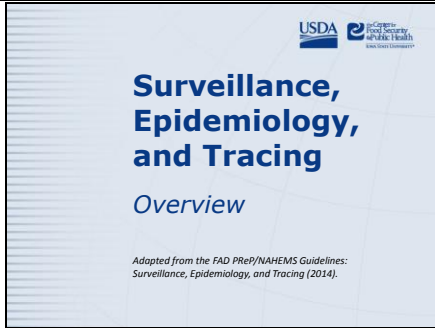
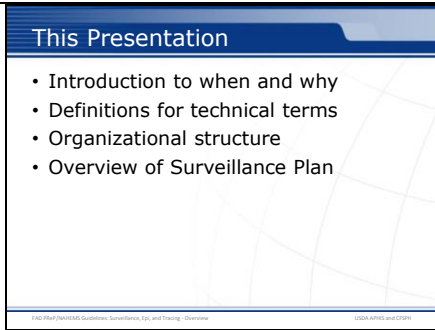


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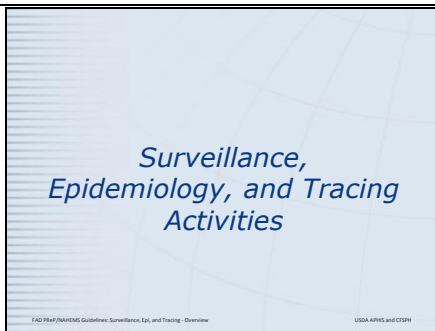
An animal health emergency could have a detrimental effect on the nation's agriculture, food supply, and economy. Veterinary responders, animal health technicians, and other trained personnel may assist with surveillance, epidemiology, and tracing activities. In order to perform these job duties, a broad understanding of surveillance and epidemiological concepts is required. This presentation provides an overview of surveillance, epidemiology, and tracing. [This information was derived from the *Foreign Animal Disease Preparedness and Response (FAD PReP)/National Animal Health Emergency Management System (NAHEMS) Guidelines: Surveillance, Epidemiology, and Tracing (2014).*]

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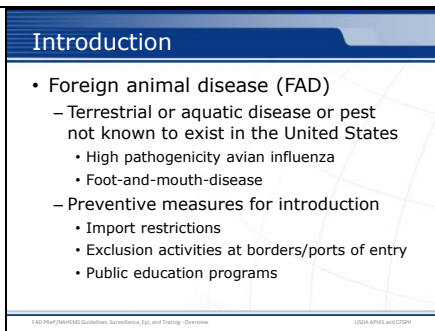
This presentation provides an introduction as to when and why surveillance, epidemiology, and tracing activities are implemented in a foreign animal disease (FAD). It gives definitions for technical terms and explains the organization structure of responding personnel. An overview of the Surveillance Plan, its epidemiological principles and tracing activities are discussed.

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This presentation will provide a background on surveillance, epidemiology, and tracing activities. It will introduce terms and principles used to provide a real-time understanding of the situation and enable the earliest possible and most appropriate intervention strategies to be implemented (e.g., quarantine, movement control, vaccination, stamping-out, etc.).

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A foreign animal disease (FAD) is a terrestrial animal disease or pest, or an aquatic animal disease or pest, not known to exist in the United States (U.S.) or its territories. Examples include high pathogenicity avian influenza and foot-and-mouth disease. Preventive measures including import restrictions, exclusion activities at borders and ports of entry, and public education programs to keep FAD agents from entering susceptible animal populations.

**Introduction (cont'd)**

- FAD investigation
  - Initiated if an FAD is suspected
    - Foreign Animal Disease Diagnostician
    - Guidance Document 12001
    - APHIS FAD PReP Manual 4-0
- Once an FAD is confirmed
  - Surveillance, epidemiology, and tracing response components are activated
    - Provide real-time understanding
    - Enable decisions on interventions

In the event an FAD outbreak is suspected, a Foreign Animal Disease Diagnostician (a specially trained veterinarian) conducts an initial site investigation. Instructions for investigating a potential FAD outbreak are found in the *Guidance Document 12001: Policy for the Investigation of Potential Foreign Animal Disease/Emerging Disease Incidents (FAD/EDI)* and in the *APHIS FAD PReP Foreign Animal Disease Investigation Manual (FAD PReP Manual 4-0)*. Once an animal is presumed positive for an FAD, or an FAD agent has been isolated and identified, appropriate Federal resources may be mobilized in support of the local response depending on the situation. Surveillance, epidemiology, and tracing components of an FAD response must be implemented quickly to contain and eradicate the disease.

**Purpose**

- Surveillance, epidemiology, and tracing techniques are used to:
  - Detect cases
  - Understand disease characteristics
  - Identify risk factors
  - Provide information for decision-making
  - Design and implement control measures
  - Evaluate the effectiveness of the control measures implemented

Surveillance, epidemiology, and tracing techniques will be employed in an FAD outbreak to:

- Detect new and existing cases (animals or premises);
- Understand characteristics of the disease (e.g., clinical signs, incubation period, populations affected) and outbreak characteristics (e.g., sources, disease incidence patterns, geographic distribution, transmission dynamics, and reservoirs) and how they affect specific populations;
- Identify risk factors associated with disease occurrence (e.g., age, production practices, species, wildlife, vectors);
- Provide information for decision-making to design and implement control measures against the disease being targeted, such as designation of zones for disease control procedures; and
- Evaluate the effectiveness of the control measures implemented and adjust them as the situation dictates.

**Definitions**

- Surveillance
  - An intensive form of data recording that encompasses gathering, documenting, and analyzing data
- Epidemiology
  - The study of the distribution of disease in populations and of factors that determine its occurrence
- Tracing
  - Information gathering on recent movements of animals, personnel, vehicles, and fomites to identify potential spread of disease, and source

Surveillance, epidemiology, and tracing activities are essential elements of an FAD response. The terms surveillance, epidemiology, and tracing are interrelated. There are many definitions for each term that vary slightly; we will define them as follows.

- **Surveillance:** an intensive form of data recording that encompasses gathering, documenting, and analyzing data. Information is then disseminated so that action can be taken to evaluate disease status and eradicate or control a disease.
- **Epidemiology:** the study of the distribution of disease in populations and of factors that determine its occurrence. Investigations involve observing animal populations and making inferences from data and observations.
- **Tracing:** information gathering on recent movements (during a defined time period) of animals, personnel, vehicles, and fomites (both to and from affected premises) to identify potential spread of disease to other premises and to detect a potential source of infection for the affected farm.

**Zone/Area Designations**

Summary of Zone and Area Designations	
Infected Zone (IZ)	Zone that immediately surrounds an infected Premises
Buffer Zone (BZ)	Zone that immediately surrounds an infected Zone or Contact Premises
Control Area (CA)	Consists of an Infected Zone and Buffer Zone
Surveillance Zone (SZ)	Zone outside and along the border of a Control Area
Vaccination Zone (VZ)	Emergency Vaccination Zone is classified as either Containment Vaccination Zone (typically inside the control area) or Protection Vaccination Zone (typically outside Control Area). This may be a secondary zone designation

During an FAD outbreak, disease control zones are established to control movements in and out of the Control Area and surrounding areas to prevent the spread of the disease agent. Types of disease control zones are described in this table. Map illustrations of the premises designations and disease control zones are provided in the PowerPoint "Personnel and Premises Designations." [This table summarizes the Zone and Area Designations. Content provided by USDA. Illustration by: Dani Ausen, Iowa State University]

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### Incident Command System

- Incident Command System (ICS)
  - Flexible and scalable
    - Number and names of deployed groups will vary
  - Planning and Operations Sections
  - Incident Action Plan

The organizational structure for emergency response personnel will follow the Incident Command System (ICS). The ICS structure is flexible and scalable and the exact number and names of groups deployed during a response will vary according to the scope and nature of the event. The Planning and Operations Sections contain the most personnel with surveillance, epidemiology, and tracing responsibilities. Information generated through these activities is used to develop the Incident Action Plan (IAP) approved by the Incident Commander. An IAP provides a concise, coherent means of capturing and communicating to all personnel the overall incident priorities, objectives, and strategies in the contexts of both operational and support activities. *[This is an illustration of an Incident Command System structure highlighting the Operations Section and Planning Section. Illustration by: Dani Ausen, Iowa State University]*

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### Surveillance and Epidemiology

Surveillance, epidemiology, and tracing activities are all interrelated and occur simultaneously. The next few slides will focus on surveillance which involves ongoing collection, analysis, interpretation, and dissemination of data related to disease, and the study of the factors related to frequency and distribution of the disease, which many refer to as epidemiology.

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### Role of Surveillance

- During an FAD outbreak, surveillance plays a key role in:
  - Identifying the infectious agent
  - Determining the scope of the outbreak
  - Assessing the effectiveness of eradication and control efforts
  - Demonstrating a return to disease free status

In an FAD outbreak, surveillance activities play a key role in: identifying the infectious agent; determining the scope of the outbreak; assessing the effectiveness of eradication and control efforts; and demonstrating a return to disease free status.

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### Surveillance Plan Elements

- Disease description
- Surveillance objectives
- Stakeholders and responsible parties
- Population description
- Case definitions
- Data sources
- Sampling methods
- Diagnostic tests

The Surveillance Plan is developed by the Disease Surveillance Branch in collaboration with the Situation Unit. The Surveillance Plan functions as a framework describing the surveillance system and the roles and responsibilities of surveillance team members during the FAD response. The Surveillance Plan includes:

- Disease description;
- Surveillance objectives;
- Identifying stakeholders and responsible parties;
- Population description;
- Case definitions;
- Data sources;
- Sampling methods; and
- Diagnostic tests.

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### Case Definitions

- Suspect case
  - Animal showing clinical signs compatible with FAD
- Presumptive positive case
  - Animal with clinical signs consistent with FAD and positive test results
- Confirmed positive case
  - Agent has been isolated and identified using approved tests

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At least three case definitions are developed during an FAD outbreak. These definitions are likely to evolve as the outbreak progresses.


- Suspect case - Animal showing clinical signs compatible with the FAD.
- Presumptive positive case - Animal with clinical signs consistent with the disease in question, epidemiological links, and/or laboratory test(s) that would support current infection or exposure to the disease of concern.
- Confirmed positive case – indicates the requirements, including laboratory testing and other criteria that are required to unequivocally determine the presence of the FAD agent.

For many high-consequence FADs, case definitions have been developed, and are available in *FAD PReP Disease Response Plans or Disease Response Strategies*. *FAD PReP SOP: Case Definition Development Process* provides additional information on how case definitions are derived.

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### Data Sources

- Livestock producers
- Veterinarians
- Livestock organizations
- Disease reporting or notification systems
- Control programs
- Sentinel units
- Post mortem diagnostic specimen collection
- Wildlife data



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Data are facts such as observations, clinical signs and laboratory results collected from multiple sources by the surveillance system. Many sources of data are available to assist with surveillance efforts. A number of various data sources are listed on this slide. Sources from which facts can be gathered may include industry, government, laboratories, and veterinarians. *[This image depicts wildlife data collection. Photo source: USDA]*

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### Sampling Methods

- Considerations for accurate and practical sampling methods:
  - Sample type
  - Sample size
  - Random sampling vs. targeted sampling
  - Sampling duration and frequency
  - Sample areas/locations
  - Availability of diagnostic tests
  - Pooled testing

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Considerations for developing accurate and practical sampling methods include sample type; sample size; random sampling vs. targeted sampling; sampling duration and frequency; sample areas/locations; availability of diagnostic tests; and pooled testing.

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### Types of Specimens

- Blood or serum
- Skin or vesicular lesions
  - Epithelial tissue or vesicular fluid
- Feces, rectal swabs, cloacal swabs, or genital tract swabs
- Nasal, oral, or oropharyngeal swabs
- Nasal discharge, saliva, tears
- Semen samples
- Tissues
  - Tonsil, spleen, kidney, liver, lymph node, lung, brain, etc.
- Milk
- Environmental samples

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The type of specimen collected is determined by the disease of concern, available diagnostic tests, and the ability to obtain samples from target species. Number and type of specimens to collect is determined and communicated by Incident Command. Diagnostic specimens that may be collected include those listed on the slide, such as tissues from the animal, animal products like milk, or environmental samples. For in-depth information on collecting diagnostic specimens, please see the *FAD Investigation Manual (FAD PReP Manual 4-0)*.

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### Core Functions

- Surveillance
  - Ongoing data collection, analysis, interpretation, and dissemination
  - Used to determine specific actions for FAD mitigation
- Field investigation
  - Used to collect additional information about cases identified via surveillance
    - Disease source, history of disease, etc.

There are four core functions of epidemiology.

- Surveillance, as mentioned earlier, involves ongoing collection, analysis, interpretation, and dissemination of data related to disease. This information is used to determine specific actions for FAD mitigation (e.g., quarantine, vaccination, depopulation, etc.). Surveillance is conducted to monitor a population for the presence, or absence, of disease. Surveillance provides information for action. In an FAD outbreak, surveillance will be used to detect cases or clusters of disease cases in the field.
- From field investigations, epidemiologists will then collect additional information regarding the disease outbreak. This may include identifying the disease source, determining if other animals have been exposed, and learning more about the history of disease.

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### Core Functions (cont'd)

- Analytic studies
  - Utilizes information gleaned from surveillance activities and field investigations
  - Disease rates and risk factors
- Evaluation
  - Effectiveness
  - Efficacy
  - Impact of activities

- In an FAD response, information gleaned from surveillance activities and field investigations will be used in analytic studies. Disease rates will be calculated, and parts of the animal population that may be at higher risk than others will be described. This will aid in identification of risk factors for disease, and determination of the source of disease. Many epidemiologic studies will require advanced analytic techniques.
- Evaluation is the process of determining the effectiveness, efficiency, and impact of activities with respect to established goals. In an FAD response, strategies to contain, control, and/or eradicate a contagious FAD must be constantly evaluated to ensure that appropriate actions are undertaken.

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### Disease Occurrence

- Endemic
  - Present in a population or geographical area at times
- Outbreak
  - Occurrence of more cases of disease than expected in a given area, or a specific group, over a particular time period
- Pandemic
  - An outbreak/epidemic that has spread over several countries

Epidemiologists also describe disease occurrence: the level or amount of disease occurring in an area and the factors that work together to cause disease. It is important to understand the level of disease present before and during an FAD event.

The following terms are used to describe amounts of disease in a population or area:

- Endemic - present in a population or geographical area at all times.
- Outbreak - the occurrence of more cases of disease than expected in a given area, or among a specific group, over a particular time period. Many epidemiologists use the terms outbreak and epidemic interchangeably.
- Pandemic - an outbreak/epidemic that has spread over several countries or continents.

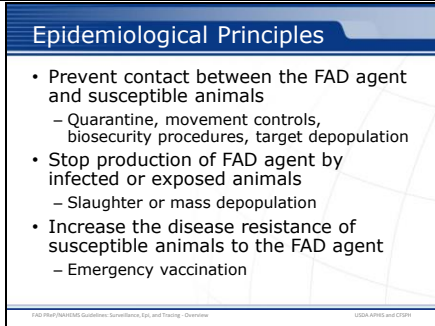
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### Risk Factors

- A characteristic that is associated with an increase in the occurrence of a particular disease
- May include:
  - Age
  - Species
  - Location
  - Contact

The concept that disease does not occur randomly in a population is critical to epidemiology. The presence of risk factors may make disease more likely to occur in some members of a population than in others. Risk factors may be related to the agent, host, or environment and can include age, species, geographic location, and contact with other animals or fomites. Epidemiologists study the presence and/or absence of risk factors in diseased and non-diseased animals in order to gain a better understanding of an FAD agent.

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**Epidemiological Principles**

- Prevent contact between the FAD agent and susceptible animals
  - Quarantine, movement controls, biosecurity procedures, target depopulation
- Stop production of FAD agent by infected or exposed animals
  - Slaughter or mass depopulation
- Increase the disease resistance of susceptible animals to the FAD agent
  - Emergency vaccination

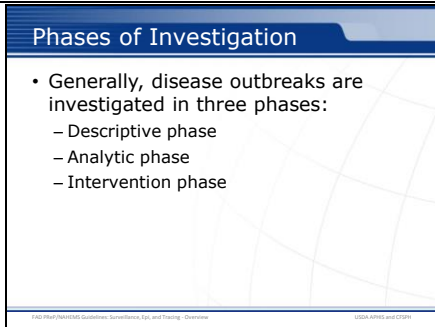
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Data collected by surveillance efforts is utilized by epidemiologists in an FAD outbreak. Three basic epidemiological principles form the foundation for response strategies for containing, controlling, and/or eradicating a contagious FAD.

- Prevent contact between the FAD agent and susceptible animals. This is accomplished through quarantine of infected animals and movement controls in Control Areas, through biosecurity procedures to protect non-infected animals, as well as accelerated depopulation of animals at risk, as warranted.
- Stop the production of the FAD agent by infected or exposed animals. This is accomplished by slaughter or mass depopulation (and disposal) of infected and potentially infected animals.
- Increase the disease resistance of susceptible animals to the FAD agent or reduce the shedding of the FAD agent in infected or exposed animals. This is accomplished by strategic emergency vaccination if a suitable vaccine is available and can be administered in a timely manner.

During an FAD outbreak epidemiologists use data collected during surveillance to design plans to achieve these goals.

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**Phases of Investigation**

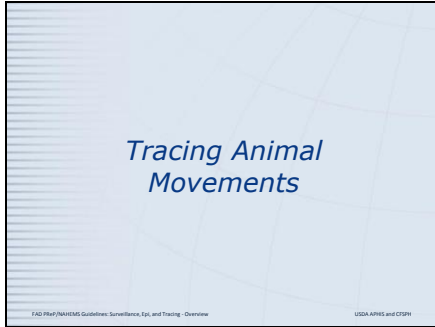
- Generally, disease outbreaks are investigated in three phases:
  - Descriptive phase
  - Analytic phase
  - Intervention phase

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Generally, disease outbreaks are investigated in three phases: the descriptive phase, the analytic phase, and the intervention phase. Although presented sequentially in this web module, these activities may occur simultaneously during an FAD response.

- In the descriptive phase information on case chronology, geography, and demography is collected, and a case definition is developed.
- In the analytic phase descriptive data and corresponding laboratory results are used to determine risk factors, and the FAD agent and source are determined (if possible).
- In the intervention phase preventative options are considered, and economic benefits and consequences of control measure are assessed.

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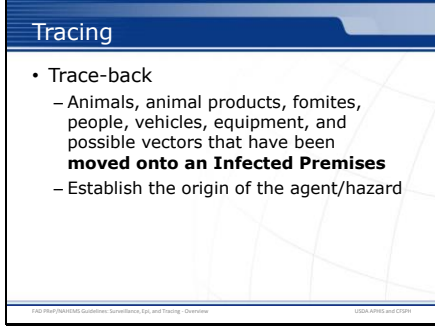


*Tracing Animal Movements*

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Tracing is a critical part of an FAD response. Tracing is the ability to track the movements of an animal or group of animals during a specific time period. By tracking the movements of animals, tracing is intended to identify the source of the infection and identify potentially exposed animals that may be infected and have moved elsewhere. Tracing aids in controlling the spread of an FAD agent or a hazard, and limits the impact of an outbreak by detecting potentially infected premises or animals. In the event of an FAD outbreak, all movements to and from the affected premises must be assessed.

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**Tracing**

- Trace-back
  - Animals, animal products, fomites, people, vehicles, equipment, and possible vectors that have been **moved onto an Infected Premises**
  - Establish the origin of the agent/hazard

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**Trace-back** seeks to identify the origin of all animals, animal products, fomites, people, vehicles, equipment, and possible vectors that have been moved onto an Infected Premises, in order to establish the origin of the agent/hazard.

**Tracing (cont'd)**

- Trace-forward
  - Animals, animal products, fomites, people, vehicles, equipment, and possible vectors that have **left the Infected Premises**

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**Trace-forward** seeks to track all animals, animal products, fomites, people, vehicles, equipment, and possible vectors that have left the infected premises and could have possibly carried the agent to other animals. Animals located on exposed premises should be investigated and kept under surveillance and/or quarantine until additional data suggest they have remained unaffected. Tracing information can be obtained from many sources. Epidemiologists and animal health officials are encouraged to use all available resources when completing FAD traces.

[This graphic shows movement of a group of swine into and out of a production facility to illustrate trace-forward and trace-back. The illustration depicts swine moving into a production facility, and one month later being moved to another location. The origin and the destination of this group, or of an individual animal, may need to be traced. Illustration by: Katlyn Harvey, Iowa State University]

**Additional Operational Procedures**

- A variety of strategies are required to contain, control and/or eradicate an FAD
  - Biosecurity
  - Health and safety
  - Personal protective equipment
  - Cleaning and disinfection
  - Quarantine and movement control

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A variety of strategies are required in order to contain, control, and/or eradicate an FAD. The following operational procedures are related to surveillance and epidemiology/tracing activities and will be implemented in an FAD response: biosecurity, health and safety, personal protective equipment, cleaning and disinfection, and quarantine and movement control. For more information on these operational procedures, see the corresponding FAD PRoP/NAHEMS Guidelines document.

**For More Information**

- FAD PRoP/NAHEMS Guidelines: Surveillance, Epidemiology, and Tracing, and SOP: Surveillance
  - <http://www.aphis.usda.gov/fadprep>
- Surveillance, Epidemiology, and Tracing web-based training module
  - <http://naherc.sws.iastate.edu/>

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More details can be obtained from the sources listed on the slide, available on the USDA website (<http://www.aphis.usda.gov/fadprep>) and the NAHERC Training Site (<http://naherc.sws.iastate.edu/>).

**Guidelines Content**

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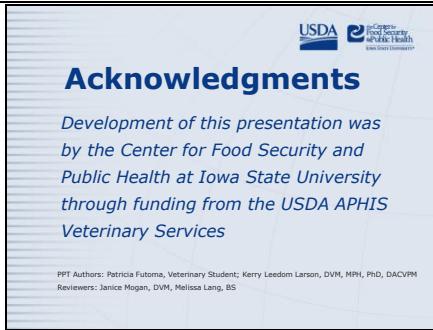
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The print version of the Guidelines document is an excellent source for more detailed information. In particular, the Guidelines document has listings of additional resources. This slide acknowledges the authors and reviewers of the Guidelines document. It can be accessed at <http://www.aphis.usda.gov/fadprep>.

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