Biological Agents

SAND No. 2006-2174C, 2007-1747 P 2007-6181C
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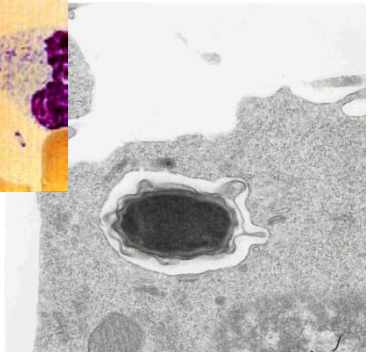
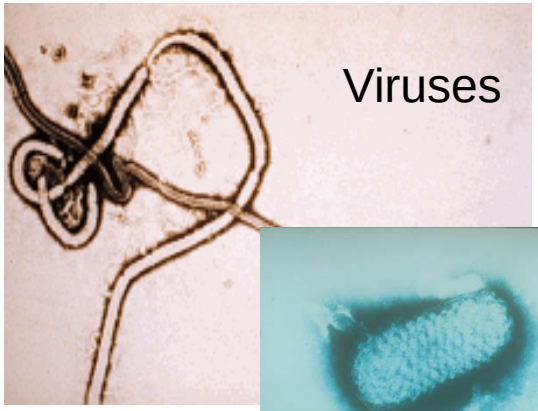
International
BIOLOGICAL THREAT REDUCTION

Types of Biological Agents

Bacteria



Viruses

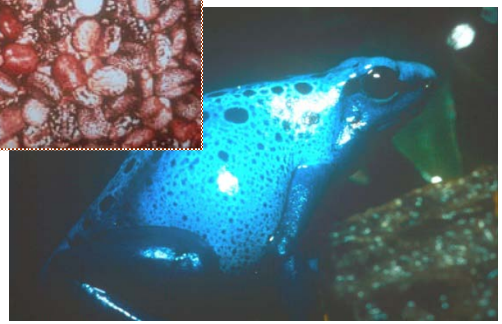


Rickettsia and Chlamydiaceae

Texas Department of Health

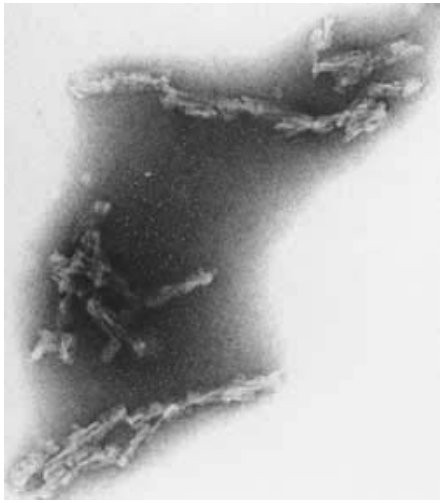
Texas Department of H

Toxins



Types of Biological Agents (cont.)

Prions



Nat Med 2004, 10(11):1175

Genetically Altered Organisms

Antibiotic Resistant Organisms

Terminology

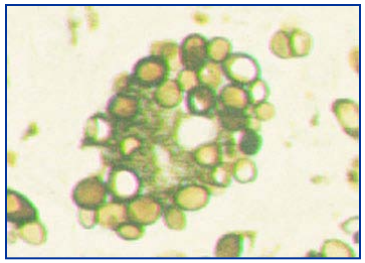
- Infectious dose (ID_{50})
  - Number of infectious organisms necessary to establish infection in 50% of animals tested
- Lethal dose (LD_{50})
  - Amount of substance necessary to kill 50% of animals tested
- Morbidity
  - Rate of illness in a given population
- Mortality
  - Rate of death in a given population
- Zoonotic
  - Spread from animals to humans

Overview of Selected Agents

- Fungi
  - *Coccidioides immitis*
- Bacteria
  - *Bacillus anthracis*
  - *Yersinia pestis*
  - *Francisella tularensis*
  - *Brucella spp.*
- Rickettsiae and Chlamydia
  - *Chlamydiaceae psittaci*
  - *Rickettsia rickettsii*
- Viruses
  - Hemorrhagic Fever viruses
  - Avian influenza virus, H5N1
  - Foot-and-mouth Disease virus
- Proteins
  - Botulinum toxin

Fungi: *Coccidioides immitis*

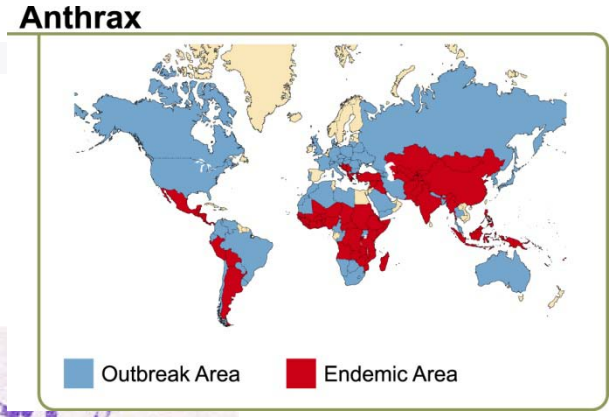
- Coccidioidomycosis (“Valley fever” or “desert fever”)
- Zoonotic
- Endemic to arid and semi-arid regions of the Western Hemisphere
- Highly stable
- Usually asymptomatic, 30-40% of infected become ill
- 5-10 out of every 1000 infected develop life-threatening infection
- 10th most common laboratory-acquired infection
- Treatment: Symptoms usually resolve without treatment
  - Amphotericin B
  - Diflucan

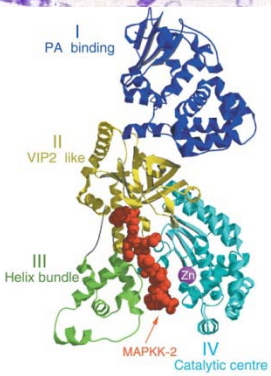


Coccidioides immitis

Bacteria: *Bacillus anthracis*

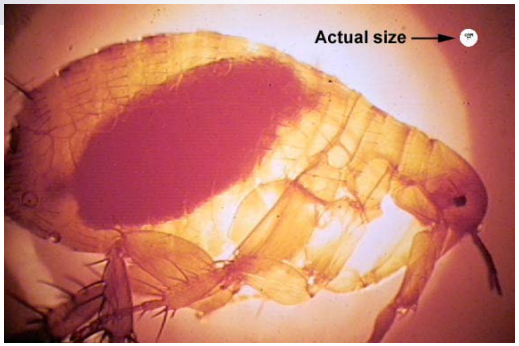
- Anthrax
  - Cutaneous
  - Gastrointestinal
  - Pulmonary
- Zoonotic
- Global distribution
  - Especially Middle East, Africa, Asia, US
  - Many less virulent strains
- Very stable
- ID_{50}: 8000-50,000 spores
- Mortality rate: 90 – 100% (pulmonary)
- Vaccine
- Antibiotics

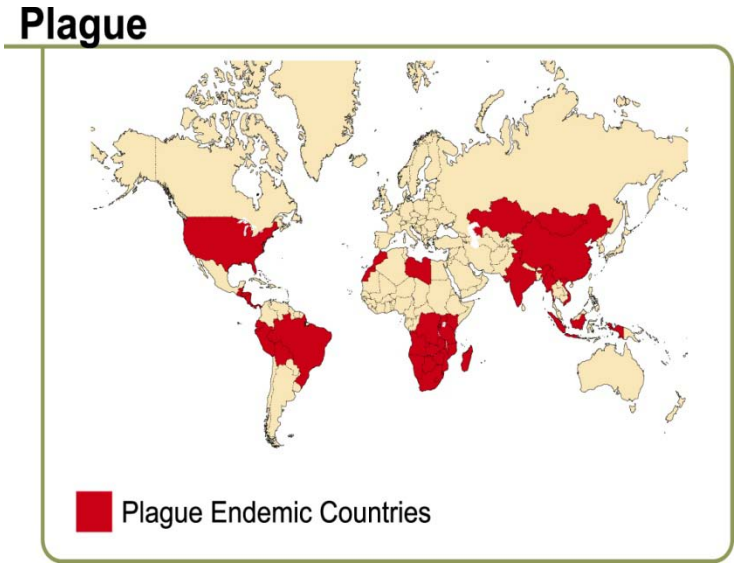




Bacteria: *Yersinia pestis*

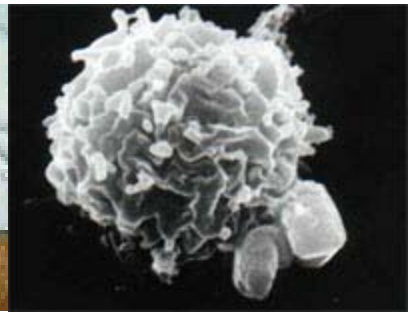
- Plague
  - Bubonic
  - Septicemic
  - Pneumonic
- Zoonotic
- Global distribution
  - Except Australia and Antarctica
  - Virulence highly variable
- Less stable – easily degraded by drying and sunlight
- ID_{50}: 100 organisms
- Mortality rate: ~100% for pneumonic
- Antibiotics
- No licensed vaccine in US; vaccine available in FSU and Mongolia





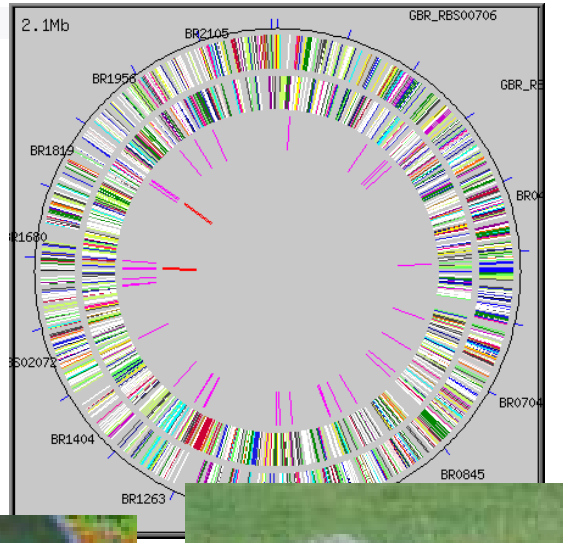
Bacteria: *Francisella tularensis*

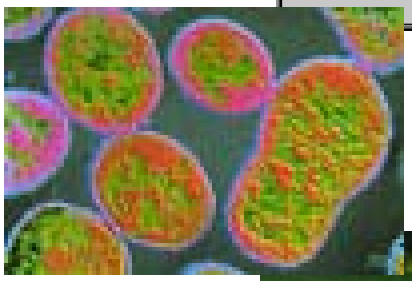
- Tularemia ("rabbit fever")
  - Ulceroglandular
  - Gastrointestinal
  - Pulmonary
- Zoonotic
- Distribution
  - North America, Europe, Middle East, Russia, and Japan
  - Rare in UK, Africa, Central and South America
- Persists in water but sensitive to UV radiation and oxidation
- ID_{50}: 10 – 25 organisms by respiratory routes
- Mortality rate: less than 20%
- Antibiotics

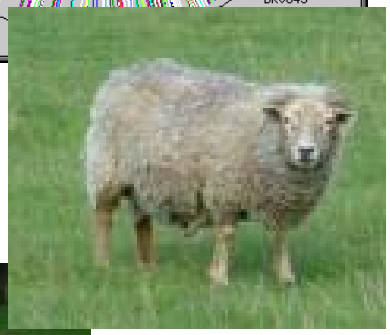


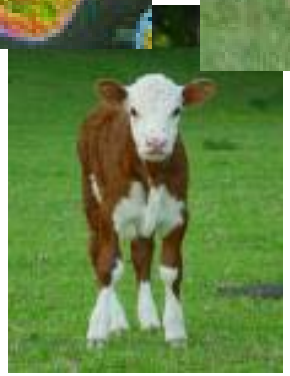
Bacteria: *Brucella spp.*

- Brucellosis
- Zoonotic
- Wide distribution
  - South America, Central America, Eastern Europe, Asia, Africa, Middle East
- Stable
- 6 species; 4 cause disease in humans
- ID_{50}: 10 – 100 organisms
- Low mortality
- Treatment with antibiotics



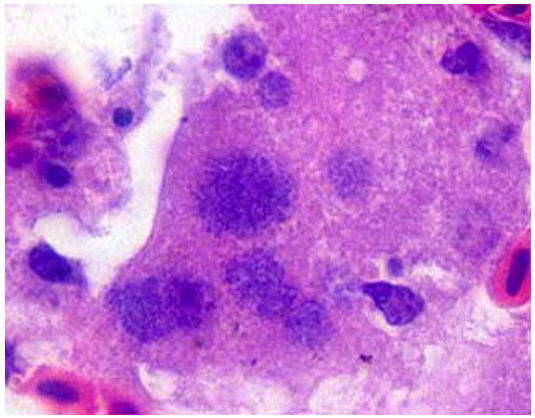






Chlamydiaceae: *Chlamydophila psittaci*

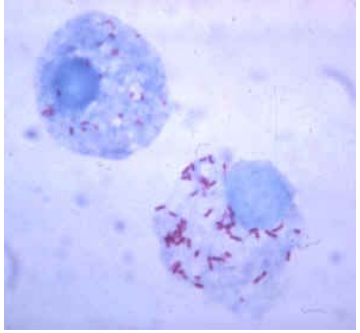
- Psittacosis
- Zoonotic
  - 465 Avian species
  - ~100 human U.S. cases reported / year; 1 death
- Global distribution
- Relatively stable
- Infectious dose: Unknown
- 1976: Fifth most commonly reported laboratory acquired infection
- Antibiotics



Univ. of Georgia College of Veterinary Medicine

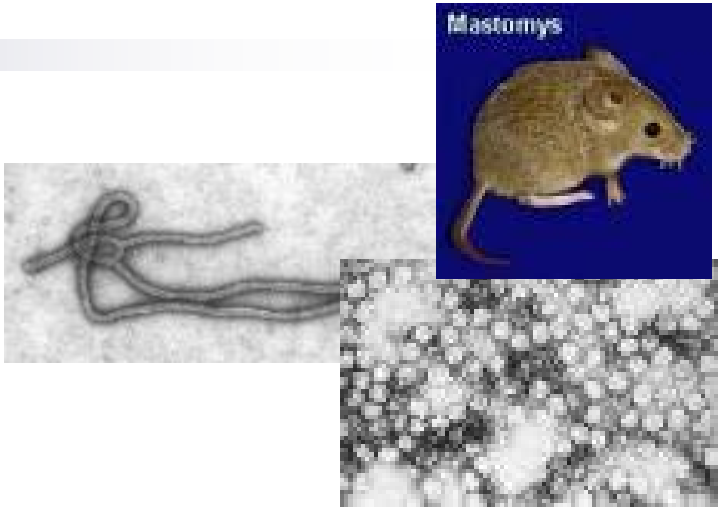
Rickettsiae: *Rickettsia rickettsii*

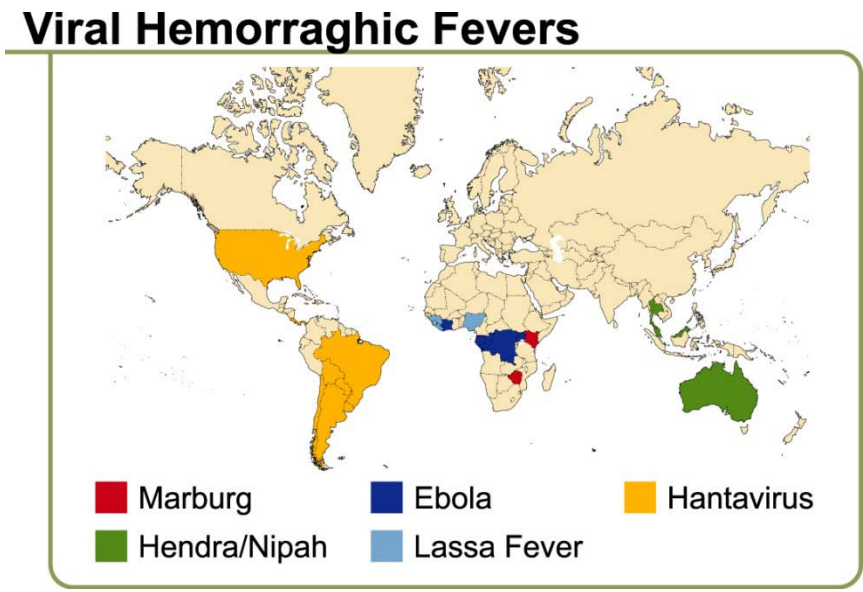
- Rocky Mountain Spotted Fever
- Zoonotic
- Distribution
  - US, Mexico, Central and South America
- Stable in tick blood at ambient T; 1 year survival
- ID_{50}: 1-10 organisms
- Mortality 15-20% if untreated; delayed diagnosis contributes to increase in fatalities
- Antibiotics: doxycycline



Viruses: Hemorrhagic Fever Viruses

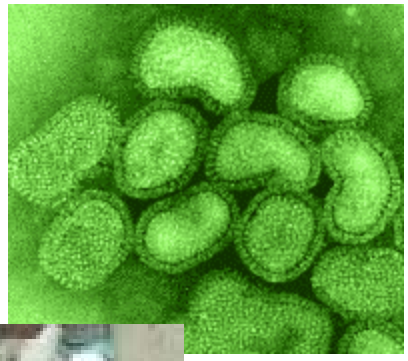
- Viral Hemorrhagic Fevers
  - Filoviruses: Ebola and Marburg
  - Arenaviruses: Lassa, Junin, Machupo, Guanarito, Sabia
  - Hantaviruses
  - Dengue
  - Yellow fever
- Zoonotic
- Distribution varies by species
- Relatively unstable (enveloped viruses)
- ID_{50}: 1 – 10 virions
- Mortality varies
  - Ebola is highest: 50 – 90%
  - Lassa: 15 – 20%
- Generally only supportive treatment
  - Ribavirin somewhat effective for arenaviruses
  - Yellow fever vaccine

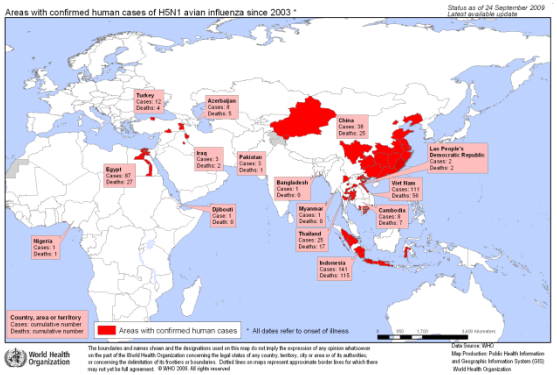




Viruses: Avian Influenza H5N1 Virus

- Highly Pathogenic Avian Influenza (HPAI)
- Zoonotic
- Distribution
- Relatively unstable
  - But stable in water
- Highly infectious in poultry; limited infectivity currently in humans
- Vaccine for animals available; human vaccine under development
- Treatment for humans:
  - Oseltamivir
  - Zanamavir



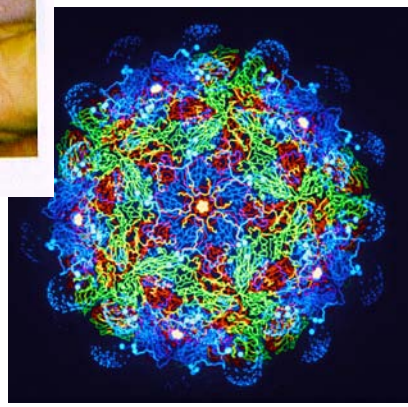


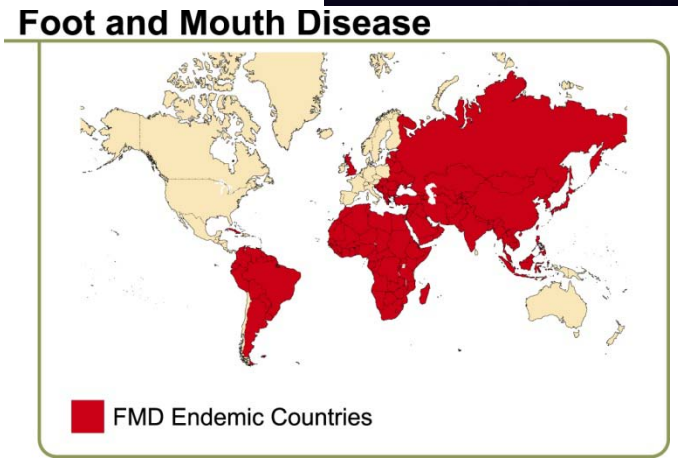
H5N1 cases 2003-Sept. 2009

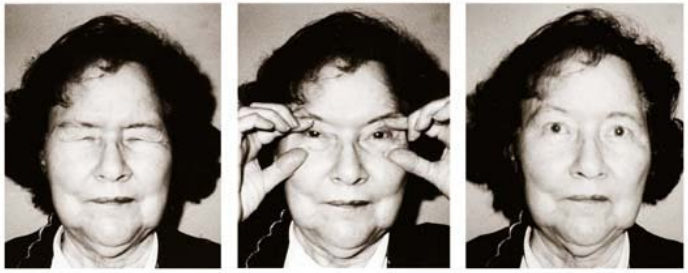
Viruses: Foot-and-Mouth Disease Virus

- Foot-and-mouth disease
- Animals only
- Wide distribution
  - South America, Europe, Asia, and Africa
- Very stable
- Highly infectious for cattle
  - ID_{50} < 10 virions
- High morbidity; low mortality for adult animals (< 5%)
- Vaccine

18 Ruptured vesicle on bovine tongue.





Proteins: Botulinum toxin

- Botulism
- Produced by *Clostridium botulinum*, *C. baratii*, and *C. butyricum*
  - Multiple types of toxin: A, B, C, D, E, F, G
  - Only A, B, E, and F produce human disease
- Zoonotic
- Degraded by heat and humidity – relatively stable for a protein
- LD_{50}: 0.001µg/kg
- Treatment
  - Antitoxin (limited supplies)
  - Supportive care