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Zoonoses diseases

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Zoonoses

- Diseases transmitted from animals to humans
- > 250 zoonoses have been described
- Pathogens include viruses, rickettsia, bacteria, fungi, parasites
  - Some rare – e.g. rabies
  - Some common – e.g. *Salmonella*
- Some are very serious (rabies), others are less serious (cat scratch disease)
- Several different means of transmission (direct, indirect, vector-borne)

Zoonoses, direct mechanisms of transmission:

- Direct contact by bite/scratch (e.g. rabies, cat-scratch fever, rat-bite fever)
- Direct contact by handling of animal (e.g. salmonellosis, avian flu, anthrax, tinea corpora)
- Direct infection by ingestion of animal products (e.g. paragonamiasis, Creutzfeldt-Jakob disease, cystercercosis)

Zoonoses, indirect mechanisms of transmission:

- Indirect infection by ingestion in contaminated water or food (e.g. giardiasis, salmonellosis)
- Indirect infection by inhalation of contaminated fluids such as feces, placenta/amniotic fluids, urine, milk, etc. (e.g. brucellosis, Hanta virus, psittacosis)
- Indirect infection by exposure to contaminated soil or water (e.g. schistosomiasis, leptospirosis)

Zoonoses, vector-borne mechanisms of transmission:

- Vector-borne diseases (insect borne):
  - Mosquito-borne infections (arboviruses): Japanese encephalitis, dengue, malaria
  - Tick-borne infections: Lyme disease, ehrlichiosis, rickettsioses, babesiosis
  - Fleas: plague, endemic typhus
  - Flies: onchocerciasis, African trypanosomiasis, leishmaniasis
  - Lice: epidemic typhus

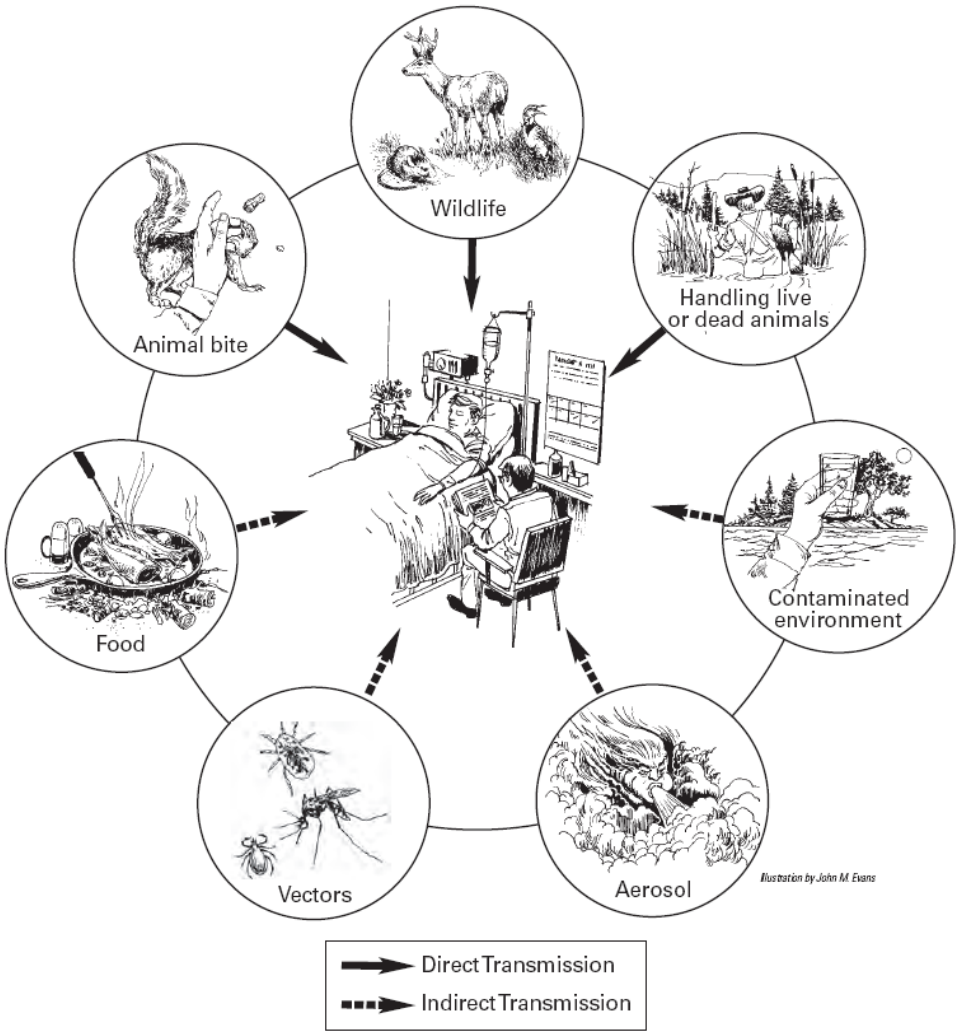


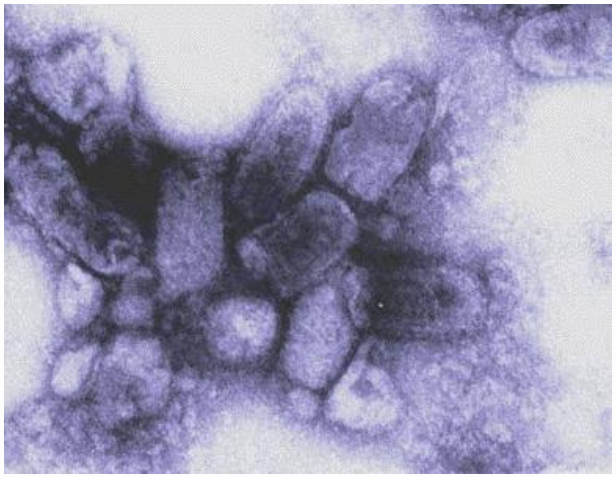
Figure 4.3 Common routes for potential transmission of infectious diseases between animals and humans and vice versa.

Module Outline:

- Different types of zoonoses will be discussed in this module:
  - Rabies: viral, transmitted via bite or scratch
  - Japanese encephalitis: viral, transmitted by mosquito bite
  - Arenavirus: viral, transmitted by aerosolized rodent body fluids
  - *Salmonella*: bacterial, transmitted by contamination of food products or direct contact with animal host

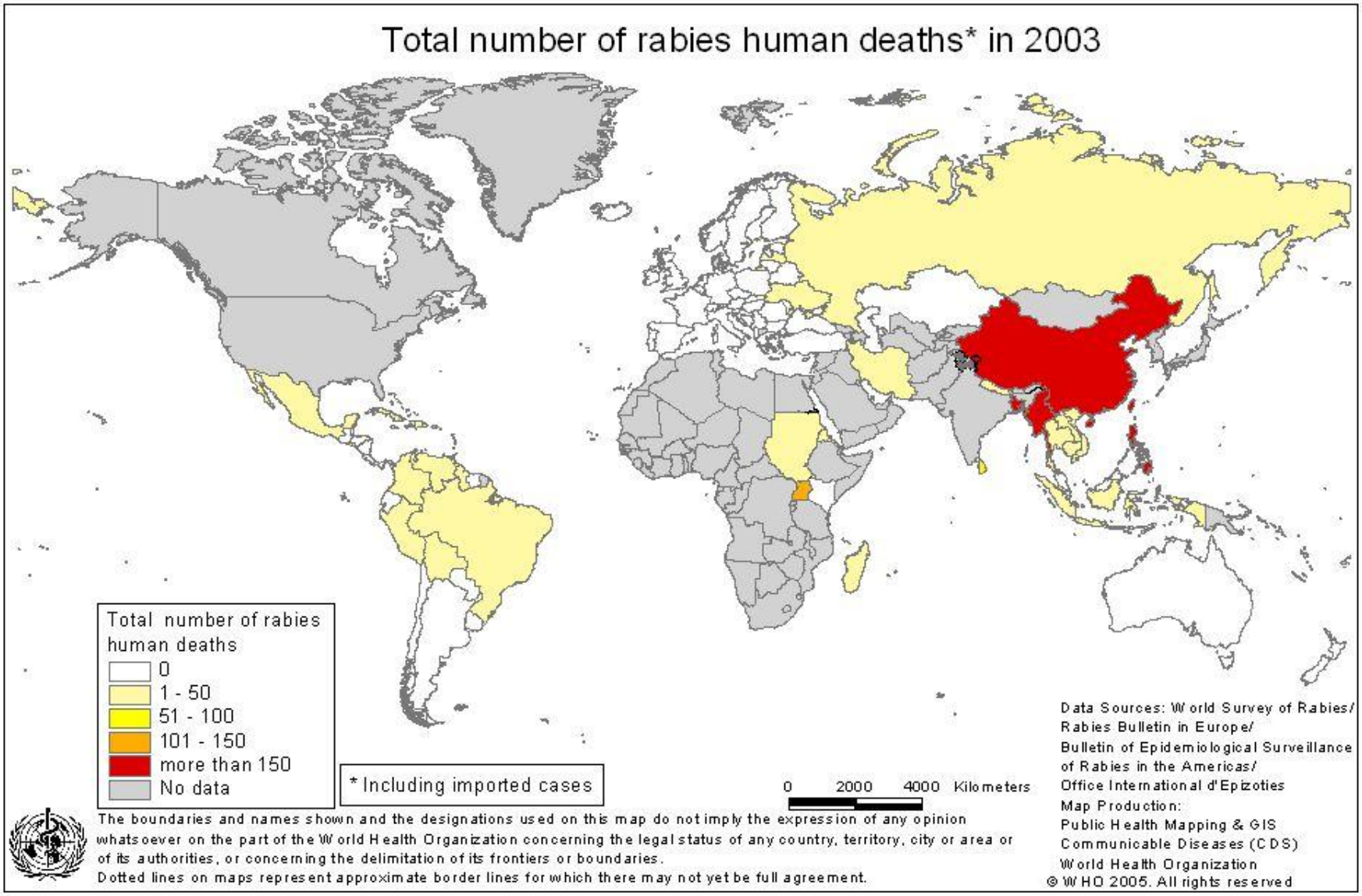
Rabies

Infection from bite or scratch



Rabies epidemiology:

- Develops from a bite, scratch or other contact with saliva from a rabid animal
- Rabies is rare or non-existent in parts of the developed world (US, Western Europe, Australia)
  - Reservoir typically wild animals (e.g. raccoons, skunks, bats)
  - Rates ~3-5 cases per year in the US
  - Compare with 50-100,000 cases per year worldwide
- Rabies is more common in developing countries
  - Reservoir typically domestic animals (e.g. dogs and cats) which aren't vaccinated



WHO, World: Total number of rabies human deaths , 2003

Rabies pathogenesis:

- Rabies is introduced via a bite or other contact into skin and muscle tissue
- The virus then travels through axons of peripheral nerves towards the central nervous system (CNS)
- Upon reaching the CNS, the virus then spreads outwards again along nerve fibers to the skin, cornea, salivary glands, etc.

Rabies clinical symptoms:

- Incubation period ranges from a few days to > 1 year
  - Most cases present between 2 and 16 weeks
- Initial symptoms are nonspecific:
  - Fever, malaise, fatigue, anxiety, headache
  - Half of patients have pain, itching or paresthesias at site of the bite

Rabies clinical symptoms:

- One of two clinical syndromes then develops:
  - Furious (encephalopathic) rabies
  - Dumb (paralytic) rabies
- Mortality is 100% once clinical symptoms appear

Rabies diagnosis:

- Always consider in case of acute onset, rapidly progressive encephalitis
- Diagnosis before death is difficult, but possible
  - Need multiple specimen types and multiple assays

Rabies prevention - Pre-exposure prophylaxis:

- Vaccination can prevent disease when given BEFORE contact
- People at high risk of exposure can undergo a 3-shot vaccination series
- Ex: veterinarians, wilderness occupations, rabies laboratory personal, visitors to endemic countries

Rabies prevention – Post-exposure prophylaxis (PEP)

- Vaccination can prevent disease when given AFTER contact with a rabid animal
  - If animal available for observation, can watch animal for 10 days and hold off on prophylaxis
- ALWAYS wash wound thoroughly with soap and water
- PEP has 2 components – vaccine and immunoglobulin
  - Day 0 - rabies immunoglobulin (RIG)
  - Days 0, 3, 7, 14, and 28 – vaccine

Japanese Encephalitis virus

Infection from insect vector

Japanese Encephalitis (JE):

- One of leading causes of encephalitis world-wide
- Estimated 50,000 cases/year with 15,000 deaths/year
- Found mostly in Asia, now spreading to Australia, India, Pakistan
- Transmitted by mosquito vector from pigs and birds
- Member of the flavivirus family
  - Includes West Nile virus, St. Louis encephalitis virus, Dengue fever virus

JE pathogenesis:

- After transmission by mosquito, virus multiplies locally and in lymph nodes
- Transient viremia with invasion of central nervous system
- Virus targets neuronal cells

JE clinical features:

- Incubation period 1-14 days
- Infection most commonly asymptomatic
  - Estimated asymptomatic:symptomatic infection ratio varies from 25:1 to 1000:1
- Onset of symptomatic disease can be abrupt, acute, subacute or gradual
- Course of symptomatic disease:
  - Prodromal stage
  - Encephalitis stage
  - Late stage with recovery or neurologic sequelae

JE prodromal stage:

- Characterized by flu-like symptoms:
  - High grade fever ± rigors, headache, malaise, nausea, vomiting
  - Nonspecific

JE encephalitis stage:

- Develops by day 3-5 of illness
- Characterized by:
  - Altered sensorium, seizures, neck stiffness, muscle rigidity, mask-like facies, abnormal movements
- Mortality varies from 8-72% but typically averages 25-30%

JE late stage:

- Regain function over several weeks
- ~1/3 recover completely
- Residual sequelae include:
  - Impaired speech, aphasia, paresis
  - Neurocognitive deficits

JE diagnosis:

- Diagnosis based on one of the following:
  - Serologic testing
  - Isolation of virus from tissue, blood, CSF or other fluid

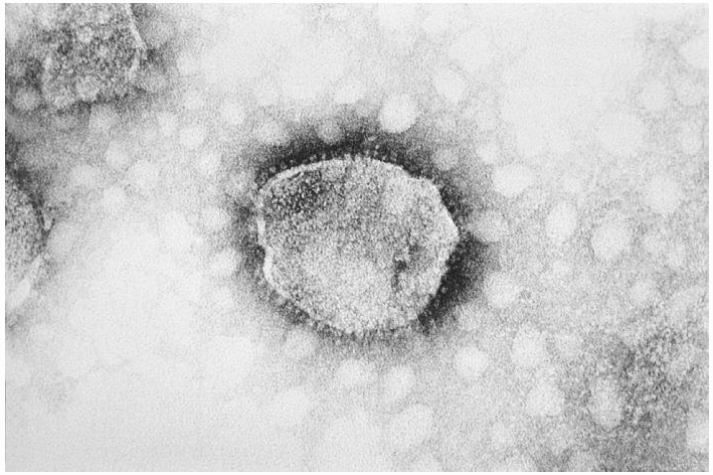
JE management:

- Supportive therapy, no specific antiviral therapy available
- Aggressive management of intracranial pressure, seizures, and fluid balance

JE prevention:

- Vector control (mosquitoes)
- Prevention of mosquito bites
- Separation of animals which carry virus (e.g. pigs) from human habitations
- Human vaccines

Arenaviruses



Infection from inhalation of dried animal secretions or direct contact


Lassa Fever

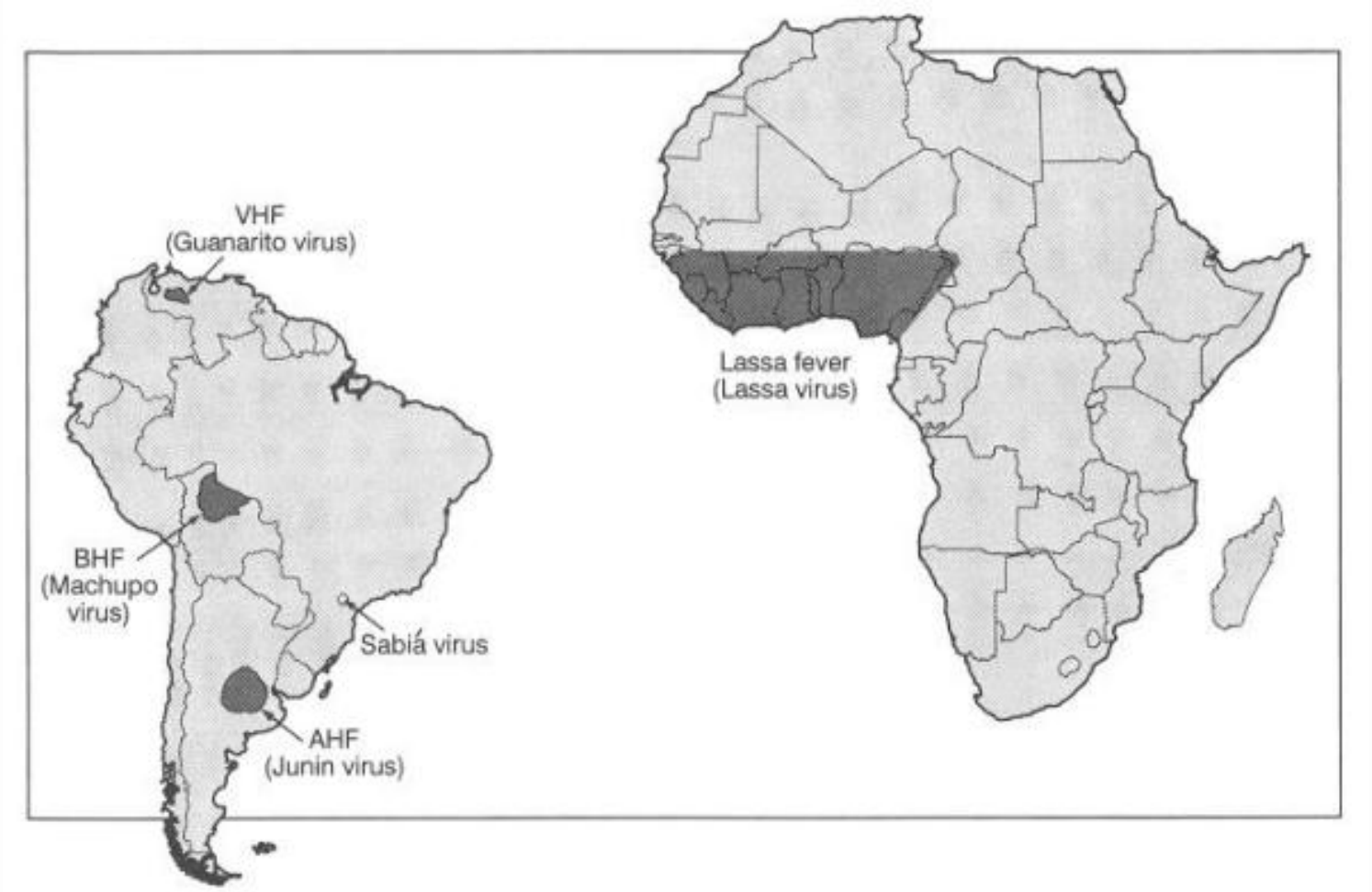
Arenaviruses classification:

Classified into Old World and New World viruses

Arenaviruses classification:

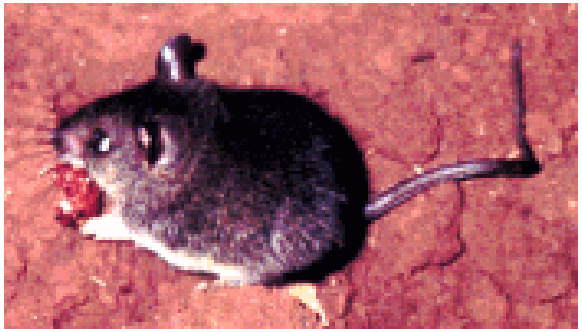
- Old World viruses:
  - Lassa fever virus which causes Lassa fever (Africa)
  - Lymphocytic choriomeningitis virus (LCMV, worldwide)
- New World viruses (North and South America)
  - Junin virus (Argentine hemorrhagic fever)
  - Machupo virus (Bolivian hemorrhagic fever)
  - Sabia (Brazilian hemorrhagic fever)
  - Guanarito (Venezuelan hemorrhagic fever)
  - Whitewater Arroyo (found in North America)

Arenavirus distribution:



Arenaviruses epidemiology:

- Most arenaviruses are found in a limited geographic distribution corresponding to the range of the specific reservoir rodent
- Thought to be transmitted by inhalation of aerosolized animal body fluids (e.g. feces, urine)



The multimammate rat (*Mastomys natalensis*) appears to be the natural reservoir for Lassa virus

Arenaviruses pathogenesis:

- Virus enters through mucous membranes (respiratory, GI or reproductive tracts) or non-intact skin
- Virus reproduces in reticuloendothelial system, then enters blood stream
- Causes endothelial cell damage, leading to capillary leakage and increased vascular permeability
- Exception: Lymphocytic choriomeningitis virus (LCMV) causes acute CNS disease by a cellular immune response

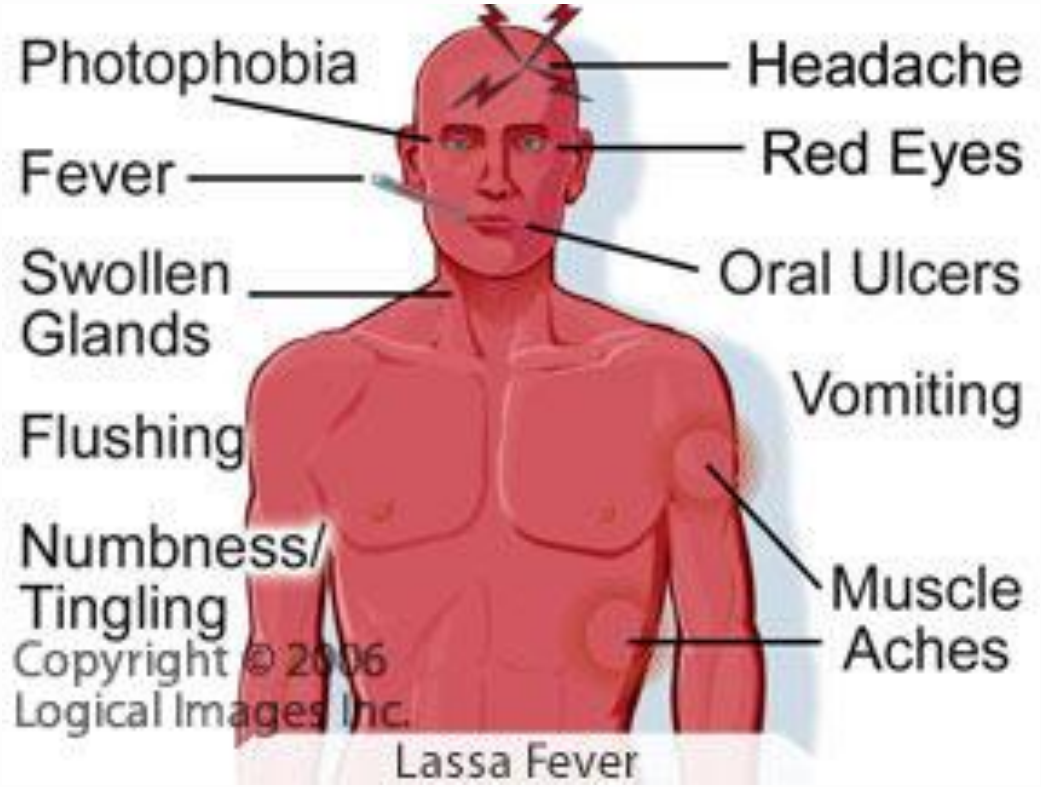
Arenaviruses clinical features:

- Clinical illness ranges from subclinical infection to shock and death
- Clinical illness generally falls into 2 stages:
  - Prodrome with non-specific signs/symptoms
  - Severe illness, can lead to death
    - CNS disease
    - Hemorrhagic fever

Arenaviruses clinical features:

- Prodrome (may be only symptoms that develop):
  - Typically: fever, headache, malaise, myalgias
  - May include GI symptoms, pharyngitis, cough, joint pain

Lassa fever:


Photophobia
Headache
Fever
Red Eyes
Swollen Glands
Oral Ulcers
Vomiting
Flushing
Numbness/ Tingling
Muscle Aches
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Lassa Fever

Arenaviruses clinical features:

- Severe illness:
  - Ex: Lymphocytic choriomeningitis virus:
    - 10-20% of patients develop neurological disease, including meningitis, encephalitis
  - Ex: Lassa virus/South American viruses:
    - Cause hemorrhagic fever
    - <10% of patients have severe illness, but case fatality is high (15-25%)
    - Initially retrosternal chest pain, back pain, GI illness, hepatitis
    - Followed by hypovolemic shock

Arenaviruses clinical features:

- Specific features:
  - Lassa virus:

    - Infection in pregnancy linked to abortion, 30% fatality for women infected in 3rd trimester
    - “swollen baby syndrome” = edema, abdominal distention, bleeding, frequently fatal
    - Hearing loss seen in 20% of patients
  - Argentine hemorrhagic fever:
    - Flushing of head/torso, petechiae, ecchymosis, bleeding, neurologic signs

Arenaviruses clinical features:

- Specific features:
  - Venezuelan hemorrhagic fever:
    - Vomiting, abdominal pain, diarrhea, convulsions, hemorrhagic findings
  - Bolivian hemorrhagic fever
    - Similar to Argentine and Venezuelan hemorrhagic fevers

Arenaviruses diagnosis:

- Nonspecific signs and laboratory abnormalities combined WITH a travel history to endemic area
- Contact with rodents is suggestive of arenaviruses
- Requires specific laboratory testing for confirmation

Arenaviruses management:

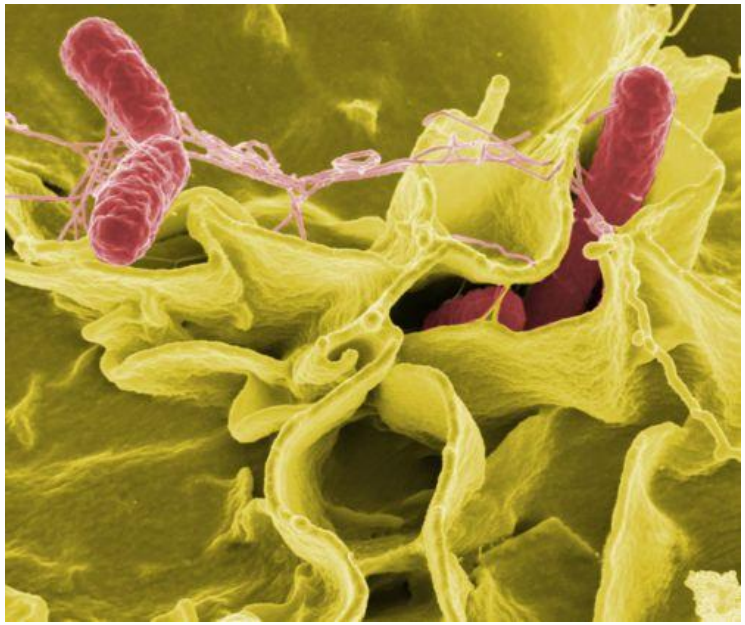
- Treatment is mainly supportive care
  - Managing electrolyte and fluid balance is key
  - Limit invasive procedures to avoid bleeding
  - Isolation precautions to limit spread
- Mortality varies from 15-30%

Arenaviruses prevention:

- Vaccines available for a few viruses
- Rodent control key to prevention of arenaviruses
  - Reduce rodent habitats near human habitation
  - Limit opportunities for rodents to live with humans (reduce available food, trapping, etc.)

Non-typhoidal *Salmonella*

Contact with animal or human feces, contaminated animal derived food products, contaminated water or produce, pets



Salmonella nomenclature:

- *Salmonella* is a gram negative rod
- *Salmonella typhi* and *S. paratyphi* infect only humans and are usually spread by contaminated food or water
  - *S. typhi* is NOT a zoonosis
  - Is the cause of “Typhoid fever”
- Other species of *Salmonella* which infect humans as well as other animals are called “nontyphoidal” *Salmonella*
  - Can be spread by contact with animals or contaminated food or water
- This section will discuss nontyphoidal *Salmonella* only

Salmonella epidemiology:

- Incidence had been rising worldwide, especially in developed countries via poultry production systems
- Rise in antibiotic-resistant *Salmonella* worldwide in the last 5-10 years (ampicillin, ceftriaxone, ciprofloxacin)
- Peak in infection in children <4 years, especially neonates

Salmonella epidemiology:

- Non-typhoidal *Salmonella* can colonize the digestive tracts of many animals (mammals, birds, reptiles, insects) including pets, rodents and farm animals
- >95% of cases of *Salmonella* infections are food-borne, typically from animal products
  - Common sources: chickens, eggs; Less common: ground beef, cheese, ice cream

Salmonella epidemiology:

- 3-5% of cases result from contact with exotic pets (e.g. reptiles, rodents)
  - 90% of reptiles may be asymptomatic carriers
- Non-typhoidal *Salmonella* in human or animal feces can also enter water supplies, contaminating produce (melons, tomatoes, sprouts)

Salmonella pathogenesis:

- Amount of *Salmonella* ingested (dose) directly correlated with duration of incubation and severity of illness
- Once in the small intestine:
  - *Salmonella* multiply within the lumen
  - Penetrate the wall of the intestine
  - Remain in intestinal wall in diarrheal disease, where they release toxins resulting in secretory diarrhea
  - In invasive disease, enters the blood stream (rare)

Salmonella clinical symptoms:

- 3 main syndromes of nontyphoidal *Salmonella*:
  - Asymptomatic
  - Gastroenteritis
  - Bacteremia (which may lead to metastatic disease)

Salmonella diagnosis:

- Stool culture best means of diagnosis in acute gastroenteritis
- Blood culture most helpful in bacteremia
- Focal sites of infection (abscesses, meningitis, etc.) require culture from that site
- Culture important in invasive disease to determine antimicrobial susceptibility

Salmonella treatment:

- Symptomatic treatment for dehydration should be given in ALL patients
- Acute gastroenteritis in healthy child or adult does NOT require antibiotics
  - Why? Antibiotics can prolong carrier state and longer period of asymptomatic shedding (inhibit growth of normal flora)

Salmonella treatment:

- Patients with risk of invasive disease (neonates and infants <1year, elderly, immunocompromised) should be treated with antibiotics, guided by susceptibility testing
  - Empiric treatment generally 3rd generation cephalosporin or fluorquinolone but resistance is increasing
- Patients with invasive disease should be treated with antibiotics and drainage/surgery if needed

Salmonella outcome:

- Complete recovery typical in healthy children with *Salmonella* gastroenteritis.
- Bacteremia with systemic involvement or metastatic foci may have a prolonged course
- Prognosis generally poor for children with *Salmonella* meningitis or endocarditis but is rare in non-typhoidal *Salmonella*

Salmonella outcome:

- Asymptomatic fecal excretion may occur for several months after clinical resolution of gastroenteritis, especially in young children or those treated with antibiotics
  - May allow transmission to others
- Rarely, a chronic carrier state may develop
  - Defined as asymptomatic excretion of *Salmonella* for >1 yr

Salmonella prevention:

- Related to hygiene:
  - Hand washing to prevent fecal-oral contamination
  - Proper hand washing and cleaning of utensils when handling foods (especially chicken and eggs)
  - Exclusion of infected persons from food preparation or child care

Salmonella prevention continued:

- Related to food items:
  - Fully cook potentially contaminated food items such as chicken and eggs
  - Clean machinery and equipment used to prepare foods

Salmonella prevention continued:

- Related to exotic pets:
  - Reptiles should not be in homes with:
    - Children < 5 years
    - Elderly
    - Immunocompromised people
    - Pregnant women
  - Reptiles should not be kept in child care centers or allowed access to sites of food preparation
  - Hands and other items should be washed well after contact with reptiles

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Further reading

- WHO website: http://www.who.int
- US Centers for Disease Control and Prevention: http://www.cdc.gov
- American Academy of Pediatrics Red Book – Report of the Committee on Infectious Diseases: http://aapredbook.aappublications.org/

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