BIOTERRORISM AGENTS: IMPLICATIONS FOR ANIMALS

TABLE OF CONTENTS

BIO-TERRORISM AGENTS: IMPLICATIONS FOR ANIMALS

INTRODUCTION

Biological Terrorism is the threatened use or use of a microorganism or toxin derived from living organisms to induce death or disease in people, animals or plants.

Weapons capable of causing death, disease or injuries to a large number of human beings, animals, or plants are considered weapons of mass destruction, or more appropriately in the case of biological agents, mass-casualty producing weapons.

Agents potentially used by a terrorist may also cause natural outbreaks. When an outbreak occurs, it is important to determine if it is a naturally occurring event or a terrorist act. Animals may be sentinels, as an outbreak may occur in animals before or simultaneously with an outbreak in human beings. A terrorist could use a zoonotic agent, a disease organism transmissible between animals and man, or an agent causing disease in only animal or plants in an attempt to introduce fear or economic havoc in our society. Certain characteristics of an outbreak in animals might help differentiate a terrorist event from a natural event:

Increased morbidity or mortality.
Appearance in a species not normally manifesting the disease.
Occurrence at the wrong time or an unusual time of year.
Occurrence in areas where it is not normally found.
Lack of response to the normal mode of treatment.

A terrorist might use a zoonotic agent, an organism capable of transmitting disease between animals and man, or an agent causing disease in only animals or plants. Animals may be used as sentinels of an attack with a zoonotic disease, because the disease is likely to occur in animals before or simultaneously with an outbreak in people.
Veterinarians should be alert to these situations and report them as soon as possible to the appropriate official responsible for investigating outbreaks, which may include the USDA regional veterinarian, State Veterinarian, Public Health Veterinarian, State Bioterrorism Coordinator.
This guide focuses on information about diseases in animals caused by agents most experts believe a terrorist might use to target the human population. These same agents can affect animals. Although there are many publications describing the effects of bioweapons on people, there are no easily available resources describing effects on animals. This guide is meant

to fill the gap, making animal-related information available to veterinarians and emergency responders.

Biological agents producing diseases only in animals or only in plants are not included in this guide. For more information on such agents or their effects in people, other guides and references should be consulted. Dosages for various medications and for various species may be found in such publications as *Veterinary Drug Handbook*, by Donald C. Plumb, published by Iowa State University Press. This source is accessible to American Veterinary Medical Association member veterinarians on the NOAH link on the website at www. AVMA.org.

TOXINS OF CONCERN

BOTULINUM FACT SHEET

CAUSE:

Botulinum, the most toxic of known toxins, is produced by the gram-positive spore forming anaerobic bacteria *Clostridium botulinum*. Animals ingest the toxin when they consume decomposing animal tissue, maggots, decaying grasses, hay, spoiled silage or grain in which the *Clostridium* bacteria has grown. The toxin may be produced in a wound contaminated with *Clostridium* and the toxin can spread throughout the body.

Eight types of botulism occur in animals and man and are classified by the type of toxin produced. Not all types occur in animals. Type A occurs in chickens and mink; type B in cattle, horses and chickens; type Alpha C in waterfowl; type Beta C in cattle, horses, mink and dogs; type D in cattle, sheep and horses; and type E in farmed fish. Serotype A is the one typically discussed in the context of biological threat agents.

SPECIES SUSCEPTIBILITY:

Most species are susceptible. Intoxication occurs most frequently in cattle, horses, chickens, wild waterfowl (ducks, loons, geese, gulls, mergansers), mink, fox, rodents, various zoo animals and birds of prey. Though intoxication can occur in dogs, cats and pigs they are comparatively resistant. In horses the disease occurs most commonly in foals under 4 weeks of age and is known as Shaker Foal Syndrome. This syndrome is thought to be caused by a wound in which the toxin is formed at the localized site and spreads through the body. In birds the disease is called Limberneck.

METHOD OF TRANSMISSION:

Botulism is spread by the consumption of animal tissues or plant material containing the bacteria or spores. Spores produce toxin when they germinate in the material or in the digestive tract. Wound botulism occurs when *Clostridium* bacteria or spores enter a wound, reproduce and then produce toxin. The toxin can only be spread between species by consumption of infected tissue of one species by another.

INCUBATION PERIOD:

The time from ingestion of the toxin until clinical signs are observed will vary with the amount of toxin ingested. The onset of clinical signs may be as short as a few hours but is seldom more than 24 hours. A very small amount of material containing the toxin can cause symptoms. Signs can develop rapidly and death can occur in as little as 6 hours after initial onset. Clinical signs may begin in human beings between 12-36 hours after inhalation of the toxin.

PREVENTION OR VACCINATION:

Birds dying of botulism must be removed from the area. The decaying carcasses develop maggots, which contain the toxin, are consumed by other birds and thus the toxin is transmitted to other birds. Spoiled grass, grain and silage should not be fed. Feed sources for animals should be kept dry and free from contamination with rodent carcasses; decomposing rodents may be a source of *Clostridium* bacteria. Rapid cooling of viscera at slaughter-houses, washing and sanitary storage are indicated to minimize the

reproduction of the organism and thus toxin production. Temperatures of feed during storage should be kept below 60°F (15°C) to minimize reproduction of the organism. Fly control may reduce the risk of maggot formation. Animals can be immunized with inactivated type C and D toxoids (type depends on species and manufacturers recommendations).

Human beings or domestic animals are most often intoxicated by consumption of the preformed toxin in such things as home-canned vegetables or even baked potatoes left unrefrigerated. As little as 0.001 microgram per kilogram body weight may be lethal.

SIGNS OR SYMPTOMS:

Flaccid muscular paralysis is the primary sign of botulism intoxication. Paralysis results from the interruption of the release of neurotransmitters. There is no fever. The flaccid paralysis is most easily seen in the legs, wings and neck (Limberneck) of birds. Other signs include blurred vision, difficulty swallowing or chewing, recumbency, drooling, inability to urinate or frequent urination, inability to stand, stilted gait, difficulty breathing and dilated pupils.

Signs may vary depending upon species affected. For example, sheep do not show typical signs of flaccid paralysis but in the early stages there is stiffness of gait, incoordination and some excitement. The head may bob up and down when walking. Paralysis and death occur in later stages.

One of the most obvious and early signs in cattle is loss of the ability to retract the tongue, so the animal's tongue hangs out of the mouth. Death occurs as a result of paralysis of the muscles of respiration. At necropsy lesions are typically not found. In the case of Shaker foal syndrome, pulmonary edema, congestion and pericardial fluid containing strands of fibrin may be observed. In many species an animal is often found dead without any previously observed signs.

The clinical signs and symptoms in human beings include, ptosis, blurred vision, diplopia, dry mouth and throat, dysphagia and dysphoria. These are a result of cranial nerve palsies. These early signs are followed by symmetrical descending flaccid paralysis, with generalized weakness and progression to respiratory failure.

TREATMENT:

Animals showing signs can be treated with antitoxin with varying results. Supportive care is indicated. Paralyzed animals have been treated with guanidine hydrochloride, however controlled studies have not been done and the treatment has not been used extensively enough to determine if this is of any value.

DIAGNOSIS / LABORATORY TESTS:

Diagnosis is usually based on history and clinical signs. Positive diagnosis can only be confirmed by demonstration of the toxin in tissues or body fluids. Isolation of the bacterial organism does not necessarily support a diagnosis of botulism although it may be highly suspected if the bacteria are isolated from a source, such as tissues. Excluding other causes of paralysis often leads to the diagnosis in animals. Blood, liver homogenates, and saline macerated filtrates of stomach/rumen contents, crop, intestinal contents, feed, and grains can be injected into mice (filtrate alone and filtrate combined with antitoxin) but a negative test is not conclusive evidence of the absence of botulinum toxin. Detection of the genes coding for the toxin by PCR or the toxin itself by Enzyme Linked Immunosorbent Assay (ELISA) can be performed in some laboratories. Interestingly, milk from botulism poisoned animals does not contain the toxin and nursing young do not become intoxicated.

HANDLING OF DEAD ANIMALS AND ENVIRONMENT CONTAMINATED BY EXUDATES:

Any animal dying should be disposed of promptly. Burning is the desired method but deep burial is acceptable. Carcasses of animals dying of botulism can also be rendered.

RICIN FACT SHEET

CAUSE:

The toxin is extracted from the seed of the Castor Bean plant, *Ricinus communis.*

SPECIES SUSCEPTIBILITY:

All species, including human beings and all animals and insects are susceptible.

METHOD OF TRANSMISSION:

Pellets of ricin have been injected into human beings and used in food as weapons of assassination. Ricin has also been aerosolized for weapons, and theoretically may be used in a food or water source for mass intoxication. Ricin disrupts cellular RNA, causing cell death. It is a very potent toxin when ingested, inhaled or injected.

The toxin is not passed between living animals. The flower of the castor bean plant contains a seed, rich in ricin. Mastication and ingestion of the seed causes an intoxication in human beings or animals; a single seed may be fatal. If the seed remains undamaged, intoxication does not occur.

INCUBATION PERIOD:

As a toxin, ricin has a latent period before clinical signs are observed. Appearance of signs depends on the dose, the method of intoxication and the species. Aerosol intoxication usually has a significant lag time before signs are seen. In some species it is as short as 3 hours (rodents) or as long as 36 hours (monkey). Generally, in most species upper respiratory signs should be expected within 12 hours of exposure. Gastric signs are expected to occur more quickly and dramatically in all species, often within a few hours after ingestion. Victims dying usually do so 3-5 days after exposure, by any route.

PREVENTION OR VACCINATION:

Vaccines are being developed and show promise in animal models, but are not available for use at this time. Avoidance is currently the only prevention.

SIGNS OR SYMPTOMS:

Aerosolized ricin is a strong pulmonary irritant. The first sign is generally a mild cough worsening as time passes. Fever, weakness, hypothermia and hypotension may all occur. Fluid will fill the airway (pulmonary edema) resulting in respiratory distress leading to cardiovascular collapse. The signs usually occur 18 - 24 hours after exposure and progress to death from hypoxemia within 36 - 72 hours.

After ingestion, the first expected signs are abdominal pain, vomiting (in species able to do this) and diarrhea, which may be bloody. Dehydration, decreased urine output and decreased blood pressure are later signs, often followed by vascular collapse and death. Seizures may also occur. Clinical signs are similar in animals and people.

ENDEMIC AREA:

Castor beans are commonly grown worldwide and can be found in many backyards. The toxin is inexpensive and relatively easy to extract in a home or small laboratory. A large manufacture can easily be hidden by using by-products of castor oil extraction; the waste mash contains 5% ricin by weight. It should be considered a readily available biological agent.

DIAGNOSIS / LABORATORY TESTS:

An ELISA test is available to detect ricin antibodies in the blood and the toxin may also be identified within tissues. Serum, gastric and intestinal contents, and samples of lung, stomach, intestines, kidney and liver are the most appropriate samples to test. The samples must be sent to a lab familiar with this toxin.

Pathology is non-specific. Aerosol exposure causes necrotizing airway lesions, tracheitis, bronchitis, bronchiolitis and interstitial pneumonia with perivascular and alveolar edema. Ingestion of ricin results in gastrointestinal hemorrhage with hepatic, splenic and renal necrosis. Injection of ricin causes severe, local muscle damage with necrosis of regional lymph nodes. Visceral organs may be moderately necrotic. These findings are reported in human beings and in laboratory animals and would be expected to be uniform in other species.

The most difficult part of diagnosis of aerosolized ricin exposure would be eliminating other causes of similar signs and pathology. Many infectious agents and gases present in similar fashion and/or have similar pathology. In the field, ricin intoxication would tend to progress more slowly than most chemical exposures and it would be non-responsive to antibiotics. In the living animal, suspicion of ricin intoxication can be increased with the following findings: bilateral chest infiltrates seen on radiographs, arterial hypoxemia and neutrophilic leukocytosis. A bronchial aspirate rich in protein compared to plasma is characteristic of high permeability pulmonary edema and may increase suspicion.

TREATMENT:

Treatment is supportive. If recent ingestion is suspected, immediate induction of vomiting or gastric lavage is recommended. Other gastric decontamination procedures, such as superactivated charcoal, followed by a cathartic, such as sorbitol, should be used in any ingestion case. It may be useful to use a GI protectant, such as carafate. Carafate should be given 1-2 hours apart from any other oral medication. Replacement of GI fluid losses is important. In the aerosolized form, treatment is aimed at maintaining a functional lung and minimizing irritation of the airway. If animals are having trouble breathing, oxygen therapy will be required. Unfortunately, no specific treatments can be advised as helpful; each case must be managed individually. Because the pathology develops relatively slowly and advanced intoxication requires intensive support, ricin intoxicated animals should be transported to a veterinary hospital, preferably one with 24 hour staffing, whenever possible. Treatment for human beings and animals is very similar.

HANDLING OF DEAD ANIMALS AND ENVIRONMENT CONTAMINATED BY EXUDATES:

Handling animals intoxicated by ingestion or injection or those already sick from inhalation poses no risk for personnel. Animals newly exposed to an aerosolized dose can potentially carry the agent on their coat, so basic precautions such as surgical gloves, protective clothing and use of a high efficiency surgical filtration mask are wise. Secondary aerosolization, however, is a very minor risk and ricin does not penetrate the intact skin of the handler.

If the animal is heavily contaminated, soap and water may be used to decontaminate skin surfaces. The toxin is not absorbed well so the feces and urine may contain significant amounts of ricin after ingestion. To prevent additional exposures, it is recommended feces and urine be contained in such a way to avoid contamination of water sources and minimize the risk of ingestion by other animals.

STAPHYLOCOCCAL ENTEROTOXIN B (SEB) FACT SHEET

CAUSE:

Staphylococcal enterotoxin B (SEB) is one of 6 serogroups (A-E) of the enterotoxin of *Staphylococcus aureus*, and a member of a class of stable secreted protein toxins called pyrogenic toxin superantigens (PTSA's). SEB toxin, related to TSST-1 toxin, the first identified cause of toxic shock syndrome, causes pathology by impairment of the immune functions of the organism exposed to pulmonary or enteric administration of the toxin. SEB is the second most common cause of out-breaks of foodborne illness. The toxin may be encountered by exposure to a toxin-producing strain of *Staphylococcus aureus*, or in a bioterrorist event, or by exposure to the purified toxin. SEB was weaponized for use as a biologic agent by the US in the 1960's.

SPECIES SUSCEPTIBILITY:

Non-human primates, as well as human beings, are highly susceptible to the effects of SEB. Mice, rats, rabbits, bovines, ovines, caprines and others species are also susceptible to the enterotoxins.

METHOD OF TRANSMISSION:

Naturally occurring ovine and bovine infections are documented to be associated with mastitis. Rodents may serve as a reservoir for toxin-producing strains in the environment. Exposure to SEB may be through contact with other animals infected with toxin producing strains, by food-borne proliferation of a toxigenic strain, or by inhalation or ingestion of the purified toxin. Intoxication by production of secondary aerosol from exposed patients is not a concern.

Transmission of toxigenic strains of *Staphylococcus aureus* occurs readily by contact with infected animals. Transmission of infection in bovines with mastitis may occur by means of contaminated milking equipment. Cross-species transmission of SEB intoxication by contact with animals having been exposed to the purified toxin is not usually of concern once cutaneous decontamination has been done. Thorough washing with soap and water is sufficient to eliminate cutaneous exposure.

INCUBATION PERIOD:

SEB is a toxin which has a latent period before clinical signs are observed. This latent period is approximately 3–12 hours after aerosol exposure in human beings while non-human primates may have a latent period of 8-20 hours.

PREVENTION OR VACCINATION:

Protection from exposure to the toxin can be achieved by wearing a surgical or HEPA-filter mask. Several traditional and recombinant experimental vaccines developed by the Department of Defense have shown promise in non-human primates. Passive immunotherapy by injection of non-specific gamma globulins have been reported to lessen symptoms of SEB exposure.

SIGNS AND SYMPTOMS:

In non-human primates, inhalation of the toxin produces signs of gastrointestinal distress within 24 hours of exposure. Clinical signs appear within 8-20 hours. These include fever of 2-5 days duration (by inhalation only), non-productive cough lasting up to 4 weeks, myalgia, and rapid hypotension. If exposure to SEB is non-lethal, signs usually resolve within 3-4 days. If exposed to a lethal dose of SEB, monkeys developed pulmonary edema and associated dyspnea along with gastrointestinal signs within 48 hours of exposure. Death may ensue from multiple organ failure within 3-4 days.

Initial signs in human beings include non-productive cough and dyspnea with inspiratory rales, fever, acute respiratory distress, myalgia, nausea, hypotension, anorexia, vomiting and diarrhea. Presence of pulmonary infiltrates on a radiograph indicates the presence of one of the infectious organisms. Radiographic abnormalities after exposure to the purified toxin are consistent with pulmonary edema. Human beings may show clinical signs of intoxication for as long as 2 weeks after inhalation exposure.

ENDEMIC AREAS:

Toxigenic strains of *Staphylococcus aureus* are endemic worldwide.

DIAGNOSOSIS / LABORATORY TESTS:

Rule-out diagnoses include Rocky Mountain Spotted Fever, Leptospirosis, Tularemia, Q Fever, Chlamydial pneumonia, Plague, and inhalation Anthrax.

Post-mortem examination of non-human primates exposed to SEB show lungs with multifocal petechial hemorrhage and areas of atelectasis. Often there has been sloughing of the respiratory epithelium and alveolitis associated with a multicell-type intra-alveolar cellular infiltrate and fibrin deposition. Associated lymph nodes in the mediastinum and mesentery are swollen. There may be peri-bronchiolar cuffing. Enteric exposure to SEB does not cause the copious intestinal fluid accumulation typical of other types of enterotoxin. Instead SEB acts by contacting enteric emetic receptors causing emesis and diarrhea by releasing cytokine mediators from T-cells and mast cells. The intestines show erosive enterocolitis and sloughing of the intestinal mucosa in varying degrees. The lamina propria indicates infiltration by monocyte/macrophage cellular infiltrate and examination of the colon may reveal multi-focal abscesses of the intestinal crypts. Documentation of signs in association with exposure to SEB in species other than primates is limited.

In human beings throat cultures, nasal swabs, blood cultures, sputum and Cerebro-Spinal Fluid (CSF) should be obtained for laboratory culture. Acute and convalescent serum samples should be sent for serology for Rocky Mountain Spotted Fever, and Leptospirosis, Tularemia, Q Fever, and Plague. Urine samples should be taken, as SEB accumulates in the urine as specific peptides which can be found. If human beings are involved, serology for measles should be included in the differential diagnosis. Serology for SEB is of limited diagnostic value due to frequent presence of cross-reactive antibody to other bacterial toxins, but serum samples should be obtained nonetheless. Detection of SEB from nasal or throat swabs may be done by PCR or toxin-specific DNA probe

technology, for up to 24-48 hours after exposure. Many assay methods may be used.

TREATMENT:

As diarrhea is usually self-limiting, fluid and electrolyte replacement is usually not needed except in the most severe cases. Fever and myalgia can be treated symptomatically and will respond to administration of anti-pyretics. Cough can be treated with codeine-containing cough preparations, with or without antihistamines. In severe cases, monitoring of pulmonary status is necessary, using pulse-oximetry and mechanical ventilation, in some cases. Administration of atropine may lessen some clinical signs. No benefit has been ascribed to the administration of steroids.

HANDLING OF DEAD ANIMALS AND ENVIRONMENT CONTAMINATED BY EXUDATES:

Handling of dead animals exposed to SEB does not require any unusual precautions other than standard precautions for healthcare workers. Carcasses may be disposed of by incineration or deep burial. Good aseptic technique must be used when handling dead animals infected with toxigenic strains of *Staphylococcus aureus*. Gloves and mask should be worn. Accidental skin contamination can be cleaned using soap and warm water. Surfaces can be decontaminated using 5% sodium hypochlorite solution (household bleach).

TRICHOTHECENE MYCOTOXINS FACT SHEET

CAUSE:

The trichothecenes are a large family of highly stable, chemically related mycotoxins produced primarily by *Fusarium* and a few other fungal species. The distinguishing chemical feature of trichothecenes is the presence of a trichothecene ring, which contains an olefinic bond at C-9, 10; and an epoxide group at C-12, 12.

SPECIES SUSCEPTIBILITY:

Humans, other mammals, birds, fish, a variety of invertebrates, plants, and eukaryotic cells are susceptible to the toxin.

METHOD OF TRANSMISSION:

These agents are toxic by oral, parenteral (i.e. injection), dermal or aerosol exposure. In food animals, the most common naturally-occurring intoxications are seen following ingestion of contaminated grain products on which the fungus has grown. The mycotoxin T-2, also known as yellow rain, has been weaponized for aerosol distribution.

INCUBATION PERIOD:

Toxins have a latent period before clinical signs are recognized. Orally the effects are seen in 3-12 hours; dermally in 6-12 hours; ocular exposure within 2-5 minutes; by the respiratory route, less than 1 hour. The mycotoxin T-2 has been reported to be active and cause effects when it contacts the skin, eyes and respiratory tract.

PREVENTION OR VACCINATION:

No vaccines are available. Avoid the use of potentially contaminated feedstuffs or obviously molded feeds.

SIGNS OR SYMPTOMS:

Manifestations are the result of inhibition of protein synthesis in rapidly proliferating tissues. Regardless of route of exposure, intoxication includes hematopoietic and immunosuppressive effects, central nervous effects, and vascular effects leading to hypotension and shock. Local route-specific effects may include: oral exposure with lesions to the upper gastrointestinal tract; dermal exposure with local cutaneous necrosis and inflammation; and ocular exposure with corneal injury.

Intoxication caused by some of this family of toxins manifest as feed refusal in animals, especially in swine. Vomiting and dermal necrosis are also common in swine. Goats standing in feed pans have suffered dermal necrosis from contact with toxin in the feed. Other animals have been similarly affected from tricothecenes. Animal deaths will occur.

Human beings suffering exposure have skin pain, pruritus, redness, vesicles, necrosis and sloughing of the epidermis. Effects on the airway include pain in the throat and nose, nasal discharge, itching and sneezing, cough, dyspnea, wheezing, hemoptysis and chest pain. Severe intoxication has resulted in prostration, weakness, ataxia, collapse, shock and death.

ENDEMIC AREAS:

Mycotoxins are found worldwide.

DIAGNOSTICS / LABORATORY TESTS:

History, clinical and epidemiological findings assist in the diagnosis. If the toxin is feed borne, multiple animals may be affected. An attack which results in dermal exposure may affect both human beings and animals. Most mycotoxins and the metabolites are eliminated from the body in the urine and feces within 24-36 hours. Urine may be collected and sent to a laboratory for antigen detection.

Gas-liquid chromatography (GLC) is most commonly used to identify this family of toxins. Mass spectrometry (MS), in conjunction with GLC can be used to definitively identify the mycotoxins at concentrations of as little as 1 ppb or 0.1 ppb of T-2 toxin.

TREATMENT:

No specific therapy is known for tricothecene-induced mycotoxicosis. Superactive charcoal given *per os* within 1 hour of oral intoxication has proven efficacious in laboratory animals. Irrigation of the eyes with isotonic saline and washing of the skin with warm, soapy water are indicated. Data suggests early use of high doses of systemic glucocorticosteroids may be useful.

HANDLING OF DEAD ANIMALS AND ENVIRONMENT CONTAMINATED BY EXUDATES:

The remains of animals poisoned orally may be considered nontoxic. Physical protection is recommended when handling dermally poisoned animals. This family of toxins is extremely stable. They are not inactivated by autoclaving, but require heating at 900 degrees for 10 minutes or 500 degrees for 30 minutes. A 5% solution of sodium hypochlorite (undiluted household bleach) is an acceptable decontamination means for most equipment.

VIRAL DISEASES OF CONCERN

VIRAL HEMORRHAGIC FEVERS FACT SHEET

CAUSE:

The viral hemorrhagic fevers are caused by a diverse group of enveloped RNA viruses from the families Arenaviridae (Lassa, Junin, Machupo, Guanarito and Sabina viruses), Bunyaviridae (Rift Valley fever [RVF] virus, Congo-Crimean hemorrhagic fever [CCHF] virus and Hantaviruses), Filoviridae (Ebola and Marburg viruses), and Flaviviridae (Yellow fever, Dengue and West Nile viruses), linked primarily by their characteristic clinical manifestations in man.

SPECIES SUSCEPTIBILITY:

Humans, nonhuman primates and a variety of mammals (eg. RVF in cloven-hoofed animals) are susceptible. In natural infections the susceptibility is typically limited by availability of rodent, mosquito or tick vectors.

METHOD OF TRANSMISSION:

Most of the viruses have rodent or arthropod reservoirs from which humans (or animals) may be exposed directly. Typically, there is transmission *via* virus in the urine of rodents, which may be inhaled as particulate after drying.

Transmission between species does not occur in nature except through natural rodent or arthropod cycles. The exceptions are Bunyaviruses (possibly to man during slaughter of domestic animals) and Filoviruses (through ingestion or handling of infected non-human primates, or other species, by humans).

INCUBATION PERIOD:

Arenaviridae, 5-16 days; Bunyaviridae, 2-35 days (or less in cloven-hoofed animals); Filoviridae, 3-16 days and Flaviviridae, 3-8 days.

PREVENTION OR VACCINATION:

Control of arthropods (mosquitoes, ticks) and rodents is important in avoiding and controlling outbreaks. There is only one licensed virus-specific vaccine for the HFVs: yellow fever vaccine. The Department of Defense (DoD) has developed Investigational New Drug (IND) vaccines for Junin (used widely in humans in Argentina) and Rift Valley fever. An inactivated RVF vaccine has also been used in at-risk agricultural and research personnel for years. A formalin-inactivated rodent brain vaccine for Hanta was developed and is in use locally in Korea.

SIGNS OR SYMPTOMS:

Viral hemorrhagic fever is an acute febrile illness characterized by malaise, prostration, generalized signs of vascular permeability, and abnormalities of circulatory regulation. Life-threatening loss of blood volume is rare, although bleeding manifestations often occur as a result of damage to the vascular endothelium. Initial examination may reveal conjunctival injection, mild hypotension, flushing and petechial hemorrhages. Full-blown VHF typically evolves to shock and generalized mucous membrane hemorrhage and is often accompanied by evidence of neurological, hematopoietic, or pulmonary involvement. Hepatic and renal involvement are often seen. Abortion may be the only clinical sign observed in adult cloven-hoofed animals.

TREATMENT:

Ribavirin is effective against Lassa fever; anecdotal data suggests it may also be effective against disease caused by Machupo virus and against CCHF. Passive antibody immunotherapy has been used to treat disease caused by Junin and Machupo. Symptomatic care, including management of hypotension and shock, and aggressive treatment of secondary infections is indicated.

ENDEMIC AREAS:

Arenaviridae is found in South America and Africa; Bunyaviridae, worldwide; Filoviridae in Africa; Flaviviridae in Tropical Africa, the Americas, India and the former Soviet Union.

DIAGNOSIS / LABORATORY TESTS:

Virus isolation is possible from serum or body fluids. Virus can be identified by antigen, ELISA or reverse transcriptase-polymerase chain reaction. Serology using ELISA can be used to identify antibodies (IgM), typically during acute illness. Definitive virus isolation requires specialized analysis in a biocontainment (BSL-3 or 4) laboratory.

HANDLING OF DEAD ANIMALS AND ENVIRONMENT CONTAMINATED BY EXUDATES:

Animal or human patients typically have significant quantities of virus in their blood, and perhaps, other body secretions. Dead animals for necropsy should be handled with caution. At a minimum use the following: mask, gown, gloves and needle-precautions; hazard labeling of specimens; restricted access; and autoclaving or liberal disinfection of contaminated materials, using hypochlorite (5%) or phenolic disinfectants. Animal remains, instruments and protective gear should be incinerated. Some of the VHF organisms are relatively stable, eg. in tissues held at refrigerator temperatures. Many of the VHFs are classified as Biosafety Level 3 or 4, therefore, any suspicion of infection with these agents mandates unusual precautions and immediate reporting to public health authorities.

VIRAL ENCEPHALITIDES FACT SHEET

CAUSE:

There are a number of viral encephalitidies. Venezuelan equine encephalitis (VEE), eastern equine encephalitis (EEE) and western equine encephalitis (WEE) are the most frequently considered encephalitis viruses. These are members of the Alphavirus of the Togaviridae family. This enveloped RNA virus has a 70nm diameter.

SPECIES SUSCEPTIBILITY:

Humans, non-human primates and equids are susceptible, as are a number of birds. Ratites seem particularly susceptible to EEE and WEE. VEE, WEE, and EEE viruses may be maintained in rodent-arthropod or bird-arthropod cycles in nature.

METHOD OF TRANSMISSION:

Transmission is through the bite of infected mosquito or through aerosol exposure. Most infections are normally confined to rodent/bird-mosquito cycles, which occasionally break out to infect horses, mules or burros. Horses are dead-end host for all but VEE, in which they achieve viremias high enough to infect mosquitoes. When mosquitoes are infected they are capable of transmitting the virus to other equids.

INCUBATION PERIOD:

In horses, neurological signs generally occur 5 days after infection. Human beings typically incubate the virus for 1-6 days.

PREVENTION OR VACCINATION:

Mosquito control and protection for human beings and horses from mosquito bites must be practiced during outbreaks. There are a number of effective repellant sprays and wipes available for both horses and human beings.

Killed veterinary vaccines for EEE and WEE are available and used widely in the United States for equines. Attenuated (TC-83) and killed (C-84) VEE vaccines, developed by the Department of Defense (DoD) for human beings, were used to halt outbreaks in horses in 1971. The killed vaccine is recommended in horses with initial vaccination being given in a set of 2 injections 30 days apart, followed by annual revaccination.

The DoD has killed vaccines for EEE and WEE for use as investigational drugs in human beings. The vaccine for VEE is a live, attenuated vaccine available as an investigational new drug for human beings. A second, formalin-inactivated, killed vaccine is available for boosting antibody titers in those initially receiving the previously mentioned attenuated vaccine. There is no post-exposure immunoprophylaxis.

SIGNS OR SYMPTOMS:

Clinical signs in horses include depression, lethargy, fever, evidence of impaired vision, irregular gait, circling, incoordination, yawning, grinding of teeth, drowsiness, bulbous lower lip, inability to swallow, inability to rise when down, paralysis, convulsions and death. Mortality in horses varies from 20-50% for WEE to 50-75% for VEE and 50-90% with EEE.

Human beings infected with VEE show flu-like illness, with only 0.5- 4.0% demonstrating neurological involvement. The disease presents as an acute systemic febrile illness with encephalitis developing in only a small percentage (4% children; <1% adults). Generalized malaise, spiking fevers, rigors, severe headache, photophobia and myalgias for 24-72 hours also occur. Nausea, vomiting, cough, sore throat, and diarrhea may follow. VEE may be lethal in children.

TREATMENT:

There is no specific treatment for these viral diseases. Supportive care and anticonvulsant medication is indicated as well as protection of the airways.

ENDEMIC AREAS:

VEE is endemic to central and northern South America, Trinidad and Mexico. EEE and WEE are endemic to areas of the United States.

DIAGNOSIS / LABORATORY TESTS:

Definitive diagnosis based on clinical signs alone is not possible, but clinical signs should raise suspicion of infection with one of these viruses. The virus may be isolated from the cerebral spinal fluid of febrile horses with acute infections. Virus may be isolated from serum early in the disease or from throat washes of acutely ill human patients. Virus can be identified by antigen ELISA or polymerase chain reaction, with appropriate primers. Serology using ELISA or hemoglutination inhibition can be used to identify antibodies, typically by the second week of illness.

HANDLING OF DEAD ANIMALS AND ENVIRONMENT CONTAMINATED BY EXUDATES:

Dead animals for necropsy should be handled with standard precautions. Animal remains, tissues, syringes, protective gear should be incinerated. Organisms are susceptible to drying and are inactivated by moist or dry heat. Surfaces should be cleaned to remove organic debris and disinfected with 1% sodium hypochlorite, 70% ethanol or 2% glutaraldehyde or formaldehyde.

SMALLPOX FACT SHEET

CAUSE:

Smallpox is caused by Variola virus, which is an Orthopoxvirus with a very narrow host range: man. Other orthopoxviruses have other hosts. There are at least 2 strains, variola major and variola minor. The disease caused by each strain is virtually indistinguishable, although variola minor is considered to run a milder course.

SPECIES SUSCEPTIBILITY:

Human beings are susceptible. Animals do not contract smallpox. They do contract other Orthopox viruses, at least two of which may be contagious to man. This includes monkeypox and cowpox. Sheep and goats may contract orf (sore mouth), which causes scabs and crusts on the mouth and, in humans, small rashes with limited numbers of pox-like lesions. Orf is caused by a parapoxvirus and should not be confused with smallpox.

METHOD OF TRANSMISSION:

In human beings, smallpox is easily transmitted by direct contact with an infected case, by fomites and by aerosol. As a weapon, it is believed variola would most likely be transmitted by aerosol distribution.

Smallpox is passed from human to human. Because of its species specificity it is not passed from humans to animals.

Monkeypox occurs naturally in West and Central Africa and causes sporadic human disease. It is passed to humans through close exposure to or through the bite of infected non-human primates or squirrels. Vaccinia, or cowpox, causes occasional mild disease in human beings, typically causing lesions on the hands. It is passed to humans by close contact with cows and, rarely, by infected cats.

INCUBATION PERIOD:

In people the incubation period of smallpox is 7-17 days, typically about 12 days.

PREVENTION OR VACCINATION:

Smallpox vaccines exist for human beings, but the supply is limited. Currently no vaccinations are given on a routine basis, as the disease has been eradicated globally. Post exposure vaccination is effective if given within the first week. Vaccine immune globulin (VIG) may also be effective when given the first week following exposure. It is not widely or easily available, although the US Army maintains a supply.

SIGNS OR SYMPTOMS:

In human beings the first manifestations of smallpox are malaise, fever, rigors, vomiting, headache and backache. About 10% of light skinned people develop a rash early in the course of the disease. The pox lesions begin on the face, hands and forearm and spread to the trunk over the next week. The lesions progress quickly from macules to papules then pustules. The lesions are preferentially found on the extremities of the body, but will be found on the trunk of the body, generally to a lesser degree except in severe cases. Lesions are also found on the palms and soles. These lesions appear generally in the same stage of development, as opposed to chickenpox in which lesions in all stages of growth are on the body at one time. Scabs form from 8-17 days after onset; these leave depigmented scars when healed. Patients should be isolated and considered infectious until all scabs separate. Variola minor carries a 1% mortality while variola major kills 3% to 30% of its victims. In variola naïve populations, mortality can exceed 50%.

In human beings, monkeypox may be clinically indistinguishable from smallpox. The only notable distinction found is in the cervical and inguinal lymph nodes which become greatly enlarged in monkeypox. Human beings infected with vaccinia (cowpox) develop pox like lesions limited to the point of entry of the virus, usually one or two nodules on the hands.

Smallpox does not occur in animals. In the US, the appearance of a large number of animals affected with pox-like lesions (macules proceeding to papules and pustules spreading over a wide area of the body) in species other than sheep and goats should raise suspicions of an engineered smallpox or vaccinial weapon release. When viruses cross species lines, signs may or may not be similar to the disease in the original species. For example, cowpox may cause either skin lesions or an unusual pneumonia in cats.

Dogs are subject to a wide variety of skin disorders possibly resembling pox-like diseases to the untrained eye. Most common are immune system diseases (lupus), bacterial folliculitis, and warts. The vesicles of immune system diseases are painless, they arise and disappear quickly, often within hours, and the active vesicles are filled with clear fluid. The dog or cat may or may not be febrile or feel ill. Warts arise on the mucous membranes of dogs, usually around the mouth. They are fleshy and numerous, coming up over days or weeks. They may take weeks or months to regress. They do not ulcerate and the animal is not ill. Bacterial folliculitis is common in the dog, rare in the cat, and is characterized by the appearance of small pustules, usually on the belly or back of a dog. These pustules are fleeting, and give way to circular crusts. They may be itchy, but the animal feels well. In contrast, pox lesions are generally large, solid or pustular, sometimes painful or itchy, last for several days and are usually accompanied by a systemic illness.

ENDEMIC AREA:

Smallpox was declared eradicated as a natural disease in 1980 by the World Health Organization (WHO). The last known case was in laboratory workers in 1978. WHO-approved stocks of variola virus still exist at the Centers for Disease Control in Atlanta and the State Research Centre of Virology and Biotechnology in Novosibirsk. It is speculated clandestine stockpiles may exist in other areas throughout the world.

DIAGNOSIS / LABORATORY TESTS:

The clinical course of smallpox in human beings is distinctive. Samples of scrapings from papules, vesicular fluids, pus or scabs may be viewed under electron microscopy. Under light microscopy, aggregations of variola virus particles, called Guarnieri bodies, are found. Use of Gispen's modified silver stain will color these inclusions black. These findings do not distinguish variola from the other Orthopoxviruses, such as vaccinia or monkeypox. Definitive diagnosis of smallpox can

be made with PCR or culture of the virus.

TREATMENT:

There is no specific treatment, other than supportive care. Cidofovir is an antiviral agent which has shown some promise in experimental animals.

HANDLING OF LIVE ANIMALS, CARCASSES, AND ENVIRONMENT CONTAMINATED BY EXUDATES:

Smallpox victims are considered infectious for 16-17 days. Droplet and airborne precautions should be taken for at least that long. This would include protective clothing, gloves and a mask of at least high-efficiency surgical mask caliber.

Normally it requires close person-to-person contact for transmission of smallpox. Virus spread *via* fomites has occurred, but it has required close and prolonged contact with the fomite. It is theoretically possible for the haircoat of an animal to act as a fomite, although this has not been reported. If convalescing and infective human beings are housed with their companion animals, such as in home quarantine, acts such as hugging the pet and allowing it to sleep in the bed may increase the viral load carried on the pet's fur. Contamination of the coat of livestock is highly unlikely, unless the animals are the epicenter of an aerosolized attack. If contamination is suspected, the living animal could be bathed. If human beings are quarantined, consideration should be given to extending the quarantine to household pets to eliminate risk of fur acting as a fomite.

BACTERIAL DISEASES OF CONCERN

ANTHRAX FACT SHEET

CAUSE:

The gram positive, spore-forming, non-motile capsulated bacteria *Bacillus anthracis* is the cause of anthrax. The bacilli is 4-8 μm x 1.15μm and grow in chains, but may be seen singly or in pairs. The organism exists in the infected host as a vegetative bacillus and in the environment as a spore. Spores do not form in the infected host unless the body tissues are exposed to air. Anthrax spores can survive adverse environmental conditions, and under ideal conditions can remain viable for decades.

SPECIES SUSCEPTIBILITY:

Human beings, cattle, sheep, goats, horses, pigs, and dogs are at risk; wildlife such as elephants, hippopotami, impalas, kudu, ostriches, bison, white-tailed deer and occasionally lions are also affected.

METHOD OF TRANSMISSION:

Infection of the skin is through contact with infected tissues, hair, wool and hides, and blood associated with infected animals. It is possible for biting flies to transmit the cutaneous form of the disease. Inhalation anthrax (Woolsorter's Disease) – the primary concern in the context of terrorism – results from the inhalation of spores which may be aerosolized from contaminated wool or hair. Intestinal and oropharyngeal anthrax result from the ingestion of contaminated, undercooked meats. There is no evidence of human to human spread.

The disease spreads among grazing animals through contaminated soil and feed, by blowflies depositing spores on scrub later eaten by browsers (e.g., goats and deer), and among omnivorous and carnivorous animals through contaminated meat or other feeds. Vultures may spread the organism from one area to another.

INCUBATION PERIOD:

The incubation period is generally between 1-6 days in people and animals.

PREVENTION OR VACCINATION:

A licensed human vaccine, an aluminum hydroxide-adsorbed preparation, is derived from culture fluid supernatant taken from an attenuated, acapsular, strain; the antigen is one of the three virulence factors, and is the protective antigen. A live non-encapsulated Sterne-strain vaccine can be used with comparative safety in all species of livestock and produces a high-degree of immunity.

SIGNS OR SYMPTOMS:

The first animal cases are characteristically found dead, in a bloated 'saw horse' posture and without rigor mortis; blood may be found at the mouth, anus, vagina, or penis. However, blood at body orifices is not a consistent sign.

Diagnosis in animals based on clinical signs may be difficult. Initially, peracute inhalation anthrax may manifest in cattle, sheep or goats as staggering, difficult breathing, trembling, collapse, convulsive movements and death. Acute anthrax in large animals follows a course of fever (may reach 107° F), a period of excitement followed by staggering, convulsions and death. Chronic anthrax typically manifests as local lesions on the tongue and oropharynx; it is most common in swine, but may occur in cattle, horses and dogs. Ventral edema may be noted. Cutaneous anthrax may also be seen in animals, typically after contamination of wounds with spores, but is not common.

Clinical signs and symptoms in human victims include fever, malaise, fatigue, cough and mild chest discomfort progressing to severe respiratory distress with dyspnea, diaphoresis, stridor, cyanosis and shock. Severe headache due to bleeding in the meningies of the brain also occurs. Hemorrhagic meningitis is evidenced on post mortem examination.

ENDEMIC AREAS:

Nearly worldwide; in the United States there are recognized regions of infection in North and South Dakota, Nebraska, Nevada, Arkansas, Mississippi, Louisiana, Texas and California. In Canada it is seen in Alberta and Saskatchewan, and in the Wood Bison National Park.

DIAGNOSIS / LABORATORY TESTS:

When large numbers of animals are found dead, anthrax may be suspected. The organism may be identified by demonstration of encapsulated bacilli in blood smears stained with polychrome methylene blue or Giemsa, or the organism may be identified by its growth characteristics in culture. It may also be identified on antigen ELISA or polymerase chain reaction.

TREATMENT:

Penicillin is the antibiotic of choice for cattle, horses and pet animals. Oxytetracycline and other antibiotics (chloramphenicol, gentamicin and ciprofloxacin) have been used effectively. Following herd exposure, sick animals should be treated with antibiotics and apparently well animals should be immunized. Prophylactic use of long acting penicillin for exposed cattle has proven effective but all such treated animals should be vaccinated 8-10 days later.

Recommended treatment for exposed people are high doses of antibiotic treatment with penicillin, ciprofloxacin, or doxycycline, although the effectiveness may be limited after the systemic symptoms have begun.

HANDLING OF DEAD ANIMALS AND ENVIRONMENT CONTAMINATED BY EXUDATES:

Dead animals should be disposed of by cremation, preferably with a napalm substance. Commercial napalm is much more efficient at disposal of an animal carcass, in less than a day, while other means of burning may take as long as 3 or 4 days. Burial is unacceptable, as spores from the carcasses will rise to the surface in subsequent rains to reinfect other animals.

Other associated items including tissues, syringes and protective gear should be incinerated or autoclaved. The organism is stable in the environment, but is inactivated by ultraviolet light, typically in a few days. Organisms protected from sunlight in soil may remain viable for months. Significant reaerosolization of spores from the soil is unlikely. Surfaces should be cleaned to remove organic debris and disinfected with 5% sodium hypochlorite (common undiluted household bleach).

BRUCELLOSIS FACT SHEET

CAUSE:

Brucellosis, also known as Bang's Disease is caused by a small coccoid or rod-like aerobic bacteria in the genus *Brucella*, which measures 0.5-1.5 micrometers in length. Four major species cause Brucellosis in both animals and human beings: *Brucella abortus, Brucella suis, Brucella melitensis,* and *Brucella canis.* The others, *Brucella ovis* and *Brucella neotomae* infect animals, but not human beings.

SPECIES SUSCEPTIBILITY:

The 6 species of *Brucella* have different host ranges. *B. abortus* affects cattle, water buffalo, bison, elk, reindeer, caribou, and occasionally horses. *B. suis* affects swine, caribou and occasionally horses. *B. melitensis* affects goats and sheep; *B. canis* affects dogs and coyotes; *B. ovis*, sheep; and *B. neotomae*, rodents.

METHOD OF TRANSMISSION:

Infectious organisms are shed in milk, uterine discharges and semen. The most common methods of infection are exposure to aborted fetuses and placental membranes, by ingestion of feed and water contaminated by genital discharges, by licking contaminated genitals of infected animals and by venereal transmission during breeding. Young animals can ingest the organism from the milk of infected dams. Less commonly, mechanical vectors can spread the disease. It is possible, although rare, for *Brucella* to spread *via* the conjunctiva and by inhalation.

The organism can survive in soil for 10 weeks, in liquid manure for 2 years, in goat cheese for 180 days at 4-8° C and in tap water for 60 days. It survives in carcasses and organs for 135 days and in blood at 4°C for 180 days. The bacteria are sensitive to heat (moist: 121° C for 15 minutes, or dry: 160-170 °C for 1 hour), ionizing radiation and most commonly used disinfectants (1% sodium hypochlorite, iodine/alcohol solutions, 70% ethanol, glutaraldehyde, formaldehyde) and are killed by pasteurization. Direct sunlight and dryness kills the bacteria within a few hours. Under the most favorable conditions the organism can survive in the environment for as long as 3-4 months.

In human beings the disease is called Undulant Fever or Malta fever. Human beings contract the disease by contact with infected material or tissues on abraded or unbroken skin, conjunctiva and mucous membranes; ingestion of raw milk and dairy products, from contact with infected animals or their secretions; and by inhalation of viable organism. On rare occasions infection can occur by self-inoculation with Strain 19 brucellosis vaccine used to vaccinate cattle. Individuals at the highest risk of exposure are veterinarians, veterinary technicians, packing plant workers, meat inspectors, farmers, artificial inseminators, and laboratory workers.

INCUBATION PERIOD:

Incubation in both human beings and animals varies between 5 - 60 days.

PREVENTION OR VACCINATION:

Individuals handling infected animals or materials should follow universal precautions including mask and frequent hand washing. Milk and dairy products should be pasteurized. Infected animals should be isolated from non-infected animals, even of other species, and culled from the herd. Exposed animals should be tested for the disease. Handlers should tend to non-infected animals before infected ones. Equipment and supplies used on infected animals should not be used on non-infected ones. Only test-

negative animals should be added to the herd or used for breeding. Prior to addition they should be isolated and re-tested in 30 days. They should only be added to the herd if still negative.

Calves may be vaccinated with Strain 19 or Strain RB 51 vaccines according to manufacturer's and government recommendations. Immunization of rams with 2 doses of killed *B. ovis* bacterin has been used in some countries and immunization with attenuated (Rev 1) *B. meletensis* vaccine has been used.

SIGNS OR SYMPTOMS:

Abortion is the most common sign of the disease. Cattle may have retained placentas, stillborn or live but weak calves, and altered or reduced milk yield. Although infected cattle usually only abort once, they may shed organisms at subsequent normal parturitions. Infection of the seminal vesicles, prostate, epididymus, ampullae, testes (abscesses), placenta, and prolonged vaginal discharges may occur. Canines may have lymphadenitis, carpal hygromas, lameness, posterior paralysis, arthritis, discospondylitis and spondylitits. Permanent infertility of the male can occur in some species. Semen quality may deteriorate. The disease manifests in horses as fistulous withers and poll evil.

TREATMENT:

There is no effective treatment for Brucellosis in animals. The goal is to eradicate the disease from the United States through testing, identification and culling infected or suspect animals from the herd. Treatments include sodium iodide for fistulous withers in horses; surgery for hygromas and fistulous withers; chlortetracycline and streptomycin in valuable breeding rams; a combination of streptomycin or gentamycin and tetracycline in dogs; and trimethoprim-sulphamethoxazole in dogs. Generally antimicrobial treatment is unsuccessful. Control based on testing and elimination of infected animals is the best procedure.

DIAGNOSIS / LABORATORY TESTS:

Diagnosis of Brucellosis is based on clinical signs, culture of the organisms from the placenta, fetus, uterine discharges or other suspected tissue, (joint fluid, disks etc.), and fluorescent antibody testing of placenta and fetus. Serological testing of serum, milk, udder secretions in the non-lactating animal and semen is helpful. Specimens for laboratory submission include aborted fetuses, fetal stomach contents, fetal lungs, any other fetal lesion, placenta or placental cotyledons, uterine discharges, material from joints, semen, milk or colostrums, whole blood, paired serum samples and mammary lymph nodes. Though not commonly used, the most sensitive bacterial isolation test is inoculation of guinea pigs intramuscularly with suspected tissue homogenates. After several weeks, serology or culture of the spleen and any infected tissues confirms the diagnosis. Due to specialized culture requirements and the public health hazard of the organism, cultures should only be performed at appropriate laboratories.

Because Brucellosis is a public health concern, testing procedures and treatment of various species may be dependent upon government regulations. Consultation with a state or federal veterinarian and/or state diagnostic laboratory is strongly recommended.

HANDLING OF DEAD ANIMALS AND ENVIRONMENT CONTAMINATED BY EXUDATES:

Animals usually do not die from Brucellosis. Those that do should be incinerated or buried deeply. Infected animals or animals classified as suspect by serological testing can be sent to slaughter and the meat used for food purposes if the reproductive organs

and mammary glands are removed.

CHOLERA (*VIBRIO CHOLERAE*) FACT SHEET

CAUSE:

Cholera is caused by *Vibrio cholerae*, an oxidase positive, curved, gram negative, motile, halotolerant bacillus which colonizes the proximal small intestine. The diarrheagenic effects of colonization with *Vibrio cholerae* are caused by *V. cholerae's* ability to elaborate two enterotoxins: CTX cholera toxin, and/or a heat stable toxin (ST). The latter is related to the heat stable toxin produced by enterotoxigenic *E. coli.* STh is generally produced by human-associated strains, and STp toxin is usually associated with strains of porcine origin. Production of CTX is conferred on the bacterium by bacteriophage. Both toxins produce intracellular increases in cyclic nucleotide monophosphate levels (AMP for CTX and GMP for ST), causing massive electrolyte flux (chloride ion efflux) in the bowel, thus profuse watery diarrhea.

SPECIES SUSCEPTIBILITY:

Human epidemic disease is usually associated with either 01 or 0139 strains. Veterinary cases are predominantly caused by non-01 and non-0139 strains of *V. cholerae*, which are endemic and can still cause severe diarrhea in human beings. Non-01 and non-0139 *V. cholerae* strains are documented to be responsible for diarrheal disease in sheep, lambs, goats, cattle, bison, equines, tortoises, and marine mammals, among others.

METHOD OF TRANSMISSION:

Cholera is transmitted by ingestion of contaminated food or water. *Vibrio* organisms are halotolerant; they survive well in brackish or salt water. Shellfish, such as shrimp, scallops, lobster, or oysters can become contaminated and can spread disease if undercooked or consumed raw. In one recent sampling, strains of both 01 and non-01 *V. cholerae* were isolated from feces of 17% of healthy aquatic birds, showing these birds serve as carriers capable of distributing *V. cholerae* over a wide area. It has also been demonstrated desert species, like the desert tortoise and camelids, can serve as vectors; the organism can be isolated from the feces of these species. *V. cholerae* survives well in water and can be isolated directly from water sources. It can also survive in viable but non-culturable states in water.

Cross-species transmission of *Vibrio cholerae* occurs readily, and is integral to the method of transmission of the disease world-wide. Reservoirs appear to be aquatic birds, shellfish and other seafood, and some water-retentive desert species, such as camels.

INCUBATION PERIOD:

The incubation period of cholera is between 4 hours and 5 days, with the average of 2 to 3 days upon ingestion of 10-500 organisms for human beings. In herbivores, the incubation period is variable, presumably dependent upon the numbers of organisms ingested. Death may occur in as little as 24 hours to 3 days.

PREVENTION OR VACCINATION:

Prevention can be achieved by washing hands carefully after defecation, and by making sure sanitation is adequate. Water run-off and sewage should be prevented from seeping into potable water sources. Water used for washing fresh fruit and vegetables should not be contaminated. Shellfish should be thoroughly cooked and those consumed raw should be from areas not contaminated with feces or the organism.

One vaccine, available in the US through Wyeth-Ayerst against *V. cholerae* 01, is

not well-tolerated and confers only short term protection in endemic areas. It is not recommended for protection against cholera in endemic areas. Production and sale of this vaccine is scheduled to be discontinued.

Two vaccines are available outside the United States and may be obtained for human use but they are not approved in the US. A third vaccine, Orochol is under development in Switzerland. All these vaccines are for *V. cholerae* 01. There are no vaccines available for *V. cholerae* 0139.

SIGNS AND SYMPTOMS:

In human beings, symptoms include abrupt onset of vomiting without nausea, abdominal distension and variable to profuse watery ("rice water") diarrhea. Copious fluid loss causes hypotension, hypovolemia, tachycardia, tachypnea, cyanosis, hemo-concentration and shock. The fluid depletion causes rapid loss of potassium reserves, metabolic acidosis, and renal failure. Stool samples of the watery diarrhea lack overt blood and neutrophils. Symptoms last 2 to 7 days and, if rehydration therapy is effective, is rarely fatal. Without rehydration therapy, a high degree of mortality can be expected.

In herbivores, presentation of *V. cholerae* non-01, non-0139, can be precipitous. Death in goats can result without overt clinical signs, similar to death from *Clostridium perfringens* infection. Affected lambs die within 24 hours of onset of pneumonia and diarrhea. Previously healthy foals can die rapidly of respiratory and heart failure, and upon necropsy be found to be suffering from *V. cholerae*-associated gastroenteritis. Bison exhibit severe depression prior to onset of diarrhea, dying in about 3 days. In case reports, although lesions of the bison were limited to the gastrointestinal tract, *V. cholerae* was isolated from the abomasum, duodenum, and colon.

Differential diagnoses should rule out other causes of diarrheal disease, such as enterotoxigenic *E. coli*, rotavirus infection, or ingestion of preformed toxins from other organisms such as *Clostridium perfringens*, *Staphylococcus aureus*, or *Bacillus cereus*. Salmonellosis, and campylobacteriosis should be ruled out, as well as ehrlichioses such as Potomac Horse Fever in equines. Infection with cyclospora or cryptosporidium should also be considered.

ENDEMIC AREAS:

Epidemic *Vibrio cholerae* serogroup 01 is divided into 2 serotypes (Inaba and Ogawa), and two biotypes (classical and El Tor). Classical strains are found primarily in Bangladesh, and El Tor strains are found in Asia, Africa and South America. Cases of cholera in the US are generally from consuming shellfish from the Gulf of Mexico, and are Inaba strains. *V. cholerae* 0139 first appeared in 1992 in Bangladesh and India as a new epidemic strain. Other strains of *V. cholerae* are included together in the grouping non-01/ non-0139. These organisms may or may not produce CTX or ST, and though they produce diarrheal disease in animals as well as people, are called endemic strains. Non-01/Non-0139 strains are found worldwide.

DIAGNOSIS / LABORATORY TESTS:

Stool samples should be submitted for culture and dark field examination for organisms 24 and 48 hours after symptoms begin. Rectal swabs can be sent for culture if submitted in Cary-Blair medium. Serum electrolytes should be monitored as necessary to gauge effectiveness of rehydration therapy.

A rapid diagnostic kit, SMART kit, is now available from New Horizons Diagnostics of Columbia, MD. Identification of *V. cholerae* isolates can be made by specific agglutination of commercially available 01 or 0139 antisera.

TREATMENT:

Rehydration therapy should begin immediately with IV lactated Ringer's (LR) solution, if available, and with oral rehydration solution (ORS). For human beings, LR solution should be given and hydration status should be reassessed every half-hour thereafter. When blood pressure has returned to normal, infusion can be slowed. ORS should be included as well as IV therapy, even if vomiting is present. Several brands of ORS are available commercially. Those made with rice instead of dextrose or glucose result in shorter duration of diarrheal symptoms. One made with rice called CeraLyte, is available from Cera Products. ORS can be made by adding 3.5 g NaCl, 2.5 g $NaHCO_3$, 1.5 g KCl and 20 g glucose to 1 liter of water.

Antibiotic therapy is effective in cases of cholera, unlike some other forms of diarrheal disease, and will decrease fluid loss and duration of diarrhea. Antibacterial sensitivity testing should be performed, since many strains of *V. cholerae* are resistant to many drugs. For human beings, treatment with ciprofloxacin for 3 days or norfloxacin for 3 days is effective in tetracycline or doxycycline resistant strains. Other drugs that may be useful are trimethoprim, sulfmethoxazole, or furazolidone.

HANDLING OF DEAD ANIMALS AND ENVIRONMENT CONTAMINATED BY EXUDATES:

Precautions include careful handling of diarrhetic feces. Standard precautions for healthcare workers are sufficient to preclude infection by handling contaminated carcasses or equipment. Gloves should be worn, and careful hand washing with soap and hot water should be scrupulously required. Creation of secondary aerosols from infected material is not a concern. All equipment should be washed and sterilized after use. Decontamination can be done by addition of 5% sodium hypochlorite solution (household bleach) to 10% of volume of disposed material. Material should be thoroughly mixed prior to disposal. Carcasses should be incinerated. Deep burial is not adequate, as *V. cholerae* survives in damp ground and water.

GLANDERS FACT SHEET

CAUSE:

Pseudomonas mallei (*Bacillus mallei or pseudomallei)* are pleomorphic bacteria varying in size and shape from coccoid to long slender rods ranging from 0.3 to 0.5 ìm in width and 0.7 to 5.0 ìm in length. They are gram negative organisms. The organism is susceptible to heat, light and disinfectants and is unlikely to survive in a contaminated area for greater than 6 weeks. However, humid or wet conditions favor the survival of the organism.

SPECIES SUSCEPTIBILITY:

Horses, donkeys, mules, asses, cats, dogs, goats and man are susceptible. Sheep, swine and cattle are highly resistant.

METHOD OF TRANSMISSION:

The disease is contracted by ingesting food or water contaminated by the nasal discharge of carrier animals. The organism is present in exudates of the nose and ulcerated skin or exudates from the ulcers of infected animals and may be passed between animals by inhalation. Contaminated equipment, harness and tack have been implicated in spreading the infection. Infection may spread through contact with wounds or exudate, especially in necropsy and laboratory workers. Other animals, especially cats, may contract the disease through ingestion of contaminated meat. Abattoir workers may acquire the disease through handling of infected meat.

Animals consuming infected meat develop the disease. Also, man may acquire the disease through handling of infected meat, coming into contact with exudate of the lesions or through inhalation of the agent.

INCUBATION PERIOD:

Incubation is approximately 10-14 days in animals and people.

PREVENTION OR VACCINATION:

There is no vaccine. Sanitation is helpful in preventing spread of the disease between infected animals and unexposed animals. Isolation of infected animals may help reduce transmission between animals.

SIGNS OR SYMPTOMS:

Following the incubation period, animals usually have high fever and septicemia, then develop a thick mucopurulent nasal discharge and respiratory signs. Death usually occurs within a few days. There is a chronic, debilitating form in horses with nodular or ulcerative cutaneous and nasal lesions. These animals may live for years as carriers, capable of spreading the disease. The prognosis is poor and even animals recovering often do not have immunity.

There is more than one form of Glanders and animals may have multiple forms concomitantly. The nasal form involves nodules in the mucosa of the nasal septum and lower turbinates. These progress to deep ulcers.

The pulmonary form involves small tubercle-like nodules having caseous or calcified centers surrounded by inflammatory zones in the lungs. This progresses to consolidation of the lung tissue.

Farcy is the name of the cuteous form, where nodules appear and follow the course of the lymph vessels, particularly in the extremities. The nodules degenerate into ulcers with a very infectious, sticky, pus, and discharge.

In people the disease causes fever, rigors, sweats, myalgias, headaches, pleuritic chest pain, cervical adenopathy, hepatosplenomegaly and generalized papular/pustular eruptions especially at the corners of the mouth. The acute pulmonary disease may result in bacteremia and acute septicemia. Without treatment, both bacteremia and septicemia may be fatal.

ENDEMIC AREAS:

Glanders was once prevalent worldwide but has been eradicated in the US. There have been reports of the disease in Turkey, India, Mongolia and China but not in the past decade.

DIAGNOSIS / LABORATORY TESTS:

The mallein test is the test of choice. This test produces a hypersensitivity type of reaction when the mallein is injected subcutaneously or intrapalpebrally. Mallein is glycoprotein produced by *P. mallei* in glycerol broth which is extracted by alcohol precipitation. Complement fixation is sensitive, but occasionally produces false positive results. The Enzyme-Linked Immuosorbent Assay (ELISA) has been demonstrated to be more sensitive than complement fixation. The causative agent can typically be cultured from exudate of the skin lesions.

HANDLING OF DEAD ANIMALS AND ENVIRONMENT CONTAMINATED BY EXUDATES:

The organism does not survive well outside the body as it is susceptible to heat, light and disinfectants. It is unlikely to survive greater than 6 weeks in the environment. Surfaces are easily decontaminated with 0.5% hypochlorite solution. Sick animals should be isolated from the herd. Gloves and respiratory protection should be used when working with diseased patients. Dead animals may be incinerated or buried.

PLAGUE FACT SHEET

CAUSE:

Plague is caused by the gram-negative rod *Yersinia pestis.* It is a bipolar staining rod which is indole negative. The colonies can take 48 hrs to develop on culture media.

SPECIES SUSCEPTIBILITY:

Species susceptible to Plague include cats, wild felidae such as Bobcats, dogs, rabbits, hares, rodents (especially Prairie dogs), Flying Squirrels, and rats.

METHOD OF TRANSMISSION:

The most common method of transmission of Plague is through the bite of a flea. Wild or domestic rodents may carry the disease as well as fleas, and thus are notable vectors of disease spread among populations living in close contact with them. Plague is also transmitted by inhalation of droplets in air or from exudates. Thus, handling infected animals, their tissues or bodily fluids is likely to result in infection.

Because cats are sensitive to *Yersinia* and live in close proximity to people, domestic cats can easily pass Plague to humans in endemic areas. The primary lesions in cats are enlarged submandibular lymph nodes, which resemble a common catfight abscess. Rupture of a node may aerosolize the agent or allow it to penetrate abraded skin, resulting in infection of the handler. Cats more rarely develop pneumonic plague, passing the agent through the air as they cough or sneeze. Pneumonic plague both in cats and human beings is considered the deadliest form, with high mortality rates if not diagnosed and treated promptly.

INCUBATION PERIOD:

The incubation period in cats is 1-2 days. Pneumonic plague in people has an incubation of 1-6 days. Bubonic plague in people has an incubation period of 2-10 days.

PREVENTION OR VACCINATION:

Prevention of naturally occurring plague is best achieved through flea control and strict isolation of infected animals. Aggressive flea control with a product having a residual effect such as 5% carbaryl dust, and elimination of contact with wild rodents or rabbits and their fleas is recommended. Cats may be easily intoxicated by many insecticides; use only agents labeled safe for this species when treating felines or their contact environment. Applications of Frontline®, or monthly applications of Advantage®, or Revolution® is effective in eliminating adult fleas and is safe in most species, including dogs, cats and ferrets. Program® is safe in all mammal species and prevents fleas from reproducing, but does not eliminate adult fleas.

Standard precautions, including a single use, high efficiency filtration surgical mask, gloves and hand washing should be used whenever handling Plague-infected animals or tissues. Respiratory protection should be worn for at least 2 days after respiratory signs cease in the animals or 4 days after treatment is completed if no respiratory symptoms are evident. People handling these animals may be prophylaxed with antibiotics. No vaccine is currently available for people or animals.

SIGNS OR SYMPTOMS:

There are 2 forms of Plague, the pneumonic form and the bubonic form. In Bubonic plague the primary signs are swollen lymph nodes, which may abscess and burst. These are known as buboes. In the Pneumonic form, respiratory signs predominate.

Prairie dogs are very sensitive to plague, but the cat may be the most sensitive domestic animal. The primary clinical signs in the cat include buboes, especially of the head and neck, and fever up to 106° F. The bubonic form can progress to the pneumonic form with coughing and sneezing, pleuritis and salivation. Septicemia may develop and

often leads to death.

Signs in dogs may include fever as high as 105°F. The disease in dogs usually lasts only a few days with rapid recovery.

In human beings the clinical signs include high fever, chills, headache, malaise, and myalgia followed by a cough, often with hemoptysis. This may progress rapidly to dyspnea, stridor, cyanosis and death. Death results from respiratory failure, circulatory collapse, and a bleeding diathesis. Bubonic plague in human beings features high fever, malaise, and painful lymph nodes (buboes) and may progress spontaneously to the septicemic form (septic shock, thrombosis, DIC) or to the pulmonary form.

TREATMENT:

Animals may be treated with doxycycline, amoxicillin, streptomycin or tetracycline. Treatment should be continued for at least 5 days after temperature returns to normal. Infected lymph nodes should be drained.

In human beings early administration of antibiotics is critical; pneumonic plague is invariably fatal if antibiotic therapy is delayed more than 1 day after the onset of symptoms.

ENDEMIC AREAS:

Plague is endemic in many areas of the western and southwestern United States.

DIAGNOSIS / LABORATORY TESTS:

Yersenia pestis can be easily cultured from exudates, especially from purulent material, blood and tissues. Plague may also be diagnosed by fluorescent antibody testing of lymph node aspirates. Evidence of the disease can be obtained by serology or on chest radiographs. Material should be submitted to the State Health Department Laboratory or CDC Plague Laboratory in Fort Collins, Colorado. Contact laboratories for appropriate transport media and shipping instructions.

HANDLING OF DEAD ANIMALS AND ENVIRONMENT CONTAMINATED BY EXUDATES:

Animals suspected of dying from Plague should be handled carefully. The body should be sprayed with an insecticide to rid the animal of any remaining fleas. Care must be taken to avoid aerosolizing the agent, as it is quite infectious. Anyone handling the body should use standard precautions, including a mask. Necropsies may be conducted in biosafety cabinets and care must be taken to avoid the generation of aerosols during the necropsy. Animal remains, tissues, syringes and protective gear should be incinerated. The organism is susceptible to drying and does not survive beyond 2-3 hours unless protected by organic material. It is also sensitive to moist heat of 121°C for 15 minutes and dry heat of 160-170°C for 1 hour. Surfaces should be cleaned to remove organic debris and disinfected with phenolic or iodophor disinfectant. The organism is also sensitive to the following disinfectants: 1% sodium hypochlorite, 70% ethanol, 2% glutaraldehyde, iodines, phenolics, and formaldehyde.

TULAREMIA (*FRANCISELLA TULARENSIS*) FACT SHEET

CAUSE:

The causative agent of tularemia (Rabbit Fever or Deer Fly Fever) is the bacterium *Francisella tularensis*, an aerobic, non-motile, encapsulated, facultative intracellular, gram-negative cocco-bacillus. Tularemia is a zoonotic disease. It is transmitted between animals by the bite of infected ticks, deer flies, mosquitoes, or fleas. There are 2 biovars of *Francisella tularensis*, biovar *tularensis*, and biovar *palearctica*, which have different virulence in affected species, different biochemical fermentation reactions, and different geographic areas of endemicity worldwide. *F. tularensis* is highly infectious, is easily aerosolized, and can cause disease in human beings with as few as 10-50 organisms. Tularemia was weaponized for use as a biologic agent by the US in the 1960's.

SPECIES SUSCEPTIBILITY:

Tularemia has been documented in over 100 species of animals, including man and non-human primates. *F. tularensis* has been recovered from the tissues of mice and rats, wild ground squirrels, prairie dogs, muskrat, beaver, skunks, mink, opossum, foxes, coyotes, bears, chickens, pheasant, quail, snakes, deer, cattle, sheep, rabbits, domestic dogs and cats, aquatic mammals such as whales, and from more exotic animals from zoologic garden settings. Scavenger birds such as raptors and corvids are demonstrably less susceptible to tularemia than other birds, and are not significant vectors.

METHOD OF TRANSMISSION:

Tularemia is transmitted to animals and man by means of over 55 types of infected arthropod vectors, as well as over 100 non-arthropod vectors. At least 13 species of ticks in the US, lice, mosquitoes, deer flies (*Chrysops discalis*), and fleas transmit tularemia to other species. Ticks commonly infected, and constituting the principle reservoir of *F. tularensis* in the US, include *Dermacentor andersoni* (Rocky Mountain Tick), *D. variabilis* (Western Wood Tick), *D. occidentalis* (Eastern Dog Tick), *Amblyomma americanum* (Lone Star Tick), and *Hyemaphysalis leporis-palustris* (Rabbit Tick, for both Cottontail and Jackrabbits). Transovarial passage of the organism in ticks has been documented, and the organism is transmitted to other animals by exposure to tick fecal material. Transmission of the organism through tick saliva has not been documented. Tularemia can also be transmitted by means of water contaminated with fecal material from infected animals, such as water rats, beaver, or muskrat. Most human cases of tularemia in the US come from contact with infected rabbits, by cat-bite, through laboratory exposure, and by means of tick bite. Transmission has also been documented by means of handling of fresh-cut or stored hay.

Natural outbreaks of Tularemia each year in human beings are bi-modal, with the May-August peak corresponding to cases associated with tick-bite, and the December-January peak associated with exposure of hunters to infected game. Cross-species transmission occurs by infected vector, by bite-wound, and by aerosolization of the organism from infected animals. Person to person transmission is rare or non-existent.

INCUBATION PERIOD:

The incubation period for Tularemia in human beings ranges from 2-10 days, with 3-5 days as the average, and is variable according to the infectious dose of organisms and route of exposure. In animal species, the incubation period is highly variable, and can be without apparent prodromal signs. In sheep, which are the primary domestic animal host, presence of flock-wide Tularemia can be the cause of severe precipitous economic loss in

combination with environmental stressors such as inclement weather, high parasite load, or lambing in ewes.

PREVENTION OR VACCINATION:

Prevention of infection can be done by using gloves when skinning or dressing wild game. Care should be taken to prevent production of aerosols from animals with known or suspected Tularemia infection. In cases of known infection, wearing a HEPA-filter mask is necessary. Infection by ticks can be prevented by the use of pyrethrins to prevent tick bite. A live attenuated vaccine for Tularemia (LVS) originally identified in the USSR was further characterized by USAMRIID at Ft. Detrick, MD. and is available through this laboratory. Administration of the LVS has been documented to confer variable immunity or decrease in severity of disease for some species. The vaccine is administered as a single dose by scarification intradermally. No passive immunity by means of specific immune globulin is available. Prophylaxis of personnel prior to exposure is conferred by ciprofloxacin, doxycycline, or tetracycline at the recommended dosage. Two-week treatment with antibiotics is also effective post-exposure if given within 24 hours.

SIGNS OR SYMPTOMS:

In human beings, Tularemia presents in 6 different forms depending upon the route of inoculation. The 6 forms are typhoidal (5-15%), ulceroglandular (75-87%), glandular (5-10%), oculoglandular (1-2%), oropharyngeal (ulceroglandular infection of the throat), and pneumonic (post-inhalation or secondary to systemic hematogenous spread). Regardless of route of exposure or presentation, symptoms in people include abrupt onset of fever, chills, headache, cough, pharyngitis, myalgia, and vomiting, with or without regional lymphadenopathy. Symptoms generally subside in 1-3 days, but recur with illness continuing between 3 weeks and many months. Long-term symptoms include muscle weakness, alternate sweating and chills, and weight loss. In animals, a variety of signs occur.

In prairie dogs, dehydration, ataxia, and severe diarrhea can occur with massive purulent plague-like bronchopneumonia. On necropsy, pinpoint white multifocal lesions are appreciated throughout the liver and spleen. In cats, signs include pyrexia, lethargy, vomiting or anorexia, dehydration, depression, oral ulceration, icterus, regional or generalized lymphadenopathy, pneumonia, and hepatosplenomegaly. The hematologic picture shows profound leukopenia, with high numbers of band neutrophils and severe toxic changes of the neutrophils, thrombocytopenia, and hyperbilirubinemia. At necropsy, oropharyngeal and lingual ulcerations are prominent, with multifocal necrosis of the spleen, liver, lungs and lymph nodes. Intestines may show diffuse enterocolitis.

Rule-out diagnoses include Melioidosis, Glanders, Rat-bite Fever, Sporotrichosis, Salmonella, Rickettsial infection, Malaria, Plague, Mycoplasma pneumonia, inhalation Anthrax, and exposure to Staphylococcus enterotoxin B or other enterotoxins.

ENDEMIC AREAS:

Tularemia is a disease of the Northern Hemisphere between 30 and 71 degrees north latitude, with the exception of the UK. Areas affected are the US, Canada and Mexico, the Far East, including Japan and the Independent States of the Former Soviet Union, Europe and Scandinavia. The two biovars of *F. tularensis* have different geographic distributions. Biovar *tularensis* (Jellison type A strains) are found only in North America, and are highly virulent for human beings and rabbits. These strains ferment glycerol and produce citrulline ureidase. Biovar *palearctica* (Jellison type B strains) are distributed worldwide, and cause less severe disease in human beings and are

usually avirulent for rabbits. These strains do not ferment glycerol and do not have citrulline ureidase activity.

DIAGNOSIS / LABORATORY TESTS:

Within 24 hours of discovery of a suspect case, nasal swabs, sputum and other respiratory secretions should be collected for culture, PCR and fluorescent antibody testing. Between 24-72 hours after onset of signs or symptoms, blood should be taken for culture, and blood and sputum should be taken for FA and PCR. Serum should be collected for acute serum IgG and IgM titers. Convalescent serum titers, IgG and IgM, should be taken 6-14 days after onset of symptoms. Bacterial isolates can be positively identified by agglutination of specific antisera.

TREATMENT:

Francisella tularensis infection responds readily to antibiotic treatment. The drug of choice for treatment of Tularemia is streptomycin, which is bactericidal. If cases are thought to be due to a bioterrorist event, choice of an alternative drug would be prudent, as a weaponized *F. tularensis* has been developed to include genes conferring resistance to streptomycin. In animals, *F. tularensis* is also susceptible to streptomycin and other aminoglycosides such as gentamycin and amikacin. Ciprofloxacin may be used for prophylaxis in human beings and the similar drug enrofloxacin in animals. Doxycycline and tetracycline may also be used in most species, including human beings.

HANDLING OF DEAD ANIMALS AND ENVIRONMENT CONTAMINATED BY EXUDATES:

Extreme care should be utilized in the handling of live or dead animals suspected to be infected with *F. tularensis*. Because *F. tularensis* can be spread by aerosol it should be considered as a Biosafety Level (BSL)-3 biologic agent. Bacteriologic culture should only be attempted in a BSL-3 biocontainment facility. Laboratory samples for identification should be treated with the same precautions. Carcasses should be handled with gloves and surgical or HEPA-filter masks should be worn. All instruments should be autoclaved or chemically disinfected after use. Boots should be decontaminated and exchanged for fresh footwear prior to leaving the necropsy area. Carcasses must be incinerated or reduced by alkaline digestion or domestic napalm. Commercial domestic napalm is more effective in disposing of carcasses. It eliminates the carcass in less than 24 hours while other means of burning require 3 to 4 days. Care should be exercised so as not to create aerosols, since as few as 10-50 organisms can cause disease by inhalation. Since *F. tularensis* can gain entry through inapparent breaks in normal healthy skin, accidental skin contamination should be treated seriously, and decontamination with soap and warm water should be immediate. Surfaces can be decontaminated with 5% sodium hypochlorite solution (household bleach), or Environ One-Stroke from Steris Corporation.

REFERENCES

Aiello, Susan E. (ed), (1989) *The Merck Veterinary Manual,* 8th edition, Merck and Co. Inc., Whitehouse Station, New Jersey.

Ashford, DA, Gomez, T, Noah, DL, *et al*. Biological terrorism and veterinary medicine in the United States, Journal of the American Veterinary Medical Association, Nov, 2000.

Aug Hinrichs U, van de Poel, H, van den Ingh, TS, (1999) Necrotizing pneumonia in a cat caused by an orthopox virus, Journal of Comparative Pathology, 121(2):191-196.

Baldwin, CJ, Panciera, RJ, Morton, RJ, Cowell, AK, Waurzyjniak, BJ. (1991), Acute tularemia in three domestic cats, Journal of the American Veterinary Medical Association, 1602-1605.

Barton EJ., Pfaller, MA., Tenover, FC., Yolken, R.H., and Murray, P.R. (eds), *Manual of Clinical Microbiology,* 6th edition, American Society for Microbiology Press, Washington, DC.

Bell, JF, Wikel, SK, Hawkins, WW, Owen CR (1978) Enigmatic resistance of sheep (*Ovis aries*) to infection by virulent *Francisella tularensis*, Canadian Journal of Comprehensive Medicine 42(3):301-305.

Biological Warfare and Terrorism - The Military and Public Health Response- Sponsored by Public Health Training Network, CDC, FDA, and The United States Army Medical Research Institute of Infectious Diseases- Satellite Broadcast- September 21-23, 1999.

Biological Warfare and Terrorism- Medical Issues and Response – Anthrax. Manual pp 12-16. Sponsored by the Public Health Training Network, CDC, FDA, and The United States Army Medical Research Institute of Infectious Diseases- Satellite Broadcast- September 26-28, 2000.

Biological Warfare and Terrorism - Medical Issues and Response - B.W.agents: Vaccine, Therapeutics, and Prophylaxis. Appendix E, Manual page D-1. Sponsored by the Public Health Training Network, CDC, FDA, and The United States Army Medical Research Institute of Infectious Diseases- Satellite Broadcast- September 26-28, 2000.

Biological Warfare and Terrorism- Medical Issues and Response – Glanders. Manual pp 21-25. Sponsored by the Public Health Training Network, CDC, FDA, and The United States Army Medical Research Institute of Infectious Diseases- Satellite Broadcast- September 26-28, 2000.

Biological Warfare and Terrorism - Medical Issues and Response - Q-fever. Manual pp 31-34. Sponsored by the Public Health Training Network, CDC, FDA, and The United States Army Medical Research Institute of Infectious Diseases- Satellite Broadcast- September 26-28, 2000.

Biological Warfare and Terrorism - Medical Issues and Response – Tularemia. Manual pp 35-40. Sponsored by the Public Health Training Network, CDC, FDA, and The United States Army Medical Research Institute of Infectious Diseases- Satellite Broadcast- September 26-28, 2000.

Bottone, EJ, (1983) *Francisella tujlarensis, Pasturella*, and *Yersinia pestis* IN: Gorbach, SL, Bartlett, JG, Blacklow, NR, Petersdorf, RG, Adams, RD, Braumwald, E, Isselbacher, KJ, Matin, JB, Wilson, JD. (eds) *Infectious Diseases,* 2nd Edition, W.B. Saunders Company, Philadelphia, PA, pp. 1819-1824.

Buchanan, TM, Hook, EW, Tularemia, IN: *Harrison's Principle's of Internal Medicine*, 10th edition, McGraw-Hill Book Company, New York, NY pp.977-979.

Canadian CDC Material Safety Data Sheets found at:
http://www.hc-sc.gc.ca/hpb/lcdc/biosafty/msds/index.html

Carpenter, CCJ, Cholera, IN: *Harrison's Principle's of Internal Medicine*, 10th edition, McGraw-Hill Book Company- New York, NY, pp. 996-998.

Coltran, RS, Kumar, V, Collin, T, (eds) (1974) *Robbins Pathologic Basis of Disease*, 1st edition, W.B. Saunders Company Publisher, Philadelphia, PA.

Dodin, A, Chamoiseau, G, Lepers, JP, and Chartier, C, (1986), Transmission of *Vibrio cholerae*: Possible role of the camel, CR Academy of Science III 303(13):557-559.

Evans, ME, and Friedlander, AM, (2000) Tularemia, IN: Zajtchuk BG.R, (ed), *Textbook of Military Medicine- Medical Aspects of Chemical and Biological Warfare*. Published by Office of the Surgeon General.

Gillespie, J.H., Timoney, J.F (1981) *Hagan and Bruner's Infectious Diseases of Domestic Animal*s, Cornell University Press, Ithaca, NY.

Gilligan, K. Shipley, M, Stiles, B, Hadfield, TL, Ibrahim, SM, (2000) Identification of *Staphlococcus aureus* enterotoxin A and B genes by PCR-Elisa, Molecular Cell Probes 14(2):71-78.

Gorbach, SL, Bartlett, JG, Blacklow, NR, Petersdorf, RG, Adams, RD, Braumwald, E, Isselbacher, KJ, Matin, JB, Wilson, JD. (eds), (1983) *Infectious Diseases,* 2nd Edition, W.B. Saunders Company, Philadelphia, PA.

Harper, GJ, (1961) Airborne micro-organisms: survival test with four viruses, Journal of Hygiene 59:479-486.

Higgins,JA, Hubalek, Z, Halouzka, J, Elkins,KL, Sjostedt, A, Shipley, M and Ibrahim MS, (2000) Detection of *Francisella tularensis* in infected mammals and vectors using a probe-based polymerase chain reaction, American Journal of Tropical Medicine, 62(2): 301-308.

Journal of the American Veterinary Medical Association, *Zoonosis Update,* 2nd edition,

Published by the American Veterinary Medical Association, Schaumburg, Illinois.

Kijeck, TM, Rossi, CA, Moss, D, Parker, RW, Henchal, EA (2000),Rapid and sensitive immunomagnetic-elecochemiluminescent detection of *Staphlococcus* enterotoxin B, Journal of Immunological Methods, 236(1-2):9-17.

LaRegina, M, Lonigro, J, Wallace, M, (1986) Tularemia in a group of non-human primates, Journal of the American Veterinary Medical Association, 175(9):962-963.

La Regina, M. Lonigro, J, Wallace M, (1986), *Francisella tularensis* infection in captive, wild-caught prarie dogs, Laboratory Animal Science, 36(2):178-18.

Leitenberg, M, (1993) *Biologicals- The biological weapons program of the former Soviet Union*. 21:187-191.

Medline- CDC internet search site.

Ogg, JE, Ryder, RA, Smith HL, Jr, (1989) Isolation of Vibrio cholerae from acquatic birds in Colorado and Utah, Applied Environmental Microbiology, 55(1): 95-99.

Plumb, Donald C, (1999), *Veterinary Drug Handbook*- 3rd edition, Iowa State University Press, Ames, Iowa.

Quinn, PJ, Carter, ME, Markey, BK, Carter, GR, (eds), (1994*) Clinical Veterinary Microbiology,* 1st edition. Wolfe Publishers, a division of Mosby.

Response to Bioterrorism - Role of the Clinical Laboratory – Seminar. Sponsored by Maryland Department of Health and Mental Hygiene. Laboratory Administration and National Laboratory Training Network, Eastern Office.

Rhodes, JB, Schweitzer, D., Ogg, JE, (1985), Isolation of *Vibrio cholerae* non-01 associated with enteric disease of herbivores in western Colorado, Journal of Clinical Microbiology, 22(4):572-575.

Schmidt, CK, Meysick, KC, and O'Brien, AD, (1999) Bacterial Toxins: Friends or Foes?, Emerging Infectious Diseases 5(2):224-234.
Sack, DL, (1983) Cholera and Related Illnesses Caused by Vibrio Species and Aeromonas, IN: Gorbach, SL, Bartlett, JG, Blacklow, NR, Petersdorf, RG, Adams, RD, Braumwald, E, Isselbacher, KJ, Matin, JB, Wilson, JD. (eds), *Infectious Diseases* 2nd Edition, W.B. Saunders Company, Philadelphia, PA, pp. 738-748.

Sack, DL, (1983) Vibrios, IN: Gorbach, SL, Bartlett, JG, Blacklow, NR, Petersdorf, RG, Adams, RD, Braumwald, E, Isselbacher, KJ, Matin, JB, Wilson, JD. (eds), *Infectious Diseases,* 2nd Edition, W.B. Saunders Company, Philadelphia, PA, pp.,1816-1818.

Sanford, JP, (1983) Tularemia, IN: Gorbach, SL, Bartlett, JG, Blacklow, NR, Petersdorf, RG, Adams, RD, Braumwald, E, Isselbacher, KJ, Matin, JB, Wilson, JD. (eds), *Infectious Diseases*, 2nd Edition , W.B. Saunders Company, Philadelphia, PA-, pp.1564-1567.

Schmidt, RE, Fletcher, KC, (1983) Non –01 *Vibrio cholera* infection in a desert tortoise (*Gopherus berlanderi*), Journal of Wildlife Diseases, 19(4):358-359.

Stolz W, Gotz A, Thomas P., Ruzicka T, Suss R., Landthaler M., Mahnel H., Czerny CP, (1996) Characteristic but unfamiliar - the cowpox infection, transmitted by a domestic

cat, Dermatology, 193(2):140-143.

Teseng, J, Komisar, IL, Trout, RN, Hunt, RE, Chen, Y-J, Johnson, AJ, Pitt, L and Ruble, DL, (1995), Humoral immunity to aerosolized Staphylococcal enterotoxin B (SEB) superantigen in monkeys vaccinated with SEB-toxoid-containing microspheres, Journal of Infection and Immunity, 63(8):2880-2885.

Thorne, GM, (1983) Toxins, IN: Gorbach, SL, Bartlett, JG, Blacklow, NR, Petersdorf, RG, Adams, RD, Braumwald, E, Isselbacher, KJ, Matin, JB, Wilson, JD. (eds), *Infectious Diseases* 2nd Edition, W.B. Saunders Company, Philadelphia, PA, pp.9-18.

Ulrich RG, Sidell, S., Taylor, TT, Wilhelmsen, CL and Franz, DR (2000) Staphylococcal Enterotoxin B and Related Pyrogenic Toxins, IN: BG.R, Zajtchuk (ed), *Textbook of Military Medicine- Medical Aspects of Chemical and Biological Warfare,* Published by Office of the Surgeon General.

Visser, IJ, Vellema, P, Wetenberg, AM, Bik, EM, (1997). Severe watery diarrhea caused by *Vibrio ch*olerae in lambs, Tijdschr. Diergeneeskd. 112(21): 600-603.

Visser, IJ, terLaak, EA, vanDijk, NW, Wouda, W, Toxigenic *Vibrio cholerae* non 01 isolated from a goat in the Netherlands, Veterinary Quarterly, 122(21): 600-603.

Wehrle, PF. *et.al,* (1970) An airborne outbreak of Smallpox in a German hospital and its significance with respect to other recent outbreaks in Europe, IN: Bulletin of the World Health Organization, 43: 669-679.

Woods, JP, Crystal, MA, Morton, RJ, Panciera, RJ (1998), Tularemia in two cats, Journal of the American Veterinary Medical Association, 212(1): 81-93.
World Health Organization fact sheet 161 - Monkeypox virus – available at http://www.who.ch

World Health Organization (1980) The global eradication of smallpox. Final report of the Global Commission for the Certification of Smallpox Eradication, Geneva, Switzerland.

World Health Organization (1995) Ad Hoc Committee on Orthopoxvirus Infections. Communicable disease prevention and control: Smallpox eradication-destruction of variola virus stocks, World Health Organization, Geneva, Switzerland.

Zajtchuk BG.R, (ed), *Textbook of Military Medicine- Medical Aspects of Chemical and Biological Warfare.- Part 1. Warfare, Weaponry and Casualty*, Published by Office of the Surgeon General.

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Bioterrorism Agents: Implications for Animals
Points of Contact

Contact Organization	Website / Telephone	Information For/ Testing/ Reagent Vaccine Availability
Active Biotec Lund Sweden	**info@activebiotech.com #01-46-46-19-20-00**	**Dukoral Vaccine For Cholera**
American College of Emergency Physicians	**www.acep.org**	**Physician education**
American Veterinary Medical Association	**1-800-248-2862**	
A.J.Buck Veterinary Distributor	**1-800-638-8673**	
Antech Veterinary Diagnostic Lab	**1-800-872-1001**	
Berna Pharmaceuticals Berne, Switzerland	**berna@berna.org #01-41-31-981-22-11**	**Mutacol Vaccine and Orochol Vaccine for Cholera**
Baltimore Zoo Veterinary Hospital	**1-410-728-5622**	
CDC Information Atlanta, GA	**1-404-639-3311**	**Information on Labs and Availability of Services, Instructions for Sample Submission**
CDC Bioterrorism Response Labs Atlanta, GA	**Dr. Richard F. Meyer CDC-NCID Director Bioterrorism Rapid Response and Advanced Technology Laboratory 1-404 639-0075 office -4234 fax 1-404 405-7477 cell phone 1-888-374-1764 pager**	**Information on where to send samples for testing**
CDC National Immunization Hotline Atlanta, GA	**1-800-232-2522**	**Information about availability of Immunizations**

Cera Products Columbia, MD	**1-410-997-2334**	**Ceralyte Oral Rehydration Solution**
Cornell University Veterinary Diagnostic Lab	**1-607-253-3900**	
Department of Defense	**US Army Medical Research Institue of Infectous Diseases www.usamriid.army.mil 1-301-619-8000 for Information**	**Reference laboratory and education**
Essex Community College Veterinary Technicians Program	**1-410-780-6306**	
Federal Bureau of Investigation/National Domestic Preparedness Office	**www.fbi/gov/programs/ndpo/ default.html**	**Crisis management**
Federal Emergency Management Agency	**www.fema.gov**	**Consequence management**
Health and Human Services/Office of Emergency Preparedness	**www.ndms.dhhs.gov**	**Consequence management**
Health and Hunan Services/Centers for Disease Control	**National Centers for Infectious Diseases www.bt.cdc.gov/**	**Domestic preparedness**
Maryland Emergency Management Agency	**1-410-517-3600**	
Maryland Dept of Health State Public Health Veterinarian	**1-410-757-5028**	
Maryland Dept of Health Rabies Laboratory	**1-410-767-6177**	
MDA Centreville Veterinary Diagnostic Lab	**1-410C758-0846**	
MDA College Park Veterinary Diagnostic Lab	**1-301-935-6074**	
MDA Frederick Veterinary Diagnostic Lab	**1-301-663-9568**	
MDA- Oakland Veterinary Diagnostic Lab	**1-410-334-2185**	
Maryland Dept of Agriculture State Veterinarian	**1-410-841-5783 or in MD 1-800-492-5590**	
National Disaster Medical System (NDMS)	**1-800-872-6367**	

National Emergency Training Center FEMA	**1-301-447-1286**	
National Parasite Collection Beltsville Agricultural Research Center	**1-301-504-8530**	**Animal Parasite Collection**
National Agricultural Library- Beltsville, MD	**1-301-504-5755**	
National Aquarium- Baltimore	**1-410-576-3800**	
National Animal Poison Control Center	**1-888-426-4435**	
National Wildlife Diagnostic Lab Madison, Wisconsin	**1-608-271-4640**	
New Horizons Diagnostics Columbia, MD	**1-410-992-9357**	**Cholera Smart 01 Field Test Kit # 89-113025/25 tests/$368.75** **Cholera Smart 0139 Field Test Kit #89-1161111/25tests/$450.00**
Pennsylvania Dept. of Agriculture Veterinary Diagnostic Lab	**1-717-787-8808**	
Virginia Maryland Regional College of Veterinary Medicine Marion Dupont Scott Equine Medical Center	**1-703-771-6800**	

Virginia Maryland Regional College of Veterinary Medicine Maryland Campus	**1-301-935-6083**
Walter Reed Army Institute of Research	**1-301-319-9000 for Information** **Department of Experimental Therapeutics** **1-301-319-9900**
US Department of Transportation (shipping etiologic agents)	**www.dot.gov/rules**