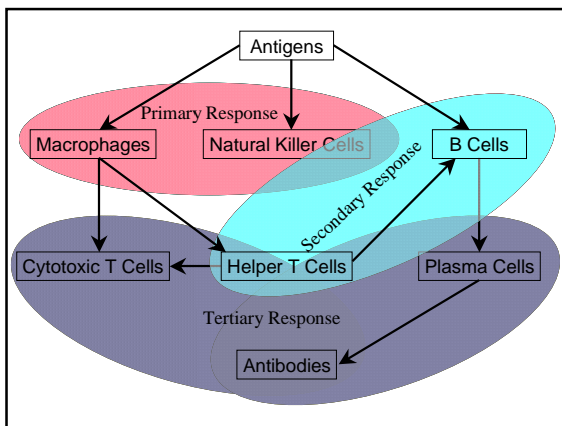


## Infectious Diseases

## Infectious disease

- Disease caused by the invasion of the body by some pathogenic organism such as a bacterium or virus
- Classification by mode of transmission: Contagious versus non-contagious
  - Within contagious diseases
    - Direct contact
    - Droplet
    - Inhalation



## Invading Organism

- **Antigen:** All invading organisms contain antigenic substances on their cell walls, proteins that generate an immune response.
  - “Australian antigen” discovered by Baruch Blumberg in 1960s when he thought he had found a new blood system antigen among Australian aborigines—later turned out to be Hepatitis B.

## Primary response:

- **Natural Killer Cells:** Non-antigen specific. These cells attack any foreign microbe in the body and attempt to kill it.
- **Macrophages:** Respond to all invading microbes, ingest and kill. Presents antigens from the microbe cell wall on the external cell wall of the macrophage to activate (thymus derived) T cells.

## Secondary response:

- **B Cells** are lymphocytes from the bone marrow which respond to antigens by differentiating into plasma cell.
  - **Plasma Cells:** Secrete one specific antibody for a particular antigen based on the cell line from the B cell.
- **Helper T Cells:** Secrete interleukin hormone to stimulate clonal growth of activated T and B cells.

### Tertiary response:

- **Cytotoxic T Cells: Bind to body cells infected by the microbes and secrete toxic substances killing cell and invader.**
- **Antibodies: Complex Immunoglobulin proteins with antigen-specific binding site which aggregates microbes together to deactivate the organisms.**

### Common Name

- Agent-type of organism: *Genus species*
- [Vector if non-contagious]
- Route of transmission
  - Comments about nature of transmission, history, evolutionary aspects of disease

### AIDS

- Human Immunodeficiency Virus
- Direct contact into host's blood by blood or semen of infected individual
  - Emerging diseases from bushmeat
    - SIV → HIV
  - Genetic resistance
    - CCR5-Δ32
      - 1% of Europeans, 20% carry one copy
      - Selected for by previous epidemics:
        - » Black Plague, Smallpox, Tuberculosis?
      - » Mutation dates to approximately the time of 14th Century Plague epidemic that killed 1/3 of Europe

### Chickenpox/Shingles

- Virus: *Varicella zoster*
- Droplet spread
  - Requires a community size of less than 1,000 because of the long latency and recurring infectious stage late in life as shingles



### Cold

- Several Viruses, including Rhinovirus, Coronavirus
- Droplet-expulsion of water vapor from lungs with protein, leaving virus on surface, direct contact
  - As with most droplet-transmitted respiratory infections, isolated communities do not harbor these viruses, and they could not have been prevalent until urban-sized aggregations developed
  - Coronavirus suspected in winter 2003 outbreak of Severe Acute Respiratory Syndrome responsible for numerous deaths

### Gonorrhea

- Gonococcal Bacteria: *Neisseria gonorrhoeae*
- Direct contact with mucous secretions

## Herpes

### HERPES VIRUS TYPES THAT INFECT HUMANS

*Herpes simplex virus* Type 1 (HSV-1)

*Herpes simplex virus* Type 2 (HSV-2)

Epstein Barr virus (EBV)

Cytomegalovirus (CMV)

*Varicella Zoster Virus* (VZV)

Human herpes virus 6 (exanthum subitum or roseola infantum)

Human herpes virus 8 (Kaposi's sarcoma-associate herpes virus)

## Herpes

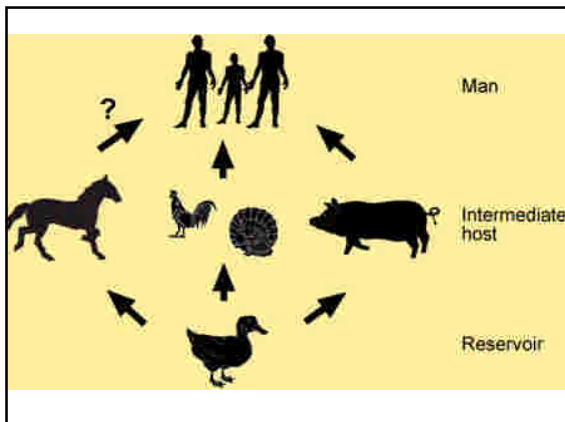
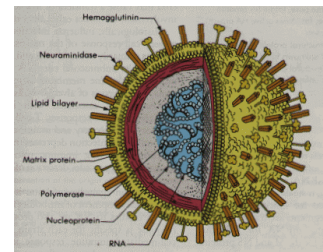
- Virus: *Herpes simplex*
- Direct contact, saliva, semen, vaginal discharge

## Hepatitis B

- Virus: Hepatitis B Virus
- Direct contact with secretions from lesions, or other body fluids (saliva, semen, blood, vaginal discharges).
  - Extremely stable virus resists boiling and drying
    - Because of stability, is transmitted on inanimate objects like needles and tattooing tools (e.g., Samoa)
  - Symptoms may be minor and lead to a chronic carrier state

## Influenza

- At least two virus families: A and B
- Droplet
  - Usually mucous membrane coming into contact with droplet causes infection
    - Same mode for measles, mumps, cold, chickenpox, smallpox (all viral)
    - 1918 pandemic



## Kuru

- Prion (abnormal PrP protein) causing spongiform encephalopathy (SE)
  - CJD, CJDv, Mad Cow all related
- Direct contact with contaminated brain tissue
  - Cannibalism
  - Mutation as signal of genetic adaptation to cannibalism in different populations

## Measles

- Virus: *Morbillivirus*
- Droplet infection—one of the most highly communicable diseases
- No reservoir other than humans so chain of susceptibles is necessary
  - Jump from animal host after development of first cities
    - Maintenance without external infections requires at least 2,500 – 5,000 new cases per year
      - Requires a population aggregation of about 500,000 to prevent the fade-out
  - Measles spread after smallpox to wipe out large numbers of Native Americans and Pacific Islanders as Europeans came in contact with these populations

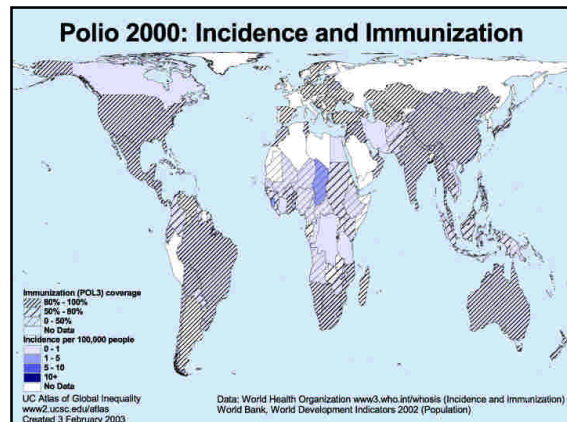
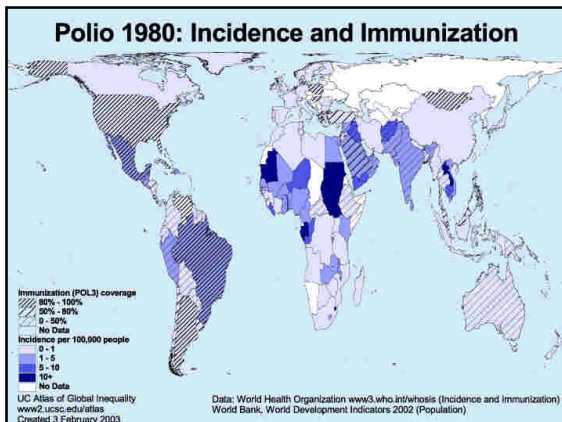


## Mononucleosis

- Virus (Epstein-Barr)
- Oral-pharyngeal route (kissing disease)

## Polio

- Virus
- Contact with saliva, feces
  - One exposure provides lifetime immunity
  - Cannot be sustained without urban-sized population aggregations
  - Areas most affected are those with highest hygiene standards, reducing early childhood exposure



## Syphilis

- Bacterial Spirochete: *Treponema pallidum*
- Direct contact with secretions from lesions, or other body fluids (saliva, semen, blood, vaginal discharges)

## Smallpox

- Virus: *Variola major*, *Variola minor*
- Droplet infection
  - Jump from animal host to man after development of first cities



## Tuberculosis

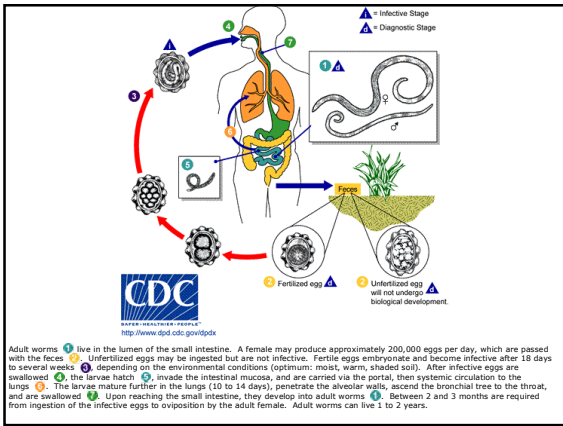
- Bacterium: *Mycobacterium tuberculosis*
- Droplet
  - Slow, chronic infection due to slow growing bacterium could persist in small communities, pre-urban conditions
  - Urban conditions generate major epidemic



A man with tuberculosis 1892. He has consumption.

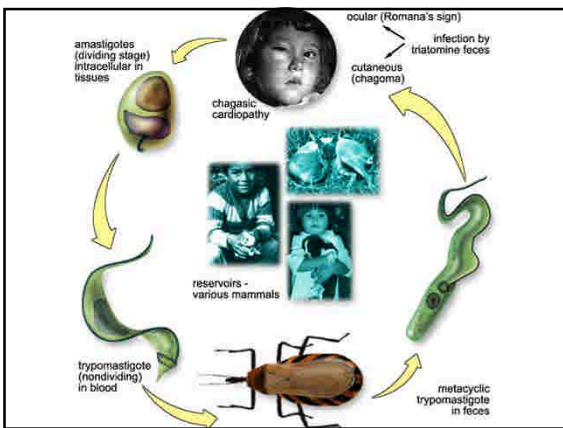
## Ascariasis

- Helminth: *Ascaris lumbricoides*
- Ingestion of infective eggs from soil contaminated with human feces (eggs undergo embryonation for 2+ weeks in soil)
  - Salads and other raw foods are common vehicle.
  - Most common world-wide small intestine parasite
    - Prevalence exceeds 50% in some tropical populations.



## Chagas' Disease

- Protozoan *Trypanosoma cruzi*
- Feces of infected insects (triatomine bugs) deposited at site of blood sucking
  - American Trypanosome disease
  - Chagas' disease is an infectious parasitic disease found only in parts of South and Central America
  - Chagas' disease exists endemically among highland populations but enzootically in lowland populations
  - Coimbra proposes three reasons for the distribution of the disease



## Chagas' Disease, cont.

- Settlement size: Highland communities are very large compared to their small lowland counterparts
  - Larger populations provide the parasites and the insects with more potential hosts
- Settlement mobility: Highland populations are very sedentary in contrast with lowland settlements
  - The lack of mobility by the highland communities has allowed specific triatomine species to adapt domiciliary nesting practices
- Animal domestication: Domestication of guinea pigs in the highlands provides the *Trypanosoma* with a reservoir and mobile transport to areas where uninfected triatomines flourish

## Cholera

- Bacteria: *Vibrio cholerae*
- Ingestion water/food contaminated with feces
  - Developed as sedentary villages and water supplies developed
  - Profuse watery diarrhea, vomiting, circulatory collapse and shock. Many infections are milder diarrhea or asymptomatic
    - 25-50% of typical cases are fatal if untreated

## Coccidiomycosis

- Fungus: *Coccidioides immitis*
- Inhalation (Valley fever)
  - An archaeologists disease
  - Symptomatic infection (40% of cases) usually presents as a flu-like illness with fever, cough, headaches, rash, and myalgias
    - Some patients fail to recover and develop chronic pulmonary infection or widespread disseminated infection (affecting meninges, soft tissues, joints, and bone)



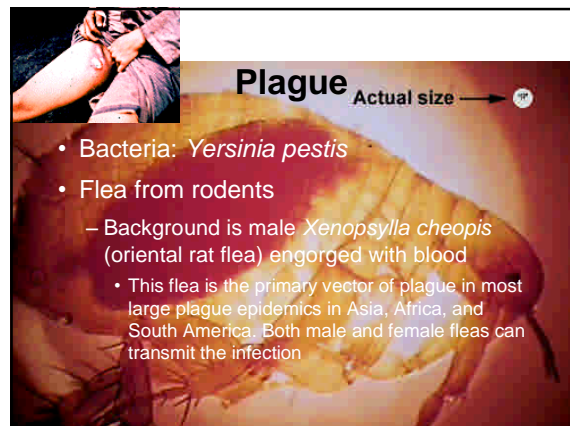
## Filariasis

- Nematodes *Wuchereria* and *Brugia*
- Vector: *Culex*, *Aedes*, and *Anopheles* mosquito transmittal
  - Prolonged and repeated infection results in hydrocoele (fluid around testes) or elephantiasis of limbs, breasts, or genitalia



## Malaria

- Protozoan: *Plasmodium* sp.
- Mosquito-borne: *Anopheles* sp.
  - Rise with agriculture, decrease with urbanization



## Psittacosis

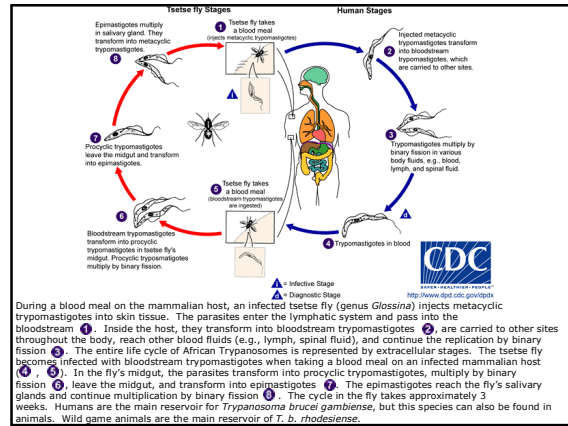
- Bacteria: *Chlamydia psittaci*
- Inhalation of dust from bird droppings
  - Incubation period is 5 to 19 days
  - Fever, chills, headache, muscle aches, and a dry cough
  - Pneumonia is often evident on chest x-ray

## Salmonella

- Bacteria: primarily *Salmonella enteritidis*, and *Salmonella typhimurium*
- Ingestion of contaminated food, water, or contact with infected animals
  - Increasing occurrences in petting zoos

## Sleeping Sickness

- Protozoan: *Trypanosoma brucei*
- Tsetse fly: *Glossina*
  - African Trypanosome
  - Two varieties, West African where humans are the primary reservoir and East African where wild game animals and cattle are an important reservoir



## Typhoid fever

- Bacteria: *Salmonella typhi*
- Ingestion water/food contaminated with feces
  - Typhoid fever is characterized by fever, headache, constipation, malaise, chills, and muscle aches with few clinical features that reliably distinguish it from a variety of other infectious diseases
    - Diarrhea is uncommon, and vomiting is not usually severe
    - Confusion, delirium, intestinal perforation, and death may occur in severe cases

## Typhus, Spotted Fevers

- Rickettsia
- Louse, flea, tick (includes Rocky Mountain Spotted fever)

Antigenic group	Disease	Agent	Predominant symptoms	Arthropod vector	Animal reservoir	Geographic distribution outside the US
Typhus fevers	Epidemic typhus	<i>Rickettsia prowazekii</i>	Headache, chills, fever, prostration, confusion, photophobia, vomiting, rash (generally starting on trunk)	Human body louse	Humans, Eastern flying squirrels (US)	Cool mountainous regions of Africa, Asia, and Central and South America
	Murine typhus	<i>R. typhi</i>	As above, generally less severe	Rat flea	Rats, mice	Worldwide
Spotted fevers	Rocky Mountain spotted fever	<i>R. rickettsii</i>	Headache, fever, abdominal pain, rash (generally starting on extremities)	Tick	Rodents	North, Central, and South America
	Mediterranean spotted fever	<i>R. conorii</i>	Fever, eschar, regional adenopathy, rash on extremities	Tick	Rodents	Africa, India, Europe, Middle East, Mediterranean
	African tick-bite fever	<i>R. africae</i>	Fever, eschar(s), regional adenopathy, rash subtle or absent	Tick	Rodents	Sub-Saharan Africa
	Queensland tick typhus	<i>R. australis</i>	Fever, eschar, regional adenopathy, rash on extremities	Tick	Rodents	Australia, Tasmania
	North Asian tick fever	<i>R. sibirica</i>	As above	Tick	Rodents	Russia, China, Mongolia, Japan
	Oriental spotted fever	<i>R. japonica</i>	As above	Tick	Rodents	Japan
Rickettsialpox	<i>R. akari</i>	Fever, eschar, adenopathy, disseminated vesicular rash	Mite	House mice	Russia, South Africa, Korea	

## Yellow Fever

- Virus: member of the flavivirus family (group B arbovirus)
- Mosquito-borne: *Aedes aegypti*
  - Primary natural host is African primates (like HIV and ebola) so man could have been exposed by mosquito bites throughout the Paleolithic
  - Many yellow fever infections are mild
    - Symptoms of severe infection are high fever, chills, headache, muscle aches, vomiting, and backache
    - After a brief recovery period, the infection can lead to shock, bleeding, and kidney and liver failure
      - Liver failure causes jaundice (yellowing of the skin and the whites of the eyes), which gives yellow fever its name.

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