

20.106J – Systems Microbiology
Lecture 23
Prof. Schauer

- Animal- and Arthropod-transmitted Diseases
- Chapter 27
- Galan and Wolf-Watz Review
- For next lecture: Review Ch. 28 and 29
- Final exam: 8-9 questions, similar format to those on the tests

- Plague
 - Infectious disease of animals and humans
 - Zoonosis: infection passed back and forth between humans and animals.
 - Examples of diseases passed from animals to humans are rabies and tuberculosis
 - There are also diseases passed from people to animals. Monkeys are very susceptible, for example.
 - *Yersinia pestis*
 - People usually get it from being bitten by a flea (vector) that carries it from a rodent (reservoir)
 - It's a bad disease, but with modern antibiotics it can definitely be treated if it's caught in time.
 - Once it becomes advanced and starts replicating in the lungs therapy becomes less effective
 - Map: areas of the world where animals are commonly infected with plague
 - The Western U.S. is one of these areas
 - Rat flea: *Xenopsylla cheopis*
 - There are usually a few thousand people a year who get the plague
 - First pandemic originated in Egypt and spread to Europe, Africa, and Asia in 542-600 AD
 - Second pandemic ("Black Death") spread from Asia to Europe in the 1300s
 - Somewhere between a quarter and a third of the European population died
 - Usually the wild rodents that might be infected (such as rock squirrels) are less likely to be in contact with people, so they don't usually spread the disease. Rats are more likely to spread it because they live closer to people.
 - Last U.S. rat-borne epidemic occurred in Los Angeles in 1924-24
 - Plague among wild rodents is very common. As many as 20% of those in the Western U.S. have it.
 - When rats get plague, they typically get sick and die off, but these wild rodents can carry it without getting sick.
 - Map of reported plague cases in the U.S.

- Most of the cases occurred in the Southwest and Arizona
 - Around 18 cases a year
 - Mostly children who might have been playing with wild rodents
 - Pretty severe: 1 in 7 people will die

- Forms of Plague
 - Bubonic plague
 - Enlarged, tender lymph nodes, fever, chills, and prostration
 - Septicemic plague
 - This follows bubonic plague, or it can come first if the patient is initially infected with enough bacterial
 - The bacteria invades all of their organs
 - Pneumonic plague
 - Rapid shock and death if not treated early
 - The bacteria gets into the lungs and can be spread through the air

- Diagnosis, Treatment, and Prevention of Plague
 - Give immediate, aggressive treatment
 - Track down anybody who's been in contact with them and give them prophylactic antibiotics
 - Plague is best prevented by controlling rat populations, such as by limiting their access to food and shelter

- The Bacterium
 - Gram negative facultative anaerobe
 - Similar to salmonella
 - There are three types, but only one of them (*Y. pestis*) causes plague in people
 - *Y. pseudotuberculosis* causes mesenteric lymph node swellings similar to those that occur on the skin in bubonic plague
 - People sometimes get this from eating Chitlins (deep fried pig intestines)
 - *Y. pestis* and *Y. pseudotuberculosis* are still very closely related genetically
 - Invasin: protein that allows the bacteria to invade cells
 - Gut-associated lymphoid tissue (GALT)
 - PCP1 and PMT1: plasmids acquired
 - Bacterial protein limits inflammation and allows the bacteria to spread
 - The infected fleas can't ever get enough blood – they're starving, so that they bite people and animals far more than they otherwise would
 - In this manner, the bacteria can modify host/vector behavior
 - Related example: Toxoplasmosis
 - Bacteria that exists in animals such as cats or undercooked meat products
 - Can cause illness in immune-compromised people

- Can cause birth defects if a pregnant woman is infected (that's why pregnant women shouldn't change cat litter)
 - The bacteria's presence can alter the cat's urine so that rats no longer avoid the smell, causing them to be more likely to get eaten by the cat, thus improving the survival of the host cat and making it more likely to reproduce and pass on the bacteria
- The bacteria replicate extra-cellularly in the body
 - Type III secretion system – critical for pathogen success