Introduction to Biosecurity & Agroterrorism

Pacific Emergency Management, Preparedness, and Response Information Network and Training Services (Pacific EMPRINTS)

University of Hawaii

Subject Matter Experts:
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Biosecurity

"The protection of the economy, environment, and health of living things from diseases, pests, and bioterrorism."[1]

- Agricultural producers:
  - Farmers
  - Farm animals, poultry, livestock & plant crops
- Livestock support industries:
  - Feed
  - Fencing
  - Pharmaceutical
  - Veterinary
- Food processing
- Food distribution
- Food retailing system
- Water supplies
- Tourism

[1]Hennessy, D. Economic Aspects of Agricultural and Food Biosecurity. Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science. Volume 6, Number 1, 2008.

Biosecurity Threats

- Natural and weather-related disasters, and their secondary effects.
- Animal and plant disease:
  - Natural
  - Accidental
  - Intentional
- Agroterrorism

Agroterrorism

- "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."
- Distinctive from other forms of terrorism:
  - Mass destruction of life (human, animal, or plant) is a major goal.
  - Onset of attack may not be apparent until the agent has spread significantly among the population.
  - Difficult to establish whether the release of the agent was intentional or unintentional.

Biosecurity Threats

- Both intentional and unintentional introduction of agents can have harmful effects.
- Strong international component to biosecurity due to food exports and imports.

Economic Effects

- Direct economic losses & indirect costs and multiplier effects:
  - Cattle & dairy farmers earn approximately $50 billion/year in meat and milk sales.
  - Domestically, approximately 10% of the U.S. Gross Domestic Product (GDP) is related to agriculture and food production.
  - Trade-off between individual businesses and common societal good.
- Loss of consumer confidence in government as well as agricultural industry.

Vulnerable Targets:
Animals & Poultry

- Animals vulnerable to eliminated diseases.
- Affected animals move.
- Large-scale indoor production allows for rapid spread of an infectious agent within a given herd.
- More valuable.
- Difficult to clear of disease.
- Destroying a large number of animals is emotionally stressful.
- Zoonotic diseases present concerns for human health.

Vulnerable Targets:
Food Supply Chain

- Typical Food Supply Chain (Farm to Table):
  - Agricultural Production.
  - Storage / transport of raw commodities.
  - Processing and manufacture.
  - Storage / transport of processed products.
  - Wholesale and retail distribution.
  - Food service sector.

Vulnerable Targets:
Agricultural Sector

- As agricultural sectors consolidate in response to urban growth, their overall size generally increases, with a commensurate increase in vulnerability to the introduction of disease.
- Large areas of farmland are difficult to secure and monitor.
- Physical parameters of packinghouses and processing plants are more easily controlled, but more personnel requires more screening and training.
- Contaminated products can enter the U.S. through international sources.

Potential Epidemiological Clues

- Epidemiological data in humans as well as animals.
- Sudden or unexplained deaths in the herd or flock.
- Severe illness affecting a high percentage of animals.
- Blisters around an animal's mouth, nose, teats, or hooves.

Potential Epidemiological Clues

- Some indicators of an agroterrorist attack may include:
  1. Simultaneous or repeated outbreaks.
  2. No shared factors among animals.
  3. Unusual disease occurrences or disease occurrences at an atypical time of year.
  4. Traceback of animals leads to dead end.
  5. Overwhelming mortality.

Early Detection

- Subtle behavioral changes are usually the first sign of animal sickness.
- Decreased production or weight loss.
- Abnormal temperature, pulse and respiration.
- Other clinical signs of ill health.

Biosecurity

- Preparedness for natural disasters:
  - Food
  - Water
  - Electricity
  - Shelter

- Improved employee training and personal planning.

Biosecurity

- Prevention against intentional biosecurity threats:
  - Perimeter fencing discourages trespassers.
  - Adequate lighting and locking mechanisms for important infrastructure.
  - Elimination of overgrown shrubs, large garbage piles, and other hiding places.
  - Natural warning systems.
  - Formal warning systems: security personnel, surveillance systems, posted warnings of surveillance systems.

Biosecurity

- Improved animal tracing, including premises registration.
- Traffic control.
- Identify where veterinary personnel would come from in a biosecurity failure.
  - U.S. National Animal Health Emergency Response Corps
- Coordination and cooperation across governments, agencies, and agricultural institutions.

Communication and Education

- Land grant universities provide organized outreach.
- Centralized information registries.
- Research in agricultural biosecurity:
  - New technologies to detect diseases at points of entry.
  - Rapid and inexpensive diagnostic tests.
  - Effective vaccines to suppress outbreaks & epidemics.

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Course Transcript

Slide 1: "Introduction to Biosecurity & Agroterrorism"
Welcome to the "Introduction to Biosecurity & Agroterrorism" tutorial designed by the Pacific Emergency Management, Preparedness, and Response Information Network and Training Services at the University of Hawaii at Manoa.

Slide 2: "Biosecurity"
Biosecurity can be defined as "the protection of the economy, environment, and health of living things from diseases, pests, and bioterrorism." A constellation of similar terms and ideas are often used in conjunction with the term biosecurity, such as agroterrorism, agricultural bioterrorism, and agrosecurity, all of which recognize the vulnerability of the nation's food and water supply to various threats. Biosecurity focuses on the protection of all sectors of the agricultural industry, from agricultural producers, such as farmers and their farm animals, poultry, livestock and plant crops to the livestock support industries, such as the feed, fencing, pharmaceutical, and veterinary industries, to the food processing, food distribution, and food retailing system. Biosecurity also encompasses the protection of water supplies, and the water supplies of major cities are usually well-monitored and protected. Biosecurity also affects the tourism industry, which will be impacted should a biosecurity concern arise in a given area.

Slide 3: "Biosecurity Threats"
Natural disasters, such as hurricanes, tornadoes, wildfires, blizzards and other forms of severe weather-related disasters present not only a human threat, but a biosecurity threat as well. Although the human impact of a disaster needs to be assessed first, animal security is also important. In addition, secondary effects of disasters, such as loss of electricity, contaminated water systems, and damage to physical infrastructure can have severe effects for animals as well as humans. Animal and plant disease are also biosecurity threats, and can be introduced naturally, accidentally, or intentionally, as in the case of agroterrorism. The natural contraction of a disease can occur when a new animal is introduced to a herd or flock, or when farm animals come into contact with wild animals or insects carrying diseases. The accidental introduction of disease involves the passing of contaminants from humans or farm equipment to animals. Finally, the intentional introduction of disease, also referred to as agroterrorism, is a biosecurity threat. Agroterrorism not only refers to the intentional introduction of animal and plant disease, but also to a variety of assaults on the agricultural sector, which will be explored in more depth in later slides.

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Slide 4: "Agroterrorism"

The Federal Emergency Management Agency 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." Agroterrorism is distinctive from other forms of terrorism in three important ways. First, in addition to the intimidation of society that is the goal of any form of terrorism, mass destruction of human, animal, or plant life is also a major goal of agroterrorism. Second, the onset of an attack may not be readily apparent until the biological agent has spread significantly among populations or species, depending on the length of incubation periods and detection of visible symptoms. Finally, it may be impossible to establish whether release of the agent was intentional, largely because sources and vectors of biological agents, such as wind-borne diseases or food contaminants, can be extremely hard to trace, and most farms and livestock are not highly secured.

Slide 5: "Biosecurity Threats"

Although much public focus has been on the intentional introduction of agents that harm the agricultural industry, the focus of biosecurity should also include the unintentional introduction of harmful agents into agricultural production, as the economic, environmental, and public health impact of both intentional and unintentional contamination of the food industry will have detrimental effects. In addition, biosecurity threats tend to have a strong international component, as the food export and import industry remains globally interconnected.

Slide 6: "Economic Effects"

The economic effects of a biosecurity threat are enormous, including both direct economic losses due to lost production, the cost of destroying contaminated products, and containment measures, as well as indirect costs and multiplier effects from dislocations in agricultural support industries, and the loss of export markets. Cattle and dairy farmers earn approximately 50 billion per year in meat and milk sales, as international trade provides a market for a major part of U.S. crop production, and a growing share of meat output. Unlike many other U.S. industries, U.S. agricultural industries rely heavily on export markets. Domestically, approximately 10 percent of the U.S. Gross Domestic Product is related to agriculture and food production. Often, in the event of a biosecurity breach, the sacrifices that must be made to ensure the common societal good of safe and uncontaminated food products may threaten the financial security of an individual business or farm, as well as impact the national economy. In addition, the loss of consumer confidence in government, as well as the agricultural industry, will have an economic impact.

Slide 7: "Vulnerable Targets: Animals & Poultry"

Although plant diseases are easy to acquire, cultivate, transport, and disseminate, animals and poultry seem to be more vulnerable targets. A number of animal diseases, such as Foot and Mouth Disease and classical swine fever

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have been eliminated from U.S. herds. The re-introduction of these diseases could therefore be disastrous. In addition, affected animals move around, and large-scale indoor production allows for rapid spread of an infectious agent within a given herd. Livestock and poultry tend to be more valuable, and are also difficult to clear of disease. Another reason animals are especially vulnerable targets is that destroying a large number of animals is emotionally quite stressful for all involved. Finally, zoonotic diseases, such as rabies, scabies or brucellosis, also present concerns for human health.

Slide 8: "Vulnerable Targets: Food Supply Chain"

According to the World Trade Organization, the typical food supply chain consists of six major steps: agricultural production and harvesting, storage and transport of raw commodities, processing and manufacture, storage and transport of processed products, wholesale and retail distribution, and the food services sector. There are differences in the supply chains of different products; however, in principle, each of these steps represents a potential entry point for a contaminant. Although the Food and Drug Administration, under the mandates provided by the Biopreparedness Act of 2002, possesses an increased ability to intercept and track the origins of any food contamination, it is unable to prevent contamination.

Slide 9: "Vulnerable Targets: Agricultural Sector"

As agricultural sectors consolidate in response to urban growth, their overall size generally increases, with a commensurate increase in vulnerability to the introduction of disease. The United States' food supply chain is a complex and highly concentrated system with many potential entry points. The production concentration of the U.S. agricultural industry allows for large economies of scale and high efficiency but also make it relatively easy to spread infections or distribute contaminates. For instance, a 100-mile wide "beef belt" centered in Kansas produces over 80% of the nation's beef. Furthermore, cattle is often raised in enormous feed lots, some containing tens of thousands of animals, and these large areas of farmland can be quite difficult to secure and monitor against intentional or unintentional attacks. While the physical parameters of packinghouses and processing plants are more easily controlled, the higher number of personnel that work in such places require more screening and training to prevent and monitor against biosecurity threats. Finally, international trade can be used to introduce contaminated foods into the United States. For example, in December 2003, a single U.S. case of bovine spongiform encephalopathy or "mad cow disease" was discovered in a cow originating from Canada. While this introduction appears to have been accidental, Japan, Mexico and South Korea temporarily halted imports.

Slide 10: "Potential Epidemiological Clues"

Although the intentional introduction of an agent may be difficult to detect, there are several epidemiological clues that may point towards the introduction of a harmful agent. In some cases, contamination may reveal itself through the

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presence of disease clusters not only in animals but also in humans. For humans, syndromic surveillance can detect elevated sales of anti-diarrheal or other over-the-counter medications from national pharmacy chains by sales per day, and by GIS mapping of rates per zip code. As for epidemiological clues in farm animals, it is essential that the people who are involved in the agricultural production industry be involved in surveillance, including the producers themselves, as well as local veterinarians, extension personnel, and animal diagnostic laboratory technicians. Plant pathologists and entomologists can also be helpful in surveillance. Potential epidemiological clues in farm animals include sudden or unexplained deaths in the herd or flock, and severe illness affecting a high percentage of animals. Symptoms that may indicate the presence of a biological agent and should prompt a response include blisters around an animal's mouth, nose, teats or hooves. In some cases, it will be nearly impossible to determine if contamination was intentional.

Slide 11: "Potential Epidemiological Clues"

Despite the difficulty in identifying an attack, there are a number of key signs that can identify an agroterrorist event, compiled by the South Carolina Area Health Education Consortium. The first potential indicator is simultaneous or repeated outbreaks of a given disease, especially in diverse geographic locations. Second, a lack of shared factors among infected animals may also suggest agroterrorism. Third, agroterrorist attacks may occur during a season in which an outbreak of a given disease is unusual, or an outbreak may be accompanied by unusual signs and symptoms. Fourth, in an agroterrorist attack, the traceback of initially infected animals may lead to a dead end, indicating that initial infection may have been intentional. Finally, overwhelming mortality often suggests an agroterrorist attack.

Slide 12: "Early Detection"

Identifying animal health problems is an important step towards safeguarding against accidental and intentional threats. 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 loss of appetite, isolation, lethargy, rough hair coat, or ruffled feathers are usually the first signs of animal sickness. Decreased milk or egg production, or reduced weight gain can also be early indicators of illness. Whenever possible, temperature, pulse, and respiration should be monitored on affected animals. Involving a veterinarian and gathering as much information as possible about the animals will help determine the urgency of the situation.

Slide 13: "Biosecurity"

Prevention against biosecurity threats is essential in maintaining a healthy agricultural industry. The first step in biosecurity is natural disaster preparedness for the humans in the agricultural industry, as well as for the animals and infrastructure involved. This includes considering the food, water, electricity and shelter needs of all involved in the event of a disaster, and determining whether

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evacuation will be an option, or if sheltering in place will be necessary in a variety of disasters. In addition, employees need to be trained to prepare for and respond to natural disasters, infectious diseases, and to be on the lookout for agroterrorism threats, and threats to infrastructure security. Employees should also have personal disaster preparedness plans of their own.

Slide 14: "Biosecurity"

Although many biosecurity threats are from natural sources, there is always the possibility for an intentional introduction of a harmful agent, especially at the agricultural production level, which tends to be harder to monitor and control. There are several prevention measures that can be taken to reduce the intentional introduction of an agent at this level. In addition to containing animals, perimeter fencing discourages trespassers as well. Adequate lighting and locking mechanisms for important infrastructure can also discourage trespassers. Eliminating overgrown shrubs, large garbage piles, and other hiding places is a further deterrent. Natural warning systems, such as dogs or loud birds, can be useful in deterring intruders as well as alerting others to their presence. In addition to these natural warning systems, formal warning systems can be employed, such as security personnel to patrol the area, surveillance systems, and posted warnings for potential trespassers about the presence of a surveillance system.

Slide 15: "Biosecurity"

A promising component of biosecurity is improved animal tracing, including premises registration. Tracing facilitates control of a problem as it arises and provides a better understanding of the problem in retrospect. The European Union requires identification and tracing capabilities for EU bovines and bovine products. Many EU countries have developed GIS to use this information. The United States has a voluntary National Animal Identification System that includes premises registration, animal identification and tracing capacity, but since it is voluntary and not mandatory, its effectiveness remains to be seen. Along with animal tracing and premises registration, traffic monitoring and control can both keep track of visitors to a production, processing or distribution site, as well as restrict access to the site. Identifying where veterinary personnel would come from in a biosecurity failure is also an important part of biosecurity preparedness. In the U.S., this can be difficult because the U.S. veterinary medicine profession is increasingly non-agricultural. The U.S. National Animal Health Emergency Response Corps, initiated in 2001, is a roster of volunteers that can be quickly mobilized by the U.S. Department of Agriculture APHIS Division, who pay food and lodging expenses. Ultimately, biosecurity can only be achieved via coordination and cooperation across governments, agencies, and agricultural institutions, as biosecurity measures continue to be developed.

Slide 16: "Communication and Education"

Education and information about the weaknesses of the agricultural industry, and steps to take in the event of a breach in biosecurity are key. Communication with

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the various sectors of the agricultural community can take place through land grant universities, as they have a mission of outreach education. Centralized information registries are also being looked into and developed as a method of both tracking and responding to various types of agroterrorism threats, outbreaks, and contaminants. Research into agricultural biosecurity can also improve prevention and response to both intentional and unintentional contamination. This research may include new technologies capable of detecting diseases at ports of entry, rapid and inexpensive diagnostic tests for determining the type of disease present, and effective vaccines that can be used to quickly suppress outbreaks and epidemics.

Slide 17: "Sources"
The displayed sources were consulted in the development of this tutorial.

Slide 18: "Sources"
Development of this course was aided in part by Dr. Daniel Jenkins.

Slide 19: "Sources"

Slide 20: "Pacific EMPRINTS"
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