The horrible events of September 11, 2001 changed our lives forever. The terrorist acts on that day cost more than 3000 people their lives. They were the worst terrorist attacks on domestic soil in United States history. We are now experiencing a great sense of vulnerability and are constantly questioning our safety and that of our families. Top Picture: Plumes of smoke poured over New York City as the World Trade Center collapsed to the ground. Bottom Picture: Three unidentified rescue workers walked away from the crash site at the Pentagon. The Daily Progress photo by Dan Lopez via Associated Press.

The October, 2001 anthrax attacks were conducted via four envelopes mailed from Trenton, New Jersey containing Bacillus anthracis spores that were sent through the U.S. postal system. A fifth envelope was likely responsible for the Florida cases but was never recovered. Twenty-two cases of anthrax resulted; eleven inhalational and eleven cutaneous cases. In all, five people died from inhalational anthrax. The person/group responsible has not been identified.

Today we will talk about bioterrorism and how you have an important role in protecting your community and our country. We will cover several topics including: generalities about bioterrorism, zoonotic disease (diseases that are transmitted from animal to human) and bioterrorism, basics of disease control, the U.S. government agencies involved in preparing and protecting our nation, and some diseases the CDC feels are the most threatening with regard to bioterrorism. Finally, we will discuss your roll and responsibility in preparedness and protection.

“Biological warfare is defined as the use of microorganisms or toxins derived from living organisms, to cause death or disease in humans, animals, or plants in civilian settings. The definition would apply to the lone perpetrator acting independently, to state-supported terrorism, and to undeclared wars, as well as to declared armed conflict. Of the 3 targets (humans, animals, and plants) in the United States, the greatest threat would appear to be to human beings and animals.” (Huxsoll, D, Patrick W, Parrott C. Veterinary services in biological disasters. JAVMA 1987;190:714-722.) This definition will be used for bioterrorism for our purposes. The motivations of terrorists and terrorist groups to launch a bioterrorist attack are many, and may include the need for attention, exacting revenge, religious beliefs, desire to mimic God, apocalyptic fulfillment, the desire to create chaos within a society, the need to copy a previous incident (copycat actions), the desire to impress with new technology, or to inflict severe economic harm.
Characteristics of a Biological Attack

- Difficult to detect release
- Dissemination may cover a large area
- Possible secondary spread
- Recognition of agent may be delayed days to weeks
- Difficulties in catching perpetrators

It can be difficult to detect a biological agents release. Dissemination often covers a large geographic area and clinical cases may take days to weeks to recognize. There is also the possibility of secondary spread, if the agent is contagious person-to-person or through a vector. These factors, especially the delayed recognition, allow the perpetrator plenty of time to leave the area.

Infectious Disease Outbreak

This graph depicts the onset of an infectious disease outbreak. Note the time from exposure to the onset of symptoms. This demonstrates how cases may be delayed in their recognition, and by the time patients seek care, the perpetrator is long gone.

Clues Suggesting Biological Agent Release

- Clustering of morbidity or mortality
  - In time and space
  - Large numbers of animals and/or people
  - Symptoms that are not typical
- Normally healthy people affected
- Unusual symptoms for area
- Unusual age distribution
- Disease occurring outside typical season

Although there are many difficulties in detecting a bioterrorism attack, there are several clues that suggest a biological agent may have been released. Healthcare providers should be alert to illness patterns and diagnostic clues that might indicate an unusual infectious disease outbreak associated with intentional release of a biologic agent. Indications of intentional release of a biologic agent include: 1) an unusual clustering of illness or mortality in a given geographic or temporal region for a large number of people or animals. This may also include abnormal or atypical unexplained symptoms; 2) normally healthy individuals suddenly becoming ill; 3) symptoms occurring in patients from an area that does not usually have clinical signs of that particular disease; 4) an unusual age distribution for common diseases (e.g. an increase in chickenpox-like illness among adult patients may be smallpox); 5) the disease is occurring outside its “typical” season (e.g. flu-like symptoms in humans in June in the northern hemisphere).

Many Agents are Zoonotic

- Zoonotic means disease can be transmitted from animals to humans
- Disease may be seen in animals before humans
- Animals are sentinels
  - Pets, livestock, wildlife

Many of potential bioterrorism agents are zoonotic. In some diseases, clinical signs may manifest in animals prior to humans. Pets in particular can act as important sentinels because they are present in large numbers and often live in close contact with humans. It is estimated that pets are present in 59% of U.S. households. Livestock are also present in high numbers especially in certain areas of the country. Many areas depend on livestock for their livelihood and this puts them at risk for bioterrorism or agroterrorism. Wildlife also play an important role in our communities because they could be important sources of infection for humans and animals, and could potentially contaminate large areas.

Factors That Promote Transmission of Zoonoses

- Frequent contact with domestic or wild animals
- Overlap with wildlife habitat
- Intensive livestock production
- Poor animal sanitation
- Poor personal hygiene
- Poor animal health

Some factors that promote zoonotic disease transmission include frequent contact with domestic or wild animals, and people visiting or living in areas that overlap with wildlife habitats or intensive livestock production. Other factors such as poor animal sanitation, poor animal health, and poor personal hygiene can also promote transmission.
**Routes of Transmission**

- Direct contact
  - Gel, liquid, powder
  - Scratches
  - Droplet spray onto mucous membranes
- Indirect contact: ingestion, injection
  - Contaminated food, water
  - Vector
- Aerosol

Direct contact with infectious organisms could occur through gel, liquid or powder forms. Infection could occur if the agent came in contact with a scratch or a droplet spray contacted mucous membranes. An example of indirect contact is ingestion of contaminated food or water or vector injection into the skin. Agents can also be transmitted via aerosolization of small, dry infectious particles. Aerosol transmission would be an efficacious way to infect large numbers of people.

**Disease Control**

- Disinfect/clean up areas contaminated with animal waste
  - Livestock, pets, wildlife, rodents
- Basic hygiene
  - Wash hands
  - Child supervision

There are many things the public can do to protect themselves from exposure to zoonotic agents. Keep areas that have been contaminated with animal waste clean and disinfected. Follow proper hygiene, especially hand washing.

**Zoonoses Control**

- Proper pet selection
- Use caution at petting zoos
- Cook food properly
- Control strays
- Visit and communicate with physician and veterinarian
- Follow guidelines for immunocompromised people

Encourage your clients to select the pet that is right for them, especially if they are immunocompromised. You should also educate your clients about petting zoos and that those animals may carry diseases that affect humans. Clients should be aware of proper guidelines for preparing and cooking food to decrease risk of disease. Control stray animal populations and encourage clients to call appropriate authorities if they observe a stray animal. Finally, it is important that your clients communicate with their physician and you on a regular basis, especially if they are immunocompromised, so that all parties are aware of what animals they may be living with or exposed to because of their occupation.

**U.S. Agencies**

Dealing with terrorism

Our country has increased spending to improve our public health system. On June 12, 2002, the President signed the “Public Health Security and Bioterrorism Preparedness Response Act of 2002”. Public Law 107-188 is designed to improve the ability of the United States to prevent, prepare for, and respond to bioterrorism and other public health emergencies. The Act is divided into the following five titles: Title I - National Preparedness for Bioterrorism and Other Public Health Emergencies; Title II - Enhancing Controls on Dangerous Biological Agents and Toxins; Title III - Protecting Safety and Security of Food and Drug Supply; Title IV - Drinking Water Security and Safety; and Title V - Additional Provisions. $4.3 billion dollars have been appropriated to state and local governments to improve planning and educate health care personnel, the CDC to upgrade their facilities, the Secretary of Health and Human Services to stockpile medical supplies, the FDA and USDA to enhance agricultural security, research and development, and finally to assess
vulnerability and develop response plans.

On November 25, 2002, President Bush signed the "Homeland Security Act of 2002" into law. On January 24, 2003 the Department of Homeland Security (DHS) was established. Twenty-two federal agencies were brought together to streamline and centralize efforts to protect our nation’s homeland. This was the most significant transformation of the U.S. Government since 1947 when the branches of the U.S. Armed Forces were merged into the Department of Defense. The DHS provides one point of contact for state and local groups and the private sector. The mission of the DHS is to prevent terrorist attacks within the US, protect against terrorist attacks by decreasing our vulnerability, and minimizing damage from potential attacks and natural disasters. The DHS is organized into: Four Policy directorates (bureau or department): Border and Transportation Security (guard borders and airports), Emergency Preparedness and Response (coordinate the response for future emergencies), Information Analysis and Infrastructure Protections (analyze threats and intelligence), and Science and Technology (protect our critical infrastructure); a Management Directorate; the US Coast Guard; and the US Secret Service. Within the four policy directorates are multiple responsibilities for coordinating the efforts of the Department of Health and Human Services (HHS) and the United States Department of Agriculture (USDA).

The Centers for Disease Control and Prevention (CDC) is recognized as the lead federal agency for protecting the health and safety of people- at home and abroad. They provide credible information to enhance health decisions and promote health through strong partnerships. The CDC serves as the national focus for developing and applying disease prevention and control, environmental health, and health promotion and education activities designed to improve the health of the people of the United States. The CDC is headquartered in Atlanta, Georgia, and is an agency of the Department of Health and Human Services. Dr. Julie L. Gerberding is the Director. CDC has been responding to public health emergencies for decades and has been preparing for bioterrorism in particular since 1998. CDC's bioterrorism plans were put into action in Fall 2001. CDC was one of the first agencies to respond during the anthrax outbreaks. One of the primary elements learned from these attacks was the importance of rapid identification. CDC works hard to help local and state health departments increase their capabilities for early detection.

The mission of the Strategic National Stockpile (SNS), previously called the National Pharmaceutical Stockpile, is to ensure the availability of life-saving pharmaceuticals, antidotes and other medical supplies and equipment necessary to counter the effects of nerve agents, biological pathogens and chemical agents. The SNS Program stands ready for immediate deployment to any U.S. location in the event of a terrorist attack using a biological, toxin or chemical agent directed against a civilian population. These response packages are stored in strategic locations around the U.S. to ensure rapid delivery anywhere in the country. Following the federal decision to deploy, the SNS will typically arrive by air or ground in two phases. The first phase shipment is called a 12-hour Push Package. "12" because it will arrive in 12-hours or less, “push” because a
The Iowa slides have been included as an example. Delete them and put in the information appropriate for your state.

Iowa’s Homeland Security Office works under the direction of the Federal Homeland Security Office. The mission of the Iowa Homeland Security office is to develop and coordinate the implementation of a comprehensive state strategy to secure the State of Iowa from terrorist threats or attacks and to coordinate the State of Iowa’s efforts to detect, prepare for, prevent, protect against, respond to and recover from terrorist attacks within Iowa. Iowa’s Homeland Security Office assesses current capabilities and assets of state government, identifies critical assets important to Iowa citizens, and ensures that they are protected, works with local emergency management agencies in each of Iowa’s 99 counties, and facilitates communication between many state departments and agencies, including the Iowa Department of Public Health and the Iowa Department of Agriculture and Land Stewardship.

The Iowa Department of Public Health established the Office of Disease Epidemiology and Disaster Preparedness (ODEDP) in October 2001. The ODEDP encompasses two centers, the Center for Acute Disease Epidemiology (CADE) and the Center for Disaster Operations and Response (CDOR). The ODEDP leads development and implementation of an integrated system of health and public health services in preparedness for and response to disaster/terrorism incidents, outbreaks of infectious disease, and other public health threats and emergencies.

The Iowa Department of Agriculture and Land Stewardship (IDALS) has been working on response plans for outbreaks of highly infectious animal diseases including the chain of communication between state agencies. The Iowa Rapid Veterinary Information Network (IRVIN) is a network of 860 licensed Iowa veterinarians who receive “burst” emails notifying them of the current concern. IRVIN was put to the test last summer when West Nile Virus was spreading throughout our state and has been used to inform practitioners of the latest pseudorabies status of Iowa.

The Center for Food Security and Public Health at Iowa State University trained veterinarians on diseases the CDC has categorized as priority agents for bioterrorism preparedness (Category A, B, C), and these veterinarians will in
Category ABC Agent Overview

In this section we first discuss how the CDC Category ABC disease/agent list was established and then overview the diseases.

(Continue)
The agents/diseases in Category A are Anthrax, Botulism, Plague, Smallpox, Tularemia, and Viral hemorrhagic fevers (four bacteria and two viruses).

In the 1950’s and 1960’s, *B. anthracis* was part of the U.S. bioweapons research program. In 1979, there was an accidental release of aerosol anthrax from a military compound in the Soviet Union. The neighboring residents experienced high fevers, difficulty breathing, and a large number died. Fatality estimates ranged from 200-1,000. In 1992, Russian President Boris Yeltsin finally acknowledged that the release occurred from a large scale military research facility. In 1991, Iraq admitted it had done research on *B. anthracis* as a bioweapon. There are several characteristics of *B. anthracis* make it attractive as a bioweapon. It is widely available and relatively easy to produce. The spores are infective, resistant, and remain infective when aerosolized. The lethal dose for inhalation of spores is low and mortality is high; the case-fatality rate for inhalational anthrax could approach 100%. Untreated pulmonary and intestinal infections are almost always fatal, especially if recognized too late for effective treatment. Person-to-person transmission of anthrax is very rare and has been reported only in cases of cutaneous anthrax. Photo courtesy of D. Bickett-Weddle, DVM, ISU.

Botulism, or “limber neck” in waterfowl, is caused by toxins produced by *Clostridium botulinum*. It is a Gram positive, spore-forming, toxin-producing obligate anaerobic bacillus. The spores are ubiquitous in soil. Botulism was first discovered by a German physician, Justinius Kerner in 1793. He called the substance “wurstgift” and found it in spoiled sausages. During this period of time, sausage was made by filling a pig’s stomach with meat and blood, boiling it in water then storing it at room temperature, which were ideal conditions for clostridial spores to survive. Botulism gets it name from “botulus” which is Latin for sausage. United States federal regulations for food preservation resulted following several outbreaks of botulism in the U.S. Botulism spores germinate and release 7 different antigenic types of neurotoxins, classified as A through G. Different neurotoxin types affect different species. Only a few nanograms of the toxin can cause severe illness and all cause flaccid paralysis. Neurologic clinical signs, including generalized weakness, dizziness, dysphagia, and flaccid paralysis, are similar in all species affected. In humans, gastrointestinal symptoms may proceed the neurologic symptoms because the preformed toxin is ingested. In animals, many species of mammals and birds can be affected. Clinical disease is most often in wildfowl, poultry, mink, cattle, sheep and horses. Ruminants and horses will often drool while humans experience dry mouth. Paralysis of the respiratory muscles leading to death may occur in 24 hours in severe cases. Waterfowl are especially sensitive and pigs, dogs, and cats are fairly resistant. Canadian cooperative wildlife health centre http://wildlife.usask.ca/bookhtml/botulism/botulismc.htm
Plague is caused by *Yersinia pestis*, a Gram negative coccobacillus. Transmission can occur via three main routes. Of these, transmission from a flea bite is most common. People (hunters especially) can be directly infected by handling the tissues of infected rodents (reservoir host) or their fleas. Human cases of plague typically occur in April through November, when fleas and their hosts are most active. Plague is a continuum of illness, progressing from one form to the next if left untreated. In humans and cats, there are three forms of disease: 1.) **Bubonic** is the most common and accounts for roughly 80% of cases, and includes flu-like symptoms and very swollen, painful lymph nodes (called “bubo”, shown in the bottom photo, an enlarged axillary lymph node.) Without treatment 50-60% of bubonic cases are fatal. 2.) **Septicemic** plague, is manifested as septic shock, disseminated intravascular coagulation, and necrosis of extremities can be seen (this is often seen in the finger tips, tip of the nose, and toes and is the result of microthrombi blocking capillaries and the circulation to these areas). Without treatment 100% of septicemic cases are fatal. 3.) **Pneumonic** is the least common form but the most fatal. Respiratory distress and hemoptysis are seen with pneumonic plague. This is the only form of plague that can be transmitted person-to-person or animal-to-person because the agent is aerosolized with a cough. Human cases have developed from domestic cat exposure. The outdoor domestic cat can be infected by eating infected rodents or acquiring infected rodent fleas. They then expose their owners to the infected flea or respiratory aerosol when coughing. Rare cases of bite or scratch transmission of plague from cats to people have been documented. The most likely route of transmission is via respiratory aerosol, infecting people with primary pneumonic plague. In rodents, the reservoir host, there may be epidemics of plague or they can maintain the virus in natural cycles and be asymptomatic. Wild carnivores, canines, and farm animals appear to be very resistant (seroconvert without clinical disease), although dogs have been infected experimentally. Image at top of slide: Male *Xenopsylla cheopis* (oriental rat flea) engorged with blood. This flea is the primary vector of plague in most large plague epidemics in Asia, Africa, and South America. Both male and female fleas can transmit the infection.

Smallpox results from infection by variola virus (genus Orthopoxvirus, family Poxviridae). The last naturally acquired case of smallpox occurred in 1977 and the last two laboratory-acquired infections were in 1978. In 1980, the World Health Organization (WHO) declared that endemic smallpox had been eradicated. Currently, the only known stocks of virus are stored at the Centers for Disease Control and Prevention (CDC) in Atlanta and the Institute for Viral Preparations in Moscow. Humans are the only mammals that are naturally susceptible to infection. The smallpox virus is transmitted from human-to-human and patients are known to be infectious from the time the rash appears until the time the scabs have separated (approximately 7 to 10 days). Virus is spread by direct contact or inhalation of aerosols. Transmission on fomites, such as contaminated clothing or bedclothes, is possible for short periods of time; however, variola does not remain viable for more than 2 days outside a human host. Smallpox has an acute onset; the initial clinical signs may include fever, malaise, rigors, vomiting, headache, backache and occasionally delirium. The characteristic skin lesions usually appear 2 to 3 days later; the first signs are macules, which develop into papules and eventually pustular vesicles. These lesions are most common on the face and extremities and develop in synchronous “crops.” Two forms of smallpox may be seen, variola minor and variola major. Variola minor is a mild disease and variola major is a more severe disease, which in a small percentage of people develops into either hemorrhagic or malignant forms. The malignant form has a mortality rate of 95%.
Tularemia, or “rabbit fever”, is caused by \textit{Francisella tularensis}, a Gram negative bacteria. The disease can be transmitted by ingestion of infected, undercooked meat (rabbit); bites from infected ticks, and less commonly deerflies; through direct contact with blood or tissues of infected animals (especially rabbits); and inhalation of contaminated dust. Initial symptoms are flu-like and they include fever, chills, headache, and myalgia. In humans there are six clinical forms of tularemia – \textit{glandular} and \textit{ulceroglandular} are the most common presentation of this disease. An ulcer may or may not be present at site of infection and local lymph nodes are enlarged. \textit{Oculoglandular} occurs when conjunctiva become infected by rubbing eyes with contaminated fingers or by splashing contaminated materials in the eyes. The \textit{oropharyngeal} presentation is caused by ingestion of organism in contaminated food (undercooked meat) or water. \textit{Typhoidal} and \textit{pneumonic} forms usually occur following inhalation, or hematogenous spread of the organism. Both of these forms tend to present as atypical pneumonia and most fatalities occur with these forms and can be as high as 30-60\% if untreated. This photo is of the \textit{Dermacentor variabilis} (American dog tick) which is an effective transmitter of tularemia. Image from: Iowa State University-Entomology Dept Image Gallery http://www.ent.iastate.edu/imagegal/ticks/aamer/aamerfanddvarf.html; Girl with ulcerating lymphadenitis due to tularemia, Kosovo, April 2000 Image from CDC website: http://www.cdc.gov/ncidod/eid/vol8no1/01-0131.htm; Ulcer caused by tularemia. Image from: CDC Photo Image Library (http://phil.cdc.gov/Phil/results.asp?page=1)
The diseases we just reviewed were the Category A agents, i.e. those that are given highest priority by the CDC. This next group is the Category B agents/diseases which have been given second priority by the CDC. The first four in this group are bacteria, two rickettsial organisms (Q Fever and Typhus fever), then one group of viruses (the viral encephalitides focusing on VEE), followed by some select toxins, and finally organisms that pose a threat to food and water.

**Brucellosis**

- **Bacteria:** Brucella spp.
- Transmission by ingestion, inhalation or direct contact
- Clinical signs
  - Humans: Cyclic fever and flu-like symptoms
  - Animals: Reproductive signs

Brucellosis, or undulant fever, is caused by various species of *Brucella*, a Gram-negative, facultative intracellular rod. The organism can persist in the environment and indefinitely if frozen in aborted fetuses or placentas. Transmission occurs via ingestion of infected food or consuming infected unpasturized milk or dairy products, via inhalation of infectious aerosols (a means of infection in abattoirs), or through contact with infected tissues through a break in the skin or mucous membranes. Brucellosis can involve any organ or organ system and have a very insidious onset with varying clinical signs. The one common sign in all patients is an intermittent/irregular fever with variable duration, thus the term undulant fever. There are 3 forms of the disease in humans. In the acute form (<8 weeks from illness onset), symptomatic, nonspecific, and flu-like symptoms occur. The undulant form (<1 yr. from illness onset and symptoms) include undulant fevers, and arthritis. In chronic form (>1 yr. from onset), symptoms may include chronic fatigue-like syndrome, and depressive episodes. Illness in people can be very protracted and painful and can result in an inability to work and loss of income. In animals, the clinical signs are mainly reproductive in nature, such as abortions, epididymitis, orchitis, and also fistulous withers in horses. Photo courtesy of D. Bickett-Weddle, DVM, ISU.

**Glanders**

- **Bacteria:** Burkholderia mallei
- Transmission by ingestion, inhalation or direct contact
  - Animal-to-human transmission is inefficient
- Clinical signs
  - Humans & horses: Skin and lung lesions, rapidly fatal illness

There are several common names associated with glanders and they include Equina, Farcy and Malleus. Glanders is caused by a Gram negative bacteria, *Burkholderia mallei* (formerly *Pseudomonas mallei*). It is closely related to the next bacteria we will overview – *Burkholderia pseudomallei* that causes Meloidosis (which we will review next). *B. mallei* is transmitted by ingestion or inhalation of infected tissues or fluids, and also through contact with broken skin or mucous membranes. Horses, mules and donkeys are the major host of this organism. Cats can be infected and may be particularly susceptible. Dogs, goats and camels can also be infected, but ruminants appear to be resistant. The clinical disease in horses and humans is similar. Transmission from animal to human appears to be inefficient. Infection by contact leads to ulceration of the skin, mucous membranes and soft tissues, as pictured on the slide. Infection by inhalation leads to acute glanders that results in pulmonary abscesses and nasal ulcers. Chronic glanders affects the joints and muscles forming ulcerated and purulent lesions. The photo is of a donkey with a ulcerative lesion on his lip. www.vet.uga.edu/vpp/gray_book/Images/056.htm

**Psittacosis**

- **Bacteria:** Chlamydophila psittaci
- Occurs worldwide
- Clinical disease
  - Humans and birds: Ranges from no symptoms to systemic illness with severe pneumonia

The fourth bacterium in the Category B list is *Chlamydophila psittaci*. It is a Gram-negative, obligate intracellular bacteria. Psittacosis or avian chlamydiosis naturally occurs worldwide and is usually a sporadic disease. In the U.S., psittacosis is reportable in humans, but true incidence is unknown due to poor reporting compliance and frequent misdiagnosis. There are 50-100 confirmed cases per year in the U.S. (1-2 deaths per year), but some estimate as many as 100-200 cases actually occur annually. Pet store employees, owners of pet birds, and poultry processing plant workers account for the majority of the reported cases. The organism is transmitted by inhaling contaminated dust from feathers or bird droppings. The elementary body form of *C. psittaci* is the infectious form and is very resistant to drying. Infectivity of *C. psittaci* has been
documented in straw or on hard surfaces for 2-3 weeks, canary feed for 2 months, in poultry litter for up to 8 months, and in diseased turkey carcasses for less than 1 year. In humans, clinical signs range from asymptomatic to systemic illness with severe pneumonia. Pneumonia occurs most commonly in adults 30-60 years old. Other signs include abrupt onset of fever, chills, headache, nonproductive cough, and breathing difficulty. In birds, clinical symptoms of avian chlamydiosis includes depression, ruffled feathers, inappetence, nasal discharge, respiratory distress, yellowish-green or green diarrhea, and conjunctivitis. Egg production may decrease. Pigeons and ducks may have neurologic signs.

**Q Fever ("query" or "puzzling" fever)** is caused by *Coxiella burnetii*, an obligate intracellular parasite, which is currently considered a rickettsial agent (new studies may change its family). The disease has been found worldwide, except in New Zealand. Transmission occurs by inhalation or direct contact of infectious organism; it also occurs following ingestion of the of the organism, and ticks spread the infection among ruminants and sometimes people. The organism is shed in high numbers in placental tissue and body fluids, and is highly infectious (one organism can cause disease). There was a report of a case where a cat infected with Q fever had kittens in the same room where a child’s birthday party was being held. Several of the children developed Q fever. *Coxiella burnetii* forms an unusual spore-like structure and can survive 7-10 days on wool at room temperature, 1 month on fresh meat in cold storage, and more than 40 months in skim milk. However, it is killed by pasteurization. Two clinical forms of disease occur in humans, acute (less than 6 months duration) and chronic (greater than 6 months). Symptoms of acute disease vary in severity and duration and usually manifest as self-limited febrile or flu-like illness, but pneumonia or hepatitis may also occur. Chronic disease occurs in 1-5% of those infected and the most common complication is heart related (endocarditis). Farm animals, including sheep, cattle, and goats, are the most important reservoirs of disease and are usually asymptomatic. Abortions, stillbirths, mastitis in dairy cattle, and complicated deliveries have been reported in these animals. Dogs, cats, rabbits, horses and many other animals can harbor the organism, but is usually asymptomatic.

**Typhus Fever**

- *Rickettsia prowazekii*
- Endemic in Eastern Europe, Middle East, and parts of Africa
- Transmitted in feces of human body louse
- Clinical signs: Humans
  - Fever, headache, red blotches, and a red-dot rash
- Not seen in domestic animals

The second rickettsial organism of the Category B agents is *Rickettsia prowazekii*. This disease, also called epidemic typhus, killed about 10% of the English population in 1557. It is transmitted by arthropod vectors, primarily the human body louse (not the human head louse). It is an obligate intracellular parasite in both humans and lice. Lice infected with *R. prowazekii* die about two weeks after ingesting the infected bloodmeal. The organism is not transmitted to the louse eggs (no transovarial transmission). As a result, the mammalian host is essential in long term propagation of *R. prowazekii*. Patients are infective for lice during the febrile illness and possibly for 2-3 days after their temperature returns to normal. Infected body louse pass rickettsia in their feces within 2-6 days after the blood meal. The rickettsia may remain viable in dead lice for weeks and in the feces for 2-3 days. The disease is characterized by the sudden appearance of headaches and high fever for two weeks. Once infected, simultaneous symptoms may include chills, prostration, coughing, severe muscular pain, bronchial disturbances, and mental confusion. A macular eruption (dark spot on the skin) appears on the fifth to sixth day, initially on the upper trunk, which then spreads to the entire body except the face, palms, and soles of the feet. Mortality rate increases with age and may reach 60% in untreated persons older than 50 years. In epidemic conditions mortality can approach 100%. Domestic animals are not susceptible to *R. prowazekii*. Human body louse J. Kalisch, University of Nebraska.
**Viral Encephalitis**
- Viruses causing EEE, WEE and VEE
- Transmitted via mosquito
- Clinical signs
  - Humans, horses, donkeys, mules: Often no signs or flu-like illness
  - Brain inflammation in some patients
- Birds do not become ill but are carriers; act as sentinels

This is the only viral group in the list of Category B agents. This group of equine encephalitis viruses are RNA viruses in the alphavirus genus. Eastern, Western, and Venezuelan Equine Encephalitis viruses are transmitted by mosquitoes. The female mosquito takes a bloodmeal from a viremic host, generally birds for EEE and WEE, and birds and horses for VEE. The virus replicates in the salivary glands of the mosquito and is transmitted back to birds or to dead end hosts, such as humans and horses, where overt disease occurs. In humans, infections can be asymptomatic or cause flu-like illness. In a small proportion of cases viral encephalitis can occur and lead to permanent neurological damage or death. Horses, donkeys and mules have similar clinical signs as humans. The disease in these animals often precede human cases by several weeks. EEE and VEE have mortality rates of 40-90%. WEE has a lower mortality rate ranging from 20-30%. Birds are asymptomatic carriers. The detection of viremia in sentinel birds is detected via ELISA.

**Food Safety Threats**
- *Campylobacter* species
- *Salmonella* species
- *E. coli* 0157:H7
- Viruses, parasites, chemicals, toxins
- Ingestion of contaminated food
- Gastrointestinal upset

There are an estimated 250 pathogens that can cause foodborne related illnesses. The most commonly recognized foodborne infections are caused by *Campylobacter*, *Salmonella* and *E. coli* O157:H7. Viruses, parasites, natural or manufactured chemicals and organism toxins can also cause foodborne disease. Most agents cause gastrointestinal upset (nausea, diarrhea, abdominal cramps) which are self-limiting in 4-5 days. However, some agents have severe complications if left untreated. *Campylobacter* is considered the leading bacterial cause of foodborne related diarrhea, with an estimated 2.4 million people affected each year. Common sources include raw or undercooked poultry, raw milk or items contaminated with infected animal or human feces. Animal sources include poultry, cattle, puppies, kittens and pet birds. Many serotypes of *Salmonella* can also cause foodborne related illness. *S. enteritidis* and *S. typhimurium* are the most common isolates, accounting for about 41% of U.S. human cases. Common sources for *Salmonella* food-borne illness include raw poultry or eggs, beef, unwashed fruit and alfalfa sprouts. Pet reptiles can also be a common source. *E. coli* O157:H7 is another major pathogen of foodborne related illnesses. Common sources include undercooked or raw hamburger, salami, lettuce and alfalfa sprouts. It has also been associated with unpasteurized milk, apple juice or cider as well as contaminated well water. Cattle are the most common animal source although other mammals can serve as a source. Severe sequela can occur with *E. coli* infection.

**Food Safety Threats: The Bioweapon**
- 1984, The Dalles, Oregon
  - Bagwan Shree Rajneesh cult
  - Salmonella typhimurium
  - Goal: incapacitate voters
  - 751 people ill

Restaurants have served as a conduit for terrorism before. In 1984, the Bagwan Shree Rajneesh cult in The Dalles, Oregon deliberately contaminated salad bars with *Salmonella typhimurium* in an attempt to incapacitate voters for an upcoming local election. At least 10 restaurants were affected and possibly one supermarket. Additionally, coffee creamers in some restaurants were also contaminated. The incident resulted in 751 people becoming ill. It wasn’t until one of the cultists broke a vow of silence and came forth one year later that the details of the “attack” became known. Plans were being made to contaminate the water also. This incident was meant to be a trial run before a full scale biological crime.

**Water Safety Threats**
- 53% of US drinking water is from ground water
- *Cryptosporidium parvum* - protozoa
- *Vibrio cholerae* - bacteria

Fifty-three percent of the U.S. drinking water comes from ground (well, aquifer) water. Surface waters such as lakes, reservoirs, and streams, are used by cities but require filtration and/or chemical treatment. Two organisms are listed in the Category B list as examples of water safety threats. They are *Cryptosporidium parvum* and *Vibrio cholerae*. 

**Cryptosporidium**
- **Cryptosporidium parvum** - protozoa
- Transmission: Inhalation, ingestion
- Clinical signs: Humans, calves, others
  - Acute gastroenteritis
- Dogs, cats, horses, pigs: Resistant

**Vibrio cholerae**
- **Vibrio cholerae** - bacteria
- Transmission: Fecal-oral, contaminated shellfish
- Clinical signs in humans
  - Acute, mild diarrhea
  - 5% severe disease
- Animals are resistant to disease

**Water Safety:**
**Public Health Significance**
- **Cryptosporidium parvum**
  - 1993: Municipal water supply contaminated in Milwaukee
  - 40,000 ill
  - 1997: Decorative water fountain at the Minnesota Zoo
  - 369 cases
  - Mostly young children

**Category C**
- Nipah virus
- Hantavirus

**Nipah Virus**
- Paramyxovirus
- Fruit bat reservoir
- Clinical signs
  - Humans: Encephalitis
  - Pigs: Respiratory, neurological
  - Dogs and cats: "Distemper"

**Cholera** results from infection by **Vibrio cholerae**, a Gram negative bacteria. Cholera is endemic in the Middle East, Africa, Central and South America, parts of Asia, and the Gulf Coast of the U.S. Major epidemics occur periodically in less developed countries. Transmission is by fecal-oral route. Infections are particularly common after ingesting contaminated water. Occasionally cases are seen in people who have eaten raw or undercooked shellfish, especially oysters, from contaminated waters. Infection with *V. cholerae* results in acute diarrhea that is often mild or asymptomatic. However, 1 in 20 can have severe disease with profuse watery diarrhea, vomiting, and leg cramps. Without treatment, dehydration, shock, and death can occur within hours. Humans appear to be the only natural host for *V. cholerae*. Experimentally some lab animals have been infected and dogs are susceptible if massive doses of bacteria are given.

Throughout the years in the U.S., several cult groups have planned or implemented attempts to contaminate water sources. There are approximately 27 potential biological organisms and chemicals that could be used to threaten the safety of our water supply. Two examples of accidental contaminations occurred in Milwaukee and Minnesota. In Milwaukee, a **Cryptosporidium parvum** outbreak occurred in 1993 and was the largest contamination of a municipal water supply. 403,000 people were affected and 40,000 became ill. In 1997, a decorative water fountain at the Minnesota Zoo became contaminated with **Cryptosporidium**. There were 369 cases of disease with the majority being in persons under 10 years old.

We will now discuss the diseases of third highest priority on the CDC Category Agent List, both of which are viruses.

**Nipah virus** was discovered as a Paramyxovirus in Malaysia in 1999, and causes a severe respiratory disease in pigs and severe encephalitis in humans. The reservoir for the virus is thought to be fruit bats, which are called flying foxes. Suspected transmission of the virus occurs from bats roosting in fruit trees close to pig confinements. The virus then spreads rapidly through the swine herd by direct contact or aerosolization (usually coughing). It can then be passed to humans, dogs, cats and other species. Transmission can also occur from direct contact with infected body fluids. To date, no person-to-person or bat-to-person transmission has been reported. In humans, the incubation period is 3-14 days. Initial symptoms include fever, headache, dizziness, drowsiness, disorientation and vomiting. Some cases show signs of respiratory illness. In severe cases, a
rapidly progressive encephalitis can occur with a mortality rate of 40%. In
swine, Nipah virus is highly contagious and easily spread. Many pigs are
asymptomatic. Clinical signs include acute fever (>104 °F), tachypnea and
dyspnea with open mouth breathing, and a loud, explosive barking cough may
also be noted. Occasionally, neurological signs can occur. Clinical signs in pigs
were noted 1-2 weeks before illness in humans making swine a sentinel for
human disease. Disease in other animal species is poorly documented. Other
species demonstrate respiratory and neurological signs. Photo of a Malayan
flying fox.

Hantavirus is an RNA virus in the Bunyaviridae family. It is recognized as
causing hantavirus pulmonary syndrome (HPS) and hemorrhagic fever with
renal syndrome (HFRS) in humans. Rodents are the asymptomatic reservoir
host and the deer mouse (Peromyscus maniculatus) is the primary carrier in all
areas of the United States, except the southeast, where the cotton rat (Sigmodon
hispidus) and the rice rat (Oryzomys palustris) are involved. It is important to
remember that the house mouse is not a carrier. Transmission to humans most
commonly occurs when they disturb the microenvironment of rodents and
breathe aerosolized infectious particles from rodent excrement. Direct contact
with rodent excreta on human mucous membranes or through skin abrasions
may also result in transmission. The virus particles can contaminate food
consumed by humans and cause infection, and in very rare cases, a bite from an
infected rodent can precipitate the disease. Clinical signs in humans initially
include fatigue, fever, myalgia, and headache. The disease can progress a severe
respiratory syndrome, HPS in the U.S., or hemorrhagic fever with renal
syndrome (HFRS) in Asia and Europe. Approximately 40% of patients die
within the first 48 hours due to uncorrected hypoxia and shock. The disease is
not seen in domestic animals.

The next four diseases that will be covered include Transmissible Spongiform
Encephalopathy, West Nile Virus and Monkeypox. These agents/diseases are
not part of the CDC Category ABC list, but we at the Center for Food Security
and Public Health decided to include them because they are important zoonotic
diseases.

Transmissible spongiform encephalopathy (TSE) describes a group of diseases
that are thought to be caused by prions (short for proteinaceous infectious
particles). These abnormal proteins cause a variety of diseases in various
species. In humans, variant Creutzfeldt-Jakob disease (vCJD), Kuru,
Gerstmann-Strassler-Scheinker syndrome (GSS), and fatal familial insomnia
(FFI) can occur. In animals, bovine spongiform encephalopathy (BSE), or “mad
cow disease”, scrapie in sheep, chronic wasting disease (CWD) in deer and elk,
mink spongiform encephalopathy (TME), and feline spongiform
encephalopathy (FSE) can occur. The incubation period for most of these
diseases is many years which complicates diagnosis. In humans with vCJD,
clinical signs include depression and schizophrenia leading to ataxia and
involuntary muscle movement. This eventually progresses to complete
immobility and muteness. In animals, initial clinical signs can be subtle, but
usually involve behavioral changes, such as excitability, nervousness,
aggressiveness, and increased sensitivity to noise. Sheep with scrapie typically
exhibit intense pruritus. The terminal state of TSEs in cattle, deer and elk, can
result in extreme wasting despite a good appetite. Additionally, tremors and
muscle fasciculations, especially in the neck and face, can occur. There is no
Bovine spongiform encephalopathy (BSE) in cattle is thought to have occurred from feeding meat or bone meal from scrapie-infected sheep to cattle, or from spontaneous genetic mutation in a cow then fed to other cows. The first cases of BSE appeared in the U.K. in 1986. The incubation period ranges from 2 to 8 years and is always fatal. BSE is the only disease that has been shown to be transmissible to humans. BSE presents itself as variant Creutzfeldt Jakob disease in humans. In 1995, ten human cases similar to Creutzfeldt-Jakob disease (CJD) were reported in the U.K. However, the disease was affecting people at a younger age, eliciting behavioral changes not seen with classic CJD and demonstrated different brain lesions. Currently, it is thought that consumption of BSE contaminated beef products (prior to the U.K.’s specified bovine offal ban in 1989) may be responsible for the disease. The mortality rate is 100% for cattle and humans. The United States began active surveillance for BSE in 1990. In May 2003 BSE was diagnosed in an 8 year old angus beef cow in Alberta, Canada. All herd mates tested negative. The US reported its first case of BSE in a 6½ year old dairy cow in Washington state; this cow had been imported from Canada.

West Nile virus (WNV) is a Flavivirus that can cause severe encephalitis in humans, horses, birds and other animal species. Transmission typically occurs from a mosquito vector. *Culex* species are the most important maintenance vectors in the eastern U.S., although WNV has been detected in 29 species of mosquitoes. It has been isolated from ticks, but their role in transmission is still unclear. A few cases of WNV have been transmitted through blood transfusions, organ donation, and breast feeding of infants. Bird species are the primary reservoir of WNV. Mosquitoes pick up the virus from birds in a bloodmeal and then transmit it to mammals via bites. It is thought that viremia in humans and horses is NOT high enough to serve as a reservoir source. Horses are the most commonly affected domestic animals and many are asymptomatic. Of those that do become ill, about 40% result in death. Clinical signs for horses include a wide variety of neurological signs, ranging from facial paralysis and head tilt, to recumbency and seizures. In humans, the incubation period for WNV is approximately 3-14 days. Eighty-percent of persons infected will be asymptomatic and approximately 20% will develop a mild illness, termed “West Nile Fever.” Signs begin with acute fever (usually >39°C), headache, and myalgia, and gastrointestinal symptoms. Illness usually lasts less than a week, but prolonged fatigue is common. Approximately 1 in 150 WNV infections will result in severe neurological disease called “West Nile encephalitis,” “West Nile meningitis” or “West Nile meningoencephalitis”. Symptoms of severe infection include headache, high fever, muscle weakness, and paralysis. This can occur in patients of all ages. The case-fatality rate ranges from 3-15% and is highest among the elderly. Year-round transmission of WNV is possible in warmer climates.
West Nile Virus: Public Health Significance

- Human illness in U.S. in 2003
  - 9,100 cases, 222 deaths
- Horses illness in U.S. in 2003
  - 4,554 cases
  - 40% of ill result in death
- Method of introduction to U.S.
  - unknown

*data current as of 1/30/04

Spread of WNV in the U.S.

This map depicts the spread of West Nile Virus since its appearance in the United States in 1999. This illustrates WNV activity in birds, horses, mosquitoes, other animals, and humans. Image taken from:

www.cdc.gov/ncidod/dvbid/westnile/surv&control.htm#map1

West Nile Virus: The Response

- Treatment: Supportive care
- Vaccine available for horses, not humans
- Source elimination
  - Eliminate mosquito larval habitats
- Personal protection
  - Reduce time outdoors
  - Wear long pants and sleeves
  - Use mosquito repellent

Treatment for WNV involves supportive care. Ribavirin and interferon may be helpful but, currently no specific antiviral has been approved by the FDA. A WNV vaccine for horses has been available since 2001 and became fully licensed by the USDA for use by licensed veterinarians in November 2002. Development of a human vaccine is underway. Acambis (a vaccine manufacturing company) has developed a live attenuated vaccine and hopes to begin clinical trials by 2003. Prevention remains the best defense against WNV by reducing the source and eliminating larval habitats. Additionally, WNV infection can be prevented by reducing your contact with mosquitoes. Personal protection measures include reducing time outdoors, particularly in early evening hours, wearing long pants and long sleeved shirts, and applying mosquito repellent containing DEET to exposed skin areas. Do not use DEET products on your pets. The concentration of DEET in mosquito products is too high to be safe for cats and dogs and they may develop severe neurological problems. Only use approved mosquito repellent products on pets, but note that not all products labeled for use on dogs can be used on cats.

Monkeypox

- Virus related to smallpox
- Transmission
  - Reservoir may be African squirrel
  - Bites, aerosol, direct contact
  - Zoonotic, animal-to-animal, person-to-person
- Animals: Fever, rash, pustules, red eyes
- Humans: Flu-like, rash, pustules, swollen lymph nodes

Monkeypox virus is a naturally occurring relative of variola (smallpox) virus and is endemic in central and western Africa. Monkeypox disease is clinically indistinguishable from smallpox, with the exception that monkeypox is less severe and there is often notable enlargement of cervical and inguinal lymph nodes. The virus was first identified and named when it was isolated from laboratory monkeys in 1958. The first isolation of the monkeypox virus from humans in Africa was in 1970. The reservoir for monkeypox virus may be an African squirrel. Many different rodents, rabbits, and primates are susceptible to infection. The virus is transmitted through bites, aerosols, or direct contact with lesions or body fluids from infected animals or humans. Fomite transmission is also possible. Transmission can be from animal to person, animal to animal or person to person. Epidemiological evidence in Africa indicates a rate of person-to-person transmission of 3.3 to 30%. The incubation period is approximately 12 days for humans and 6-7 days for animals. In rodents symptoms include fever, conjunctivitis, cough, lethargy and a blister-like rash. The disease in non-human primates is usually fever followed by a self-limiting rash. In humans, flu-like symptoms occur in the first 10 days, followed by the development of the rash (macular, papular, vesicular or pustular) and enlarged lymph nodes. An infected animal or person is contagious one day before clinical symptoms and for 21 days after symptoms or until scabs heal. Case-fatality rates reported from
a rural African outbreak ranged from 1-10% with higher death rates among children. Images courtesy of CDC and USDA APHIS.

The final section of the presentation addresses our what to do if a bioterrorism agent is suspected and how to respond.

In conclusion, if a bioterrorism event is suspected it is important to stay informed of the situation and remain calm. Each event is very specific and reactions to them can be quite different. It is everyone’s responsibility to follow the advice of public health officials and abide by federal and state guidelines. Movement restrictions and quarantine may be necessary to prevent spread of disease. In a society that is free to come and go as we please, this may be difficult to accept at first. Remember that it is for the betterment of society and the particular situation to follow the advice of educated and trained infectious disease and bioterrorism specialists.

It is important that you have your local veterinarian’s telephone number available in case you are suspicious of an accidental or intentional release of a biological agent. You should also inform your local physician if you develop any signs that are unusual, especially if your animals have been sick. If in doubt it is better to call and let the officials decide if your situation needs further investigation. The faster an outbreak can be identified the faster it can be contained and controlled. http://www.marathoncom.com/images/telephone.jpg

We have discussed several main points. We looked at the threat of bioterrorism, pointing out that the threat does exist and Americans need to be educated about it. We highlighted the public health infrastructure and discussed the systems and programs in place that have been, or are being, strengthened. Then, we discussed specific diseases that could be used in bioterrorism, noting that most are zoonotic. It has become clear that awareness education is an important component of preparedness and protection.
Prevention, recognition and response involves everyone. It is important to report any suspicious activity, unexplained behavior or death loss in your animals to the proper authorities. Most importantly, each of you play a critical role.