This plan does not replace existing regional, State, Tribal, local, or industry preparedness and response plans relating to FMD. Regional, State, Tribal, local, and industry plans should be aimed at more specific issues in an FMD response.

In particular, States should develop response plans focused on the specific characteristics of the State and its livestock industry.
Outline

- Introduction and Information
- Framework for Preparedness and Response
- Preparedness and Response
- Response Goals and Strategy
- Specific Response Critical Activities and Tools
- Recovery after an Outbreak
FMD RESPONSE PLAN

Introduction and Information
Objectives of this Plan

- Identify the capabilities needed to respond to an FMD outbreak.
- Identify critical activities that are involved in responding to that outbreak and the time-frames for these activities.

In an outbreak situation, these critical activities are under the authority of an Incident Command (IC) per the National Incident Management System (NIMS).
Etiology

- Foot-and-mouth disease (FMD) is also known as fiebre aftosa, fievre aphteuse, and maul-und-klauenseuche.

- It is a highly contagious viral disease that affects domestic cloven-hoofed animals (cattle, swine, sheep, and goats) and more than 70 wildlife species (deer, bison, pronghorn antelope, and feral swine).
FMD Virus Subtypes

- There are seven immunologically distinct FMD virus (FMDV) types: A, O, C, South African Territories types SAT-1, SAT-2, SAT-3, & Asia 1.
- More than 65 strains of FMDV have been recognized.
- There is no cross protection between serotypes, and protection between strains varies depending on their antigenic similarity.
FMD Virus Subtypes

Serotype O has been most predominately isolated from positive FMD samples. Serotype C is rarely seen on all continents.
History

- FMD is present in approximately two-thirds of the world and endemic in parts of Africa, Asia, Eastern Europe, the Middle East, and South America.

- From 2010 to 2013, FMD outbreaks have occurred in countries including (but not limited to) Egypt, China, Japan, South Korea, Russia, South Africa, Israel, and Botswana.

- The last FMD outbreak in the United States was in 1929.

- North America (the United States, Canada, and Mexico) and Central America are free of FMD, as is Western Europe, Australia, and New Zealand.

- FMD is still a significant threat to agriculture.
Threat in the United States

- Although the United States has been FMD-free (without vaccination) since 1929, international travel and trade pose a substantial risk of it entering the country.

- The disease is a critical threat to the United States because of the millions of susceptible cloven-hoofed livestock and wild animals, such as feral swine.

- FMD can be transmitted over long distances by animal products, fomites, people, and other mechanical vectors; the virus is also considered a potential agent for agricultural terrorism.
Zoonotic Potential

- FMD is *not* considered a public health threat.
  - FMDV infections in humans are very rare: about 40 cases have been diagnosed since 1921.
- Human cases are typically characterized by vesicular lesions and influenza-like symptoms. Disease is generally mild, short-lived, and self-limiting.
- FMD differs from hand, foot, and mouth disease (HFMD) of humans.
Susceptible Species

- FMD affects cloven-hoofed animals. Susceptible species include the following:
  - Cattle
  - Pigs
  - Sheep
  - Goats
  - Deer
  - Elk
  - Bison.

- The disease is generally most severe in cattle and pigs.

- New World camels in the family Camelidae (alpacas, llamas, guanacos, and vicuñas) have low susceptibility to FMDV but can develop clinical illness. Old World camels (dromedaries, Bactrian camels) are more susceptible.

- While rare, FMD has been documented in several other species including elephants and hedgehogs.
Density of FMD Susceptible Animals Livestock Species
Combined Cattle, Pigs, Sheep and Goats

Source: Knight-Jones, T. and Rushton. (n.d.)
Economic Impact

- The 2001 FMD outbreak in the United Kingdom cost an estimated $13 billion and reduced the British gross domestic product by 0.2 percent.
- A U.S. outbreak contained in California would likely cost between $6 and $14 billion; a nationwide outbreak could range between $15 and $100 billion.
Carriers

- There is no known natural reservoir of FMD—instead, there is a “carrier state.”
- FMDV carriers are defined as “recovered or vaccinated and exposed animals in which FMDV persists in the oropharynx for more than 28 days.”
- Carriers of FMD can include cattle, sheep, goats, and African buffalo, though sheep and goats seem to become carriers less often and for shorter periods than cattle (most cattle carry the virus for 6 months or less).
- Animals can become carriers regardless of whether they showed clinical signs of the virus.
Introduction and Transmission

- Animal to animal contact
- Air/Windborne
- Fomites
- Feed
- Personnel
- Wildlife
Persistence in the Environment and Animal Products

- FMD viruses are susceptible to both acid and alkaline pH and are quickly inactivated by pH < 6.0 and pH > 9.0.
- FMDV is preserved by refrigeration and freezing but progressively inactivated by temperatures above 50°C.
- Meat must be subjected to heat treatment at 70°C for 30 minutes to ensure FMDV deactivation.
- FMDV can also persist in wool, hair, and other products for substantial periods.
Diagnosis

➢ Incubation period ranges from 2–14 days.

➢ The incubation period varies between species.
Clinical Signs

- Animals affected with FMD show a variety of clinical signs.
- FMD is typically recognized by vesicular symptoms.
- Clinical signs are usually more prominent in cattle and pigs than in sheep and goats and are indistinguishable from other vesicular diseases.

Infrared image of a cow infected with foot-and-mouth-disease virus (left) and one that is not (right). Note that the hooves are red. Red color in the hooves indicates heat, or FMD infection.

Photo by Craig Packer
Clinical Signs in Cattle

- Pyrexia (fever), anorexia, shivering, reduction in milk production for 2–3 days, followed by:
  - smacking of the lips, grinding of the teeth, and drooling,
  - excess nasal mucous secretions,
  - lameness, stamping, or kicking caused by vesicles on buccal and nasal mucous membranes or between the claws and coronary band,
  - ruptured vesicles, and
  - vesicles on mammary gland.

- Vesicles on the tongue
- Abortion
- Sudden death in young animals
- The infection usually resolves in 8–15 days unless there is a serious secondary bacterial infection.
Clinical Signs in Pigs

- Pyrexia (fever) and blanching of the coronary bands, followed by:
  - severe foot lesions,
  - severe lameness,
  - reluctance to move,
  - no drooling, and
  - lesions on snout, muzzle, gums, and interdigital spaces

- High mortality in piglets
- Possible abortion
Clinical Signs in Sheep and Goats

- Clinical signs of FMD in sheep and goats are typically less pronounced and frequent than in pigs and cattle and may go unrecognized.
- Possible mild lameness where there are small vesicles or erosions on coronary band.
- Death of young animals.
- Lesions in dental pad of sheep.
- Agalactia in milking animals.
- Possible abortion.
Gross Pathological Lesions

- Lesions typically include vesicles or blisters on the tongue, dental pad, gums, cheek, hard and soft palate, lips, nostrils, muzzle, coronary bands, teats, udder, snout of pigs, corium of dewclaws, and interdigital spaces.
  - Post-mortem lesions can be on rumen pillars, as well as in the myocardium.

- Necrosis may also occur.

- Lesions will vary among cattle, swine, and sheep.

Differential Diagnosis

- Vesicular stomatitis, swine vesicular disease, and vesicular exanthema of swine are all clinically indistinguishable from FMD.
- FMD also has common features with bovine viral diarrhea, mucosal disease, infectious bovine rhinotracheitis, and bluetongue.
Morbidity and Mortality

- The morbidity and mortality of FMD varies depending on the species affected, as well as the serotype and strain of the virus.
- Morbidity is significant, and can approach 100 percent.
- Mortality is typically low in adult animals (1–5 percent), though higher mortality rates are typically observed in very young animals, usually from multifocal myocarditis.
Immunity
Natural Infection

- Infection with FMDV causes animals to develop a humoral antibody that is transient and also specific for the subtype of the infecting FMDV.
- Approximately 7–14 days post-infection, protective antibodies are developed against FMDV structural proteins.
  - Evidence has not suggested any maternal antibodies are produced.
Immunity
Vaccination

- Vaccination against FMDV has been practiced with relatively positive immunity results, mostly in cattle.
- Vaccine has not only prevented clinical disease but helps control FMDV transmission in an outbreak.
- Vaccination campaigns are more likely to succeed if the interval between vaccination and exposure is sufficient to ensure animals develop adequate immunity to FMDV.
Vaccines provide only serotype-specific protection. Vaccination against one serotype may fail to protect fully or at all against other strains within the serotype. This protection depends on:

- the similarity between the field strain and the vaccine, and
- the potency of the vaccine (more potent vaccines are likely to be protective against even less well-matched strains).
Immunity
In Studies

Onset of immunity is not immediate. Inactivated FMD vaccines may decrease viral shedding and clinical signs in cattle and sheep in challenge studies as early as 4–5 days after vaccination with protection improving for the next 2–3 weeks.

Swine appear to be more difficult to protect shortly after challenge; limited studies have reported some protection as soon as 3–4 days after vaccination.

− With more severe challenges, pigs may not be completely protected against disease until 21–28 days after vaccination.
Vaccination

- No currently available vaccine provides “sterilizing immunity” which will prevent subsequent infection.
- It is possible that individual vaccinated cattle, sheep, and goats infected with FMDV could still become asymptomatic virus carriers.
Differentiating Infected Animals from Vaccinated Animals

- Differentiating infected animals from vaccinated animals, known as a “DIVA” strategy, may be critical to a successful emergency vaccination strategy in an FMD outbreak.
- DIVA diagnostic techniques typically use tests for antibodies against viral nonstructural proteins to differentiate animals that are infected with FMDV in the field (natural infection) from those that have been vaccinated with an FMD vaccine.
- This diagnostic DIVA capability may be important for an effective vaccination campaign, business continuity processes, and FMDV surveillance.
Impacts

Livestock Disease Impact

Direct

Visible Losses
- Loss of milk production
- Loss of draught power
- Lower weight gains
- Dead animals

Invisible Losses
- Fertility problems
- Changes in herd structure
- Delay in the sale of animals and/or livestock products

Indirect

Additional Costs
- Vaccines
- Vaccine delivery
- Movement control
- Diagnostic tests
- Culled animals

Revenue Foregone
- Use of sub-optimal breeds
- Denied access to markets both local and international

Source: Knight-Jones, T. and Rushton. (n.d.).
Framework for Preparedness and Response
Foundation of Preparedness and Response

- Successful emergency preparedness for and response to FMD is based on the principles found in the National Response Framework (NRF) and National Incident Management System (NIMS).
- APHIS Veterinary Services (VS) established FAD PReP to provide guidance for preparing and responding to a foreign animal disease (FAD) emergency.
National Response Framework

The NRF is a guide to how the Nation conducts all-hazards response, through a whole community approach.

It describes core capabilities for response, defines specific authorities, and establishes a comprehensive approach for responding to domestic incidents that range from serious but purely local events to large-scale terrorist attacks or catastrophic natural disasters.

The NRF is available at www.fema.gov/national-response-framework.
National Incident Management System

- NIMS is a companion document to the NRF.
- It provides a systematic, nationwide, proactive approach guiding departments and agencies at all levels of government, the private sector, and non-governmental organizations.
- Its goal is to help these organizations work seamlessly to prepare for, prevent, respond to, recover from, and mitigate the effects of incidents, “…regardless of cause, size, location, or complexity—in order to reduce the loss of life, liberty, property, and harm to the environment.”
- NIMS information is available at www.fema.gov/national-incident-management-system.
NIMS Key Components

- Preparedness
- Communications and information management
- Resource management
- Command and management
- Ongoing management and maintenance
FAD PReP

➢ The precursor to FAD PReP was the NAHEMS, which offered a functional veterinary framework for responding to FADs like FMD.

➢ Now incorporated into FAD PReP, the NAHEMS Guidelines join strategic concept of operations documents, disease response plans (such as this FMD-specific plan), SOPs, and other materials to create a comprehensive approach to FADs that is consistent with NRF and NIMS.
FAD PReP offers...

- competent veterinary guidance on cleaning and disinfection, disposal, mass depopulation, and other activities;
- information on disease control and eradication strategies and principles;
- guidance on health, safety, and personal protective equipment issues;
- biosecurity information and site-specific management strategies; and
- training and educational resources.
USDA Roles and Responsibilities

As the primary Federal agency for incident management during an FAD event of livestock or poultry, USDA APHIS:

- deploys Incident Management Teams (IMTs),
- coordinates the incident response,
- manages public messages, and
- takes measures to control and eradicate FMD.
Measures to Control and Eradicate FMD

- Surveillance and diagnostics
- Quarantine and movement control
- Biosecurity measures
- Epidemiological investigations
- Appraisal and compensation
- Depopulation (euthanasia) of affected livestock
- Carcass disposal
- Cleaning and disinfection
- Emergency vaccination (may be used in some cases)
Requesting Support

- During the course of an FMD outbreak response, USDA may request support as necessary from other Federal agencies.
- If the President declares an emergency or major disaster, or if the Secretary of Agriculture requests the Department of Homeland Security (DHS) lead coordination, the Secretary of Homeland Security and DHS assume the lead for coordinating Federal resources.
- USDA maintains the lead of overall incident management.
Preparedness and Response

FMD RESPONSE PLAN
Domestic Activities

USDA has a variety of ongoing preparedness and response activities with respect to FMD. Domestically, the USDA prevents the introduction of FMD into the country and also performs FAD investigations for suspected cases or reported vesicular conditions. The following list details a selection of ongoing USDA activities:

- Vesicular disease surveillance
- Other preparedness and disease models
- National Import Export Services (NIES)
- Smuggling Interdiction and Trade Compliance (SITC)
- Emergency veterinary assistance
International Activities

In addition to the domestic activities, the USDA also conducts ongoing international activities in support of FMD eradication and to bolster preparedness planning and response capabilities. The following list details a selection of USDA activities:

- Hemispheric collaboration
- International coordination
- Global Foot-and-Mouth Disease Research Alliance (GFRA)
- Emergency veterinary assistance
USDA APHIS Organizational Strategy

- APHIS employs NIMS and the Incident Command System (ICS) organizational structures to manage response to an FMD outbreak.

- ICS is designed to enable efficient and effective domestic incident management by integrating facilities, equipment, personnel, procedures, and communications operating within a common organizational structure.
The APHIS Administrator is the Federal executive responsible for implementing APHIS policy during an FMD outbreak. – The Administrator is supported by the APHIS Management Team (AMT).

Depending on the size of the outbreak, the APHIS Administrator and AMT may establish an APHIS-level Multiagency Coordination (MAC) Group to coordinate resources. – Many MAC functions may be delegated to the VS Deputy Administrator, who is the Chief Veterinary Officer of the United States.

The VS Deputy Administrator is supported by the VS Executive Team (VSET) to coordinate policy.
APHIS Incident Management Structure, continued

- An APHIS Incident Coordination Group (ICG), with an Incident Coordinator, is immediately established to oversee the functions and response activities associated with the incident.
  - This ICG is flexible and scalable to the size and scope of the incident, and works closely with IC personnel in the field, in one or more Incident Management Teams (IMTs).

- The ICG also coordinates with any MAC Group that is established at the APHIS or USDA level, based on the specific incident.
Overview of USDA APHIS Multiagency Coordination, Incident Coordination Group, Field Personnel (Incident Management Teams and Districts), and Stakeholder Relationships for an FMD Incident

Multiagency Coordination: Provides Policy, Resources, and Coordination

Incident Management: Requests Resources, Coordination, and Policy

VS Type III IMTs Available: Green, Gold, Blue, Red

District 1 Command
ME, NH, VT, MA, CT, RI, NY, NJ, PA, DE, MD, DC, WV, VA, NC

District 2 Command
TN, SC, GA, AL, FL, PR, VI

District 3 Command
MN, WI, IA, IL, IN, OH, KY

District 4 Command
MO, OK, AR, MI, IA, TX

District 5 Command
MT, ND, SD, ID, WY, NE, KS

District 6 Command
WA, OR, CA, NV, UT, CO, AZ, NM, AK, HI

Preparedness and Response
Details of USDA APHIS Multiagency Coordination, Incident Coordination Group, and an Incident Management Teams for an FMD Incident

Preparedness and Response
Multiagency Coordination

MAC functions are executed at various levels, and typically include:

- the coordination of policy,
- incident priorities,
- resource allocation and acquisition, and
- resolution of issues common to all parties.

The size and scope of the FMD incident dictates what levels and types of MAC Groups and MAC functions are required.
APHIS Incident Coordination Group

- APHIS ICG responsibilities in an FMD outbreak include:
  - providing policy guidance for response activities,
  - providing information and coordination with health and safety personnel,
  - to ensure responder and public health and safety,
  - supporting IMT's and their requirements,
  - assisting in coordinating resources and integrating other organizations into the ICS, and
  - providing information to the Joint Information Center (JIC) for use in media and stakeholder briefings.
APHIS Incident Management Levels

- APHIS uses a three-level system of emergency response/incident management types.
- The levels range from Level III, which has the lowest significance, to Level I, which is an event of national significance.
- The levels are used both within APHIS and externally to communicate the resource requirements for an event or incident.
## Incident Management Levels

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<td>Local, State, and Federal Execution</td>
<td>Local, State, and Federal Execution</td>
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<td>Sector Facilitation</td>
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<td>DHS Situational Awareness</td>
<td>DHS Facilitation of Interagency Preparations to Support</td>
<td>DHS Coordination Authority</td>
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- **Incident Management**
  - Local and State Incident
  - Food and Agriculture Sector Managed Incident
  - Incident jointly managed by Federal, State, Local, and Private Sector

- **Sector emergency declaration**
- **Sector Secretary requests DHS support**
- **Presidential declaration**

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**Preparedness and Response**
National Animal Health Emergency Response Corps

- NAHERC assists and augments Federal and State response to domestic and international animal disease outbreaks, threats, or natural disasters.
- NAHERC is composed of veterinary medical officers and animal health technicians who volunteer to become temporary Federal employees in the event of a national animal health emergency.
- After appropriate training, NAHERC members can be deployed to the field for response activities.
The National Veterinary Services Laboratories (NVSL) is the official reference laboratory for FAD diagnostic testing and study in the United States.

- The NVSL provides all confirmatory testing for FMD on all specimens, including those found presumptively positive at a National Animal Health Laboratory Network (NAHLN) laboratory or other USDA-approved laboratory.

- The NVSL has two locations for FAD diagnostic testing:
  - Ames, IA (NVSL-Ames).
  - Foreign Animal Disease Diagnostic Laboratory (FADDL), Plum Island, NY (NVSL-FADDL).
Diagnostic Resources and Laboratory Support
National Animal Health Laboratory Network

- NAHNLN consists of more than 60 laboratories and coordinates the veterinary diagnostic laboratory capacity of State animal health laboratories and their extensive infrastructure, including facilities, equipment, and professional expertise.

- Of these laboratories, over 40 are currently approved to perform FMD testing diagnostics.
  - The NAHNLN provides a means for early detection of FMD, rapid response through surge capacity to test outbreak samples, and recovery by the capability to test large numbers of samples to show freedom from FMD.
Response Goals and Strategy

FMD RESPONSE PLAN
Response Goals

The goals of an FMD response are to:

- detect, control, and contain FMD in livestock as quickly as possible;
- eradicate FMD using strategies that seek to protect public health and the environment, and stabilize animal agriculture, the food supply, and the economy; and
- provide science- and risk-based approaches and systems to facilitate continuity of business for non-infected animals and non-contaminated animal products.
Critical Activities

- Public communication and messaging campaign
- Swift imposition of effective quarantine and movement controls
- Stringent and effective biosecurity measures
- Rapid diagnosis and reporting
- Epidemiological investigation and tracing
- Increased surveillance
- Continuity of business measures for non-infected premises and non-contaminated animal products
  - (Secure Food Supply Plans—Beef, Pork)
- Rapid mass depopulation and euthanasia, potentially including preemptive depopulation
- Effective and appropriate disposal procedures
- Cleaning and disinfection measures
- Emergency vaccination (as the response strategy indicates)
Epidemiological Principles

Three basic epidemiological principles form the foundation to contain, control, and eradicate FMD in the U.S. domestic livestock population:

– Prevent contact between FMDV and susceptible animals.
– Stop the production of FMDV by infected or exposed animals.
– Increase the disease resistance of susceptible animals to the FMDV or reduce the shedding of FMDV in infected or exposed animals.
Critical Activities in the First 72 Hours of U.S. FMD Response

Response Goals and Strategy

Presumptive positive detection of FMD in the United States

- Establish quarantine, hold orders, movement restrictions, and standstill notices (e.g., 24–72 hours) for relevant zones and regions
- Initiate appraisal process
- Begin depopulation activities
- Notify States, industry, trading partners, media
- Implement increased biosecurity measures
- Start tracing activities (epidemiological investigation)
- Begin confirmatory diagnostics and further virus typing
- Initiate incident management organizational structures and processes
- Decide to deploy Incident Management Team (IMT) to field
- Begin data collection and information management in Emergency Management Response System (EMRS)
- Initiate virus identification for an FMD vaccine

Evaluate quarantine and movement controls

- Continue depopulation and disposal activities
- Ensure compensation process moves forward for indemnity
- Proceed with surveillance and tracing activities
- Execute timely and accurate data entry in EMRS
- Initiate public awareness messaging and communication campaign
- Implement and enforce increased biosecurity measures
- Initiate continuity of business plans
- Continue confirmatory diagnostics
- Prepare for arrival of IMT with affected State
- Continue virus identification for an FMD vaccine

Continue ramping up Incident Command and Incident Coordination Group

- Ensure compensation process proceeds
- Continue any ongoing depopulation and/or disposal activities
- Continue timely and accurate data entry in EMRS
- Continue surveillance and tracing activities
- Implement and enforce increased biosecurity activities
- Continue public awareness campaign
- Ramp up permitting and continuity of business activities
- Continue agent identification for an FMD vaccine (as appropriate)

Use of appropriate critical activities and tools continues throughout FMD response

0–24 hours

24–48 hours

48–72 hours
Response Strategy for Control and Eradication of FMD in Domestic Livestock

- There are five generally accepted strategies for the control and eradication of FMD in domestic livestock following an outbreak.
  - Stamping-out
  - Stamping-out modified with emergency vaccination to kill
  - Stamping-out modified with emergency vaccination to slaughter
  - Stamping-out modified with emergency vaccination to live
  - Emergency vaccination to live without stamping-out
“Stamping-out” is defined in the OIE *Terrestrial Animal Health Code* as the:

“killing of animals which are affected and those suspected of being affected in the herd and, where appropriate, those in other herds which have been exposed to infection by direct animal to animal contact, or by indirect contact with the causal pathogen; this includes all susceptible animals, vaccinated or unvaccinated, on infected establishments.”
Stamping-Out
Critical Goals

➢ The goal is that, within 24 hours of (or as soon as possible after) a presumptive positive classification, infected livestock are depopulated in the quickest, safest, and most humane way possible.

➢ Where resources are limited, premises are prioritized so that those with the highest potential for active FMD spread are ‘stamped-out’ first.

➢ Public concerns about stamping-out require a well-planned and proactive public relations and liaison campaign (stakeholders, the public, and the international community must be involved).
Example of Zones and Areas in Relation to Stamping-Out (Infected Premises would be Depopulated)

Note: Figure is not to scale.
Stamping-Out Modified with Emergency Vaccination to Kill

Definition

Depopulation of clinically affected and in-contact susceptible animals and vaccination of at-risk animals, with subsequent depopulation and disposal of vaccinated animals.

Depopulation and disposal of vaccinated animals may be delayed until logistically feasible, as determined by Incident Command (IC) and the VS Deputy Administrator (U.S. Chief Veterinary Officer [CVO]).
Examples of Zones and Areas in Relation to Stamping-Out
Modified with Emergency Vaccination to Kill
(Infected Premises would be Depopulated)
Examples of Zones and Areas in Relation to Stamping-Out Modified with Emergency Vaccination to Kill (Infected Premises would be Depopulated)

Emergency Vaccination in Control Area

Emergency Vaccination in Infected Zone and Partial Buffer Zone

Note: Figures are not to scale.
Stamping-Out Modified with Emergency Vaccination to Slaughter

Definition

Depopulation of clinically affected and in-contact susceptible animals and vaccination of at-risk animals, without subsequent depopulation of vaccinated animals.

Vaccinated animals intended for breeding, slaughter, milking, or other purposes live out their useful lives.
Examples of Zones and Areas in Relation to Stamping-Out Modified with Emergency Vaccination to Slaughter (Infected Premises would be Depopulated)

Response Goals and Strategy
Examples of Zones and Areas in Relation to Stamping-Out Modified with Emergency Vaccination to Slaughter (Infected Premises would be Depopulated)

Emergency Vaccination in Control Area

Emergency Vaccination in Infected Zone and Partial Buffer Zone

Note: Figures are not to scale.

Response Goals and Strategy
Stamping-Out Modified with Emergency Vaccination to Live Definition

Depopulation of clinically affected and in-contact susceptible animals and vaccination of at-risk animals, with subsequent slaughter and processing of vaccinated animals, if animals are eligible for slaughter under USDA Food Safety and Inspection Service (FSIS) authority and rules and/or State and Tribal authority and rules.
Example of Zones and Areas in Relation to Stamping-Out Modified with Emergency Vaccination to Live (Infected Premises would be Depopulated)

Note: Figure is not to scale.
Emergency Vaccination to Live without Stamping-Out
Definition

Vaccination used without depopulation of infected animals or subsequent slaughter or depopulation of vaccinated animals.
Example of Zones and Areas in Relation to Emergency Vaccination to Live without Stamping-Out

Note: Figure is not to scale. Yellow signifies a Vaccination Zone. Containment Vaccination Zones are typically inside a Control Area; Protection Vaccination Zones are typically outside a Control Area. Protection Vaccination Zones are intended to be zone(s) without infected animals.
Summary of FMD Vaccination

➢ In order to be effective, vaccines used in emergency vaccination must be matched to a specific serotype, and ideally matched with the field strain causing the outbreak.

➢ There are many challenges to using emergency vaccination in an FMD response, but also many benefits.

➢ An FMD response may use one strategy or a variety of strategies in order to detect, control, contain, and ultimately eradicate FMD in domestic animals.

➢ The use of emergency vaccination will be determined by the Unified Command, the State Animal Health Officials (SAHOs), and the CVO.
North American Foot-and-Mouth Vaccine Bank

- The North American Foot-and-Mount Disease Vaccine Bank (NAFMDVB) may be activated in the event of an FMD outbreak in the United States.
- It is jointly administered by the CVOs of Mexico, Canada, and the United States.
Management of Incident

- The outbreak response effort should be implemented through ICS with an appropriate span of control and delegation of authority.
- As soon as possible, an Incident Coordinator and Incident Commander should be identified, an IMT may be deployed, and a unified State-Federal ICP established.
- In-State resources (whether Federal, State, Tribal, local, or privately owned) should be used to manage the response.
- If the response requires, out-of-State resources may be used to support the State impacted by the outbreak.
Factors Influencing the Selection of Response Strategy/Strategies

- Consequences of the outbreak
- Acceptance
- Scale of the outbreak
- Rate of outbreak spread
- Veterinary countermeasures available
- Resources available to implement response strategies
Criteria Needed for FMD-Free Status

The OIE has six official country recognitions for FMD:

- FMD-free country where vaccination is not practiced;
- FMD-free country where vaccination is practiced;
- FMD-free zone where vaccination is not practiced;
- FMD-free zone where vaccination is practiced (in an FMD-free country where vaccination is not practiced or in a country of which parts are infected);
- FMD-free compartment; and
- FMD-infected country or zone.
United States and OIE recognition of FMD freedom as of November 2015
OIE Minimum Time to FMD-Free Designations

If the United States is recovering its free status after an outbreak, the following minimum time requirements apply in coordination with surveillance efforts and other documentation.

- Three months, if a stamping-out policy is employed, after the last case.
- Three months, if a stamping-out policy modified with emergency vaccination to slaughter is employed, after the slaughter of all vaccinated animals.
- Six months, if a stamping-out policy modified with emergency vaccination to live is employed, after the last case or last vaccination.
Six Types of FMD Outbreaks

Type 1: Focal FMD Outbreak
Type 2: Moderate Regional FMD Outbreak
Type 3: Large Regional FMD Outbreak
Type 4: Widespread or National FMD Outbreak
Type 5: Catastrophic U.S. FMD Outbreak
Type 6: Catastrophic North American FMD Outbreak

Size of FMD Outbreak
(in terms of animals, premises, and jurisdictions affected)

Even a focal FMD outbreak would require significant operational capabilities and have significant economic implications for the United States, including from lost international trade and disruptions to interstate commerce.

Response Shifts from Emphasis on Stamping-Out to Emphasis on Alternate Strategies (duration of FMD response)
Phases of FMD Response

Heightened Alert Phase: FMD outbreak in either Canada or Mexico (but not U.S.)

Phase 1: From confirmation of the first case of FMD in the U.S. until reasonable evidence to estimate outbreak extent.

Phase 2: Surveillance and epidemiology provides timely evidence of outbreak extent to support decisions by Incident Command.

Phase 3: Recovery—surveillance and epidemiology indicates FMD is under control; plan implemented to recover disease-free status.

Phase 4: U.S. declared free of FMD, possibly with vaccination.
Example of Stamping-Out

FMD Outbreak Type 3:
Large Regional FMD Outbreak
Examples of Stamping-Out Modified with Emergency Vaccination to Kill or Emergency Vaccination to Slaughter
Example of Stamping-Out Modified with Emergency Vaccination to Live
Example of Stamping-Out Modified with Emergency Vaccination to Slaughter and Emergency Vaccination to Live
Example of Stamping-Out Modified with Emergency Vaccination to Live (Regional)
Example of Stamping-Out Modified with Emergency Vaccination to Live (Large Scale)

FMD Outbreak Type 4: Widespread or National FMD Outbreak

Response Goals and Strategy
Example of Emergency Vaccination to Live (No Stamping-Out)

FMD Outbreak Type 4:
Widespread or National FMD Outbreak
Suspect Case
Definition

➢ An FMD-susceptible animal that has either
  – clinical signs consistent with FMD; OR
  – inconclusive or positive laboratory test results performed on a sample taken during routine surveillance, with or without presence of clinical criteria.
Presumptive Positive Case Definition

A suspect case that has both

– epidemiological information indicative of FMD; AND

– positive laboratory test results (see laboratory criteria above).

- Identification of antibodies to NSP 3D by AGID or 3ABC by ELISA; or to structural proteins by virus neutralization for serotype identification, OR
- Identification of FMDV nucleic acid by RT-PCR, OR
- Identification of FMDV serotype by antigen ELISA.
Confirmed Positive Case
Definition

- An animal from which FMDV has been *isolated* and *identified* at the NVSL-FADDL or other laboratory designated by the Secretary of the USDA.
Surveillance

The following are goals in an FMD outbreak:

- Implement surveillance plans within 48 hours of the confirmation of an outbreak.

- Implement a surveillance plan that
  - (1) defines the present extent of HPAI and
  - (2) detects unknown IP quickly.

- Have the surveillance plan consider the susceptible wildlife population in the area:
  - Coordinate with APHIS, DOI, State wildlife agencies, and State agriculture departments to perform appropriate FMD surveillance in relevant populations.

- To provide complete surveillance data summaries and analysis at intervals as specified by IC.

- To develop effective surveillance plans that can achieve desired outcomes by leveraging available resources, satisfying jurisdictional requirements, and implementing continuity of business measures.
Surveillance Objectives

- Detect FMD IP during an outbreak.
- Determine the size and extent of an FMD outbreak.
- Supply information to evaluate outbreak control activities.
- Provide information for animal and product movement within the CA.
- Provide information for animal and product movement out of the CA.
- Prove disease freedom (DF) and regain disease-free status after eradication of the outbreak.
Surveillance Planning for FMD Outbreak

A surveillance plan indicates the frequency, number, and distribution of animals and premises to be sampled. This requires tradeoffs be made among six surveillance parameters:

- design (threshold) prevalence,
- confidence level,
- types of tests,
- sampling frequency,
- risk-based sampling, and
- sampling scheme.

Critical Activities and Tools
Surveillance Objectives by Time Period

➢ The initial 72 hours post-HPAI outbreak declaration.
   – Detect existing infected animals and premises as quickly as possible.

➢ The control and eradication period
   – From initial 72-hour period until last case is detected and depopulated.

➢ Eradication to freedom.
   – When new detections cease, the objective is to provide evidence that the control area (CA) and free area (FA) are free of disease.
     ○ Consistent with OIE recommendations and requirements on surveillance.
Developing an FMD Outbreak Surveillance Sampling Scheme

1. Resources are limited (Question 1)
   - Conduct observational surveillance
     - Clinical signs?
       - Collect tissue samples
   - Answer questions 2-12
     - Answered "No" more times than "Yes"?
       - Collect tissues from apparently healthy animals
     - Answered "Yes" more times than "No"?
       - Combine surveillance methods
         - Collect tissues from both apparently healthy and clinical animals

Critical Activities and Tools
Diagnostics

- During a suspected or actual FMD outbreak, the key goals of response are to:
  - meet the surge requirements for diagnostic testing at specific intervals, starting at time zero and at 24-hour intervals as the response escalates, and
  - report all diagnostic test results to appropriate personnel and information management systems as soon as possible and within 12 hours of diagnostic test completion.

The *FAD Investigation Manual (FAD PReP Manual 4-0)* offers detailed information on diagnostic sample collection, diagnostic testing, and reporting.
Diagnostic Flow for Initial Investigation of FMD

Estimated Time to Test
Completion
- VIAA: Overnight
- 3ABC: Overnight
- Vi: 3 days x 2 cycles ~ 1 week
- VNT: 3 days
- AgELISA: 6 hours
- RT-PCR: 4 hours

Initial Investigation of Suspected FMDV in the United States

Sample Type (examples of all types should be sent)

Epithelial Tissue (1gm) or Vascular Fluid

Oral Swab or Prolong

Serum

Critical Activities and Tools
Diagnostics After FMD Detection

- Confirmation of FMD on any premises not currently in an FMD CA will be done by NVSL-FADDL.
  - After NVSL confirmation of FMD on a premises (index case), subsequent swab samples for rRT-PCR may be sent to USDA-approved laboratories that are part of the NAHLN network.

- IC will provide specific instructions regarding the direction and collection of samples, which is likely to change as the outbreak evolves. In all cases,
  - NVSL will confirm the index case,
  - presumptive positive samples (on a rRTPCR) from outside an established CA will be tested and confirmed by NVSL, and
  - NVSL will receive samples routinely from inside the CA to monitor for changes in the FMDV.
Outbreak Diagnostics after Positive Confirmation of FMD in U.S.

Critical Activities and Tools

Outbreak Diagnostics After Positive Confirmation of FMD by NVSL FADDL

Unvaccinated Population

In Control Area?

rRT-PCR

Neg

Pos

FMD Field Infection

Estimated Time to Test Completion
ViAA- Overnight
3ABC- Overnight
VI- 3 days x 2 cycles ~ 1 week
VNT- 3 days
AgELISA- 6 hours
RT-PCR- 4 hours

STOP means not infected, unless there is a circumstantial reason to request additional samples and conduct additional diagnostic testing.

Vaccinated Population

Outside of Control Area? (See Previous Figure for Details)

rRT-PCR

Neg

Pos

VI

AgELISA for 7 serotypes of FMDV

STOP: Proceed to VI, rRT-PCR, possibly obtain serial probangs, continue to 2nd NSP serology test as available.

Neg

Pos

3ABC Prions ELISA

Neg

Pos

Indicates FMD Herd Field Infection

Sequencing of VP1 and P1 regions and full genome

FMD Field Infection

Strain ID, Topotyping, Vaccine Selection

^ A second bleed on an animal showing non-specific or inconclusive results on the 3ABC test should be requested. If this is likewise positive or inconclusive, serial probangs can be done on individual animals for VI and PCR if the original antigensamples tested negative and there was still concern over the possibility of the existence of a carrier state in a bovina.
Surge Capacity

- Surge capacity may be needed in an FMD outbreak. Additional resources, such as personnel and materials, will be needed for sample collection.
  - Additional capacity may also be required for laboratory sample testing.
- Surge capacity can help facilitate a rapid response and continuity of business for non-infected premises.
- In the event that the affected State(s) NAHLN lab(s) and NVSL-FADDL are overwhelmed by the diagnostic testing requirements, NAHLN laboratories from across the country may provide surge capacity for diagnostic testing.
Cases of clinical illness that are found to be presumptive positive by NVSL-FADDL, based on the current case definition, will be reported to the affected States, other States, Tribal Nations, industry, other Federal agencies, trading partners, and the World Organization for Animal Health (OIE).

Appropriate Federal-State-Tribal-industry response and containment measures will be initiated during FMD investigations.
Example of Zones, Areas, and Premises in FMD Outbreak Response

Zones and Areas

Premises

Note: The Vaccination Zone can be either a Protection Vaccination Zone or Containment Vaccination Zone. Stamping-out is not pictured in these figures. The Surveillance Zone is part of the Free Area.
Epidemiological Investigation

- Epidemiological investigation and movement tracing during an outbreak are critical in controlling and eradicating FMD.

- In an FMD outbreak, the goals are to:
  - within 6 hours of identifying potential IP or CP through tracing activities, assign a premises classification and a priority of investigation; and
  - within 24 hours of identifying the IP or initial CP, identify all additional CP;
  - within 96 hours of identifying the index case, characterize the nature of the FMD outbreak, identify the risk factors for transmission, and develop mitigation strategies.
Tracing

- One of the most important activities during an FMD outbreak is to rapidly and diligently trace-back and trace-forward movements from an IP.
- Tracing aids in the control of the spread of FMD and limit the impact of the outbreak.
- Tracing should cover all movements from the premises, including susceptible livestock, non-susceptible species, animal products, vehicles, crops and grains, and people.
- Tracing also includes consideration of all potential modes of transmission and possible contact with wildlife.
Communication

- Establish a network of stakeholders and systems for communication prior to an incident or outbreak.
- Brief the media, public, industry, Congress, trading partners, and others on the FMD outbreak status and the actions being taken to control and eradicate the disease.
- Coordinate with Federal, State, and local agencies, Tribal entities, producer groups, and land grant university-based cooperative extensions.
Communication Objectives

- All FMD communications must:
  - furnish accurate, timely, and consistent information;
  - maintain credibility and instill public confidence in the government’s ability to respond to an outbreak;
  - minimize public panic and fear; and
  - address rumors, inaccuracies, and misperceptions as quickly as possible.
Key Communication Messages

➢ For consumers:
  – FMD does not cause disease in humans.
  – Meat and meat products are safe to eat.
  – Milk and dairy products are safe to eat.
  – We are responding quickly and decisively to eradicate the virus.
  – Meat and meat products from vaccinated animals are safe to eat.
  – Milk and dairy products from vaccinated animals are safe to eat.

➢ For producers:
  – Protect your herds with good biosecurity practices.
  – Be vigilant about reporting signs of illness.
During an FMD outbreak, responders are exposed to many hazards, particularly in working with heavy equipment and large animals.

Personal protective equipment (PPE) is fundamental in ensuring personnel are protected in the FMD response effort.

All workers involved in the handling, culling, transport, or disposal of items or animals infected with FMDV must be provided with appropriate PPE.
Biosecurity

An FMD outbreak would seriously impact the agricultural industry; strict biosecurity measures need to be implemented to prevent or slow the spread of FMD. Biosecurity procedures should be implemented within 24 hours of the identification of an index FMD case.

Proper biosecurity measures have two functions:

- containing the virus on IP (biocontainment), and
- preventing the introduction of the virus via movement of personnel and material to naïve livestock and premises (bioexclusion).
**FMD Biosecurity Hazards and Appropriate Biosecurity Measures**

<table>
<thead>
<tr>
<th>Biosecurity Hazards</th>
<th>Biosecurity Measures to Mitigate Risk</th>
</tr>
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<tbody>
<tr>
<td>• Movement of livestock, vehicles, equipment, and people.</td>
<td>• Clean and disinfect premises, vehicles, and equipment and dispose of materials that cannot be disinfected in an appropriate manner.</td>
</tr>
<tr>
<td>• Contaminated feed and water.</td>
<td>• Account for the movement of all livestock, other animals, and equipment for accurate records.</td>
</tr>
<tr>
<td>• Contact with infected domesticated livestock and other non-susceptible animals that can act as mechanical vectors (cats, poultry, or foxes).</td>
<td>• Provide a location for all individuals to carry out appropriate cleaning and disinfection procedures and insist that these procedures are followed.</td>
</tr>
<tr>
<td>• Contact with contaminated people, clothes, footwear, or hands.</td>
<td>• Prevent close or direct contact between herds (over a single fence line).</td>
</tr>
</tbody>
</table>

**Critical Activities and Tools**
Biosecurity
Closed Herds

➢ To the fullest extent possible, close the herd to the introduction of new livestock (with population increases occurring only from offspring).

➢ If closing a herd is not possible, isolate newly purchased livestock (from the healthiest possible sources) and those returning from existing herds for 30 days or more.

➢ Do not introduce vaccinated animals to naïve herds.
Quarantine and Movement Control

- By restricting the movement of infected animals, animal products, and contaminated fomites, quarantine and movement control can be a powerful tool in controlling and eradicating an FMD outbreak.

- Movement control is accomplished through a permit system that allows entities to make necessary movements without creating an unacceptable risk of disease spread.
  - EMRS is the system of record for these movements.
Virus Inactivation: Milk and Dairy

- Pasteurization processes do not inactivate FMDV, and milk/milk products can infect naïve animals if not treated.

- For human consumption, milk and cream should be sterilized by the ultra high temperature process (UHT; heating to 132°C for 1 second) or the high temperature-short time method (HTST; 72°C for 15 seconds).
  - If milk has a pH of 7.0 or over, apply HTST twice.

- For animal consumption, milk can be treated by HTST twice or employing either HTST or UHT in combination with either maintaining a low pH for 1 hour or additional heating to 72°C and desiccation.
Virus Inactivation: Meat

- Chilling and freezing preserve the virus, so it can remain in beef, liver, and the blood of slaughtered animals.
- Meat can be treated with high heat (70°C internal temp) for at least 30 minutes through canning or cooking methods to inactivate the virus.
- Deboned, salted meat can be completely dried as long as it is not allowed to deteriorate at room temperature.
Virus Inactivation: Wool and Hides

- These can harbor FMDV for various lengths of time, ranging from a few days to almost a year depending on the humidity and temperature of storage and any processing done on the products.

- Industrial washing, scouring, depilation, fumigation, or controlled temperature storage can eradicate FMDV from wool and hair.
Continuity of Business

- Secure Food Supply Plan recommendations help animals and products keep moving during the outbreak.
- These items and their movements were permitted, issued, and recorded successfully in EMRS.
- Successful collaboration between States (both sending and receiving product), the Unified Incident Command, and APHIS.

**Secure Beef Supply**: In progress.
Goal of planning is to avoid and mitigate interruptions in the movement of beef and beef products during an FMD outbreak.
Mass Depopulation and Euthanasia

The *Mass Depopulation and Euthanasia SOP* offers FMD-specific information on mass depopulation and euthanasia, including evaluation of various euthanasia methods, such as

- gunshot,
- penetrating captive bolt,
- electrocution,
- injectable euthanasia, and
- carbon dioxide and other gas.
Disposal

On-site burial, which has been a commonly accepted means of disposal, may be an inexpensive and biosecure method of disposal that minimizes the transportation of infected materials.

- On-site methods may be significantly limited by several factors and the potential for environmental contamination, such as topography, soil type, soil depth to bedrock, seasonal high-water table, and environmental regulations.

Other disposal methods such as composting, incineration, and rendering may also be employed, as indicated by the circumstances of the outbreak and disposal requirement.
Cleaning and Disinfection

➤ Because of FMD’s high survival rate on both organic and inorganic materials, aggressive cleaning and disinfection practices are required for control and eradication.

➤ Cleaning and disinfection are to be conducted within 48 hours of the disposal of depopulated animals.
Challenges of FMD Vaccination
Vaccine Production

- Conventional inactivated FMD vaccines cannot be manufactured in the United States.
- Growth of wild-type virus in cell culture to produce vaccine seeds requires large volumes and biosafety level (BSL)-3 facilities.
- A short shelf-life for formulated vaccines requires the banking of non-formulated antigen concentrates.
- Antigen drift results in the emergence of field isolates that may not be controlled effectively with older vaccine antigen types; this requires an ongoing expense to stockpile current antigens.
Challenges of FMD Vaccination
Vaccine Production, continued

- Once an outbreak is detected, the antigen(s) must be identified for vaccine matching, and vaccine must be formulated from antigen concentrates. This results in a 1-2 week delay.

- At least one serotype is less immunogenic than the others and requires a higher antigen payload; some serotypes are less stable than the others and require additional quality assurance measures to ensure potency throughout the manufacturing process and storage.

- Highly purified vaccines must be used, otherwise it is difficult to differentiate vaccinated from infected animals due to the presence of nonstructural proteins in vaccines.
Challenges of FMD Vaccination

Vaccine Use

- Vaccines provide only serotype-specific protection.
- Vaccination against one serotype may fail to protect fully or at all against other strains within the serotype, depending on how closely the vaccine and field strain are related, and the potency of the vaccine.
- Onset of immunity is not immediate.
Challenges of FMD Vaccination
Vaccine Use, continued

➢ Duration of immunity depends on the type of vaccine used and varies by species of animal. No currently available vaccine provides “sterilizing immunity” which will prevent subsequent infection.

➢ Diagnostic testing capabilities to differentiate infected and vaccinated animals are necessary if an emergency vaccination strategy is utilized.
Challenges of FMD Vaccination In Trials

- Inactivated FMD vaccines may decrease viral shedding and clinical signs in cattle and sheep in challenge studies as early as 4 days after vaccination with protection improving for the next 2–3 weeks.

- Swine appear to be more difficult to protect shortly after challenge.
  - Limited studies have reported some protection as soon as 3–4 days after vaccination

- With more severe challenges, pigs may not be completely protected against disease until 21–28 days after vaccination.
Differentiating Between Infected and Vaccinated Animals

- One of the most significant challenges to any emergency vaccination strategy is differentiating between field infected and vaccinated animals for effective surveillance of FMDV (also known as a DIVA strategy).
Examples of Containment Vaccination Zones

- Emergency Vaccination in IZ
- Emergency Vaccination in BZ
- Emergency Vaccination in CA
- Emergency Vaccination in IZ and Partial BZ

Critical Activities and Tools
Examples of Protection Vaccination Zones

- The Protection Vaccination Zone (PVZ) is an emergency vaccination zone typically outside the CA. Typically, a PVZ is observed with stamping-out modified with emergency vaccination to live.
Examples of Vaccinated Premises

- Vaccinated Premises (VP) are typically a secondary designation to another premises designation, and is only used if vaccination is employed in an outbreak.
Wildlife Management and Vector Control

- An assessment of the risk that wildlife poses for the transmission of FMDV to susceptible livestock will be conducted within 7 days of confirmation of the index case.
- FMD can be transmitted mechanically by mice, vultures, and other vectors.
- To date, there is no evidence that insects can biologically transmit the FMDV to susceptible animals.
Appraisal and Compensation

- Indemnity payments are to encourage disease reporting, reduce the spread of animal disease, and compensate owners on the basis of fair market value.

- The following website offers additional guidance on appraisal and compensation:
  USDA APHIS Livestock Appraisal, Indemnity, and Compensation Section
Finance

During an FMD outbreak, funding may be rapidly required. For responding to specific emergency situations, VS has access to a variety of sources for funding. The two most common sources are the APHIS Contingency Fund (CF) and the Commodity Credit Corporation (CCC).
Recovery after an Outbreak

RESPONSE PLAN
Proof of Freedom
Recognition of Disease Freedom

➢ In May 1994, the World Assembly of Delegates of the OIE requested the Foot-and-Mouth Disease and Other Epizootics Commission (now called the Scientific Commission for Animal Diseases) develop a procedure for OIE to officially recognize the FMD-free status of members.

➢ Any member that wishes to be included in the list of disease-free countries or to change its status (for example, to move from the list of countries or zones free where vaccination is practiced to the list of countries or zones where vaccination is not practiced) sends a request to the OIE director general, accompanied by specific documentation and the relevant questionnaires for FMD.
Surveillance for Recognition of Disease-Freedom

- A country re-applying for country or zone freedom from FMD where vaccination is practiced or not practiced should show evidence of an active surveillance program for FMD as well as absence of FMDV infection/circulation.
Release of Quarantine and Movement Control

- Quarantine and movement controls will be maintained until at least 28 days have elapsed since the decontamination of all confirmed IP and negative results of surveillance activities.
Repopulation

- Following appropriate cleaning and disinfection procedures, IP will remain vacant for a period of time before restocking susceptible animals onto premises (minimum recommendation is 21 days).

- During restocking, animals will be subject to clinical inspection every 3 days for the first 14 days, and once per week thereafter up to 28 days.
  - At 28 days after the last animals are introduced, each animal must be clinically examined by a veterinary inspector and samples tested for the presence of FMDV antibodies.

- Introduced livestock must originate on and come from premises on which there has not been a confirmed case of FMD within 6.2 miles (10 kilometers) for at least 30 days.
Further Information
FAD PReP Supporting Documents and Materials

- Strategic Plans—Concept of Operations
- Industry Manuals
- Disease Response Plans
- Standard Operating Procedures (SOPs) for Critical Activities
- Continuity of Business Plans
  - Commodity specific plans developed by public-private-academic partnerships
- Ready Reference Guides
### Key Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>DIVA</td>
<td>Differentiation of infected from vaccinated animals</td>
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<tr>
<td>FAD</td>
<td>Foreign animal disease</td>
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<tr>
<td>FAD PReP</td>
<td>Foreign Animal Disease Preparedness and Response Plan</td>
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<tr>
<td>FMD</td>
<td>Foot-and-mouth disease</td>
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<tr>
<td>FMDV</td>
<td>Foot-and-mouth disease virus</td>
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<tr>
<td>NRF</td>
<td>National Response Framework</td>
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<tr>
<td>NVS</td>
<td>National Veterinary Stockpile</td>
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<td>NVSL</td>
<td>National Veterinary Services Laboratories</td>
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<td>OIE</td>
<td>World Organization for Animal Health</td>
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<tr>
<td>PPE</td>
<td>Personal protective equipment</td>
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<tr>
<td>VS</td>
<td>Veterinary Services</td>
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