Evolution and Human Health

- Why we get sick
- Chapter 13 in text

- Evolutionary Biology 1859 Darwin’s Origin of Species
- Modern Medicine 1858 Pasteur’s Germ theory of disease

Why we get sick

- Environment of evolutionary adaptedness
- Diseases of excess
  - Taste for salt, fat, sweets
- Diseases of genes in new environment
  - Nearsightedness G x E
- Disease transmission
  - Domesticated animals, e.g. bird, swine flu
  - Human density, transmission rate, virulence

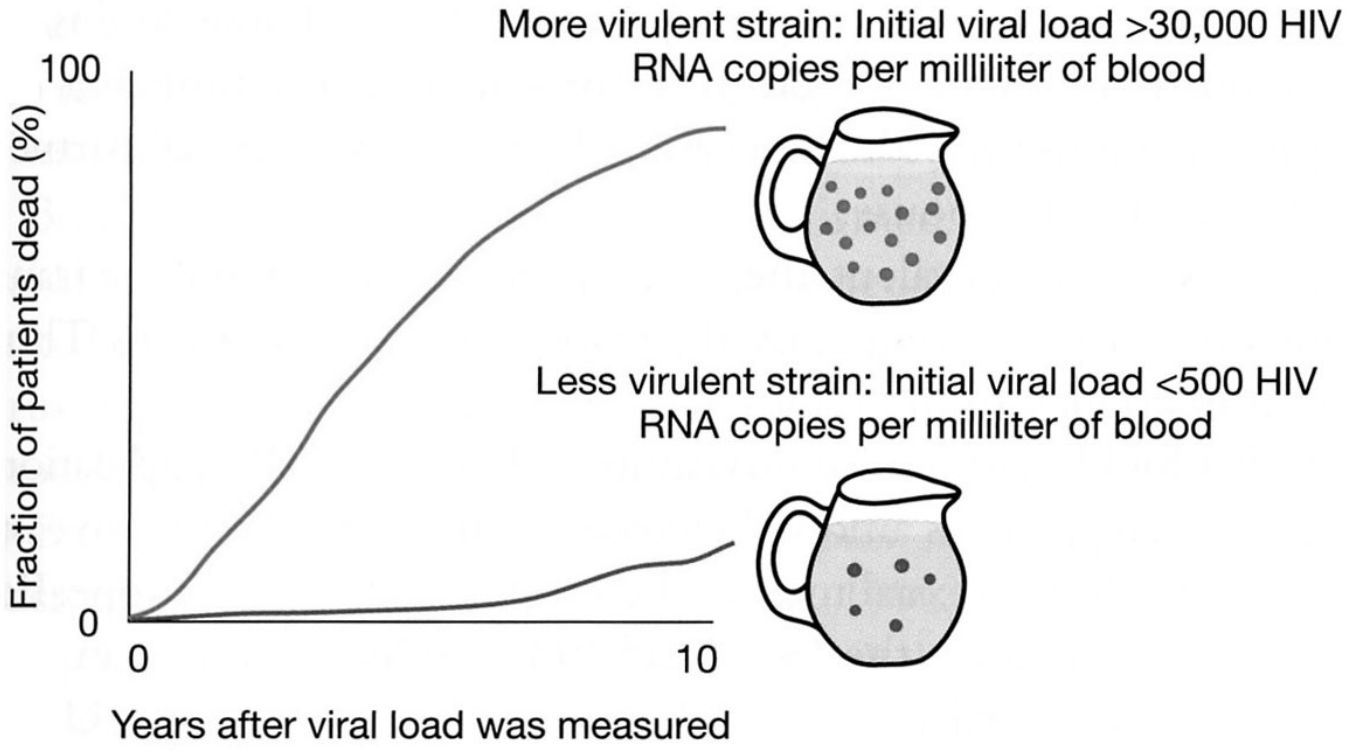
How we treat disease

- Symptoms as evolved defenses
  - Fever, iron withholding, allergies, cough
- Pathogens as evolved populations

Virulence

- Virulence: ability to cause disease in a host
- Mostly a function of growth rates

a) Assumption 1: More virulent strains maintain a higher concentration of HIV virions in the patient's blood, and kill the patient faster.



Does virulence Evolve?

- Let’s think…if virulence evolves, who should it favor?
  - Humans
  - Itself
- Think as though you were a virus particle that could set your own virulence

Virulence thought experiment

- Fast growing virus
  - Advantage: you replicate faster than the slow virus alternative WITHIN the host you are in
  - Disadvantage: you kill your host faster, so you have less time to be transmitted to a new host
- Slow growing virus
  - Advantage: your host stays alive a long time, giving you the possibility of spreading to more new hosts
  - Disadvantage: fast growing strains will out reproduce you WITHIN the host

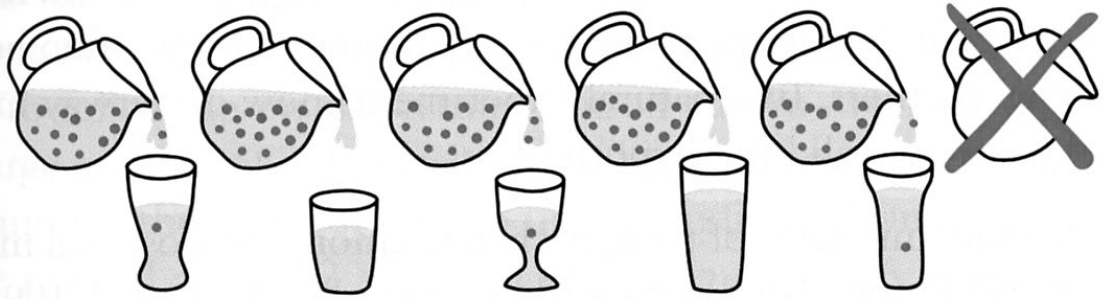
Paul Ewald: Transmission rate hypothesis

- If transmission from one host to another is frequent, that favors virulent strains
- If transmission from one host to another is rare, that favors less virulent strains

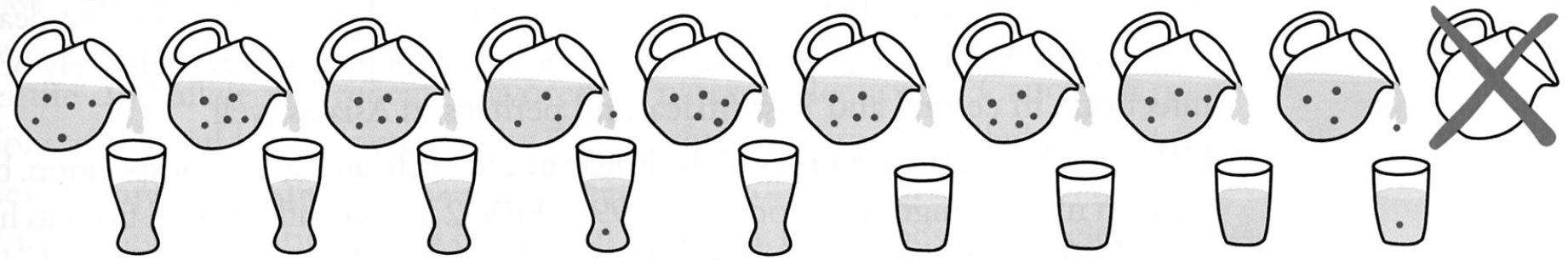
Transmission rate hypothesis

c) Hypothesis:

When the host switches partners often, a more virulent strain has higher fitness. It has the opportunity to infect many new hosts, even though it kills its original host relatively quickly.



When the host switches partners rarely, a less virulent strain has higher fitness. It allows its host to live long enough to give it the opportunity to infect more than one new host.



Behavior, Transmission, and Virulence

- Behavior of fewer partners, condoms, not sharing needles
- Lowers transmission rate
- Favors less virulent strains of virus

- So the reverse, promiscuous unprotected sex and shared needles etc. allows high transmission, favoring more virulent virus