposure of broken skin to an infected animal's saliva. Immunization given early (preferably within 24 hours but certainly within 72 hours) can usually prevent the disease.

Retrieved from www.nlm.nih.gov/.../ency/fullsize/17261.jpg

IV. Transmission of Disease

A. Contact

1. Direct

- a. Person to person: Individual touches, coughs, kisses someone who is infected.
 - i. Influenza, mononucleosis
- b. Animal to person: Individual is bitten, scratched, or handles animal waste.
 - i. Rabies, toxoplasmosis
- c. Mother to unborn child: Woman passes disease to her baby
 - i. HIV, group B *streptococcus*

2. Indirect

- a. Fomite (object): Person picks up pathogen from touching object and then touches face, mouth or eyes.
 - i. Common cold, anthrax

B. Air

1. Droplet and particle transmission: Cough or sneeze into air and pathogen transfer through the air.
 - a. Influenza, tuberculosis



Retrieved from
<http://www.rimnphysics.com/charud/oldnews/94/sneeze.jpg>

C. Vectors and other vehicles

1. Bites and stings: Organism carries pathogen in body or intestinal tract and lands on you or bites you.
 - a. Mosquitoes carry the malaria parasite or West Nile virus.
 - b. Deer ticks carry the bacterium that causes Lyme disease.
 - c. Fleas found on rats transmit bubonic plague.

2. Food contamination: Allows pathogen to be spread to many people from a single source.
 - a. Cholera is caused by the bacterium *Vibrio cholerae* found in contaminated water.
 - b. Food poisoning (bacterial):
 - i. *Escherichia coli* (*E. coli*) is transmitted by eating raw or undercooked hamburger, unpasteurized milk or juices, or contaminated well water.
 - ii. Salmonellae can be life threatening and is transmitted by undercooked foods such as eggs, poultry, dairy products, and seafood.
 - iii. *Clostridium botulinum* is transmitted in foods such as home-packed canned goods, honey, sausages, and seafood.

IV. What Causes the Symptoms of a Disease?

1. Pathogen entering the body encounters the immune system – if it overcomes the defenses of your immune system it can metabolize quickly and multiply causing damage to tissues it has invaded.
- A. Damage to the host by viruses and bacteria
1. Viruses cause damage by taking over a host cell's genetic and metabolic machinery – eventually kills the cells.

2. Bacteria inflict damage using toxins – poisons enter the blood.
 - a. *Clostridium tetani* produced tetanospasmin, the toxin that causes tetanus. It is normally present in soil and if it enters a deep wound in the body it can kill you.
 - b. *Clostridium botulinum* produces botulin, the toxin that causes botulism. About one microgram is lethal to humans. It acts by blocking nerve function and leads to respiratory and musculoskeletal paralysis.

V. Patterns of Diseases

- A. Centers for Disease Control and Prevention publish weekly report about incidence of specific diseases – they can spread rapidly.
1. Endemic disease – disease that is constantly present in the population – common cold.
 2. Epidemic – when many people in a given area are afflicted with the same disease at the same time – influenza.
 - a. 1950's polio epidemic swept the U.S. Some left paralyzed and others died from destroying the brain and spinal cord. Jonas Salk vaccine life changing.



Medical personnel tend to polio victims in an iron lung ward during a 1950s epidemic in Boston.
Retrieved from www.utexas.edu/~polio/graphics/polio2.jpg



Girl recovering from polio from the Helen Hayes Hospital, New York, 1940-1944. Retrieved from www.helenhayeshospital.org/~polio/girl.jpg

VI. Treating Diseases

- A. Antibiotic – substance produced by a microorganism that will inhibit or kill other microorganisms especially bacteria.
1. Produced from naturally occurring bacteria and fungi.
 2. Bacteria may become resistant to the antibiotic.
– Penicillin is an example because it's been used since the 1940's.
 3. Gonorrhea is one that worked well with Penicillin, but now it is resistant to the drug.

Literature Cited

Biggs, A., Gregg, K., Crispen Hagins, W., Kapicka, C.,
Lundgren, L., Rillero, P. (2002). *Biology: The dynamics
of life*. Columbus: Glencoe/McGraw-Hill