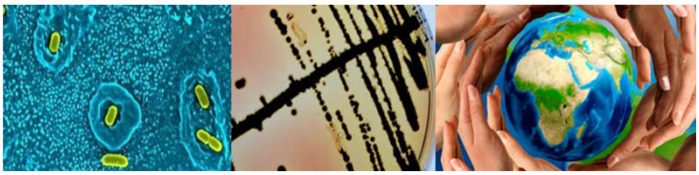

Public Health Necessity for Food Regulations I/II

Epidemiology of Transboundary Diseases of Importance in the United States

AGSC 5540: Food Policies and Regulations

8-19-2021

Tennessee State University, Nashville, TN

Aliyar Cyrus Fouladkhah, PhD, MPH, CPH

Faculty Director, Public Health Microbiology Laboratory

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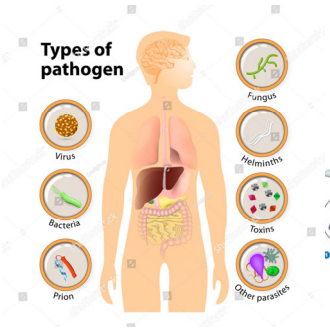
Week One: Content

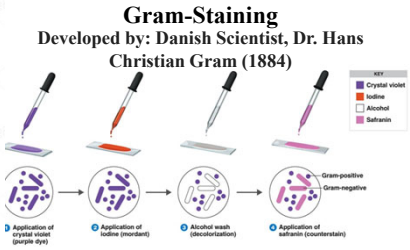
- Anthrax; Pseudorabies; Bluetongue; Bovine Spongiform Encephalopathy; Brucellosis
- ***Exercise 1***
- Classical Swine Fever; Contagious Bovine Pleuropneumonia (CBPP); Equine Encephalitis; Hendra Virus; Japanese Encephalitis
- ***Exercise 2***
- Lumpy Skin Disease; Q fever; Rinderpest; Sheep and Goat Pox
- ***Exercise 3***
- Review of common epidemiological terminology
- ***Exercise 4***

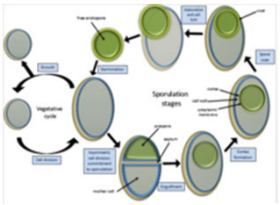
2

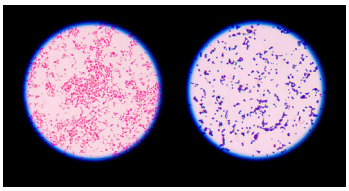
Anthrax

- Causative agent: *Bacillus anthracis*
- A **Gram-positive** and **spore-forming** bacteria
- Can be found as a spore in the **soil worldwide**
- Spores **viable** for **decades in soil**
- **In the US**: Dakotas, northwest Minnesota, Texas, and Nevada
- Common in parts of Africa, Asia, and Middle East
- In Human:
  - Skin
  - Intestine
  - Inhalation
- Animal disease
  - Septicemia and rapid death









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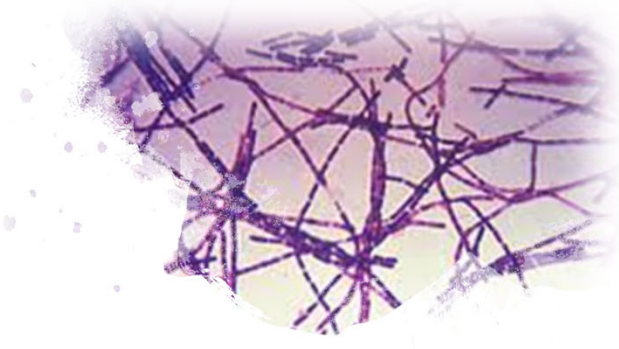
Anthrax

- Spores highly infective
- Remain effective during aerosolization
- Low lethal dose
- High mortality
- Person-to-person transmission rare
- **Symptoms** begin between **one day** and **two months** after the infection



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Anthrax- Control and Treatment

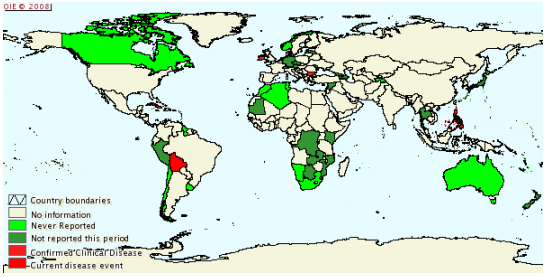
- **Four types in human:** Cutaneous (skin); Inhalation; Gastrointestinal; Injection anthrax
- Vaccine for livestock annually to prevent
- Personal Protective Equipment
  - When handling sick animals
- Disinfection:
  - **Sporicidal agents:** 5% formaldehyde, 2% glutaraldehyde, 10% sodium hydroxide
  - **Sterilization:** chlorine dioxide, formaldehyde gas, heating to 121ºC for at least 30 minutes
- **Antibiotics:** effective for humans when **prescribed early**
- **Zoonotic Disease**

5

Pseudorabies

-Different than rabies that is an important zoonotic diseases.
-Rabies death in the U.S. now < 5 per year
-About 59,000 annually worldwide (>98% from stray dogs)

Source: CDC, 2021



- **Contagious** viral diseases from **herpes family**
- Primary concern in domesticated **pigs and feral swine (around 75 million hogs in the United States in 2021)**
- Primarily spread through direct **animal-to-animal** (nose-to-nose)
- **Other mammals**
  - Reproductive
  - Nervous system
- **Humans are not affected**
- Could be a **ubiquitous virus** in some area
- **Eradicated in many countries**
  - Still occurs in parts of world
- Current **USDA Surveillance** to detect any potential case

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Pseudorabies

- **Transmission:**
  - Direct contact,
  - Reproductive,
  - Aerosol,
  - Ingestion
- **Incubation period: 2-6 days**
- Common symptoms:
  - Neurological
  - Respiratory issues
  - Itching intensively
  - **Stillbirths and abortion**
- **Morbidity and mortality up to 100%**
- **Neonates are particularly susceptible** to the virus

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Pseudorabies

- Considered a **reportable disease**
- Could lead to **economic** and **trade restrictions**
- **Treatment** usually **not recommended**
- Current **control practices**:
  - **Depopulation** of the diseased
  - **Test and removal** of carries
  - **Offspring segregation**
- **Vaccine available** in some countries for affected animals

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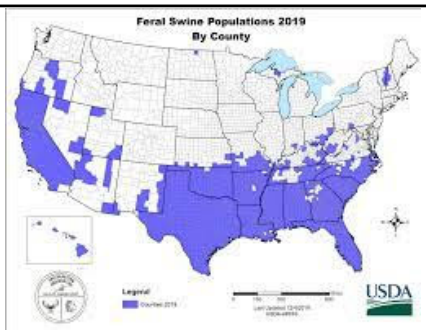
Prevention of Pseudorabies

- **Isolation:** new or returning animals before entry into the herd
- **Disinfect** vehicles, equipment, premises, footwear
- Separation of pigs and feral swine
- USDA extensive **surveillance program**
  - All 50 states are current free since **April 2008 (commercially)**
  - Feral swine remain as a reservoir of the pathogen



Source: USDA APHIS accessed 2021

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Bluetongue

- A viral disease
- A **vector-borne disease** by *Culicoides* (biting midge)
- Common in **Ruminants** (primarily sheep)
- Currently **24 serotypes worldwide**
- **Six serotypes** isolated in North America
- Distributed world-wide
- Most significant outbreak:
  - **Mediterranean 1997-2002**

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Bluetongue

- Incubation period is 5-10 days
- Symptoms in Sheep
  - Swelling of face
  - Extensive nasal discharge
  - Blue (Cyanotic) tongue
  - Reproductive symptoms
- Cattle, goats
  - Mostly subclinical symptoms;
- Wildlife
  - Hemorrhages (Bleeding internally)
  - Sudden death

Sources, CDC Public Health Image Library, with modification accessed 2021

Bluetongue is not a significant threat to human health, in rare cases could cause skin complication

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Bluetongue- management

- Cost cattle industry **$125B per year**:
  - Lost in trade
  - Animal testing
- **No treatment in Animal Industry: Supportive care** is only existing treatment
- **Prevention**:
  - Vector control (Climate change?)
  - Vaccination
- Vaccination challenge:
  - Serotype specific (Climate change?)
  - Adverse effects
- In Humans: low risk of infection, self limiting (Immunocompromised?)

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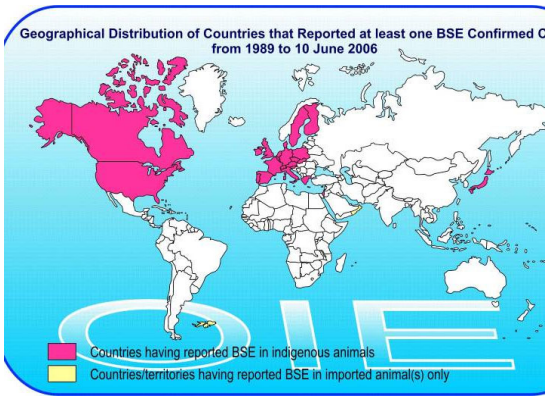
BSE- Bovine Spongiform Encephalopathy

Commonly known as Mad Cow Disease

- Caused by **prions** (infectious protein particles)
- **Cattle and humans** are susceptible
- A neurological disease that could be fatal
- **Transmitted** by:
  - Consumption of **scrapie-infected feed**
  - **Spontaneous mutation**
- Distribution is worldwide



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Symptoms of BSE

- In Cattle
  - Incubation period is 2-8 **<u>years</u>**
  - Initial signs are mild and subtle
  - At final stages
    - tremors
    - loss of balance
    - death
- In Humans
  - **Unknown incubation period** (many years to many decades)
  - Neurological signs
  - Depression and schizophrenia-like symptoms
  - Could lead to death

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BSE Management

- **Very resistant infectious agent (sanitization very difficult)**
- **Currently no effective treatment or vaccine**
- Prevention:
  - **Surveillance program** and **testing**
  - **Restriction in trade**
  - **Animal feed regulation** (bone meals and mammalian products)
- Outbreak in 2001-2002 in United Kingdom: Cost the industry 3.7 billion Euro

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Brucellosis

- Caused by bacteria (several species)

(Genus *Brucella* e.g. *B. melitensis, B. abortus, B. suis, and B. canis)*

  - **Highly infectious (N95 or KN95 mask during farm visits?)**
  - Easily **aerosolized**
- **Transmission**:
  - Ingestion
  - Inhalation
  - Direct contact
- **Signs in animal**:
  - Reproductive complications
- **Signs in humans**:
  - Cyclic fever and
  - Flu-like symptoms

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Brucellosis- Treatment & Prevention

- Treatment: long-term antibiotics (Problem: Diversity of causative agents)
- Prevention:
  - **Vaccination** of calves
  - **Minimizing exposure to wildlife**
  - **Segregation of infected animals**
  - **Disinfection of environment**
- **No vaccine available for human**

Main infection source for human:

- Contaminated milk, cheese, and ice-creams
- Handling farm animals (glove, goggle, secondary outfit +mask?)
- Hunting Activities

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Exercise 1

- What are the common sporicidal agents and sterilization methods for control of Anthrax?
- What is the incubation period of Pseudorabies and common symptoms in Animals?
- What is the incubation period for Bluetongue diseases and main symptoms in sheep?
- What are the BSE symptoms in Cattle and Human?
- What are some of the Brucellosis signs in human and strategies to prevent the disease in animal population?
- What is the causative agent for each disease? (Bacterial, Viral, or prions)

Anthrax; Pseudorabies; Bluetongue; Bovine Spongiform Encephalopathy; Brucellosis

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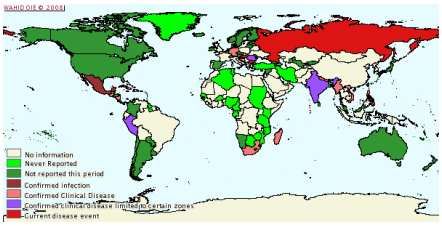
Classical Swine Fever

- **Viral Disease** and very contagious and economically significant
- Disturbed worldwide
- **Spread through**:
  - Ingestion of virus
  - Direct contact
  - Aerosol
  - Insects (vector-bone disease)
- Feeding swine **untreated food wastes** containing infected pork scraps can cause infection
- (**By Product, Animal Food Regulation, FSMA**)

Source, USDA APHIS, accessed 2021



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Classical Swine Fever

- Incubation period is 2-14 days
- **Clinical signs variable** depending on:
  - **Strain of virus**
  - **Susceptibility and genetic makeup of the pig**
- Signs very similar to many swine diseases
- Signs could be acute to asymptomatic
- Main symptoms:
  - fever
  - weakness
  - anorexia
  - **purplish discoloration** of skin of ears, inner thighs
  - Could cause death

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Classical Swine Fever

- **Not a zoonotic diseases**
- Could cause **100% mortality** in **swine herds**
- Could cause **import/export restrictions** and economical losses
- Controlled by:
  - **Quarantine**
  - **Slaughter**
  - **Vaccine in endemic area**

Was **eradicated** from the U.S. in 1978

Producers obligated to **report sporadic cases** to USDA APHIS point of contact

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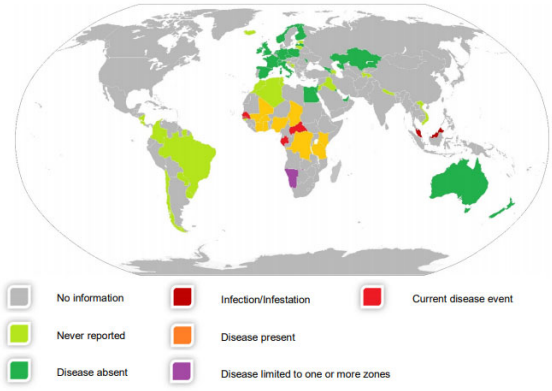
Contagious Bovine Pleuropneumonia (CBPP)

- **Bacterial** diseases
- Mainly a concern in **Cattle** (**93 million** head inventory in the U.S. with about **31 million as beef cattle**, as of 2021)
- Also, a concern in **Buffalo, bison, yak, water buffalo**
- Transmission by:
  - Aerosol in **close contact**
  - **Transplacental**
  - Direct contact
    - **Saliva**
    - **Urine**
    - **Fetal fluids**
- **Eradication** had been successful in **UK and Australia**



Sources, USDA APHIS accessed in 2021

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CBPP

- Incubation period is 20-123 days
- Respiratory signs
  - Cough
  - Broad stance
- **Morbidity** could be as high 100% in a herd with close contact
- **Mortality** could range from 10 to 70%
- **Vaccine available** in endemic counties
- Human are immune, **not a zoonotic disease**

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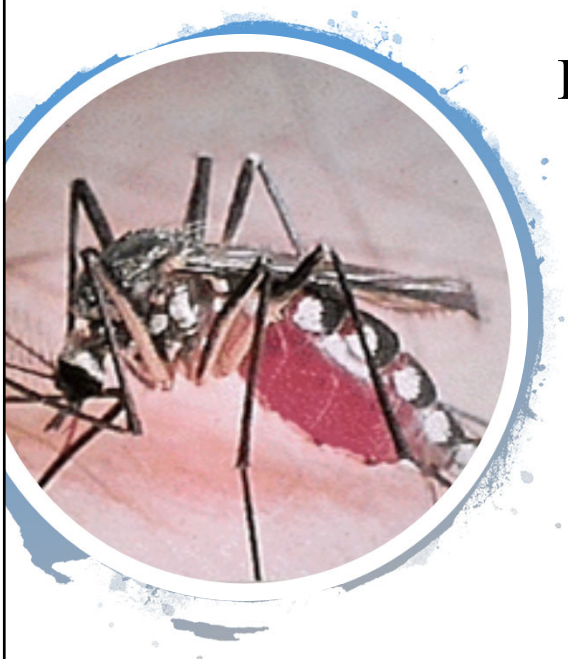

Equine Encephalitis Viruses

- Three viruses:
  - Eastern (EEE)
  - Western (WEE)
  - Venezuelan (VEE)
- Transmitted by mosquitoes (**vector-borne disease**)
- **Birds** could be **asymptomatic carrier**
- **Clinical signs** in human and Equids (Horses, mules, donkeys)
  - No to mild signs to
  - Flu-like illness
  - Encephalitis in small proportions
  - **Can also infect a wide range of animals including:** mammals, birds, reptiles, and amphibians

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Equine Encephalitis Viruses

- The viruses are **very unstable** in environment
- **Supportive care** is the only current treatment
- **Vaccine are available** for Equine
- **Vaccine for human very expensive** primarily for:
  - Researchers
  - Public health workers with enhanced exposure
  - **Travel Clinics for International Travel**

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Hendra Virus

- Viral disease **consider as emerging** (**first observed in Australia**)
- Natural infections had been **reported only** in:
  - Horses
  - Humans (first reported in 1994, very rare and under-reported)
- Current transmission by:
  - Fruit bats
  - **Bodily fluids** and **urine** of those infected
- Clinical signs in horses
  - Sudden respiratory signs
  - Nasal discharge
  - Fever
  - Encephalitis
  - Sudden death
- Clinical signs in Humans
  - Flu-like illness
  - respiratory complications
  - **Highly fatal in human, could be as high as 2 in 3 cases**

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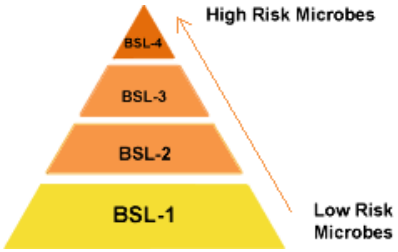
Hendra Virus

- Little is known about pathogen
- **People at risk:**
  - Those occupational or recreational **exposure to horses**
  - Those **living close to "Flying fox" bats** (genus *Pteropus*)
  - **Researchers**
- Highest level of security (**CDC biosafety level 4**) needed for studying the pathogen (around 4 labs in the US and <50 in the words, as of 2021 [US has about 1,500 BSL3)
- Could cause high mortality in humans
- Currently no treatment option is available

(Great topic for term paper)



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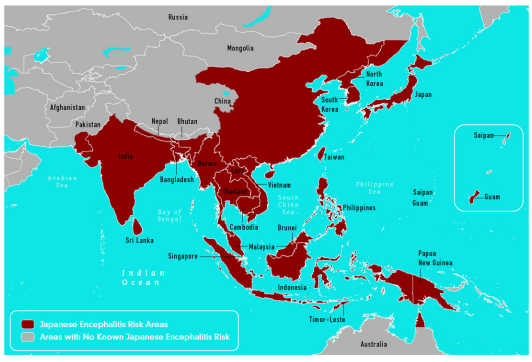
Japanese Encephalitis (JE)



Source, CDC Accessed in 2021

- Viral infection
- Vector-borne diseases
- **Species of concern**:
  - Humans
  - Pigs
  - Other domesticated animals
- **Endemic** in many Asian countries
- **Supportive care** is currently the only treatment option
- **Vaccines available and effective** for **Prevention**: human, horses, and swine

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Japanese Encephalitis (JE)

- Incubation period is typically 6-10 days
- Clinical signs in Horses
  - Fever and
  - Neurologic complications
- Swine
  - Stillbirths
- Humans
  - Fever, weakness, and movement disorders
  - Headache, neurologic symptoms, and mental status changes
  - Could be fatal
  - Seizures common, especially among children
- Illness only 1% of people infected
- Typical incubation period in humans is typically 5-15 days
- Most cases, travelers to Eastern Hemisphere

Sources, CDC, accessed 2021

Sources, CDC, accessed 2021

Sources, CDC, accessed 2021

Just like many infections disease: No treatment available but prevention by vaccines

(Measles, polio etc., no to **antivacers**) (Great topic for term paper)

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Exercise 2

- What is the incubation period of Classical Swine Fever and what are the diseases symptoms?
- What CBPP stands for and what are the transmission routes of the dieses?
- What are the three Equine Encephalitis Viruses and what are the signs in human and equine?
- Among the pathogens we studies today, which one is considered an emerging pathogen than require highest level of biosecurity for researcher intent to study the pathogen?
- What is the incubation period of Japanese Encephalitis and what are the main symptoms in human, horses, and swine?
- What is the causative agent for each disease? (Bacterial, Viral, or prions)

Classical Swine Fever; Contagious Bovine Pleuropneumonia (CBPP); Equine Encephalitis; Hendra Virus; Japanese Encephalitis

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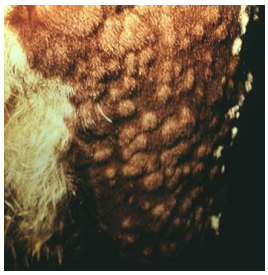
Lumpy Skin Disease

- Viral infection in cattle
- Transmitted by **mosquitoes and biting flies**
- Endemic in sub-Saharan Africa
- **Hyperendemic in rainy season** (Why?)
- Causes severe **economic losses**
- Could lead to **secondary infections**



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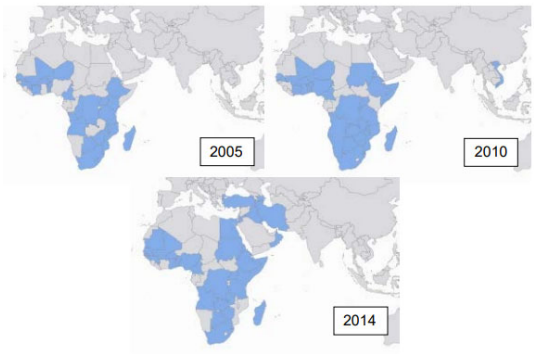
Lumpy Skin Disease

- Incubation period is typically 2-5 weeks
- Common symptoms:
  - Fever
  - Abortions
  - Decreased milk production
  - Nodules typically appear 10 days later
- Mortality rates could range as low **as 2 to 85% of herd**
- Vaccination with **attenuated virus** available for livestock (needs refrigeration)



Sources, USDA APHIS, Accessed 2021

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Q Fever

- Bacterial diseases caused by ***Coxiella burnetii*** **(pasteurization indicator)**
- First described in 1937, is a worldwide zoonotic disease
- Was designated as **nationally notifiable disease** in the United States in 1999
- Transmission by:
  - Aerosol
  - Direct contact
  - Ingestion
  - Ticks
  - **Raw milk** (Cow-share program?)
- Clinical signs in sheep, cattle and goats
  - Can be **asymptomatic**
  - **abortions possible**
- Clinical sign in humans
  - **Flu-like pneumonia**

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Q Fever

- Highly infectious bacteria
- Aerosols could **travel ½ mile by wind**
- Often **self-limiting disease** in human and animals
- **Antibiotic** required in case of complications (human and animals)
- **Vaccines for human** in some countries
- Prevention in human:
  - **Consumption of pasteurized milk**
  - **Limited exposure to diseased animals**

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Rinderpest (known as cattle plague)

- A contagious viral disease
- Primarily in cattle and domestic buffalo
- **Transmission** by
  - Direct or close contact with virus
  - Ingestion of contaminated food
  - Contaminated equipment
- **Was** common in East Africa and less common in Asia
- **Vaccine** offers **life-long immunity** for various species
- Not a zoonotic diseases

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Rinderpest

- Incubation period is typically 3-15 days
- Diseases had 4 forms:
  - **(1)** **Classical**: Common signs are fever, diarrhea, nasal discharge
  - **(2)** **Peracute**: Mostly occurs in young animals and is rapidly fatal
  - **(3)** **Subacute**: Mild signs with low mortality
  - **(4)** **Atypical**: Irregular fever mild diarrhea

- Major problem in 18th, 19th, and early 20th century
- Successful **global irradiation campaign**, last positive case in 2010
- In USDA Removed **Rinderpest Restrictions** after Worldwide Eradication (could re-emerge)
- Is now a **reportable disease.**
- Rinderpest only the **second disease in history** to be fully eradicated (outside research laboratories), following smallpox.

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Sheep and Goat Pox

- Viral Disease
- The **dominant Pox disease of domestic animals**
- Infection could **limit trade** of livestock and product
- **Common** in: Africa, Asia, and India
- Could lead to **secondary infections**
- Not a **human pathogen**
- **Vaccines for animals** available in endemic area
- **Susceptible to sunlight.**
- **Survives freeze–thaw cycles (infectivity may be reduced)**
- Could Remain viable in for **up to three months** in animal **by-products** (wool/hair and dry scabs on skin)

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Sheep and Goat Pox

- Incubation period is 4-13 days
- Common clinical symptoms:
  - Fever
  - Difficulty breathing
  - Skin lesions that may take up to 6 weeks to heal
- Mortality could be 50% in susceptible herds
- Mortality, typically around 10%, could 100% in the young

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Exercise 3

- What is the incubation period of Lumpy Skin Disease and what are the diseases symptoms?
- What microorganism is causing Q Fever in human and animals?
- What is the incubation period of Rinderpest and what are the four forms of the disease?
- What are the common clinical symptoms of Sheep and Goat Pox?
- What is the causative agent for each disease? (Bacterial, Viral, or prions)

Lumpy Skin Disease; Q fever; Rinderpest; Sheep and Goat Pox

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Occurrence Level of Disease

- **Sporadic** refers to a disease that occurs infrequently and irregularly.
- **Endemic** refers to the constant presence and/or usual prevalence of a disease or infectious agent in an animal or human population within a geographic area.
- **Hyperendemic** refers to persistent, high levels of disease occurrence.
- **Epidemic** refers to an increase, often sudden, in the number of cases of a disease above what is normally expected in that population in that area.
- **Outbreak** carries the same definition of epidemic, but is often used for a more limited geographic area.
- **Pandemic** refers to an epidemic that has spread over several countries or continents, usually affecting a large number of people.

- Source: CDC with modification

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Exercise 4

For each of the following situations, identify whether it reflects:

A. Sporadic disease

B. Endemic disease

C. Hyperendemic disease

D. Pandemic disease

E. Epidemic disease

1. ____ 22 cases of Salmonellosis occurred within 3 weeks among residents of a particular neighborhood (usually 0 or 1 per year)
2. ____ Average annual incidence was 364 cases of pulmonary tuberculosis per 100,000 population in one area, compared with national average of 134 cases per 100,000 population
3. ____ Over 20 million people worldwide died from influenza in 1918–1919
4. ____ Single case of Aspergillosis was diagnosed in a community
5. ____ About 60 cases of listeriosis are usually reported in this region per week, slightly less than the national average

Source: CDC, with modification

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Additional Resources and References:

Centers for Disease Control and Prevention:

https://www.cdc.gov/csels/dsepd/ss1978/index.html

Photo courtesy and source:

http://www.cfsph.iastate.edu/Animal_Response/English/pdf/S8_SPN_ADE_Pathogens_Shortversion.pdf

Food and Agriculture Organization of the United Nation:

http://www.fao.org/emergencies/emergency-types/transboundary-animal-diseases/en/

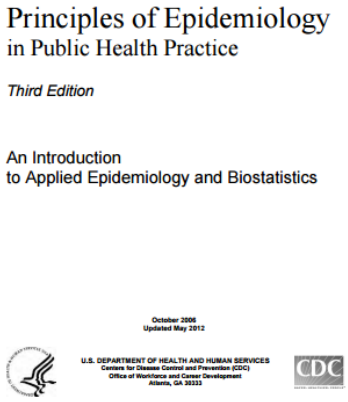

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Photo courtesy: Adobe Stock, royalty (standard license) purchased by public health microbiology laboratory

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