ENVH451/541

Exposure pathways

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1415 human pathogens (in 2001)

- 217 viruses and prions
- 538 bacteria and rickettsiae
- 307 fungi
- 66 protozoans
- 287 helminths

Terminology

- Reservoir
- Vehicle
- Vector
- Route of transmission
- Port of entry/exit

Reservoir

- An ecological niche where a pathogen lives and multiplies
- Human, animals (domestic and wild), insects, and environments (soil, water, air)

Different reservoirs

- Human: many respiratory and sexually-transmitted diseases (Measles virus, HIV,…)
- Animals: many waterborne and foodborne diseases (*Brucella melitenisis*, *Giardia lamblia,…*)
- Insects: vectorborne disease (*Plasmodium spp*. (malaria), *Borrelia burgdoferi* (Lyme disease)…
- Environment: *Clostridium botulinum* (soil), *Mycobacterium avium* complex (water), *Legionella pneumophilia* (air)…

Vehicle

- An inanimate object/material by which organisms get from one host to another
- Fomites, biological products (blood), water, food, and air

Vector

- A living organism that bring infectious organisms to a host
- Mechanical vectors: no multiplication: Fly (enteric bacteria)
- Biological vectors: multiplication: mosquitoes (malaria), ticks (Lyme disease), fleas (plague)

Routes of transmission

- Direct host-to-host transmission
- Indirect transmission
  - Fomites
  - Food
  - Water
  - Air
  - Insects

Direct host-to-host transmission

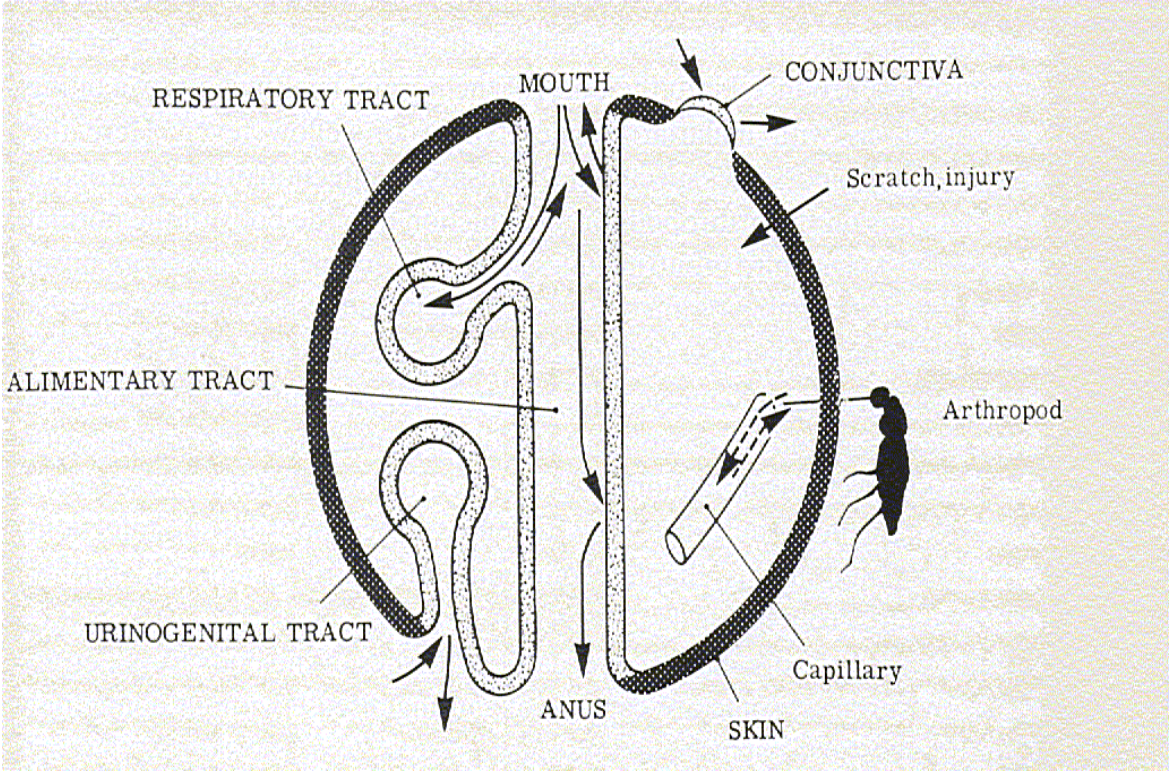
- Direct contact between hosts
- Many respiratory, skin and sexually-transmitted disease
- Pathogens sensitive to environmental stress and unable to survive for significant periods of time outside of a host
- Not readily controllable – personal hygiene, sex education, vaccination, treatment of the patients, quarantine?

Indirect transmission

- Transmitted by vehicles and vectors
- Many foodborne, waterborne, and vectorborne diseases
- Pathogens relatively resistant to environmental stress and able to survive for significant periods of time outside of a host
- Controllable – surface disinfection, water purification, food safety program, reservoir and vector control

Sites or Portals of Entry to and/or Exit From the Body

- Respiratory
- Enteric or Gastrointestinal
- Skin: especially if skin barrier is penetrated
- Genitourinary
- Eye



Trends in infectious disease

- Reduction in the occurrence of many infectious disease
  - Improved sanitation, reservoir and vector control, vaccination, and antibiotic treatment
- Eradication of some human pathogens
  - Smallpox, Polio (by 2000?), Measles, Dracunculiasis
- Emergence of new and previously unrecognized pathogens

Emerging and re-emerging pathogens (during the last 20 years)

- 175 new species
  - 77 viruses and prions
  - 53 bacteria and rickettsiae
  - 19 fungi
  - 16 protozoans
  - 10 helminths

Scientific advances

- Advance in analytical techniques
  - Molecular biological methods (PCR)
  - Flow cytometry (FACS)
- Implementation of effective monitoring system
  - US: MMWR (Morbidity and Mortality Weekly Report): CDC, State Health Departments
  - World: WER (Weekly Epidemiological Record): WHO

Microbial adaptation (I)

- “Will to Survive”
- To change themselves
  - Viruses: Mutation
    - RNA viruses (Influenza, SARS)
  - Bacteria: Mobile genomic elements (plasmids, transposons)
    - Virulence factor (*E. coli* O157:H7)
    - Antibiotic resistance (MRSA (Multi-drug Resistant *Streptococcus aerosinosa*), VRE (vancomycin-resistant *Enterococci*))
    - Morphologic change (*V. cholerae* O139 (capsule))

Microbial adaptation (II)

- To find susceptible populations
  - the elderly, organ transplant/cancer patient, AIDS patients
  - *Cryptosporidium parvum, Mycobacterium avium* complex

Microbial adaptation (III)

- To find a new niche (habitat)
  - Legionnaire's disease (Air conditioning system: *Legionella pnuemophila*)
  - *Mycobacterium avium* complex (Water distribution system)

Vulnerable situation

- Growing number of population with weak immune systems
- Population expansion/urbanization
  - 50 % of world populations in cities
  - Slums: high population density, poor sanitation, malnutrition
- War, civil unrest, and natural disaster
  - Breakdown of public health infrastructure
- International travel and commerce
  - 690 million international travels in 2001