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For the West, About the West, From the West

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Your Role in Bioterrorism Prevention

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Use of infectious organisms as biological weapons is now considered a realistic threat in the United States. In October, 2001 anthrax attacks were conducted via five envelopes that were sent through the U.S. postal system. All were mailed from Trenton, New Jersey, and all contained spores identified as Bacillus anthracis. As participants in an animal industry we have the opportunity and responsibility to be observant of disease outbreaks that might represent a biological weapon release.

It could be difficult to detect the release of biological agents. They could be disseminated over a large geographic area and clinical cases may take days to weeks to recognize. There is also the possibility of secondary spread via person-to-person contact or through vectors such as flies, ticks or mosquitoes. Wildlife would also have the potential to spread disease over large areas and could serve as a source of infection for humans and animals. These factors, especially the delayed recognition, would allow a perpetrator plenty of time to leave the area and make the biological attack extremely effective.

Many pathogens that may be potentially used as bioweapons are zoonotic. Therefore, disease could first occur in animals, before it occurs in humans. For example in 1999, when West Nile virus was first identified in the Western Hemisphere unusual bird mortality occurred before any human illness was detected.

Some clues suggesting that a biological agent may have been released would include: 1) an unusual clustering of illness or mortality in people or animals in a given region or at a given time 2) normally healthy individuals suddenly becoming ill 3) unusual or atypical symptoms 4) an unusual age distribution for common diseases (e.g. an increase in chickenpox-like illness among adult patients may be smallpox) or 5) the disease occurring outside its "typical" season (e.g. flu-like symptoms in humans in June in the northern hemisphere).

Humans can become infected with zoonotic diseases in various ways. These include: 1) respiratory - by inhaling contaminated dust from the soil or environment or via an aerosol from a person or animal (e.g. sneezing or coughing) 2) vector transmission via bites of fleas, lice, ticks or mosquitoes 3) direct contact with a sick person or animal or its body fluids such as blood, saliva, feces, urine or vomit 4) ingestion of contaminated food or 5) drinking of contaminated water. Different infectious agents can be spread via one or more of these mechanisms.

Some factors that promote zoonotic disease transmission include frequent contact with domestic or wild animals, people living in or visiting areas that overlap with wildlife habitats or intensive livestock production. These are difficult to manipulate. However, other factors such as poor animal sanitation, poor animal health, and poor personal hygiene can also promote transmission of zoonotic diseases, and these can be minimized.

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Hemorrhagic Bowel Syndrome: Search for a Cause Continues

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Hemorrhagic Bowel Syndrome (HBS) is a newly emerging, highly fatal intestinal disease of adult dairy cows in the United States. This disease has also been called Jejunal Hemorrhage Syndrome, bloody gut, or clostridial enteritis. The disease is seen most commonly in adult dairy cows early in lactation, although cases occasionally occur in late lactation or the dry period. This disease commonly occurs as an occasional disease on most dairies, although several cows may be affected in a relatively short period of time, and some dairies struggle with this disease on virtually a continual basis.

Affected cows are rapidly debilitated by the combined effects of sudden and massive hemorrhage into the small intestine. As a result, affected cows may simply be found dead or dying. The cow's extremities are often cool and the rectal temperature is often subnormal, reflecting the loss of blood into the intestine and the resulting shock. In this sense, affected cows can resemble milk fever cases. Unlike milk fever, however, the feces of affected cows is dark, tar-like, and may contain dark red to black clots of digested blood. As clots form in the affected segments of the intestine, the intestine may become obstructed, causing some cows to become bloated and show signs of colic. The affected segments of intestine quickly die and will occasionally rupture, resulting in invariably fatal peritonitis (infection of the abdominal cavity).

Successful treatment of this disease is difficult. Occasional anecdotal reports exist of successful treatment with fluids, laxatives, anti-inflammatory drugs, and antibiotics; however, it appears that such treatment successes are quite rare. More frequently, if treatment is attempted, the veterinarian will perform abdominal surgery and attempt to either break down the clots in the affected segments or remove the segments of damaged and obstructed bowel. Reports to date indicate that the prognosis for successful surgical treatment can vary extensively. Unfortunately, in our experience, surgical treatment is usually not successful, because affected cows can develop repeated clotting and recurrent obstruction of the intestine after surgery. Also, in many cases, multiple segments of the intestine are obstructed with clots and nonviable by the time surgery occurs, making removal of all of the affected intestine impossible. In addition, some affected cows have developed severe peritonitis by the time of surgery and must be euthanized. Of 22 cows affected with HBS presented to our clinic over the past few years, only 6 (27%) survived.

The cause of HBS is currently unknown, and no consistent predisposing factor has been identified. While infectious agents such as bovine viral diarrhea (BVD) virus and Salmonella may cause bloody diarrhea in affected cows, the symptoms, disease course, and necropsy findings are dramatically different from HBS. The majority of HBS cases seen at our clinic occur during the first 3 months postpartum. The physiologic stress associated with peak milk yield may therefore be involved, as well as the relatively high-energy, low-fiber rations fed during this stage of production. We have been unable to definitively link HBS to a particular feed component in the dairies that we service. Cases have occurred during all times of the year, although we tend to see more cases in the fall and winter months.

Several reports indicate an association between *Clostridium perfringens* type A and HBS. This association is based on the following observations: (1) affected cows often have positive fecal cultures for this organism, (2) *C. perfringens* type A can be readily isolated from intraluminal blood clots in the jejunum of affected cows, (3) there is microscopic evidence of intestinal wall damage associated with heavy growth of *C. perfringens* type A, and (4) other infectious agents associated with hemorrhagic enteritis are rarely identified in tissues or enteric contents of affected cows.

Clostridium perfringens type A is a bacteria that is considered to be widespread in the environment and in the gastrointestinal tract of most mammals. Interestingly, previous research has shown that the rate of isolation of this organism from the gastrointestinal tract of cattle may be enhanced by high grain diets. An important fact to know is that this organism proliferates rapidly in the intestine of most cattle after death, making isolation of *C. perfringens* type A from decomposed carcasses of questionable diagnostic significance.

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(Bioterrorism, continued from page 1)

The best protection from the effects of potential release of infectious zoonotic agents is implementation and adherence to strict biosecurity protocols and early detection of any signs of an unusual disease. Because of the delayed recognition, sealing a house with much publicized "plastic and tape" approach is unlikely to be implemented at the time when it could have been effective in minimizing numbers of aerosolized pathogens entering your home.

Bioterrorism agents have been categorized according to their harmful potential into categories A, B and C by the Center for Disease Control and Prevention (CDC) with category A diseases being most dangerous. These agents include anthrax, botulism, tularemia, plaque, smallpox and viral hemorrhagic fevers. Of those, only smallpox is not a zoonotic disease. Following is a short description of category A agents and clinical signs in animals. It is important to realize that weaponized agents may have atypical routes of transmission and clinical manifestations (including an extended host range). The information provided below is intended to alert you to the presence of possible bioterrorism agents. You should contact your local veterinarian if you suspect that a bioterrorist agent may have been released.

Anthrax is caused by infection with *Bacillus anthracis*. All domestic animals can become infected with anthrax, but cattle, sheep and horses seem to be extremely susceptible. The main clinical signs in these animals are sudden death with lack of rigor mortis and presence of unclotted blood. In infected animals, large numbers of bacteria are present in the hemorrhagic exudates from the mouth, nose and anus. Carcasses of animals that died of anthrax should not be opened. Vegetative organisms are thought to be destroyed within a few days during the decomposition of unopened carcasses. However, exposure to oxygen leads to generation of very resistant spores, which can survive in the environment for decades. Because of this environmental resistance, the infective spores in the aerosolized form can be used very effectively as biological weapons.

Botulism is caused by ingestion of toxin produced by the bacterium *Clostridium botulinum*. It is an anaerobic spore-forming bacterium. Botulism occurs when animals ingest preformed toxins with food or *C. botulinum* spores germinate in anaerobic conditions in tissues (eg deep wounds) and produce toxins as they grow. Seven types of botulinum toxin, designated A through G, have been identified. All types of botulinum toxin produce the same disease; however, the toxin type is important if antiserum is used for treatment. Cattle in phosphorus-deficient areas may chew bones and scraps of attached meat. One gram of dried flesh may have enough botulinum toxin to kill a cow. Ruminants may also be fed hay or silage contaminated by toxin-containing carcasses of birds or mammals. The incubation period ranges from 2 hours to 2 weeks; in most cases, the symptoms appear after 12 to 24 hours. Botulism is characterized by progressive motor paralysis. Typical clinical signs may include muscle paralysis, difficulty chewing and swallowing, visual disturbances and generalized weakness. Death usually results from paralysis of the respiratory or cardiac muscles. In cattle, the symptoms may include drooling, restlessness, incoordination, urine retention, dysphagia and sternal recumbency. Laterally recumbent animals are usually very close to death.

Viral hemorrhagic fevers can be caused by viruses such as filoviruses (Ebola or Marburg) or arenaviruses (Machupo or Lassa fever). Filoviruses affect humans and non-human primates. Transmission occurs by direct contact with infected blood, secretions, organs or semen, and on fomites. Arenaviruses are spread in rodent droppings or urine and are transmitted to humans through broken skin, by ingestion and in aerosols. Neither of these viruses is known to affect ruminants.

Plague results from infection by *Yersinia pestis*. Rodents are the reservoir hosts. Plague is usually spread between rodents or humans by the bites of infected fleas. It can be also transmitted directly through mucous membranes, broken skin, animal bites or aerosols from people or animals with the pneumonic form. Cats often become infected when they eat diseased rodents. *Yersinia pestis* can survive for long periods of time in organic material; it may remain viable for up to 100 days in blood and for as long as 9 months in human bodies. It can also be found in water, moist soil and grains for several weeks. *Yersinia pestis* is not resistant to desiccation or heat: it is destroyed by exposure to 55°C for 15 minutes or several hours in sunlight. Asymptomatic infections and mild illness are typical in some reservoir hosts (rodents). Wild carnivores including coyotes, skunks and raccoons can also seroconvert without clinical disease. Other animals may have fever, lymphadenitis, abscesses in internal organs, or sudden death from sepsis. Plaque has not been reported in ruminants.

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(HBS, continued from page 2)

Given the evidence cited above, many dairies that have suffered unacceptable losses from HBS have initiated vaccination for *C. perfringens* type A, using autogenous vaccines generated from isolates taken from HBS cases. No formal studies have been completed to scientifically evaluate the effect of such vaccines on the incidence of, or survival rate for, this disease.

Based on ongoing research at CSU, we believe that *Clostridium perfringens* type A is present in higher numbers in the intestine of cows affected by HBS in comparison to their normal herd mates. However, when we sample normal cows within hours to a few days after a case of HBS is seen on a dairy, we tend to find the organism in greater numbers in normal cows than if we sample normal cows several days to weeks after an HBS case occurs. This could indicate that all cows on a given dairy are ingesting the organism in the feed, but only certain cows develop HBS as a result. Alternatively, all cows could be ingesting an unknown triggering factor (a nutrient, toxin, or other bacterial, fungal, parasitic, or viral organism) that causes explosive growth of the *C. perfringens* type A that already is residing in their intestines. Another theory is that the triggering factor causes bleeding into the intestine, and *C. perfringens* type A simply proliferates in the intestine as it rapidly utilizes the nutrients in the blood.

Our future plans for research involve comparing the characteristics of *C. perfringens* isolated from HBS cows with genetic characteristics of the same organism isolated from normal cows. We hope to determine if HBS is associated with "hot," or highly pathogenic, strains of this bacteria. It is important to emphasize that our focus on this bacteria reflects no definitive proof that it is truly the cause of this disease; rather, since the expertise and laboratory facilities available at CSU are best suited to study bacteria in general, this is the most appropriate contribution that we can make to the study of HBS. Other universities and private companies are investigating other potential causes for this disease. As we continue our studies, we know that we join the rest of the dairy industry in hoping for a breakthrough somewhere, because HBS is a disease that none of us want to have to continue to see in our cows.

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Tularemia results from infection by *Francisella tularensis*. It can be transmitted by ingestion, inhalation, arthropod-borne transfer or direct contact through the skin and mucous membranes. Organisms are found in the blood and tissues of infected animals and can survive for long periods of time in the environment. Vectors for *F. tularensis* include ticks (most often), but also biting flies and mosquitoes. Individual flies may carry the organism for 2 weeks and ticks throughout their lifetimes. Viable bacteria can also be found for weeks to months in the carcasses and hides of infected animals and on fomites including grain dust, straw, water, soil and bedbugs. This organism is highly resistant to freezing; live organisms have been found after 3 years in rabbit meat stored at -15° C. Among domestic animals, sheep seem to be particularly susceptible to clinical disease. Tularemia has also been seen in dogs, cats, pigs and horses; cattle seem to be resistant. Spectrum of clinical signs in animals ranges from asymptomatic infections to fever, lethargy, anorexia, stiffness, increased pulse and respiration, coughing, diarrhea and sudden death.

Category B agents include brucellosis, various toxins (eg ricin), Q fever, food safety threads (eg salmonellosis), glanders, melioidosis, psittacosis, typhus fever, viral encephalitis and water safety threads (eg cryptosporidiosis). Of those, brucellosis, psittacosis, Q fever and various toxins can affect cattle. Other zoonotic agents affecting cattle that could potentially be used as bioweapons include West Nile virus, Rift valley fever, and bovine spongiform encephalopathy (mad cow disease). More information on zoonotic agents can be found at the CDC web site: http://www.bt.cdc.gov/Agent/agentlist.asp. The CDC Public Response Hotline phone number is 888-246-2675.

Western Dairy News *is published as a service to the people interested in the health and welfare of the western dairy industry. Archives of this publication may be found at http://animalscience-extension.tamu.edu/dairy/wdn/wdn.html*

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