

Iowa Foot-and-Mouth Disease State Response Plan



This is a draft plan and is subject to change

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1. Introduction

Foot-and-mouth disease (FMD) is a severe and highly contagious viral disease affecting cows, pigs, sheep, goats, deer, and other animals with divided, or split, hooves. It can also infect hedgehogs and Asian elephants. It does not infect people and is neither a food safety nor public health concern [1]. Animals which pass ante-mortem and post-mortem inspection by the [USDA Food Safety and Inspection Service \(FSIS\)](#) at slaughter or a facility licensed and inspected by the Iowa Department of Agriculture and Land Stewardship (IDALS) [Meat and Poultry Inspections Bureau](#) are safe for human consumption, even if the animals may have been exposed to or have recovered from FMD. Products passing inspection are able to enter normal commerce.

Animals with FMD typically develop a fever with blisters on the tongue and lips, in and around the mouth, on mammary glands, and around hooves. Other signs of illness include depression, anorexia, excessive salivation, lameness, and reluctance to move or stand. Most adult animals do not die from FMD, but instead weaken and may recover, however they may never regain full productivity. Younger animals may not survive. Because clinical signs of FMD mimic signs of endemic diseases causing blisters ([Vesicular Stomatitis](#), Senecavirus A, etc.), the recognition, identification, and confirmation of FMD may be delayed.

A single FMD detection could close international export markets for meat, dairy, and other products, causing billions of dollars in lost trade for the U.S. [2]. While there is a vaccination against FMD, a 2019 report from the U.S. Government Accountability Office found that the number of doses stockpiled in the *North American Foot-and-Mouth Disease Vaccine Bank* available during 2018 was less than 10% of the total doses needed to vaccinate all susceptible species in Iowa [3].

Therefore, the primary strategy to mitigate FMD's impact on Iowa's agricultural economy is to prevent it from entering or eradicating it as quickly as possible if it does enter. This may be accomplished through instituting restricted and/or controlled movements of susceptible species if the virus is detected in the U.S. and stamping-out positive or epidemiologically linked herds/flocks in Iowa. Identifying all premises before a potential outbreak would greatly increase IDALS' ability to control and mitigate an FMD introduction.

In the event of an outbreak the primary transmission risk to Iowa herds/flocks is direct transmission from infected animals to susceptible animals or indirect transmission from fomites (contaminated people, supplies, or equipment). Transmission from infected animals could occur from domesticated animals or wildlife. If infected, white tailed deer could potentially spread the virus but the role they would play in propagating an outbreak is thought to be limited [4] [5]. While feral swine can become infected with FMD and are reported in three bordering states (Missouri, Illinois, and Wisconsin); with the exception of Crawford County, Wisconsin (separated from Iowa by the Mississippi River), no county directly borders Iowa and the introduction of FMD from feral swine is unlikely at this time [6]. The risk of intentional release of FMD into an Iowa herd/flock is unknown.

During any foreign animal disease (FAD) outbreak IDALS will work collaboratively with USDA to respond. The goals of any FAD response include: (1) detecting, controlling, and containing the disease as quickly as possible; (2) eradicating the disease using strategies that seek to stabilize animal agriculture, food supplies, the economy, and to protect public health and the environment; and (3) providing science- and risk-based approaches and systems to facilitate continuity of business for non-infected animals and non-contaminated products.

Lastly, during an outbreak FMD may be incorrectly associated with [Hand, Foot and Mouth Disease](#) that affects people. This confusion with an entirely unrelated condition could cause unnecessary public health concern [7].

2. Pre-Outbreak Actions

i. Biosecurity

- a. IDALS places the responsibility of implementing good biosecurity practices on the producers and owners of a premises. At a minimum IDALS recommendations premises utilize existing enhanced biosecurity outbreak guidance available in the [NAHEMS Guidelines for Biosecurity](#) [8] and those outlined in the [Secure Pork Supply \(SPS\)](#), [Secure Beef Supply \(SBS\)](#), [Secure Milk Supply \(SMS\)](#), and/or Secure Sheep and Wool Supply, but also practice increased biosecurity practices, where appropriate, on a daily basis.
- b. IDALS further recommends:
 - Premises that do not allow pigs to have outdoor access utilize guidance available in the [Self-Assessment Checklist for Enhanced Pork Production Biosecurity: Animals Raised Indoors](#) [9];
 - Premises that allow pigs to have outdoor access utilize USDA biosecurity recommendations as highlighted in the [USDA Biosecurity Checklist for Pigs with Outdoor Access](#) [10] and well as the [Self-Assessment Checklist for Enhanced Pork Production Biosecurity: Animals with Outdoor Access](#) [11];
 - Premises housing beef cattle on feedlots utilize guidance available in the [Self-Assessment Checklist for Enhanced Biosecurity for FMD Prevention: Beef Feedlots](#) [12];
 - Premises housing beef cattle on pasture utilize guidance available in the [Self-Assessment Checklist for Enhanced Biosecurity for FMD Prevention: Cattle on Pasture](#) [13];
 - Premises housing dairy cattle utilize guidance available in the [Self-Assessment Checklist for Enhanced Biosecurity for FMD Prevention: Dairy](#) [14];
 - Premises housing sheep utilize guidance available in the Self-Assessment Checklist for Enhanced Biosecurity for FMD Prevention: Sheep and Wool;
 - All premises implement personnel policies that restrict employees (and visitors) from:

- entering a premises for a minimum of 5 days after arriving in the U.S. after visiting any country or area of the world experiencing active FMD cases;
- bringing any clothing (including footwear) that was worn when hunting white tailed deer or other ruminants, hunting feral swine, or visiting a country or area of the world experiencing active FMD cases before it is completely washed and laundered;
- entering a premises without adhering to the premises' established biosecurity protocols;
- bringing cellular phones and other outside materials that have not been properly disinfected onto a premises; and
- Controlling potential mechanical vectors (such as flies) that may be present on the premises.

ii. Premises Registration

Premises registration of all livestock premises and assignment of a premises identification number will greatly enhance IDALS' ability to respond to and mitigate an FMD outbreak.

3. Classifications of an FMD Outbreak in relation to Iowa

There are three classifications of an FMD outbreak in relation to Iowa that would prompt IDALS to initiate a response. Formal notification of confirmed FMD cases outside of Iowa would be announced by USDA. Any confirmation of FMD within Iowa would be announced jointly by IDALS and USDA.

The three classifications of an FMD outbreak in relation to Iowa are:

- **Continental:** FMD outbreak in Canada or Mexico but not in the U.S.
- **Domestic:** Confirmation of the first FMD case in the U.S. but not in Iowa.
- **In-State:** Surveillance shows a positive case in Iowa or epidemiologic evidence proves a connection of an Iowa herd/flock to an infected herd/flock.

Iowa Code [163.1](#) describes IDALS legal authority to control infectious or contagious diseases affecting animals. Therefore during any FMD outbreak classification, IDALS may take the following actions:

i. Continental: FMD outbreak in Canada or Mexico but not in the U.S.

While historically FMD was endemic throughout North America, it was eradicated in from the U.S. in 1929, Canada in 1952, and Mexico in 1954 [15]. If FMD re-emerged in Canada or Mexico IDALS may:

- 177 • Receive confirmation of an FMD outbreak in North America (Canada or Mexico)
178 from USDA and receive reports on trade status with the infected country.
- 179 • Notify internal staff of the potential threat and initiate frequent communication to
180 ensure stand-by readiness to deploy if necessary.
- 181 • Confer with the Iowa Veterinary Diagnostic Laboratory to review submission
182 procedures for the National Animal Health Laboratory Network (NAHLN), including
183 the designated National Veterinary Service Laboratory (NVSL) [Foreign Animal](#)
184 [Disease Diagnostic Laboratory \(FADDL\)](#).
- 185 • Communicate the threat to stakeholders and the public. IDALS will explain the
186 disease and its effect on susceptible livestock, provide a description of the current
187 response, make recommendations on how producers should protect their herds/flocks,
188 explain how to report suspected cases or unusual disease, and provide resources to
189 find more information. Complete details on communication pathways can be found in
190 the *IDALS' Foreign Animal Disease Communications Plan*.
- 191 • The State Veterinarian may issue quarantine orders or special import rules/orders in
192 cases where there is a potential FMD threat to Iowa agriculture. Import rules may
193 include:
 - 194 ○ Special import permits or requirements for susceptible animals entering Iowa.
 - 195 ○ Negative results to diagnostic tests. Diagnostic tests may be utilized to the
196 highest degree possible to demonstrate a lack of evidence of infection.
- 197 • Notify cooperating state agencies, including but not limited to Homeland Security and
198 Emergency Management (HSEMD), Iowa Department of Public Health (DPH), Iowa
199 Department of Natural Resources (DNR), Iowa Department of Public Safety (DPS)
200 and Iowa Department of Transportation (DOT). HSEM can coordinate the
201 notification process.
- 202 • Notify veterinary and other professional associations, licensed and accredited
203 veterinarians, livestock and trade associations, livestock producers, transit companies,
204 and others of any changes to import regulations.
- 205 • Conduct historic tracing and surveillance of susceptible animals imported from the
206 FMD-affected country within a minimum of two incubation periods (30 days) prior to
207 the date of onset (or best approximation) of the index case.
 - 208 ○ Information may be gathered from a number of sources, including Certificates
209 of Veterinary Inspection (CVIs), entry permits, producer records, and
210 livestock market and slaughter facility records. These may include shipments
211 from high-risk areas such as the infected country, production systems
212 associated with the outbreak, or from other states with frequent movements
213 from the infected country (e.g., movements from Mexico into Texas).

- Begin a more aggressive surveillance program to try to determine if FMD has been introduced into Iowa. Available diagnostic testing will be utilized to the highest degree possible as a tool to help determine the FMD status of individual animals or herds/flocks.

- Tests may be conducted on:

- Animals based on epidemiological link(s);
- Animals showing suspicious clinical signs;
- Recent samples submitted to the Veterinary Diagnostic Laboratory at Iowa State University for diagnosis of illness (i.e. targeted samples); and/or
- Samples collected from concentration points, such as slaughter facilities, buying stations, livestock markets, etc.

- If it is anticipated that the incident may require support beyond IDALS resources, IDALS will notify the Governor's office and coordinate with Iowa Department of (HSEMD) to review needed resources and purchasing procedures to support a response.

- Continuously update the Governor's Office and HSEMD, and collectively anticipate future needs and evaluate the need for a Declaration of Emergency.

ii. Domestic: Confirmation of the first FMD case in the U.S. but not in Iowa

In addition to the activities and considerations listed for the Continental classification, if FMD is detected in the U.S. but not Iowa IDALS may:

- Be in frequent communication with USDA to confirm:
 - Situational awareness of the FMD status of other states, including current response strategy (stamping-out) and epidemiological links to Iowa and other states;
 - The identity of FMD contacts that may have been transported to Iowa within the last 30 days at a minimum;
 - Status of trade with U.S.'s international trading partners;
 - If USDA is considering a Secretarial Emergency Declaration for the affected state(s).
 - If USDA is recommended a national standstill order for all susceptible species.

- 248 • If a standstill order is implemented, immediately contact DOT and DPS.
- 249 • Conduct surveillance to provide the highest degree of confidence possible that animal
250 and/or animal product movements can occur to support business continuity without
251 spreading infection. This may include monitoring for clinical signs and testing of live
252 animals including, but not limited to, screening serum samples stored at the Iowa
253 Veterinary Diagnostic Laboratory and/or testing animals at packing plants.
- 254 • Carefully evaluate the risk of animals and animal products to be imported. Imports
255 that pose a high-risk of introducing FMD will be prohibited from entering Iowa.
256 Imports from certain geographical areas, production systems associated with the
257 outbreak or other locations that may have epidemiological links to FMD Infected
258 Premises will be carefully screened before being allowed to enter Iowa.
- 259 • Implement all, or aspects of, the [*IDALS' General Standstill Protocol*](#).
- 260 • Investigate imports into Iowa within the last 30 days that may pose a risk to Iowa
261 livestock.
- 262 • Continue the surveillance program for FMD to determine any epidemiological links
263 to premises in Iowa.
- 264 • Activate a Departmental Operations Center.
- 265 • Ready the premises identification database to facilitate the identification of premises
266 that may be at-risk or infected.
- 267 • Communicate with veterinary and other professional associations, licensed and
268 accredited veterinarians, livestock and trade associations, livestock producers, transit
269 companies, and others concerning the elevated threat, and provide information on
270 monitoring the health of susceptible animals, and implementing enhanced biosecurity.
- 271 • Re-evaluate the threat and take action to protect Iowa livestock. In addition to
272 movement controls, actions may include epidemiological investigations, reminders of
273 reporting requirements, and enhanced surveillance at livestock markets and slaughter
274 facilities, among other activities.
- 275 • Confer with USDA to evaluate federal resources that may be available, if needed.
- 276 • Request HSEMD to notify appropriate personnel from supporting local and state
277 agencies.
- 278 • Reassign and/or pre-position IDALS staff members to locations of anticipated need,
279 such as to the Departmental Operations Center (DOC), the State EOC, the Joint
280 Information Center (JIC), or an existing Incident Command Post.
- 281 • Coordinate with HSEMD to anticipate needed resources and purchasing procedures to

- support a response to a potential outbreak.
- Request specific agencies provide support for response activities, which may include implementing a call center to respond to questions from veterinarians, producers, allied businesses, and the public, instituting Just-In-Time Training for response tasks, providing outreach to a variety of audiences to keep them aware of the threat and mitigation measures, and requesting supporting agencies send representatives to the JIC to develop and distribute messages to appropriate stakeholders.
 - Notify all producers, processors, and transit companies about the changes to Iowa's import and movement criteria, and provide information about the permitting system and requirements.
 - Continue to monitor all states.
 - Closely monitor any epidemiologically linked premises to determine what, if any, additional actions need to occur on that premises to stop the outbreak. This would designate a transition from the Continental to In-State classification.
- iii. In-State: Confirmation of FMD in Iowa or Epidemiologic link of Iowa herd/flock to infected herd/flock**
- In the event of confirmation of FMD in Iowa or the epidemiologic link of an Iowa herd/flock to an infected herd/flock, IDALS is the lead agency for the emergency response to eradicate the disease and initiate recovery. In addition to the activities and considerations listed for the Continental and Domestic classifications, if FMD is suspected or detected in Iowa IDALS may:
- Receive notification of an epidemiological contact from an Infected Premises, or may be notified of suspicious clinical signs in a susceptible animal in Iowa.
 - Conduct epidemiological investigations (with or without the assistance of the USDA) to identify Infected Premises and Contact Premises.
 - Collaborate with USDA to dispatch a state or federal Foreign Animal Disease Diagnostician (FADD) to conduct an investigation and collect diagnostic samples for laboratory submission. Divided samples will be provided to the Iowa State University Veterinary Diagnostic Laboratory in Ames and sent to the designated Foreign Animal Disease Diagnostic Laboratory (FADDL) for confirmation and virus isolation. An FADD investigation is conducted according to [*VS Guidance Document 12001.2 - Policy for the Investigation of Potential Foreign Animal Disease/Emerging Disease Incidents \(FAD/EDI\)*](#).
 - Collaborate with the U.S. Department of Homeland Security (DHS) and Federal Bureau of Investigation (FBI) to determine if FMD was intentionally introduced into Iowa.

- 320 • Initiate containment activities on the Infected (or Suspect) Premises. Initially, in most
321 cases this will include quarantine, setting up premises biocontainment, and a review
322 of producer records to trace recent animal movements into and out of the herd/flock
323 (*see Appendix 3: Mitigation, subsection ii. Quarantine*).
- 324 • Request FMD vaccinations from the USDA Veterinary National Stock Pile and
325 implement a the *Iowa FMD Vaccination Plan* (*see Appendix 3: Mitigation, subsection*
326 *vii. Vaccination*).
- 327 • Form a Unified Command with USDA to exercise state and federal authority to
328 protect animal health. Initially, local USDA representatives will participate. Positions
329 may rotate to other USDA representatives over time and as more assistance is
330 requested.
- 331 • Assign personnel to Incident Command System positions to manage the emergency
332 response activities with the help of supporting agencies.
- 333 • Prompted by a positive laboratory result confirming FMD, establish a Control Area
334 around the Infected Premises, and institute movement controls (*see Appendix 3:*
335 *Mitigation, subsection ii. Quarantine and subsection iii. Permitting*), as well as
336 epidemiological tracing (*see Appendix 2: Epidemiological Investigation and*
337 *Surveillance*).
- 338 • Through HSEMD, request supporting agency representatives to report to the SEOC
339 with knowledge of available capabilities and resources.
- 340 • Continue disease surveillance to detect other Infected Premises or potential spread of
341 FMD.
- 342 • Communicate through HSEMD with state agencies and local emergency managers
343 and officials of the affected areas to determine local resource needs and availability.
- 344 • Based on a stamping-out strategy dependent on the size of the herd/flock, implement
345 a depopulation plan with greatest probability of depopulating the herd/flock in a
346 timely manner (*see Appendix 3: Mitigation, subsection v. Mass Depopulation*).
- 347 • Collaborate with Iowa's Department of Natural Resources (DNR) to approve the
348 animal owner's disposal plan for carcasses and other associated materials (*see*
349 *Appendix 3: Mitigation, subsection vi. Carcass Disposal*).
- 350 • Require biocontainment protocols to prevent spread of FMD from Infected Premises
351 (*see Appendix 3: Mitigation, subsection iv. Biocontainment*).
- 352 • If not already instituted, implement a system of permitted movement to approve and
353 document movements into, within, and out of the Control Area (*see Appendix 3:*
354 *Mitigation, subsection iii. Permitting*).

- Develop protocols for cleaning and disinfection to decontaminate buildings, areas and articles on the premises after infected animals have been removed. Protocols will be guided by [FAD PReP Guidelines: Cleaning and Disinfection](#).
- Decide the method of releasing a Control Area and restrictions imposed on movements into, out of, and within the Control Area. The Control Area may be released as a whole or in parts to gradually reduce the size. Considerations include:
 - Premises due to be released do not appear to pose a risk for further spread of FMD;
 - Results of epidemiological surveillance and confirmed/suspected cases in the vicinity;
 - Disease status of other neighboring premises;
 - Progress of the eradication effort and current response approach; and/or
 - Reasonable confidence that the non-infected premises due to be released will not be vulnerable to re-exposure (*see Appendix 3: Mitigation, subsection iii. Permitting*).
- Recommend slaughter or euthanasia of any exposed or recovered animals due to the chance that some may become long-term carriers [16].
- Allow repopulation once infected/contagious animals have been removed and the environment of a premises is no longer a risk to spread FMD (through cleaning and disinfection or a fallow period - *see Appendix 3: Mitigation, subsection vi. Cleaning and Disinfection*). Conditions for repopulation may change if the response strategy transitions from stamping-out.
- Continue disease surveillance to detect new infections, and also to collect data to prove FMD freedom if possible.
- Initiate regular briefings for the media and for information release to the general public through the JIC.

Appendix 1: Standstill Order

During an FMD outbreak IDALS may implement aspects of the [*IDALS' General Standstill Protocol*](#). While the order is in effect, no unpermitted movements of animals susceptible to FMD would be allowed within the state. Exceptions may be made, depending on the epidemiology of the outbreak, for critical movements (i.e. slaughter, etc.) at the discretion of IDALS.

Appendix 2: Epidemiological Investigation and Surveillance

During an FMD outbreak the following premises definitions will be used:

- **Infected Premises (IP):** any premises with laboratory confirmed FMD
- **Contact Premises (CP):** any premises with an established epidemiological link to a IP in the previous 30 days at a minimum

The following are IDALS' initial goals of an FMD epidemiological investigation conducted in Iowa:

- identify each potential IP through tracing activities, assign a premises classification and investigation priority;
- identify any CP (this includes all potential CP within a production system where sites may be separated by large geographic distances); and
- characterize the nature of the FMD outbreak, identifying any potential lateral transmission pathways and mitigation strategies.

Identifying potential CP within the same production system may include, but is not limited to, IDALS auditing the following aspects of movement onto and off a premises:

- live animal movement logs,
- animal product movement logs,
- feed delivery logs,
- personnel logs,
- visitor logs (both domestic and international),
- list of equipment shared between premises,
- animal disposal logs (i.e. rendering, etc.), and
- supply delivery logs (i.e. fuel delivery, etc.)

In addition to active investigations, the need for statewide FMD surveillance may become necessary. This will take two forms: 1) passive surveillance and 2) active surveillance.

Passive surveillance will occur from veterinarian and producer reporting of suspicious clinical signs and mortalities noted in susceptible animals. IDALS will widely communicate that anyone suspecting a possible FMD introduction into Iowa reports it immediately to IDALS and/or the USDA. At which time either an IDALS or USDA FADD will be dispatched to the premises to conduct an investigation.

Active surveillance will occur through screening diagnostic samples that are collected on a regular basis. This would include any samples from susceptible animals submitted to the Iowa Veterinary Diagnostic Laboratory, for any purpose, as well as samples retained at the Laboratory from the previous 60 days. Samples may be screened with the following diagnostic tests:

Test	Sample Types
RT-PCR (Real-Time Polymerase Chain Reaction)*	Tissue (tonsil, spleen or lymph node)
ABC CSF Staining (Avidin-Biotin Complex Classical Swine Fever)	Tissue (tonsils preferred)
ELISA (Enzyme-linked immunosorbent assay)**	Serum (10mL Red top tube)
Immunoperoxidase**, +	Serum (10mL Red top tube)
Virus Isolation	Tissue (tonsil, spleen or lymph node)
Virus Neutralization** ++	Serum (10mL Red top tube)
Nested PCR***	Tissue (tonsil, spleen or lymph node)

*RT-PCR will be used in suspect cases because of the rapid turn-around time and the lag in time before the pigs will produce antibody.

**Screening tests used for OIE screening for international trade.

***Only to be used after a positive rRT-PCR reaction

+ Used after an inconclusive ELISA test

++ Used after an inconclusive Immunoperoxidase test

At the onset of the surveillance program any sample that screens positive would be sent to a designated National Veterinary Service Laboratory (NVSL) [Foreign Animal Disease Diagnostic Laboratory \(FADDL\)](#) for confirmatory testing. This would continue until testing became decentralized and more widely available at other laboratories.

Depending on the capacity/capabilities of the Iowa State University Veterinary Diagnostic Laboratory in Ames and other reference laboratories, oral fluid testing in swine may also be incorporated into a statewide FMD surveillance program [17].

Any sample that tests and is then confirmed positive, regardless of the sample type, would prompt an epidemiologic investigation to determine where the infected animal originated and where it could have potentially exposed other susceptible animals.

Appendix 3: Mitigation

i. Quarantine

Any premises with confirmed FMD or that is epidemiologically linked to a confirmed FMD case will be placed under a quarantine as established in the [IDALS's General Quarantine Protocol](#). If a premises is part of a large production system, the entire system may or may not be temporarily placed under a quarantine while the epidemiologic investigation of that system is ongoing.

ii. Control Area

During an FMD outbreak a Control Area will be established to contain the infection, target stamping-out activities, and control animal movements. The function and minimum size of the Control Area is explained in the [IDALS General Control and Monitoring Zones Protocol](#). However, during an FMD outbreak IDALS may expand the outer boundaries of the Control Area or include multiple premises within one production system in the Control Area based on the epidemiology or scale of the outbreak.

iii. Permitting

Premises inside the Control Area may be allowed permitted movements based on protocols established in the [IDALS General Animal Permitting Protocol](#). Any premises of a large production system with an epidemiological link to one of their premises in the Control Area may be designated a CP.

iv. Mass Depopulation

To maximize biocontainment procedures and reduce the overall viral burden of an infected premises the goal is to have all infected and exposed premises depopulated as soon as possible, preferably within 24 hours, after the confirmed diagnosis [18]. The size and strength of the animals, necessary restraint, as well as the safety and expertise of available responders may factor into IDALS' selection of appropriate depopulation methods. IDALS may consider various methods during an FMD outbreak and the method chosen may depend on resource availability, premises and herd/flock size, and worker safety concerns. However, regardless of the method chosen, if a producer wishes to seek indemnity for depopulated animals, USDA APHIS must preapprove the method. Any animal that dies prior to depopulation will not qualify for indemnity.

The following is a list of some depopulation methods in alphabetical order IDALS may chose during an FMD outbreak:

- Carbon dioxide and other gasses,
- Firearms,
- Injectable euthanasia,

- Penetrating captive bolt, and
- Ventilation shutdown.

Potential depopulation methods:

- *Carbon Dioxide and Other Gasses:* Carbon dioxide (CO₂) has been used commercially in harvesting poultry and swine to stun the animal prior to exsanguination. Asphyxiates such as carbon dioxide, nitrogen, argon, and carbon monoxide exclude oxygen. An animal exposed to an atmosphere which is completely devoid of oxygen will lose consciousness very rapidly. Some farms use carbon dioxide as their primary method of euthanasia for suckling or nursery pigs (up to 70 lb [154 kg]). The AVMA has categorized the use of CO₂ as a “preferred method” for the depopulation of swine and small ruminants under 2 months of age. It is not listed for cattle of any age or small ruminants over 2 months of age under any circumstance [19].

Personnel involved in the procedure must be trained. Safety procedures along with appropriate safety equipment must be utilized according to guidelines reviewed or established by the Safety Officer.

- *Firearms:* When firearms (gunshot) is the method of choice, it is important that firearm handlers use a caliber of firearm, projectile, and propellant load that are appropriate for the species being euthanized, the location of the procedure, and the overall situation. The shooter should comply with all guidelines established by the Safety Officer such as the use of protective head and eye gear. The AVMA has categorized the use of firearms as a “preferred method” for depopulation of swine (other than suckling pigs) and cattle. It is not recommend for confined or restrained small ruminants at a distance of over 3 feet [19]. For large herds/flocks this may take a substantial amount of time and labor to complete.

For reference purposes in choosing a suitable firearm for euthanasia of livestock, [FAD PReP/NAHEMS Guidelines: Mass Depopulation and Euthanasia](#) provides the weight of the projectile, muzzle velocity, and muzzle energy available with various cartridges that are in common use. This document also describes the proper use, target area, and safety considerations in the use of firearms for euthanasia.

- *Injectable euthanasia:* The use of chemical methods to euthanize livestock during an animal health crisis may not be practical because of the residue potential if carcasses must be rendered, composted, or buried. Chemical adjunct measures include injection of lethal amounts of products such as chloral hydrate, chloral hydrate and magnesium sulfate, or various alkaloid poisons. Potassium chloride (KCl) which is not controlled and is readily available will produce cardiac arrest when bolused by the intravenous or intracardiac route. The dose of KCl required is 7.2gm/100Kg of body weight. The animal should be rendered insensible before KCl is administered. Any product to be used as a lethal adjunct measure should be one with specific published clinical properties.

The AVMA has categorized the use of injectable euthanasia as a “preferred method” for depopulation of swine, cattle, and small ruminants [19]

- *Penetrating Captive Bolt*: Euthanasia by penetrating captive bolt is appropriate for most hoofstock. This method targets the cerebral region and the brainstem. In the hands of trained and experienced personnel, this method produces rapid and humane death and is especially useful in field situations to euthanize numerous animals and/or avoid carcass residues associated with some chemical methods.

Penetrating captive bolt devices are placed in contact with the skull to deliver a lethal blow to the animal through direct trauma to the brain. The use of an extended length penetrating captive bolt is usually fatal when properly conducted. Personnel must be prepared to administer an adjunct measure such as pithing or IV KCL administration to ensure rapid death if the use of the penetrating captive bolt fails to result in death. The AVMA has categorized the use of penetrating captive bolt guns as a “preferred method” for depopulation of all swine, cattle, and small ruminants [19].

Refer to [FAD PRoP/NAHEMS Guidelines: Mass Depopulation and Euthanasia](#) for the proper use, target area, and safety considerations in the use of penetrative captive bolt for euthanasia.

Non-penetrating captive bolts are intended to deliver concussive trauma to render an animal unconscious, and have not been specifically designed to result in death. They should be used with an adjunct measure to ensure death. The AVMA has categorized the use of non-penetrating captive bolt guns as a “preferred method” for depopulation of all swine [19].

- *Ventilation Shutdown (VSD)*: While AVMA preferred methods will first be considered in an FMD response, VSD may be considered if these methods will not achieve depopulation of infected herds (based on the presumptive positive result) within a timely manner or be accomplished in a way that assures human safety. VSD is an adjunct method that may be considered by IDALS for depopulation of infected swine based on the defined policy and considered on a premises-by-premises basis. However, VSD should be used only after a full consideration of the epidemiologic threat posed concludes that no other method can be completed in a timely manner to minimize the chance of the virus spreading. Timely implementation would significantly reduce virus amplification and the risk of ongoing transmission while also protecting nearby and epidemiologically linked production facilities [20]. However, depending on weather conditions and facility design, VSD may require supplement heating for buildings during colder seasons and/or an added source of CO₂ gas. The AVMA has categorized the use of VSD as “permitted in constrained circumstances” for depopulation of all swine. VSD is not listed for cattle or small ruminants under any circumstance [19].

v. Carcass Disposal

In most cases during an FMD outbreak IDALS will require on-site disposal of animal carcasses and other associated materials. On-site disposal eliminates the need to move carcasses great distances and eliminates potentially moving live virus off the premises. During an FMD outbreak in most cases IDALS will require the animal owner to utilize one of the following on-site disposal methods:

- above ground burial,
- incineration,
- composting, or
- natural in-place decomposition for swine.

Explanations on disposing of carcasses using burial, incineration, composting, and incineration can be found in the [NAHEMS Guidelines: Disposal](#) and [Iowa DNR Mass Animal Mortality Plan](#).

If IDALS elects to go with natural in-place decomposition several factors need to be considered. The first is the amount of time it will take for the carcasses to reach a point where they are easier to move. With pig carcasses indoors and not exposed to the elements, decay rates will be slowed [21] [22]. In addition, pigs weighing more than 50 lbs may take 3 times as long to decompose as pigs weighing less [23] [24]. This would require more time for facilities housing pigs larger than nursery piglets, with gestation barns potentially taking the longest to reach the ideal decomposition phase. While no studies have been performed on the rate of natural carcass decay inside a swine facility it has been shown that on average swine carcasses left outdoors during the spring, summer, and fall take approximately 2 weeks to reach skeletonization to a few months during the winter [25]. Therefore when ambient temperatures fall below 60°F it may become necessary to heat facilities to expedite the decomposition process. If facilities are kept at 60°F or higher, carcasses >50 lbs should reach skeletonization and be removed after approximately three weeks with carcasses <50 lbs taking approximately two weeks. At this stage, remains can be disposed of using another method.

The second is the potential occupational safety issues when entering a barn where natural in-place decomposition has occurred. When entering the barn to remove decomposed carcasses personnel should wear appropriate PPE including respirators.

Lastly proper insect control should be implemented to prevent flies and other insects as serving as mechanical vectors and carrying the virus to other premises.

vi. Cleaning and Disinfection

In general Cleaning and Disinfection (C&D) protocols for FMD should follow the basic principles outlined in the [IDALS's General Cleaning and Disinfection Protocol](#). The following are disinfectants currently approved for FMD [26]:

- Aseptrol FC-TAB
- Aseptrol S10-TAB
- Lonza DC-101
- Maquat MQ615-AS
- Oxonia
- Virkon S
- Acetic acid
- Citric acid
- Sodium hypochlorite

Additional information on these disinfectants can be found on the [USDA APHIS webpage](#).

vii. Vaccination

NOTE: The *Iowa FMD Vaccination Plan* is currently under development between IDALS, USDA, and Iowa State University with funding made available through the 2018 Farm Bill (Agriculture Improvement Act of 2018).

While vaccines against FMD exist, there are seven known types and more than 60 subtypes of the FMD virus and immunity to one type does not provide cross protection. Instead, vaccines must be closely matched to the viral strain circulating [2].

FMD vaccine provides immunity for up to six months. Cattle, sheep, and goats require a single vaccine dose for full immunity, while swine require two doses two weeks apart. Animals would need to be re-vaccinated every six months for as long as vaccination is being used as a control measure [2].

In the event of a FMD detection in Iowa, IDALS will work with USDA APHIS to vaccinate at risk animals and stop further spread. Vaccination Strategies include:

- Vaccinate-to-kill: killing means any procedure which causes the death of an animal that does not enter the human food chain.
- Vaccinate-to-slaughter: slaughter means any procedure which causes the death of an animal by bleeding where the animal may enter the human food chain.
- Vaccinate-to-live: the animal is allowed to live out its useful life-span.

FMD-free status will not be able to be established until the long-term control and eradication program is successful. FMD-free *with vaccination* status may be an intermediary step to FMD-freedom *without vaccination*.

677 FMD-free status *with vaccination* can be attained 2 years after the last outbreak as long as
678 there is no evidence of virus circulation within the past 12 months ([OIE TAHC Article](#)
679 [8.8.3](#)). If vaccination is stopped, FMD-free status may be attained 12 months after the last
680 evidence of FMD infection and the last FMD vaccine was administered ([OIE TAHC](#)
681 [Article 8.8.2](#)).
682

683 If the FMD-free status *with vaccination* can be attained, it is expected few countries will
684 resume trade with the U.S. as long as they can access sources of animal protein from
685 countries that are FMD-free without vaccination.
686

687 If FMD-free status *without vaccination* can be attained as recognized by OIE, it is
688 expected to take much longer for the U.S. trading partners to recognize the status and
689 resume trade.
690
691

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