Animal Biosecurity and Protection – Dr. Charlie Stoltenow, Extension Veterinarian, NDSU

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Agriculture is one of the United States' largest industries and contributes to the nation's health and prosperity. The US generates over $100 billion through the livestock and poultry industry. About 17% of all American jobs are directly or indirectly related to agriculture and the food industry; in 2001, US agricultural exports were worth approximately $50 billion.

Agriculture is one of the easiest sectors of the economy to disrupt and is vulnerable to natural or intentional threats. In 2006, spinach suspected of being contaminated with *Escherichia coli (E. coli)* was removed from grocery shelves and restaurant menus. An investigation revealed the contamination was accidental. Another recent example is the 2007 Salmonella contamination in peanut butter that made the product recall national news.

In Great Britain, a foot-and-mouth disease epidemic in 2001 and an outbreak of bovine spongiform encephalopathy (BSE, also known as mad cow disease) that peaked in 1992 cost the country billions of dollars in livestock losses and limited export capabilities.

Industries that support livestock (feed, fencing, pharmaceutical, veterinary, etc.) were also heavily affected, and there was a negative effect on tourism. Both of these disease events were unintentional biological disasters.

Biosecurity is the implementation of measures to prevent the introduction of disease into a healthy population of animals or limit the spread of disease once introduced. A wide variety of resources are available to guide producers on the implementation of biosecurity programs.

Keeping the livestock industry healthy and free from infectious diseases requires an interdisciplinary effort. The United States Department of Agriculture (USDA), through the Animal and Plant Health Inspection Service (APHIS) Veterinary Services (VS), cooperates with other countries around the world and works to prevent foreign animal diseases from crossing our borders.

Veterinary Services officials work closely with state animal health officials to safeguard animal health. Collaborative efforts identify, control, and eradicate specific diseases in the U.S. and monitor animal movement. Local practicing veterinarians, Extension personnel, producers, and animal diagnostic laboratories are primary resources in disease surveillance and reporting. These resources provide valuable information about the prevention and control of diseases to livestock producers. The unified efforts to establish and maintain effective animal disease barriers have spared US livestock operations from many devastating diseases.

Biosecurity is critical for a livestock operation because it reduces the risk of introduction of infectious agents. Effective measures should be incorporated into every farm's management plan to reduce the

risk of disease exposure in livestock and to maintain a safe and wholesome food supply.

Biosecurity is part of a preventive medicine program. Farm owners should recognize vulnerabilities to infectious and non-infectious disease agents on the farm and incorporate prevention/mitigation activities.

Complete biosecurity is difficult to achieve due to the proximity of nearby herds and wildlife, and risks posed by transportation of animals, people, and vehicles on and off the farm. "Biological risk management" may be another way of thinking about a set of best management practices that prevent infectious diseases from being introduced into a healthy herd/flock.

Livestock owners and managers are ultimately responsible for protecting the health of animals under their care. They should develop a biosecurity program for their livestock operation in cooperation with private veterinarians, Extension educators, and state and federal animal health officials.

Reacting to a disease outbreak is financially and emotionally expensive. The safest and most cost-effective method of herd protection is to prevent disease. Each farm operator should consult with their animal health professional to carefully evaluate their management practices, identify specific high-risk activities that could present potential problems, and adopt practices to prevent and mitigate those risks.

Producers can help protect the health and welfare of their livestock through a relationship with their local veterinarian. The veterinarian-client-patient relationship (VCPR) is the basis for veterinarians working with clients and animals. Three basic principles must exist for a valid VCPR, and these principles are recognized by the American Veterinary Medical Association and by many state laws:

- The veterinarian has assumed responsibility for making judgments regarding the health of animals, and the client has agreed to follow the veterinarian's instructions.
- The veterinarian has sufficient knowledge of the animals to initiate at least a preliminary diagnosis via recent examination of animals and knowledge of their husbandry and care.
- The veterinarian is readily available (or has arranged for another veterinarian) for emergencies, follow-up evaluation of adverse reactions or failure of treatment.

Producers in a VCPR can obtain prescription medications for their livestock and secure veterinary services during an animal health emergency.

A biosecurity plan can be adopted for any type of animal agriculture operation. Vulnerabilities of a backyard poultry flock differ from those of a commercial broiler operation. For example, backyard flocks are more exposed to vector- and weather-borne pathogens. Commercial broilers are more isolated due to confinement, but a disease might spread more rapidly if introduced. Although the principles of biosecurity are similar for all livestock, they should be individualized for each farm.

Biosecurity is also an important part of farm financial management. The economic effect of an animal

disease includes the costs associated with death loss, reduced productivity, decreased feed efficiency, reproductive failure, increased culling, and reduction in value. Expenses for the treatment and increased management of the sick animals further reduce revenue and increase cost. Prevention or reduction of disease through a good biosecurity program can limit financial losses.

Major components of a sound biosecurity program include:

- Resistance
- Isolation
- Traffic control
- Sanitation and disinfection
- Animals can be ***resistant*** to infection or resistant to sickness after infection. Some diseased animals may be sub-clinically infected and can spread the disease to others without becoming sick themselves. Healthy animals are more resistant to diseases than stressed and malnourished animals.

  Vaccination programs can be used to supplement other disease control procedures, but should not replace them. Vaccines are used to increase an animal's specific resistance to disease, but no vaccine is 100% effective.

- ***Isolation*** of new, sick, and show animals from the herd can reduce exposure of resident animals to infectious diseases. Many (but not all) infectious diseases have an incubation time of less than four weeks. The incubation time is the time from exposure to a disease to appearance of clinical signs. New animals should be isolated for a minimum of 28 days, during which time there is no contact with resident animals.

- During the isolation period, animals should be closely monitored for physical signs of disease, preferably by a veterinarian. While many diseases have obvious outward physical signs, other diseases may be more difficult to detect. Blood testing and other diagnostic procedures performed by a veterinarian provide the most accurate method of detecting disease. During the diagnostic visit, the veterinarian can also provide other essential preventive treatments, such as updating vaccinations, de-worming, hoof care, etc.

- During a disease outbreak, sick livestock should be isolated from healthy animals to decrease the spread of disease. The exposed (but still healthy) animals should be quarantined (restricted from movement to other barns, pastures, and areas of the farm). It is important to control traffic of animals, people, and vehicles in areas with sick, exposed, and unexposed animals. If animals are incubating an infectious disease, these actions should contain the infected livestock to one area of the farm.

- ***Traffic control*** involves limiting access to the farm, barn, and even individual animal pens.

  Traditionally, livestock producers have permitted visitors to easily access the farm. This practice allows numerous opportunities for animal health threats to be introduced into an animal agriculture operation. Producers should take steps to limit or control access to the property.

  Monitor traffic into a livestock operation with a sign-in sheet to document visitors. Consider positioning it as a guest book to reduce reluctance of visitors to register. Request an address or phone number to facilitate contacting the visitor(s) if necessary.

- Traffic control also involves controlling physical access to the road(s) that lead into the farm. Limit access to only the essential entrances and monitor them by either direct or remote observation. Driveway warning bells may be useful to detect traffic on small operations. Signs restricting visitors, informing them they must register at the office, and that the premises are under 24-hour surveillance may also be effective tools.

  Visitors can introduce infectious diseases onto animal agriculture facilities. It is reasonable to require visitors to wash their hands and wear protective boots on livestock operations. Large operations may restrict access to poultry or swine confinement units to only prescreened individuals who must shower-in and shower-out. Visitor's cars should remain in designated parking areas and not be allowed onto the farm, which can help prevent the spread of infectious agents on tires.

- Traffic control measures should include all vehicles entering the property, such as delivery trucks, milk tankers, and veterinary vehicles. The foot-and-mouth outbreak in Great Britain demonstrated how vehicles, tires, and equipment can easily spread a virus. All fomites should be thoroughly cleaned and disinfected between farms to limit the spread of disease.

  Livestock that is routinely transported on and off the farm (petting zoo animals, show livestock, etc.) should be housed separately from resident livestock.

  Varying degrees of susceptibility among livestock require a systematic approach to animal housing and traffic patterns between groups of animals. Animals with vulnerable immune systems (e.g. pregnant females, young animals) should be housed separately from older healthy animals with stronger immune systems. Always work with the healthiest yet most susceptible animals first to limit exposure to disease.

- ***Sanitation*** reduces animal exposure to pathogens through general cleanliness of all components of an animal agriculture operation. People, materials, and equipment entering an operation should be prevented from contaminating a clean environment by introducing animal manure, fluids, or tissues. Cleanliness of people, materials, and equipment already at the operation is extremely important.

All farm visitors and employees should wear clean clothing or disposable (e.g. Tyvek®) outer coveralls. In addition, they should wear disposable plastic footwear or thoroughly wash boots and disinfect with an EPA (Environmental Protection Agency)-approved disinfectant. Information on disinfectants is available at The Center for Food Safety and Public Health website <http://www.cfsph.iastate.edu/BRM/disinfectants.htm>. Different disinfectants are approved for use in dairies and poultry facilities, as well as other livestock areas. For specific recommendations, contact the farm veterinarian, Extension agent, or State Veterinarian's Office for approved disinfectants for use by species.

The primary objective of sanitation is to prevent contaminated materials from entering the nose or mouth of animals. Ensure the cleanliness of all feed-handling equipment and equipment introduced into the mouths of animals (e.g. dose syringes, balling guns). Wagons used for manure handling should not be used for transport of feed or bedding. Store cleaned equipment in clean, dry areas.

There are three common routes of disease exposure in animals. They are:

- Natural
- Accidental
- Intentional

Natural exposure to a disease can occur when new animals are introduced to the herd/flock even if the symptoms are not clinically detectable. Pinkeye (infectious keratoconjuntivitis) and sore mouth/orf (contagious ecthyma) are examples of diseases that an animal may transmit as a carrier. Being a carrier means the animal does not exhibit symptoms of the disease but is still capable of spreading the pathogen to other animals.

Wildlife and insects also can act as vectors for the transmission of infectious agents to animals. Other diseases can spread through the environment to infect animals via wind, waterways, and other methods. While no one knows how West Nile Virus came to North America, once established in birds, it rapidly spread from New York to the Eastern seaboard and continued westwardly across the entire United States.

Accidental (unintentional) transmission of a disease can occur when soil or contaminants on people or equipment is brought onto the farm, or is moved from one area of the farm to another. People may unknowingly come in contact with infected animals and carry pathogens on their hands, clothing or shoes for several hours or days and accidentally infect their own livestock upon return to their operation.

Foot-and-mouth disease (FMD) is an example of a disease believed to have been accidentally introduced in 2001 in the United Kingdom. It originated on a farm that fed swill (garbage) to pigs. The swill included

undercooked meat products that originated from a foreign country with endemic FMD. The virus spread to a sheep farm about seven kilometers away and proceeded to cause billions of dollars in damages.

In October 2002, exotic Newcastle disease (END), a deadly viral disease of birds, was diagnosed in backyard flocks in Los Angeles County, California. Millions of birds were depopulated, an extraordinary emergency was declared, and extensive eradication efforts were conducted to contain this outbreak, which threatened a multi-billion dollar US industry. It is believed that infected backyard birds were smuggled across the border from Mexico.

Intentional diseases include infection of horses during WWI with glanders and anthrax; anthrax infection of cattle during a Zimbabwe war, which led to human outbreaks; and infection of Afghanistan freedom fighters' horses with glanders by the Soviets during the 1980's.

The size and nature of a disaster will dictate the amount of resources that are needed to save lives, protect property, protect the public health and safety, or lessen or avert the threat of a disaster. The emergency services personnel (fire departments, rescue squads, police, emergency medical service, etc.) in the community handle disasters on a daily basis.

If the incident exceeds the ability of local resources to respond then surrounding communities will often assist. In the event of an animal emergency/biosecurity event a similar scenario will play out. When the event exceeds the ability of the local resources then the state resources will be utilized and finally the federal resources will become available.

If an incident involves the introduction of a foreign animal disease (FAD), federal resources would be mobilized immediately due to the potentially devastating impact of the FAD on animal health nationwide. The response to any disaster generally requires the interaction of many agencies working together with the common goal of controlling the losses associated with the event. This coordination is often associated with the uses of emergency management principles.

In the event of animal disease emergency the Office of the State Veterinarian is the immediate authority. By administering veterinary medical regulatory programs, this office works to protect domestic animals and poultry from contagious and infectious diseases. The State Veterinarian's Office has regulatory authority to enforce regulations and quarantines to control the spread of disease through commerce.

The accredited veterinarian is a resource that the Animal and Plant Health Inspection Service branch of the US Department of Agriculture and the Office of the State Veterinarian utilize to regulate animal disease. Many veterinarians who deal with livestock and poultry are accredited veterinarians. This means that they have been trained and have entered into an agreement with USDA and the Office of the State Veterinarian concerning animal disease regulation. In this capacity they may perform such tasks as issuing health certificates and testing animals for regulated diseases (historically tuberculosis and brucellosis). Accredited veterinarians, since they regularly visit farms as part of their private

veterinary practice activities, serve as a first line of defense against the introduction of animal disease whether it is a natural introduction or an intentional act.

The State Veterinarian's Office should be contacted if there is any suspicion that a foreign or other reportable animal disease is present on an animal agriculture operation. In addition, any activity that might be related to the risk of introduction of such a disease should also be reported.

While the costs associated with these unintentional events were significant, the result of a targeted intentional agroterrorism attack could be even more devastating.

Local incidents caused by human activities, whether accidental or intentional, can cause animal disasters with global repercussions. Examples of some of the hazards include:

- **C**hemical
- **B**iological
- **R**adiological
- **N**uclear and
- **E**xplosive agents

These hazards are commonly identified by first responders as CBRNE hazards and devices. When used intentionally, CBRNE agents can be identified as weapons of mass destruction (WMD).

The Federal Emergency Management Agency (FEMA) defines agroterrorism as "the malicious use of plant or animal pathogens to cause devastating disease in the agricultural sector. It may also take the form of hoaxes and threats intended to create public fear of such events."

Attacks on the US agricultural sector can have a widespread effect with low risk of detection since most farms and livestock are not highly secured areas. In addition, if terrorists are using an agent that only affects animals and not people, they may escape unharmed.

Many chemicals are stored on farms. Examples of potentially harmful chemicals include those used for:

- Equipment (engine fluids)
- Animals (pesticides)
- Buildings (propane)

Accidental or intentional chemical contamination of animal feed can have significant economic effects. One example of the significant economic and health impact a chemical contamination of animal food can cause is the contamination of pet food with melamine in 2007. The incident caused a massive recall of canned pet foods after kidney disease and numerous deaths in cats and dogs were reported.

Exposure to chemical agents can occur through ingestion, inhalation, injection, or topical exposure to skin or mucous membranes. Some chemicals have long residual times, meaning they linger in the environment for long periods of time, while others degrade quickly.

In March 1970, Ku Klux Klan (KKK) members were reported to have poisoned cattle belonging to African-American farm owners in Alabama. Intending to intimidate and economically menace the ranchers, the KKK contaminated the water supply with a cyanide salt, resulting in the death of 30 cattle and the sickening of nine others.

In 1996 in rural Wisconsin, chlordane, an organochlorine pesticide, was intentionally added to rendering plant material that was then distributed to major animal feed producers. Tainted feed was identified as having been distributed to over 4,000 farms, principally dairies. Recalls of cheese, butter and other dairy products in four Midwestern states occurred because of suspected contamination. The charged suspect was a competitor of the facility. The cost to the feed producer alone was estimated at over $250 million.

Exposure to chemicals on the farm is commonplace. Toxic industrial chemicals are routinely found on farms. One example is anhydrous ammonia, a common fertilizer for crops. This chemical is often stolen from farms for manufacture of the illegal drug methamphetamine.

Farms nearby well-traveled roads or railroads have potential exposure to chemicals, which are safe while contained. However, in the event of a collision or derailment, toxic chemical spills and released gas can require immediate evacuation of people and animals to safe areas.

Wind, humidity, ambient temperature, and other environmental factors can influence the direction a plume of toxic gasses or smoke travels from a hazardous chemical spill or fire. With appropriate wind conditions, these gasses and smoke can spread for miles. Atmospheric effects on plumes were demonstrated when smoke from the 2007 wildfires in southern Georgia and northern Florida could be seen north of Atlanta, Georgia.

Even common household chemicals can cause severe problems. Accidental mixing of household bleach and ammonia causes highly toxic fumes, resulting in immediate choking and breathing difficulties.

Some commonly used livestock pesticides and biowarfare agents are examples of chemical nerve agents. All farm workers should handle pesticides with extreme caution. Nerve agents cause distinctive clinical signs in all mammals:

- **S**alivation
- **L**acrimation (tearing)
- **U**rination
- **D**efecation (or diarrhea)

- **M**uscle tremors

This is commonly known as a SLUD response. Veterinarians and ambulances carry atropine and other medicines to counteract the SLUD response in animals and people. Farm operations should have on file Material Safety Data Sheets (MSDS) for chemicals stored on the farm. These information sheets include information on hazards associated with the chemicals, protective equipment needed, clinical signs of exposure, fire and explosive hazards, and other important information. The MSDS can be requested from the supplier or manufacturer. In addition, the MSDS can be obtained on the Internet from many free sites by searching for "MSDS". One example is the Vermont Safety Information Resources, Inc. website <http://hazard.com/msds/>.

A complete discussion of chemical hazards on a farm is beyond the scope of this lesson. If suspicious odors are detected, immediately notify the fire department. Possible evacuation of people and animals upwind and uphill of the suspected area may be necessary. Toxic gasses can kill quickly, and some can be explosive.

Biological agents are microorganisms or toxins from living organisms that can cause illness in animals and/or people. Animal exposure can occur naturally or through human activity (intentional; e.g. criminal activity, terrorism).

Infectious organisms that can contaminate the body include bacteria, viruses, parasites, and fungi, etc. ***Contagious*** (also referred to as communicable or transmissible) biological agents may spread between animals and/or people.

For example, influenza is infectious (caused by a virus) and contagious (able to be spread to others). Tetanus (caused by bacteria found in soil or manure) is infectious but not contagious (it is an individual animal disease).

Direct transmission is when disease is passed through direct contact between animals.

Indirect transmission occurs when disease is contracted from fomites, vectors, alternate hosts, etc.

Contagious diseases are transmitted through ***direct contact*** from animal to animal via:

- Inhalation (e.g. influenza)
- Ingestion (e.g. salmonellosis)
- Direct contact of skin or mucous membranes (e.g. ringworm)
- Venereal transmission (e.g. contagious equine metritis)
- Blood-borne contact (e.g. hemorrhagic fever)
- Bites or salivary contact (e.g. rabies)

Indirect contact may involve the transfer of infectious agents through:

- An intermediary vector, such as an insect or tick (e.g. West Nile Virus)
- Inanimate objects called fomites, such as pitchforks, tires, boots, and equipment (e.g. salmonellosis and foot-and-mouth disease)

Diseases transmitted from an animal to a human are known as a ***zoonoses***, or ***zoonotic diseases*** , and include rabies, scabies, brucellosis (undulant fever), etc.

A disease that is not believed to occur in the US is an exotic or ***foreign animal disease*** (FAD). The United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) works with state animal health officials and veterinary professionals to identify, control, and eradicate these animal diseases and mitigate their effects.

Identifying animal health problems is an important step towards safeguarding against accidental and intentional threats (e.g. CBRNE hazards).

Knowledge and recognition of signs of animal illness are essential, regardless of the agent that causes accidental or intentional harm to livestock. Behavioral changes, such as not eating or drinking, lethargy, rough hair coat, or ruffled feathers are often some of the first signs of animal sickness. For some species, decreased milk or egg production or decreased weight gain can be early indicators that problems exist. Whenever possible, temperature, pulse, and respiration should be monitored on affected animals. Gathering as much information as possible about the animal(s) (vaccination history, number of animals affected, complete list of clinical signs, etc.) will help determine the urgency of the situation.

Damage from an explosive device may cause obvious trauma, but the device may also release radiation (e.g. dirty bomb), which cannot be seen. Intentional chemical contamination of feed can cause subtle or obvious signs in several animals but may require time for a diagnosis. Chemical exposure often causes symptoms that can be attributed to infectious diseases.

. Disgruntled employees who wish to retaliate against management may intentionally introduce diseases or harm livestock with other CBRNE agents. Criminals, animal rights extremists and terrorists may also try to injure animals. Terrorists (both domestic and international) could threaten to use or use CBRNE agents to strike at the US economy and create fear.

While many different definitions exist for agroterrorism, a general working definition is that agroterrorism is the intentional use of any chemical, biological, radiological, nuclear, or explosive/incendiary (CBRNE) agent against agricultural or food industries with the intent of destroying these resources and causing serious harm to the nation.

The increasing threat of agroterrorism emphasizes the need for physical security on the farm, which reduces the risk of criminal activity and intentional acts against animals and farm structures. For example, theft of anhydrous ammonia (fertilizer) for use in manufacturing methamphetamine can be

prevented with special locks designed for that purpose. Ask participants to identify some physical security measures that can be implemented on an animal agriculture production facility that can help safeguard against criminal activity (such as anhydrous ammonia theft). If they need prompting, some suggestions are provided below.

Perimeter fencing not only keeps animals contained, but also deters trespassers. Other deterrents to criminals include:

- Adequate lighting of critical structures, anhydrous ammonia and fuel tanks, etc.
- Elimination of hiding places such as overgrown shrubs and large brush or garbage piles
- Posted warnings of active video security
- Locked buildings (feed storage areas, chemical/fuel storage buildings, etc.)
- Natural warning systems (e.g. dogs and vocal birds such as guinea hens)
- Night security personnel
- Surveillance cameras

Criminals generally look for easy targets such as rural areas with limited security, few personnel, predictable schedules, and hiding places. Consult local law enforcement agencies or private security companies for suggestions on farm security.

Individuals with malicious or terroristic intent can circumvent even the most comprehensive physical security program to inflict damage. For instance, few expected the use of airplanes in the major terrorist events of September 11, 2001.

Participants who wish to pursue further physical security planning can refer to *Rural Security Planning: Protecting Family Friends and Farms (PPP-64),* developed by Purdue University Cooperative Extension Service, Purdue Pesticide Programs <http://www.btny.purdue.edu/Pubs/PPP/PPP-64.pdf>.

Although criminals or agroterrorists can use many types of agents to inflict harm (CBRNE), biological agents may be a weapon of choice. Biological agents are inexpensive and easily obtained, manufactured, and disseminated. In addition, they can be difficult to detect and may overwhelm medical/veterinary capabilities. Delayed detection may also allow the perpetrator(s) to escape before the effects are noticed. By the time diagnosis is made, the infection may be widespread. Finally, the mere threat of a biological attack can be enough to cause panic.

Agroterrorism and biological warfare are not new. Historical examples of individuals or countries using diseases or toxins to damage agriculture and the economy include the following:

- World War I: Germans infected horses with glanders and anthrax before the animals were shipped to Europe.

- 1979: Zimbabwe war. Native cattle were infected with anthrax and outbreaks occurred in humans.
- 1980s: The Soviet army infected Afghanistan freedom fighters' horses with glanders.

Glanders is a bacterial disease that primarily affects horses and is considered to be a foreign animal disease. It causes coughing, thick nasal discharge, and tender lymph nodes, which often results in animal death. This disease is zoonotic.

Symptoms that may indicate the presence of a biological agent and should prompt a response include:

- Sudden or unexplained deaths in the herd or flock.
- Severe illness affecting a high percentage of animals.
- Blisters around an animals mouth, nose, teats, or hooves.
- Staggering, falling, or other central nervous system disorders that prevent animals from rising or walking normally.

Early detection and a careful, rapid reaction are critical for containment of an animal health emergency. The acronym ***RAIN*** can be used to help remember the proper procedure.

Recognize the problem. ***Avoid*** further contamination. ***Isolate*** the animal to reduce spread of the agent. And, most importantly, ***notify*** the local veterinarian.

R - Recognize
A - Avoid
I - Isolate
N - Notify

The Centers for Disease Control and Prevention (CDC) (<http://www.bt.cdc.gov/agent/agentlist.asp>) maintains a list of all major bioterrorism diseases and agents. ***All of the diseases on the list are zoonotic except smallpox, which affects only humans and not animals.***

The nature of these diseases emphasizes the close relationships among agroterrorism, livestock health, and public health. The RAIN system is an effective tool to identify biological agents, whether introduced naturally, accidentally, or intentionally.