

20.106J – Systems Microbiology

Lecture 22

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- Epidemiology
 - Microepidemiology
 - Environmental issues
 - Also applies to noninfectious diseases, like cancer
 - We'll mostly be discussing infection disease today
- Epidemiology: The study of the occurrence, distribution, and control of disease in a population
 - Testing
 - Chart: mortality rate per 100,000 in the United States
 - The big spike is from the Influenza virus of 1918
 - Mortality has also gotten a little bit worse again in the last 20-30 years
 - This recent rise has a lot to do with increased travel
- Epidemiology Vocabulary
 - Acute – dramatic onset of the illness – they come and go quickly
 - Chronic – lasts for a long long time, or your entire lifetime. Sometimes you might not have a lot of symptoms
 - Carrier – somebody that is infected but may not show signs of the illness. They don't appear sick, and so they act as a human vector.
 - Reservoir – a carrier of illness. A Carrier is a human reservoir, but often when we talk about reservoirs we mean animals or inanimate places or objects.
 - Morbidity – the incidence of illness in a population. This involves clinical symptoms, because it won't get recorded unless people are visibly sick. Thus there is actually more morbidity in a population than gets recorded, because people don't always go to the doctor.
 - Mortality – the incidence of deaths in a population.
- Map of the world: colored by child mortality
- Transmission
 - Vertical transmission – parent-to-child transmission, such as from a pregnant mother to her fetus
 - Horizontal transmission – generalized person-to-person transmission
 - Direct host-host transmission
 - Indirect host-host transmission
- Clinical Disease Progression
 - Infection – has to do with the actual onset – when the pathogen is in the host and replicating, rather than just when the person gets sick

- Incubation Period – time between infection and onset of clinical disease symptoms. This could last as long as years or decades.
 - Acute period – the height of clinical disease
 - Decline period – the organism has left your body and you're recovering
 - Convalescent period – return to prior health and strength
- Maps of amount of disease in different parts of the world
 - Prevalence: fraction of people infected
 - Incidence: number of people infected
 - Endemic disease – relatively constant
 - Epidemic disease – clusters
 - Pandemic disease – epidemics on multiple continents, consistent throughout neighboring countries
- Epidemics
 - Common source epidemics
 - Such as cholera originating from one city well in London
 - Host-to-host epidemics
 - This is much harder to contain, because you have to find everybody that's infected and quarantine them
- Eradication and Elimination
 - Control – the reduction of a disease to a locally acceptable level – a lot of the time it's just impossible to totally eliminate a disease, such as when it's an environmental pathogen
 - Elimination of disease – you're not controlling the infections, but you are controlling the illness – tetanus is an example
 - Elimination of infection – stopping infection, such as with polio in most countries
 - Eradication – as a result of worldwide efforts, intervention measures are no longer needed. Smallpox is eradicated – they've stopped needing to vaccinate for it. It's not extinct, however, because there are still some contained laboratory strains in the U.S.
 - Extinction – infection agent no longer exists in nature.
- Eradication
 - Some diseases that can be targeted for eradication:
 - Polio
 - Guinea worm disease
 - Lymphatic filariasis
 - River blindness
 - Trachoma
 - Schistosomiasis
 - Many organisms can't ever be eradicated because:
 - There's not a vaccine
 - There's always going to be an environmental source

- They tried to eradicate hookworm and yellow fever in the early 1900s
 - They tried to kill all the mosquitoes that acted as a reservoir, but you can never truly kill all those mosquitoes, and after 5 or 6 years it came back
- Control Measures
 - Cycle: Reservoir → Portal Exit → Transmission → Portal Entry → Susceptible Host → Reservoir again
 - Against reservoir:
 - you can vaccinate domestic animals, such as for rabies or polio
 - you can prevent contact with wild animals
 - Against transmission
 - You can prevent contamination
 - Immunization
 - Quarantine
 - Control measure for outbreaks
 - Surveillance
 - Careful observation, recognition, and reporting of diseases as they occur
 - This is typically done with pathogens that have the potential to create epidemics
 - Herd immunity
 - Vaccines won't really be effective for public health until you make a high enough percentage of the population immune
 - Once enough people are vaccinated, you can prevent transmission
 - Typically at least 70% must have protective immunity
 - Highly infectious agents require up to 95% protection
 - Polio requires this kind of high percentage of protection, which is one of the reasons they're having such a hard time eradicating it.
- Pie chart: causes of death as a percentage of mortality in the total population in the Americas versus Africa
 - Infectious diseases cause far more deaths in Africa. In America it's only around 10%.