ADAPTATION TO DISEASE STRESS

Human/Microbe Interactions
Co-Evolution of Disease
Sickle Cell Anemia
Black Death
Polio

INTERSPECIFIC CO-ADAPTATION

• Host-microbe interaction
• A well adapted microbe lives in the host for a long time
• A successful disease does not kill its host

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PARASITE: an organism that derives nourishment from a living plant or animal

• Escherichia coli
• Staphylococcus aureus
• Streptococcus mutans
• Pneumocystic carinii
• Neisseria meningitidis

INTERSPECIFIC CO-ADAPTATION

ZOONOSES: animal disease transmissible to humans

• tapeworm
• hookworm
• anthrax
• brucellosis
• encephalopathy
• Lyme disease
• tuberculosis?

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ENDEMIC: peculiar to or occurring constantly in a population

• goiter
• yellow fever
• chicken pox
• hookworm
• herpes

INTERSPECIFIC CO-ADAPTATION

EPIDEMIC: a sudden increase in the incidence rate of a disease over a wide area

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“Homo sapiens (have) been vulnerable to microbial assaults over the millennia…each catastrophic epidemic event in human history (was) the ironic result of humanity’s steps forward. As humans improve their lots, they actually increase their vulnerability to disease.

We’ll never escape the limits of the ecosystem. We are caught in the food chain, whether we like it or not, eating and being eaten.”

Evolution of Human Disease

Today
- "global village"
- antibiotic resistance
- age-related degeneration
- emerging disease

Co-Evolution of Disease

"We are engaged in a type of race, enmeshing our ecologic circumstances with evolutionary changes in our predatory competitors... We have crowded together a hotbed of opportunity for infectious agents... Affluent and mobile people are ready, willing, and able to carry afflictions all over the world within 24 hours' notice. This condensation, stratification, and mobility is unique, defining us as a very different species from what we were 100 years ago... But despite many potential defenses—vaccines, antibiotics, diagnostic tools—we are intrinsically more vulnerable than before, at least in terms of pandemic and communicable diseases."


Evolution of Human Disease

HUNTER/GATHERERS parasites, zoonoses
SETTLED VILLAGES intensified zoonoses, infection
PREINDUSTRIALIZE CITIES endemic, beginnings of epidemics
INDUSTRIALIZED CITIES endemic, epidemic, pandemics
TODAY age-related disease, emerging diseases

HUNTER/GATHERERS
- parasites, zoonoses
- intensified zoonoses, infection

SETTLED VILLAGES
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PREINDUSTRIALIZE CITIES
- endemic, epidemic, pandemics

INDUSTRIALIZED CITIES
- age-related disease, emerging diseases

Co-Evolution of Disease

Sickle Cell Anemia
- low O_2 tension
- capillary blockage

Polio
- virus
- WWII American & Egyptian soldiers
- antiseptic conditions
- childhood form
- adult immunity

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Co-Evolution of Disease

Sickle Cell Anemia
- point mutation
- SS, Ss, ss = genotypes
- African & Mediterranean groups
- Anopheles gambiae mosquito
- 150 bites per year
- 100% infection rate in kids
- 25% greater survivability = Ss

The Black Death
- particularly virulent strain of plague
- by 1350, 20,000,000 dead

Co-Evolution of Disease

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Flu Questions
- Younger people are more social & mobile
- Older people immunized by previous exposure to less virulent strains
- Viruses mutate in unpredictable ways
- Kill the host or leave it immune, therefore it died out
- When it resurfaces, less ‘candidates’ available
- Still not sequenced, tho’ they do have the DNA from samples at the AFIP

Flu Pandemics
- 1918: Spanish Flu: 500,000 in the US, between 20 and 50 million worldwide. Over half young healthy adults.
- 1957-58: Asian Flu: 70,000 in the US.
- 1968-69: Hong Kong Flu: 34,000 in the US.
- 1976: Swine Flu scare
- 1977: Russian Flu scare
- 1997,99: Avian Flu scare
OTHER QUESTIONS

Chicken pox/herpes
- Varicella-zoster virus (VZC)
- "Shingles is sometimes called "herpes zoster" but it is not caused by a herpes virus"
- "Part of the Herpes family, for which there are over 100 types"

CO-EVOLUTION OF DISEASE

CO-EVOLUTION OF DISEASE

"Cures"
- eat lettuce
- alternate sleep on left & right sides to keep liver balanced
- apply paste of gum resin, white lillies & human excrement
- don’t think about it
- thin blood with leeches
- burn fires to purify the air

"Causes"
- moral pollution; 1/3 of Cardinals died
- Jewish plot to destroy Christendom
- opportunity to get rid of debts, Jews were money lenders
- Jews were killed before plague arrived in many towns
- image of a witch

RESULTS

Plague Today
- 10-15 cases/yr in the US
- 1000-3000 cases worldwide
- northern New Mexico, northern Arizona, southern Colorado
- California, southern Oregon, far western Nevada

Societal changes
- city life stopped
- harvests were uncollected
- bodies piled up in the streets
- no sanitation
- no bread baked
- famine, lawlessness
- houses abandoned

Co-Evolution of Disease

Results
- macabre art becomes common
- labor shortage results in end of feudal system
- recurring outbreaks last for another 300 years
- the Renaissance is born
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Blood Types -- ABO System

- A & B alleles are co-dominant
- proteins (antigens) on outer surface

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<tr>
<th>Genotype</th>
<th>Phenotype</th>
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<tbody>
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<td>AA or AA</td>
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Co-Evolution of Disease

- Joan Barry, actress
  - "white slavery"
  - 1941, 1946 ruling
  - child support till 18
  - "looked like him"

- Baby type B
- Mother type A
- Chaplin type 0
- Supreme Court did not admit blood typing evidence

Blood Types -- ABO System

Genotype    Phenotype
AA or AA    A
BB or BO    B
AB          AB
OO          O

Blood Types -- ABO System

- natural immunity
- antibodies to other allele
- Type O = universal donor (no protein to cause reaction)
- Type AB = universal recipient (no antibodies to either allele)

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Blood Types and Disease

- H-antigen is similar to protein on Yersinia pestis
- lives in blood type O individuals longer, gains a foothold
- killed huge numbers of blood type O as a result
- easily rebounded as a result of heterozygotes

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RECOMMENDED READINGS

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