



# Infectious Diseases of the Blood and Lymphatics





# Infectious Diseases of Ruminants and Horses Causing Erythrocyte Destruction





# Anaplasmosis

- **Etiology**

- *Anaplasma marginale* in cattle and *Anaplasma ovis* in sheep and goats

- **Clinical signs**

- Age dependent
  - Mild in young animals in the first 6 to 9 months of life
  - Early clinical signs in adults are short lived fever, decreased feed intake, pale mucous membranes
  - As signs progress neurologic signs like staggering or behavioral changes may occur because of anemia and cerebral hypoxia, yellow mucous membranes, constipation, dark yellow urine, abortion in pregnant animals

- **Differential diagnosis are diseases that cause anemia or yellow mucous membranes**

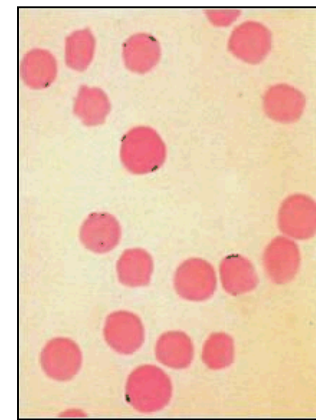
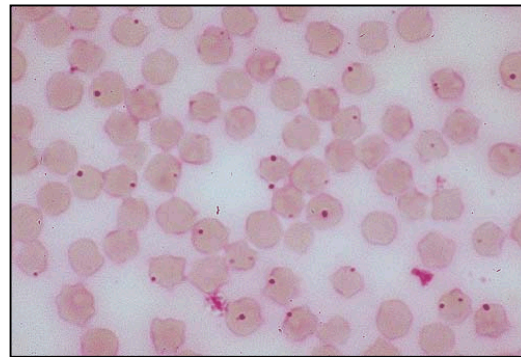
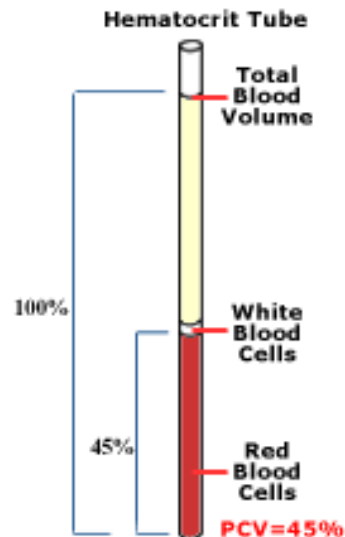
- Infectious causes include babesiosis, bacillary hemoglobinemia, and leptospirosis
- Non infectious causes include liver disease, plant toxins, and copper poisoning in sheep



# Anaplasmosis

- **Clinical Pathology and Diagnosis**

- Rapid fall in pack cell volume (red blood cell numbers) can result in death
- When the pack cell volume drops slowly the animal adapts and can withstand lower pack cell volumes
- During the acute phase *Anaplasma marginale* can be detected in the red blood cells by microscopic examination of blood smears stained with Wright's stain, new methylene blue, or Giesma stains





# Anaplasmosis

- **Pathophysiology**
  - Anaplasma species are transmitted by Ixodidae ticks
  - After transmission the bacteria invade the red blood cells
  - Clinical signs appear when greater than 1 percent of red blood cells are infected
  - The immune system and spleen eliminate the damage red blood cells resulting in hemolysis and anemia

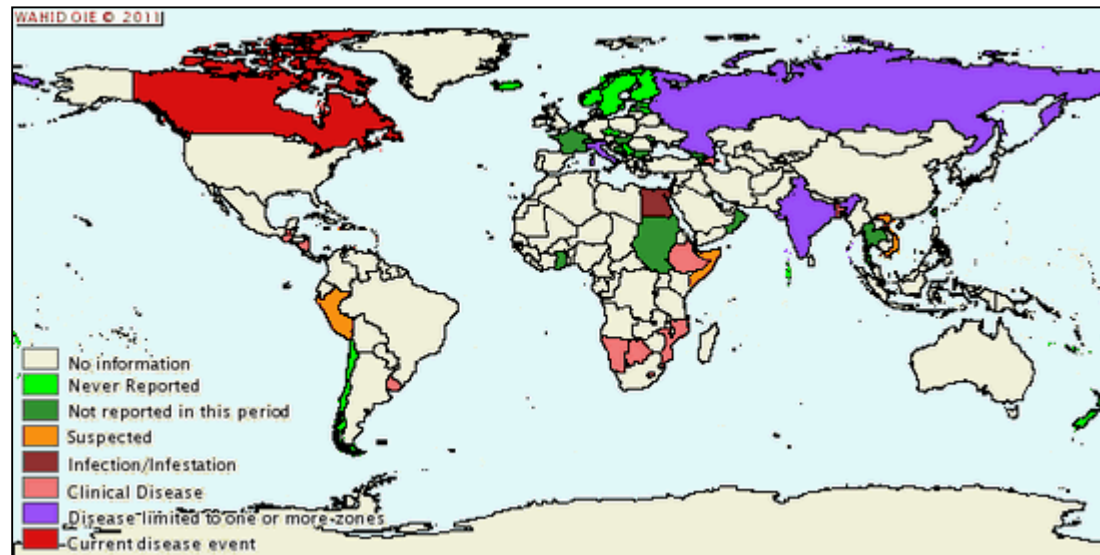




# Anaplasmosis

- **Epidemiology**

- Anaplasmosis is found worldwide
- Animals that recover from the initial infection become carriers and serve as reservoirs for infection
- Infection usually occurs in spring and summer when the vector is abundant
- Can be transmitted by veterinarians using contaminated medical products





# Anaplasmosis

## • Treatment

- Tetracyclines are the treatment of choice for treating the acute disease
  - **Oxytetracycline at 11 mg/kg intravenously every 24 hours for three to five days**
  - **Long acting oxytetracycline can be given at 20 mg/kg intramuscularly every 72 hours for one or two doses**
- Blood transfusions can be used to stabilize animals with severe anemia
- Treatment will not usually clear the infection but rather create persistent carriers
  - **Some studies indicate that long acting oxytetracycline treatments may clear the infection if given once every three days for four treatments**





# Anaplasmosis

- **Prevention**

- In places where the disease is severe, young animals are allowed to become infected early to prevent the acute disease
- An attenuated live vaccine is available for use in young animals only
- A killed vaccine is available for use in older animals but repeated boosters are necessary to maintain immunity
- Vector control will also help minimize the disease
  - **Placement of insecticides in pastures, spraying animals with insecticides**





# Babesiosis

- **Etiology**

- Babesiosis is a tick-borne disease of domestic and wild mammals and humans
- Caused by protozoa *Babesia sp.*
- The specific species of *Babesia* is dependent on geographical location and species
- The protozoan is spread by *Boophilus* ticks

- **Clinical signs in ruminants**

- Clinical signs become apparent approximately two to three weeks after tick infestation
- Fever, depression, icterus (yellow mucous membranes), reluctance to eat, high heart and respiratory rates, anemia, hemoglobin in the urine, abortion, central nervous system signs, and death
- Anemia is intravascular destruction of red blood cells, and bilirubin is released causing icterus or yellow tinged mucous membranes

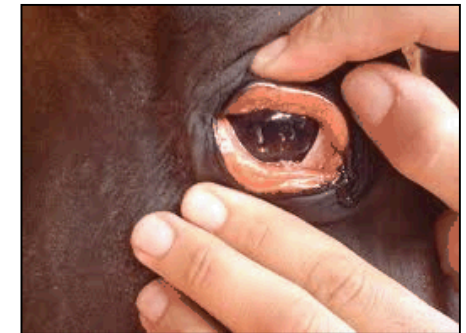




# Babesiosis in Horses: Equine Piroplasmosis

- **Clinical signs in horses**

- The course of disease is similar to ruminants
- Clinical signs in horses include:
  - **Fever**
  - **Hemolytic anemia**
  - **Jaundice**
  - **Hemoglobinuria**
  - **Depression**
  - **Incoordination**
  - **Reluctance to eat**
  - **Nasal discharge**
  - **Eyelid swelling**



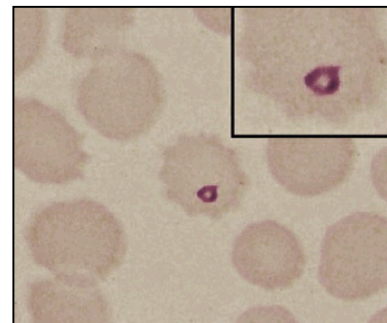
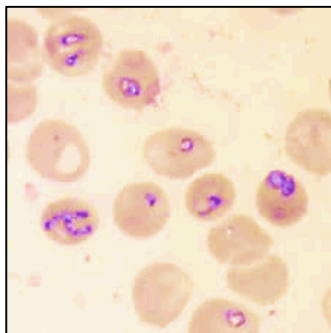
- **Differential Diagnosis in horses**

- Equine Erlichiosis, equine infectious anemia, liver failure with hemolytic anemia, other hemolytic anemias of horses (immune mediated)



# Babesiosis

- **Differential diagnosis**
  - Anaplasmosis, trypanosomiasis, theileriosis, leptospirosis, chronic copper toxicity, and bacillary hemoglobinuria
- **Diagnosis**
  - Diagnosis can be made based on clinical signs
  - Definitive diagnosis requires visualization of the organism on a Giemsa-stained blood smear
  - Organisms are easy to see in the acute phases of the disease but become less obvious as the disease progresses to chronic
  - Testing for antibodies can be done using complement fixation or indirect fluorescent antibody tests, if the chronic phase of the disease is suspected



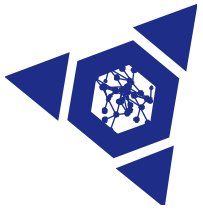


# Babesiosis

## • Treatment

- Important to differentiate babesiosis and anaplasmosis to apply the appropriate treatment because babesiosis is caused by a parasite and anaplasmosis is caused by a bacteria
- Horses and cattle are treated with the same agents
- Acute cases where the pack cell volume has not dropped below 12 percent respond well to treatment
- Therapies include:
  - Imidocarb dipropionate at 1 to 3 mk/kg
  - Diminazine aceturate at 3 to 5 mg/kg
  - Phenaminidine diisethionate at 8 to 13 mg/kg
  - Amicarbalide diisethionate at 5 to 10 mg/kg
- Prevention is based on elimination of the Boophilus tick or prevention of tick infestation
  - Application of acaricide externally or to the pasture has been shown to be effective





# Equine Infectious Anemia

- **Etiology**

- Caused by the equine infectious disease virus, which is a retrovirus
- Retroviruses integrate into the host genes and as a result the host is infected for life

- **Clinical signs**

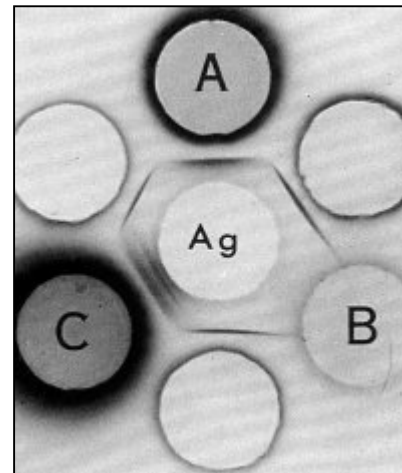
- Three stages of disease
- **Acute stage** – characterized by viremia, high fever, low platelet count, lethargy, depression, reluctance to eat and drink, and hemorrhages may be apparent on the mucous membranes
- **Chronic stage** – recurrent episodes of viremia, severity of signs diminish over time, episodes may be triggered by stress of transport, weather, poor nutrition
- **Inapparent stage** – virus is contained by the immune system and animals no longer experience episodes of viremia





# Equine Infectious Anemia

- **Differential diagnosis**
  - Symptoms are nonspecific and may mimic many infectious disease and septicemia
- **Diagnosis**
  - Detection of serum antibodies using agar immunodiffusion or ELISA assays is diagnostic
    - A sample of serum is required to run the assays – collection of blood in a tube that does not contain anticoagulant
  - Necropsy findings include enlarged organs (lymph nodes, spleen, liver), hemorrhages on the surface of organs and body wall





# Equine Infectious Anemia

- Epidemiology**

- The virus is spread through direct inoculation of infected blood through contaminated needles, blood products, or insect vectors
- The virus is found world wide and has been detected in India

- Treatment**

- There is no treatment
- In countries where the disease has been eradicated, infected animals are euthanized to prevent spread
- The United States Department of Agriculture conducts serosurveillance to prevent outbreaks

AI-819A (Rev. 4/99)

SAMPLE ONLY

State of New York  
Department of Agriculture and Markets  
1 Winners Circle  
Albany, New York 12235

Accession No./Date \_\_\_\_\_  
Owner (print or type) Please Print Clearly \_\_\_\_\_

Last										
First										

INDIVIDUAL

Address \_\_\_\_\_ Phone \_\_\_\_\_

EQUINE INFECTIOUS ANEMIA TEST RECORD

Print name and address legibly for window envelope use

City \_\_\_\_\_ State \_\_\_\_\_ Zip Code \_\_\_\_\_

Horse(s) stabled at \_\_\_\_\_

Dr. \_\_\_\_\_ Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_ No. of horses on premises \_\_\_\_\_

Date \_\_\_\_\_ Signature \_\_\_\_\_ NYS Vet ID. NO. \_\_\_\_\_ County \_\_\_\_\_ Town \_\_\_\_\_

*Authorized Veterinary Use ONLY*

Falsification of this form or knowingly using a falsified form is a criminal offense and may result in a fine of not more than \$10,000 or imprisonment for not more than 5 years or both (U.S.C. Section 1001).

OFFICIAL TAG NO.	TATTOO NUMBER	NAME	REG. NO. C&C/CR	BREED	SEX*	AGE

Left Side Right Side

1 2 3 4 5

A B C D C D A B

Remarks: \_\_\_\_\_


1. Coronet  
2. Pastern  
3. Fetlock  
4. Knee  
\* M - Mare  
S - Stallion  
G - Gelding

LAB USE ONLY

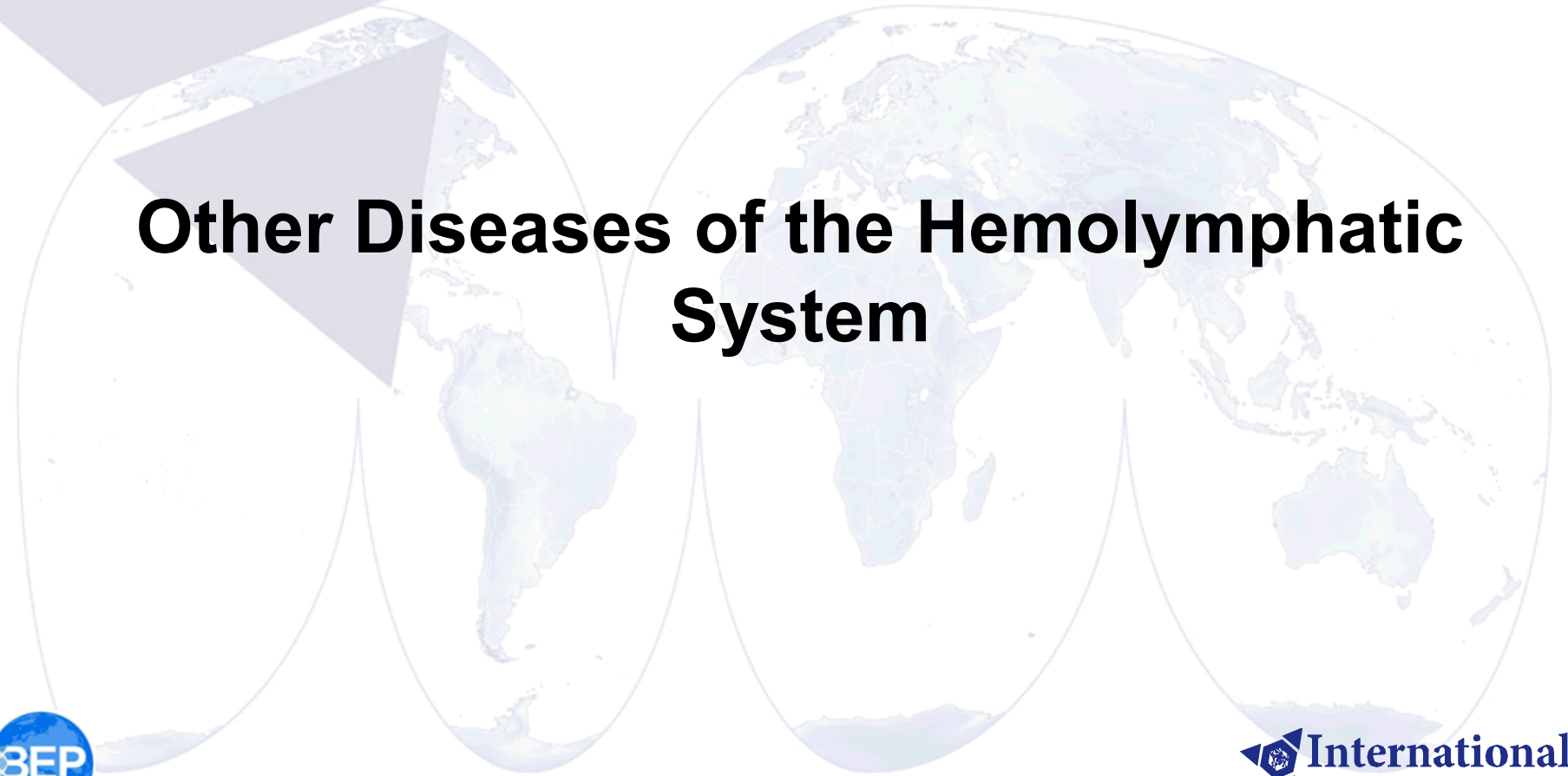
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# Other Diseases of the Hemolymphatic System



# Anthrax

- **Etiology**

- Anthrax is a soil born bacterial disease that primarily affects herbivores and humans
- *Bacillus anthracis* is the causative agent – it is a spore forming gram positive rod

- **Pathogenesis**

- Animals are exposed by grazing contaminated pastures and ingesting spores
- Ingested spores cross mucosal barriers, are phagocytosed by macrophages, and are transported to regional lymph nodes
- Spores have the ability to evade the immune system through the expression of virulence factors
  - **Virulence factors are protective antigen, lethal factor, and edema factor – the complex helps the organism evade the host response, and produce toxins that are lethal to the host**

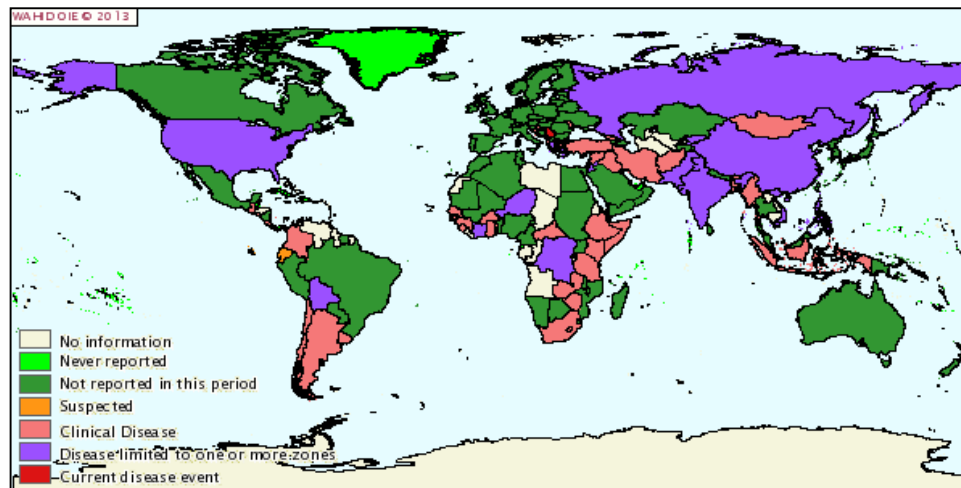




# Anthrax

- **Epidemiology**

- Disease occurs worldwide and outbreak occurrence is based on geographical location
- Regions of Africa and South Asia are known as **anthrax zones** because the soil spore concentration is very high
- Droughts followed by heavy rainfall or flooding often occur prior to anthrax outbreaks
- Carcasses of animals that have died from anthrax serve as reservoir for the pathogen





# Anthrax

- **Clinical signs**

- Ruminants are the most susceptible
- Because of the course of infection in ruminants, clinical signs may not be observed prior to death
  - **Other signs include respiratory distress, fever, depression, convulsions, congested mucous membranes, bloody diarrhea and urine, and tissue swelling**
  - **Dead animals will have hemorrhage from body orifices**
- Horses develop an acute intestinal form with signs of acute abdominal pain, diarrhea, fever, depression, and septicemia





# Anthrax

- **Differential diagnosis**
  - Other causes of sudden death
    - Clostridial infections (bacillary hemoglobinuria, blacks disease), lightning strikes, plant poisoning, nitrate poisoning, exposure to pesticides (organophosphates), hemorrhagic septicemia

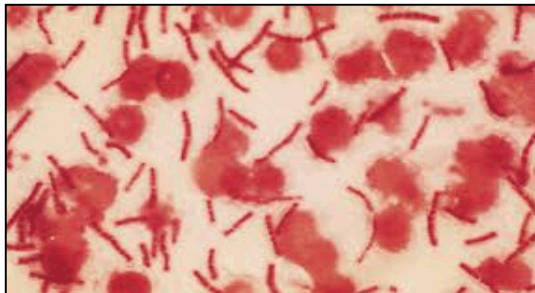




# Anthrax

- **Diagnosis**

- Care must be taken when confirming a diagnosis of anthrax
- Avoid opening the carcass to prevent sporulation of the organism and potential environmental contamination
- Blood should be taken as a sample and submitted for direct smears or for culture
  - **Samples should be collected carefully – gloves, glasses, lab coat should be worn to collect samples**
  - **A diagnosis can be made based on the morphology of the organisms detected in the blood and the clinical symptoms**
  - **Isolation and culture is the gold standard for diagnosis**



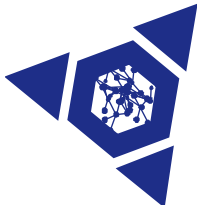


# Anthrax

- **Treatment and Control**

- Animals rarely respond to treatment
- Carcass management is critical to preventing and controlling the disease
  - **Carcasses should never be opened or moved**
  - **Carcasses should be buried in a deep hole or burned**
    - **Burning is the most effective**
    - **Bedding and all contaminated material should also be burned**
  - **Safety precautions should be implemented when disposing of the carcass**
    - **Gloves, masks, and protective clothing**

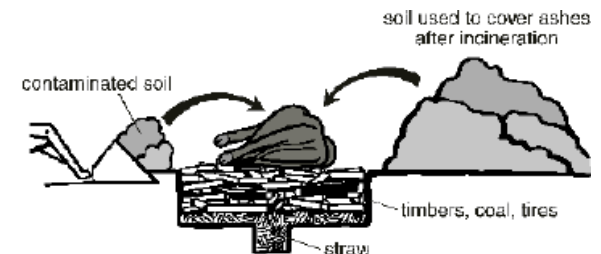
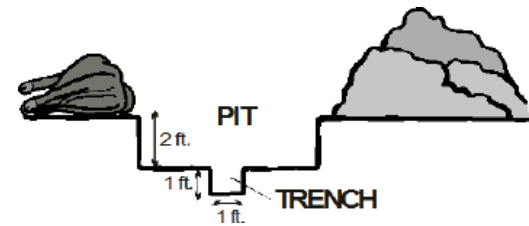
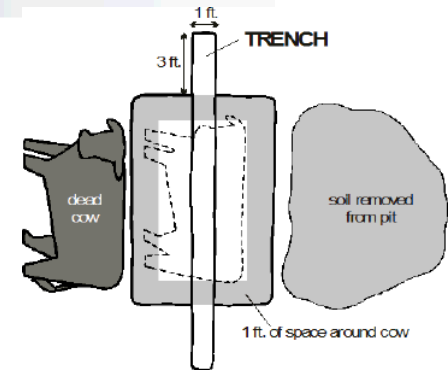




# Anthrax: Carcass Disposal

## Burning method

- Dig a pit two feet deep that is slightly wider and longer than the carcass
- Dig a trench in the center that is 20cm wide and deep down the middle of the pit that extends a meter beyond each side of the pit
- Fill the trench with straw or burnable material and soak the material with fuel (kerosene or diesel fuel)
- Fill the pit with timbers or coal until it is level with the ground – tires may be used in place of timbers
- Cover the pit with fuel and pull the carcass over the pit
- Carefully start the fire at either end of the pit
- After about one hour place corrugated metal over the carcass to retain heat but not lose ventilation





# Anthrax

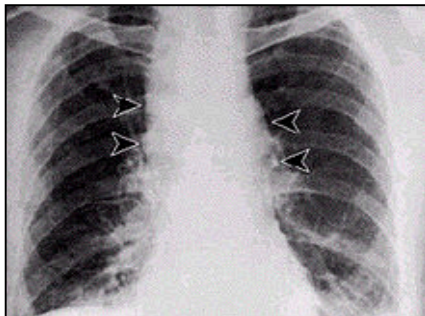
- **Vaccination is the best treatment/prevention in enzootic areas**
  - Animals should be vaccinated annually four weeks prior to exposure to potentially contaminated pastures or where previous outbreaks have occurred
  - Initial vaccinations should be given followed by a booster at two to three weeks
  - Animals should not be slaughtered within 42 days of vaccination
    - **Withdrawal time is 42 days**





# Anthrax – Public Health

- **Anthrax is a zoonotic disease**
  - Three forms develop in humans
    - **Cutaneous, inhalation, and gastrointestinal**
  - Veterinarians are at risk because of carcass handling
    - **Wear personal protective equipment when collecting samples and disposing of the carcass**
  - Animals suspected of having anthrax should never be consumed
  - People who handle wool are susceptible to the cutaneous form – wool handlers disease
  - Treatment includes: ciprofloxacin, doxycycline, and penicillin





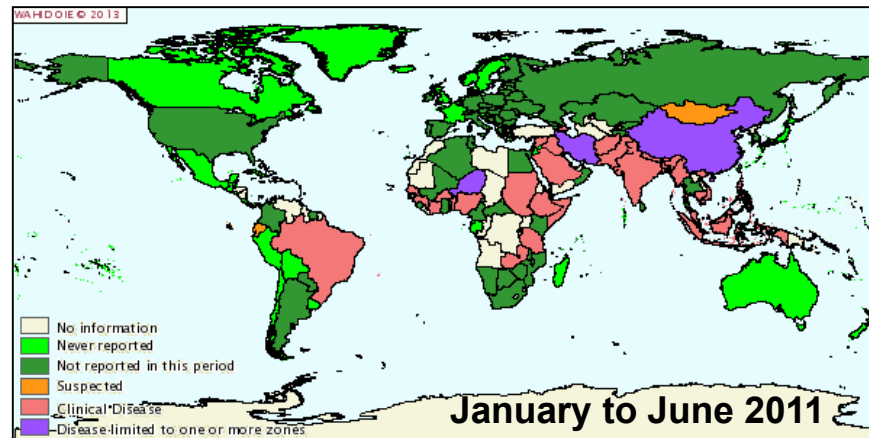
# Hemorrhagic Septicemia

- **Etiology**

- Important and highly fatal disease of cattle and water buffalo
- Caused by bacteria *Pasteurella multocida* subspecies *multocida*
- Two nomenclatures are used the two types are B:2 or 6:B and E:2 or 6:E

- **Epidemiology**

- *Pasteurella multocida* is transmitted by inhalation or ingestion through direct contact or contact with fomites
- *Pasteurella multocida* is not stable in the environment
- Problematic in the Middle East, Africa and South Asia





# Hemorrhagic Septicemia

- **Clinical signs**

- Fever, dullness and reluctance to move may be the first signs
- Salivation and a profuse serous nasal discharge develop
- Edematous swellings in the submandibular region that spread to the neck and brisket
- Respiratory distress occurs, with frothing at the mouth and the animal usually collapses and dies within 6 to 48 hours
- May just find animals dead without demonstration of other signs
- Calves may develop hemorrhagic gastroenteritis





# Hemorrhagic Septicemia

- **Differential diagnosis**

- Causes of sudden death should be considered as differentials
  - **Anthrax, Clostridial infections (bacillary hemoglobinuria, blacks disease), lightning strikes, plant poisoning, nitrate poisoning, exposure to pesticides (organophosphates)**

- **Diagnosis**

- Hemorrhagic septicemia strains can be cultured from blood, but animals become septicemic only in the terminal stages of the disease
- The organism may be isolated from nasal secretions
- Necropsy can be done but must be differentiated from anthrax before doing so At necropsy, the organism
- Samples should be kept cool during transport to a laboratory



# Hemorrhagic Septicemia

- **Control**

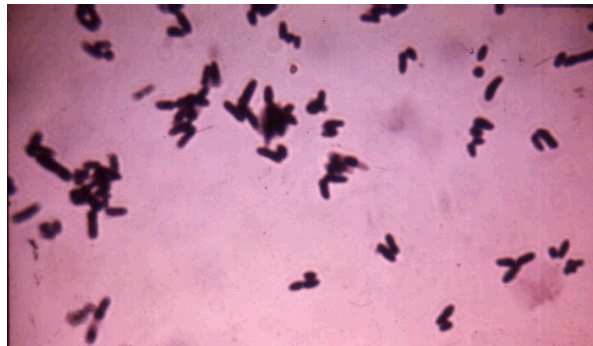
- Treatment after the onset of disease is usually not effective and prevention is the best treatment
- Can be eradicated with quarantines, movement controls, tracing of contacts, euthanasia of infected and exposed animals, and cleaning and disinfection of contaminated areas
- *Pasteurella multocida* is susceptible to most common disinfectants, as well as to mild heat (55°C/131°F).
- In endemic areas, hemorrhagic septicemia is prevented by vaccination
- Management to keep the animals in good condition can reduce the risk of clinical signs and/or transmission of the organism
- Animals should not be crowded or stressed, especially during wet weather



# *Corynebacterium Pseudotuberculosis*

- **Etiology**

- *Corynebacterium pseudotuberculosis* is the causative agent of:
  - Caseous lymphadenitis in sheep and goats
  - Granulomatous and mastic, visceral and mixed infection of cattle
  - Ulcerative lymphangitis and external and internal abscess of horses
  - Human may also become infected
- *Corynebacterium pseudotuberculosis* is a gram positive bacterium
  - The organism produces toxins that are responsible for producing clinical signs

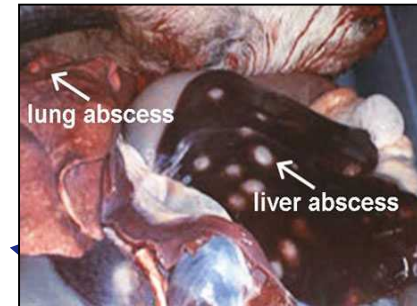
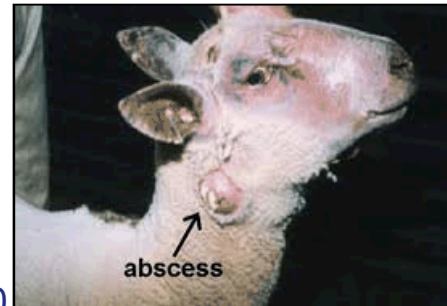




# *Corynebacterium Pseudotuberculosis:* Sheep and Goats

- **Clinical signs**

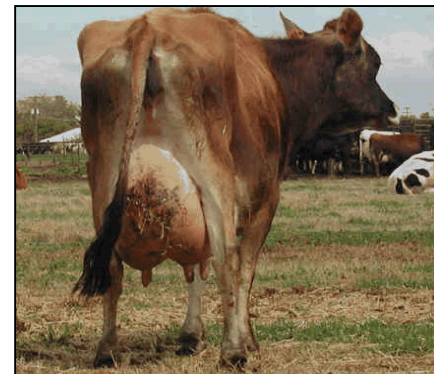
- Clinical characteristics are internal and external abscesses
- Primarily manifests as abscess formation of lymph nodes
  - **Most often involve mandibular, parotid, prefemoral or prescapular lymph nodes**
- The abscess material is thick and is white in sheep or greenish in goats
- Internal abscesses are often found in internal lymph nodes
  - **The clinical presentation is weight loss and poor condition**
- Differential diagnosis is other causes of abscess formation including trauma, hematoma, foreign body, or injection reaction

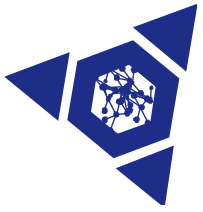




# *Corynebacterium Pseudotuberculosis:* Cattle

- **Clinical signs**
  - Occurs as a herd problem in cattle
  - Cattle most often appear with cutaneous granulomas
    - The granulomas are not abscesses but rather ulcerative, exuding granulomatous lesions as large as 20 cm in diameter
    - Usually appear on the face, neck, thorax, flank
    - Lesions heal spontaneously in two to four weeks and do not cause production losses
    - Mastitis can also occur as a result of infection by *Corynebacterium pseudotuberculosis*

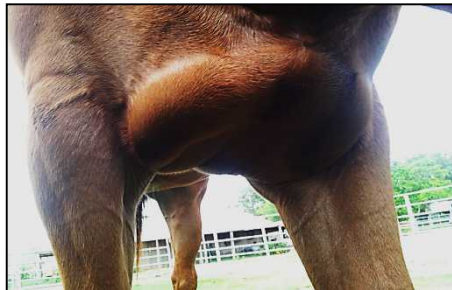




# *Corynebacterium Pseudotuberculosis:* Horses

- **Clinical signs**

- Three forms occur in horses: ulcerative lymphangitis, external abscesses, and internal abscesses
  - **In a study in the United States, 90 percent of cases had external abscesses**
- Ulcerative lymphangitis appears as severe cellulitis affecting one or more limbs, with multiple draining ulcerative lesions
  - **Lameness, fever, depression, reluctance to eat also occur**
- External abscesses often occur in the pectoral region but can also occur on the prepuce, mammary gland, head, maxilla and mandible
- Internal abscesses present with nonspecific signs of fever, weight loss, reluctance to eat, high heart and/or respiratory rates





# *Corynebacterium Pseudotuberculosis*

## Public Health

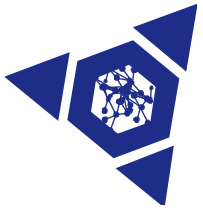
- **Humans can become infected after exposure to strains infecting small ruminants or equipment that has been contaminated by the organism**
- **Caution should be used when handling *Corynebacterium* lesions in any species**
- **Humans can also become infected after drinking unpasteurized milk containing the organism**
- **Human infection occurs as pneumonia and/or lymphadenitis**



# *Corynebacterium Pseudotuberculosis*

- **Epidemiology**

- The organism survives months to years in the soil even with exposure to direct sunlight
- Abscesses occur after the organism is introduced via a wound in the skin
  - **Abscesses in horses tend to occur more often in the fall and early winter**
  - **Cattle infections occur mostly in spring and summer and are thought to associated with the presence of flies**
- Biting insects may also contribute to the introduction of infection



# Corynebacterium Pseudotuberculosis

- **Treatment**
  - External abscesses
    - **Let the abscess mature**
    - **Establish drainage**
    - **Lavage the wound with antiseptic solution**
    - **Antibiotics should not be administered until after the abscess has started to drain**
  - Internal abscesses
    - **Require long term antibiotic therapy**
      - Penicillin, trimethoprim sulfa (horses), tetracycline, cephalosporins
      - Since long-term therapy is required, oral antibiotics might be the best option
      - Use antibiotic that will not cause diarrhea or adverse affects
  - Prognosis is good for external abscesses