SWINE INDUSTRY MANUAL

FAD PReP

Foreign Animal Disease Preparedness & Response Plan

National Animal Health Emergency Management System

USDA

APHIS

the Center for Food Security & Public Health
Iowa State University

United States Department of Agriculture • Animal and Plant Health Inspection Service • Veterinary Services

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Swine Industry Manual

The Foreign Animal Disease Preparedness and Response Plan (FAD PReP) Swine Industry Manual provides an overview of U.S. swine production methods to enhance understanding of normal business operations and the inherent high risk disease transmission behaviors in order to effectively aid in containing or eradicating a highly contagious foreign animal disease outbreak in the United States.

This FAD PReP Industry Manual was produced by the Center for Food Security and Public Health, Iowa State University of Science and Technology, College of Veterinary Medicine, in collaboration with the U.S. Department of Agriculture Animal and Plant Health Inspection Service through a cooperative agreement.

The FAD PReP Swine Industry Manual was last updated in March 2011. Please send questions or comments to:

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THE IMPERATIVE FOR FOREIGN ANIMAL DISEASE PREPAREDNESS AND RESPONSE

WHY FOREIGN ANIMAL DISEASES MATTER

Preparing for and responding to foreign animal diseases (FADs), like highly pathogenic avian influenza (HPAI) and foot-and-mouth disease (FMD), are critical measures to safeguard our nation's animal health, public health, and food supply.

There are significant potential consequences of an FAD outbreak in the United States. For example, the 2001 FMD outbreak in the United Kingdom cost an estimated £8 billion ($13 billion) and reduced the British gross domestic product by 0.2 percent. Studies have projected a likely cost of between $6 billion and $14 billion for a U.S. outbreak contained to California. In addition to the economic impact, the social and psychological impact on both producers and consumers would be severe.

CHALLENGES OF RESPONDING TO AN FAD EVENT

An FAD outbreak will be challenging to all stakeholders. For example, there will be disruptions to interstate commerce and international trade. Response activities are complex, and significant planning and preparation must be conducted before an outbreak. Outbreaks can become large and widespread. Large, geographically dispersed and diverse teams will need to be assembled rapidly and must react quickly. The response effort must have the capability to be rapidly scaled up, involving many times more resources, personnel, and countermeasures. As such, responding to an FAD—large or small—may be a very complex and difficult effort.

LESSONS LEARNED FROM PAST FAD OUTBREAKS

Past outbreaks both in the United States and other countries have allowed us to learn important lessons that can be applied to preparedness and response efforts. To achieve successful outcomes in future FAD outbreaks, it is vital to identify, understand, and apply these lessons learned:

- Provide a unified State-Federal-Tribal-industry planning process that respects local knowledge.
- Ensure the unified command sets clearly defined and obtainable goals.
- Have a unified command that acts with speed and certainty to achieve united goals.
- Employ science-based and risk-management approaches that protect public health and animal health, stabilize animal agriculture, the food supply, and the economy.
- Ensure guidelines, strategies, and procedures are communicated and understood by responders and stakeholders.
- Acknowledge that high expectations for timely and successful outcomes require the:
  - rapid scale-up of resources and trained personnel for veterinary activities and countermeasures, and
  - capability to quickly address competing interests before or during an outbreak.
- Execute FAD tracing, which is essential for the efficient and timely control of FAD outbreaks.

FAD PREP MISSION AND GOALS

The significant threat and potential consequences of FADs and the challenges and lessons-learned of effective and rapid FAD response have led to the development of the Foreign Animal Disease Preparedness and Response Plan, also known as "FAD PReP." The mission of FAD PReP is to raise awareness, expectations, and develop capabilities

surrounding FAD preparedness and response. The goal of FAD PReP is to integrate, synchronize, and de-conflict preparedness and response capabilities as much as possible before an outbreak, by providing goals, guidelines, strategies, and procedures that are clear, comprehensive, easily readable, easily updated, and that comply with the National Incident Management System.

In the event of an FAD outbreak, the three key response goals are to: *(1) detect, control, and contain the FAD in animals as quickly as possible; (2) eradicate the FAD using strategies that seek to stabilize animal agriculture, the food supply, the economy, and protect public health; and (3) provide science- and risk-based approaches and systems to facilitate continuity of business for non-infected animals and non-contaminated animal products.*

FAD PReP DOCUMENTS AND MATERIALS

FAD PReP is not just one, standalone FAD plan. Instead, it is a comprehensive U.S. preparedness and response strategy for FAD threats. This strategy is provided and explained in a series of different types of integrated documents, as illustrated and described below.

FAD PReP Suite of Documents and Materials

Note: APHIS=Animal and Plant Health Inspection Service, NAHEMS = National Animal Health Emergency Management System, SOP = standard operating procedures.

Strategic Plans—Concept of Operations

- *APHIS Framework for Foreign Animal Disease Preparedness and Response:* This document provides an overall concept of operations for FAD preparedness and response for APHIS, explaining the framework of existing approaches, systems, and relationships.
- *National Center for Animal Health Emergency Management (NCAHEM) Stakeholder Coordination and Collaboration Plan:* This plan describes NCAHEM strategy for enhancing stakeholder collaboration and identifies key stakeholders.
- *NCAHEM Incident Coordination Group Plan:* This document explains how APHIS headquarters will organize in the event of an animal health emergency.

NAHEMS Guidelines

- These documents describe many of the critical preparedness and response activities, and can be considered as a competent veterinary authority for responders, planners, and policy-makers.

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Industry Manuals

- These manuals describe the complexity of industry to emergency planners and responders and provide industry a window into emergency response.

Disease Response Plans

- Response plans are intended to provide disease-specific information about response strategies. These documents offer guidance to all stakeholders on capabilities and critical activities that would be required to respond to an FAD outbreak.

Critical Activity Standard Operating Procedures (SOPs)

- For planners and responders, these SOPs provide details for conducting 23 critical activities such as disposal, depopulation, cleaning and disinfection, and biosecurity that are essential to effective preparedness and response to an FAD outbreak. These SOPs provide operational details that are not discussed in depth in strategic documents or disease-specific response plans.

Continuity of Business Plans (Developed by public-private-academic partnerships)

- *Secure Egg Supply (SES) Plan:* The SES Plan uses proactive risk assessments, surveillance, biosecurity, and other requirements to facilitate the market continuity and movement of eggs and egg products during an HPAI outbreak.
- *Secure Milk Supply (SMS) Plan:* Currently under development, the SMS plan will help facilitate market continuity for milk and milk products during an FMD outbreak.

Outbreak Response Tools

- Case definitions, appraisal and compensation guidelines and formulas, and specific surveillance guidance are examples of important outbreak response tools.

State/Tribal Planning

- State and Tribal planning is essential for an effective FAD response. These plans are tailored to the particular requirements and environments of the State or Tribal area, taking into account animal populations, industry, and population needs.

Industry, Academic, and Extension Planning

- Industry, academia, and extension stakeholder planning is critical and essential: emergency management is not just a Federal or State activity.

APHIS Emergency Management

- APHIS directives and Veterinary Services Memorandums provide critical emergency management policy. APHIS Emergency Management documents provide guidance on topics ranging from emergency mobilization, to the steps in investigating a potential FAD, to protecting personnel from highly pathogenic avian influenza.

These documents are available on the FAD PReP collaboration website: *https://fadprep.lmi.org*. For those who have access to the APHIS intranet, these documents are available on the internal APHIS FAD PReP website: *http://inside.aphis.usda.gov/vs/em/fadprep.shtml*

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The information provided here is meant to be used as a preparedness resource rather than a comprehensive document. Several key APHIS documents complement this "FAD PReP Swine Industry Manual" and provide further details when necessary. This document references the following APHIS documents:

- APHIS Framework for Foreign Animal Disease Preparedness and Response Plan

- FAD PReP/NAHEMS Guidelines:
  - Appraisal and Compensation (2011)
  - Biosecurity (2011)
  - Cleaning and Disinfection (2011)
  - Disposal (2011)
  - Surveillance, Epidemiology, and Traceability (2011)
  - Personal Protective Equipment (2011)
  - Mass Depopulation and Euthanasia (2011)
  - Vaccination for Contagious Diseases (2011) with Appendix A: FMD Considerations and Strategies (2011)
  - Wildlife Management and Vector Control (2011)

- FAD PReP Standard Operating Procedures (SOP):
  - Appraisal and Compensation (2011)
  - Biosecurity (2011)
  - Cleaning and Disinfection (2011)
  - Disposal (2011)
  - Surveillance, Epidemiology, and Traceability (2011)
  - Personal Protective Equipment (2011)
  - Mass Depopulation and Euthanasia (2011)
  - Vaccination for Contagious Diseases (2011) with Appendix A: FMD Considerations and Strategies (2011)
  - Wildlife Management and Vector Control (2011)

- FMD Response Plan: The Red Book, USDA-APHIS

- VS Memo 580.4 Procedures for Investigating a Foreign Animal Disease/Emerging Disease Incident (FAD/EDI) October 2008

These documents are available on the FAD PReP collaboration website at: *https://fadprep.lmi.org*. Username and password can be requested.

Additional information can also be obtained from:
- Pork Industry Handbook (On CD and available from Purdue University Extension)
- Pork Quality Assurance Guidelines, National Pork Board
- Transport Quality Assurance manual, National Pork Board (*http://www.pork.org/Producers/docs/TQA_08.pdf*)

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Purpose

This industry manual provides the reader with a broad overview of U.S. swine production methods and the relationship to procedures that may be established in the event of a swine-susceptible, highly contagious, foreign animal disease (FAD) outbreak. A highly contagious FAD outbreak could severely impact industries with susceptible livestock as well as allied industries and service providers. A quick, effective and well-coordinated response can minimize harm to the swine industry. Wide dissemination of this information is encouraged to establish open communication between regulators and producers with the goal of reducing the probability that animals or their caretakers become infected with a highly contagious FAD.

Intent

Local, state, and national level officials involved in developing policy and/or managing a highly contagious FAD outbreak should read this manual to understand the normal business operationsof the swine industry in order to effectively aid in disease containment or eradication. Veterinarians and animal health technicians who are members of the USDA-APHIS National Animal Health Emergency Response Corps (NAHERC) or their state or county veterinary response teams carrying out disease control efforts on swine operations should familiarize themselves with this manual. Livestock producers and any support personnel interacting with swine operations need to be aware of the procedures as described here that may be implemented in a highly contagious FAD event and the biosecurity procedures they would be expected to follow to reduce the chance of becoming infected.

Scope

This manual is divided into two parts plus acronyms, glossary and appendices.

- Part I provides an overview of U.S. swine production including life stages and animal husbandry, facility types, and animal movement.
- Part II describes the response to prevent or mitigate the spread of a highly contagious foreign animal disease, such as foot and mouth disease (FMD) or classical swine fever (CSF) including designated zones and areas, disease specific biosecurity measures, and providing animal care.
- Acronyms and glossary explain the terms used in the swine industry and in emergency response.
- Disease specific biosecurity measures are found in the appendices: FMD prevention practices, CSF prevention practices.

Learning Objectives

Upon reviewing this manual, readers will be able to:

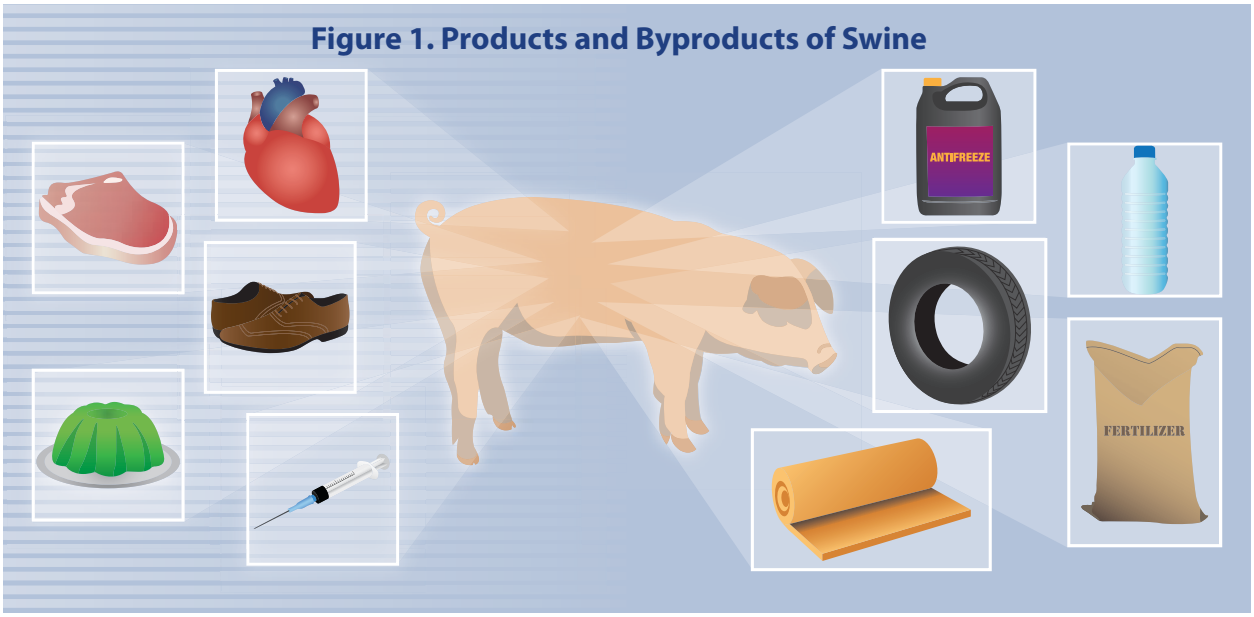
1. Describe the various types of housing for swine;
2. Explain the animal care needs of piglets, growing pigs and adult swine;
3. Illustrate FAD response zones and areas used in quarantine and movement control efforts and explain classifications of premises in a response;
4. Implement biosecurity measures and surveillance activities on a swine farm to prevent highly contagious foreign animal disease entry and monitor its presence/absence;
5. Communicate with supervisory personnel and/or the regulatory officials regarding swine farm status (animal needs, biosecurity measures in place, test results, tracebacks/traceouts, facility flow); and
6. Identify biosecurity deficiencies that increase a premises chances of becoming infected/transmitting the highly contagious FAD.

PART I. UNITED STATES SWINE PRODUCTION

1. SCOPE OF THE SWINE INDUSTRY

Over the last 10 to 20 years, the U.S. pork industry has evolved to include larger-sized, technology dependent, highly integrated farms that produce a safe food source for the United States and the world. Pork was regarded as

the most widely eaten meat in the world in 2005. Along with meat, other important products from swine are insulin, valves for human heart surgery, suede, and gelatin for food uses. Pigs also generate important byproducts that can be used in manufacturing insulation, rubber, antifreeze, plastics, and fertilizer (Figure 1).

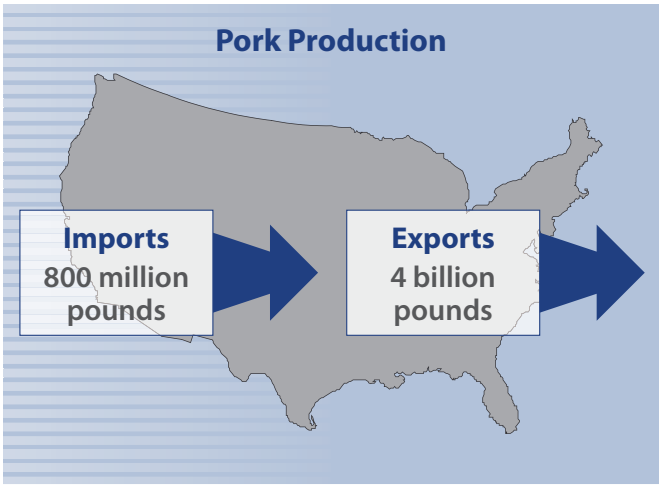


Animal health is paramount to swine production and modern operations/production systems often have the necessary biosecurity measures in place to aid in preventing the entry or containing the spread of disease. Regulatory authorities managing a highly contagious FAD outbreak are encouraged to work individually with managers of these production systems and utilize their knowledge and skills in the areas of swine transportation and biosecurity (both within and among herds).

Many swine production systems have also developed control and mitigation strategies in the event of a highly contagious FAD incursion. Regulatory authorities and swine producers are encouraged to work together to evaluate these plans and understand their merits prior to an animal health event. A customized interaction with key management personnel will help minimize the extra time, effort, and cost that will accompany a "one-size fits all" approach to containing and ultimately eradicating the outbreak.

1.1 Swine Numbers

As of December 2009, the U.S. inventory of hogs was 65.3 million head on approximately 71,450 operations. Inventory continues to slightly increase while the number of hog operations decreases. This inventory equates to 32.7 billion pounds of pork production with nearly 800 million pounds in imports and 4 billion pounds in exports. For pounds of production and value of production per year, pork ranks third among livestock in the United States, behind cattle and broilers. The swine industry also contributes substantially to the economy. USDA estimated in 2009 that $14.4 billion dollars of farm income was generated through the sale of swine.



Sources:

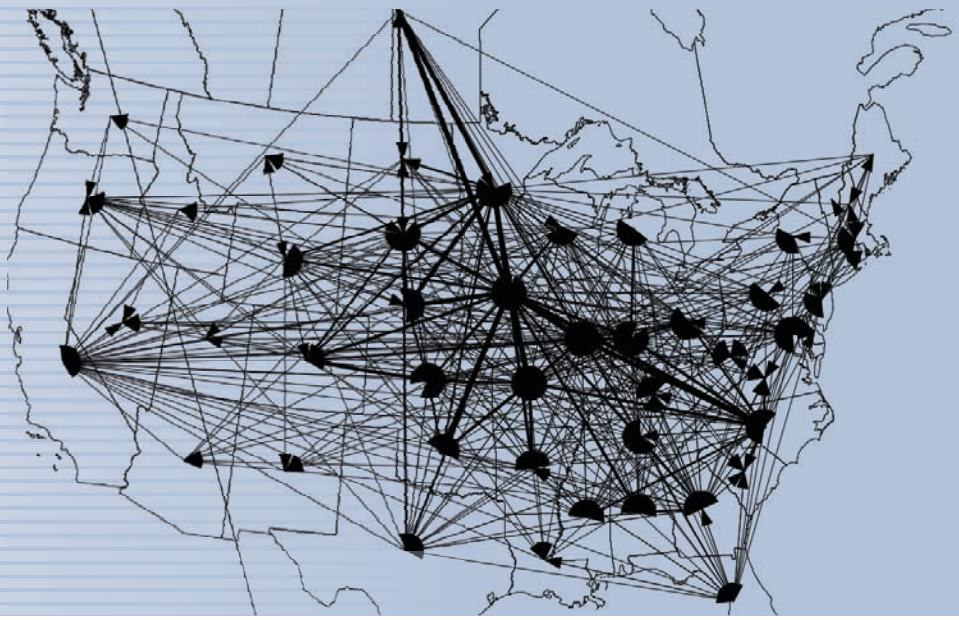
- *USDA NASS. Meat AnimalsProduction, Disposition and Income 2009 Summary, April 2010, accessed March 6, 2011 at http://usda.mannlib.cornell.edu/usda/current/MeatAnimPr/MeatAnimPr-04-29-2010.pdf.*
- *Farms, Land in Farms, and Livestock Operations, 2010 Summary, February 2011, Accessed March 6, 2011 at http://usda.mannlib.cornell.edu/usda/current/FarmLandIn/FarmLandIn-02-11-2011_revision.pdf*

1.2 Animal Production Systems

1.2.1 Location and Movement

Swine production in the United States is generally concentrated in the upper Midwest (northern-most Corn Belt states), near abundant feed supplies and slaughtering facilities. Since 1990 significant growth of swine production has occurred in North Carolina, Oklahoma, Colorado, Utah, and Texas. Modern production involves the routine interstate shipment of pigs as the various stages of production occur in different states as illustrated in Figure 2. There is very little, if any, excess capacity built into the production system necessitating the uninterrupted movement of animals. Any stop movement affecting flow for more than a few days could result in overcrowding conditions and disruptions of animal health schemes leading to animal welfare and animal health issues. Transport disruptions of moderate duration may necessitate the euthanasia of pigs, abortions of pregnant sows or the cessation of breeding programs.

Figure 2. Potential Movement of Swine



The production of pigs is generally categorized into four production phases (breeding/gestation, farrowing, nursery, grow/finish) and each is unique in its housing, feeding, and animal care needs. Traditionally, all stages of production took place at a single location. To capture economies of scale, capitalize on specialized labor, and for biosecurity purposes, modern swine farms often separate some of these phases into physically distinct sites that may be many miles, even states apart. This separation of phases generates a need for the interstate movement of pigs. By definition in the Code of Federal Regulations, a swine production system is an "enterprise that consists of multiple sites of production; i.e., sow herds, nursery herds, and growing or finishing herds, but not including slaughter plants or livestock markets, that are connected by ownership or contractual relationships, between which swine move while remaining under the control of a single owner or a group of contractually connected owners".

Source:

- *Code of Federal Regulations, Title 9, Chapter I, Part 71.1 Definitions*

In order to connect these production phases over state boundaries, inshipments have become an integral part of the industry. Inshipments are the total number of animals moved into a state for feeding or breeding purposes, excluding animals brought in for immediate slaughter. In 2009, hog inshipments totaled 41 million head, making it the largest sector of livestock inshipments in the United States.

Inshipments

Total number of animals moved into a state for feeding or breeding (excludes immediate slaughter)

In 2001, North Carolina shipped between three and four million pigs to the Midwestern states for feeding. Iowa received over half of U.S. swine inshipments in 2009, while Minnesota, Indiana, Missouri, and Illinois each imported more than 1 million head as shown in Table 1.

Table 1. Total Number of Inshipments by State in 2009

Rank	*State*	*Total # of Inshipments*
1	Iowa	23,300,000
2	Minnesota	6,080,000
3	Indiana	2,862,000
4	Missouri	1,975,000
5	Illinois	1,034,100

It is estimated that 71 percent of pigs in the U.S. enter the growing/finishing phase at a different location from which they were born. Many of these movements do not require interstate or intrastate health certificates as pig ownership is maintained and pigs stay within a state. Half of the annual pig crop is born on farms in only four states (NC, IA, MN, and IL). These same four states also account for 62 percent of the Nation's market hog inventory and about 56 percent of the slaughter capacity. In Iowa, 1.7 million pigs move into the state every month: approximately 67,000 pigs every day. Therefore, the efficient and timely movement of pigs is important for animal welfare and continuation of business for individual operations and the swine industry.

Sources:

- *USDA NASS. Meat Animals Production, Disposition and Income 2009 Summary, April 2010, accessed March 6, 2011 at http://usda.mannlib.cornell.edu/usda/current/MeatAnimPr/MeatAnimPr-04-29-2010.pdf.*
- *Shields DA, Mathews KH, Interstate Livestock Movements, Electronic Outlook Report LDP-M-108-01, June 2003, Economic Research Service, United States Department of Agriculture.*

With these animal movements, swine operations can introduce pigs in a "continuous" or "all-in-all-out" flow. In continuous flow operations, a steady flow of pigs enters the stage with a concurrent flow of pigs leaving the stage. The rooms or buildings will have pigs of different ages and the facility is never completely empty. All-in-all-out (AI/AO) production involves completely filling a room, building, or site with animals and then completely emptying it to allow for cleaning and disinfecting before the next group of pigs arrives. This process breaks the disease cycle by preventing the mixing of pigs of different ages and different immunological and disease statuses.

From the grow/finish operations, pigs are moved to slaughter facilities when they weigh between 240-280 pounds, at approximately 5 to 6 months of age. In 2008, 113 million market hogs were slaughtered; 7 million came to the U.S. from Canada. Additionally, sows that are no longer used for breeding purposes are slaughtered, with numbers reaching 3.37 million head in 2008; 561,000 came from Canada. Assuming slaughter facilities run five days a week, approximately 625,000 pigs can be in transport on any given day in the United States. Movement is critical to each stage of the swine industry to maintain animal welfare and domestic markets.

Sources:

- *Steve Meyer, Paragon Economics, personal communication*
- *John Lawrence, Shane Ellis, December 2008 Hog and Pig Report Down 2 Percent, Iowa State University, accessed at: http://www.econ.iastate.edu/outreach/agriculture/periodicals/ifo/info/Dec%2008%20HP.pdf*

1.2.2 Routine Deliveries

Swine operations rely upon routine deliveries to farm sites from a variety of support industries. In addition to the transportation of live animals on and off the premises, deliveries of items such as feed, supplies (semen, pharmaceuticals), and equipment generate quite a bit of traffic. This results in a large number of vehicles and people moving on and off an operation every week in order to provide routine animal care.

In a disease outbreak situation, deliveries of certain essential items must be made in order to continue to meet the needs of the animals and employees that work with them. Table 2 lists the types of vehicle movements and frequency that might be expected on a swine operation in a given month. This information can be evaluated as to essential and non-essential personnel in the event of an outbreak.

Table 2. Type and Frequency of Vehicle/Personnel Movement onto Swine Operations

Daily	*Weekly (Visits per Week)*	*Monthly*	*Seasonal/Variable*
Employees	Feed delivery (2)	Receive replacement gift	Propane (every two weeks in winter)
	Load out weaned pigs (1-2)	Load out cull animals	Repair personnel
	Semen (2)	Utility meter reader	Tractor (agricultural)
	Veterinarian	Veterinarian	Manure removal
	Rendering (1-3)	Garbage pick up	
		Sales people	

In a study by Bates, et al., swine operations in California with >2,000 pigs had a relatively low number of animal shipments, referred to as direct contacts (0.2 per month). However, indirect contacts (service personnel, veterinarians, neighbors, commodity truck, employees) were very high (807.3 per month).

Source:

- *Bates, TW, Thurmond MC, Carpenter TE. Direct and indirect contact rates among beef, dairy, goat, sheep, and swine herds in three California counties, with reference to control of potential foot-and-mouth disease transmission. Am J Vet Res 2001, 62:1121-1129.*

1.2.3 Diverse Workforce

The workforce on United States swine operations can be very diverse. Cultural and language differences may present a barrier to communication and hinder response efforts in the event of a highly contagious foreign animal disease outbreak. Some workers may also be skeptical and afraid of government officials and could complicate containment efforts if they leave the operation area. As a regulatory official or someone assigned to visit an operation, effective communication with all involved will be necessary to conduct the disease investigation or to carry out eradication efforts. Many integrated swine production systems utilize veterinarians to supervise the animal health staff. Their experience with and understanding of the workforce is an important human resource for performing animal health response activities. Establishing relationships prior to an outbreak will help build trust, but timing may not always allow for this. Understanding some general concepts about the primary workforce will help establish a successful working relationship.

Authority figures may be viewed very differently by certain workers, so identifying who is regarded as the primary facility manager is important. Working with that person to communicate tasks to the other employees will help with acceptance and with coordination of the work. A translator can be very beneficial to overcome language barriers. Not all translators, however, have the necessary background in animal health emergencies and livestock production. Pre-qualifying translators before they are needed can help to ensure that they have the requisite knowledge. If language barriers still exist, demonstrating concepts or tasks can be helpful. It is also important to remember that not all workers can read in their native language. Having a variety of educational tools, the more visual the better, can be an effective way of explaining what is needed. Being aware and respectful of ethnic and cultural differences is critical for effective communication so that disease prevention practices can be implemented.

Depending on the highly contagious FAD, strategies to control its spread could include mass depopulation of infected animals and subsequent disposal on farm or in the community. Farm workers, owners, and outside labor may be directly involved in this process. Workers and owners may not be prepared to deal with the loss of animals that have been a part of their lives and a source of livelihood. Returning to an empty farm in subsequent days/weeks may also be another psychologically upsetting situation. Providing a support network for owners and their workers, again in an ethnically and culturally acceptable format, needs to be part of preparedness plans at the local level.

1.2.4 Business Continuity

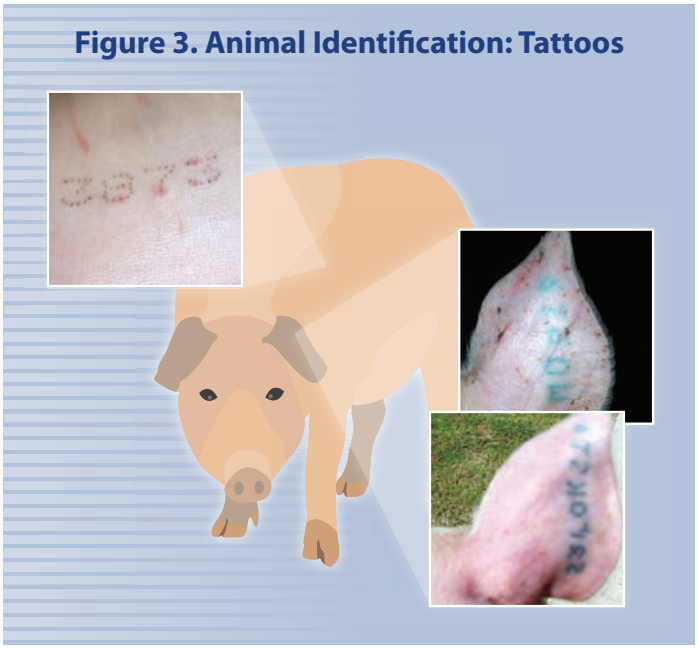
The swine industry relies on animal and resource flow – animals to/from the facility, feed delivery, supply delivery, animals to slaughter – as part of their normal business structure. In the event a highly contagious FAD is diagnosed in the U.S., stop movement orders may be implemented until an investigation can identify the infected, suspect and at-risk premises. This may involve a local community, an entire state or a large region of the country. During this time, swine facilities will need to make arrangements to ensure their animals receive the necessary supplies to ensure they are fed, watered, healthy, and comfortable. If traffic flow is disrupted, this will be difficult and plans for dealing with this situation should be discussed prior to an event.

In order for business to continue during a disease outbreak response, uninfected swine operations in the disease Control Area (see Section 6. Designation of Zones, Areas and Premises) will need to cooperate with regulatory officials on many levels. The first critical control point for the business is biosecurity. The facility needs to document they are not 'at-risk' of exposure to the highly contagious FAD. Records of animal movement, people movement, and supplies received are some examples of what will be needed to verify exposure status. Once that is complete, surveillance will be implemented to monitor the health of the animals through visual exams and diagnostic testing. For animals to be moved, demonstrating negligible risk for the spread of the disease of concern is vital. This could be done through risk assessments or surveillance and diagnostic testing, if available. The final step in the process is permitting. This could involve the state officials for the farm of origin if the animals are to be moved to another in-state facility. If it is an interstate movement, officials from the origin and destination states, along with all states in between will need to be in agreement on the movement. This is a difficult decision and one that will be considered fully; information provided by the swine operation will aid in this effort. Business must continue to ensure the welfare of the animals, the livelihood of the producers caring for them, and product availability to consumers, while ensuring that disease transmission will not occur. Record keeping, transparency, and cooperation on all levels will be vital.

1.3 Swine Disease Traceability

For swine moving in interstate commerce and to slaughter, animal identification has been mandatory since 1988. Ear tags and back tags are used for cull sows and boars entering the harvest chain. Slap tattoos, consisting of at least 4-characters applied by a tattoo hammer to the pig's shoulder area, are used for market pigs at the first point of concentration (usually the slaughter plant) as illustrated in Figure 3. Feeder pigs moving as individuals or as commingled groups are often identified with farm specific tattoos applied to the pig's ears shortly after birth.

Figure 3. Animal Identification: Tattoos



For most grow-finish pigs, sows, and boars, unique individual animal identification is not required for movements within a state. Most nursery and grow-finish pigs can be identified as a group or lot, thus negating the need for individual identification. When a group is assembled, the group gets a unique number, but individual pigs are not identified. The group is kept together and not commingled with other pigs throughout the growing/finishing period and through the slaughter process. When pigs leave the group for whatever reason, they are individually identified.

Ear notches are a form of on-farm animal identification used for animal health management and husbandry purposes. When piglets are born, their ears may be notched (using a special instrument to remove a small "V" shape from the edge of the ear) to indicate which sow they were born to (litter mark in the right ear) and their number in the litter (individual mark in the left ear). To review all official forms of identification, see the Code of Federal Regulations, Title 9, Chapter I, Part 71.19 Identification of swine in interstate commerce.

For more information about the USDA's cooperative approach with States and Tribal Nations animal disease traceability, visit the USDA Animal Disease Traceability website: *http://www.aphis.usda.gov/traceability/*

Traceability relies on record keeping regarding inventory and animal movement which can vary by operation and range from hand written paper documents to computerized software programs. Swine disease traceability plays a key role in disease surveillance, control, eradication, and continuity of business. As defined by the World Organization for Animal Health (Office International des Epizooties), animal traceability "means the ability to follow an animal or group of animals during all stages of life". During an animal health event, it is necessary to locate the source of the animal(s) in question, the other premises on which the animal(s) resided, other animals that were exposed, and animals at risk of exposure. If this information is not readily available, response time is prolonged. Producers are encouraged to document animal movements using on-farm records to expedite disease investigations.

Sources:

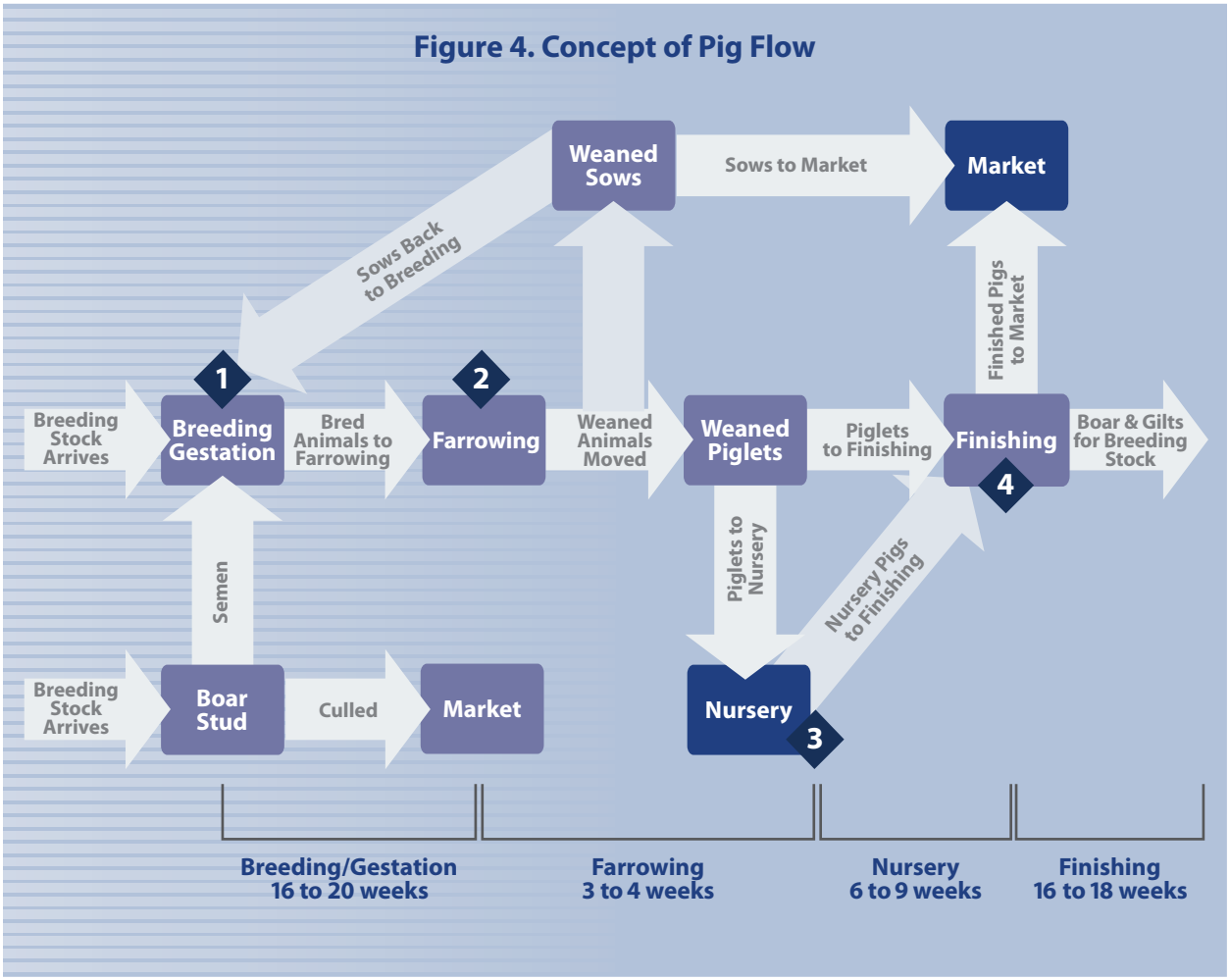
- *Draft Swine Program Standards, Pork Industry Working Group, June 22, 2006*
- *OIE Terrestrial Animal Health Code 2009, Glossary, accessed February 5, 2010 at: http://www.oie.int/eng/normes/mcode/en_glossaire.htm#terme_systeme_d_identification_des_animaux*

2. LIFE STAGES AND ANIMAL HUSBANDRY NEEDS

2.1 Concept of Pig Flow

Swine production is generally categorized into four production phases as illustrated in Figure 4: Breeding/gestation (1), Farrowing (2), Nursery (3), and Finishing (4). Pig flow ultimately begins with breeding and gestation which includes gilts, brought in for their initial breeding, and sows. Semen is brought in from boar studs to inseminate the gilts/sows. In some facilities, live boars are still kept as part of the breeding herd and used as semen donors or for natural mating. The majority of the industry acquires semen from an off-site boar stud.

Figure 4. Concept of Pig Flow



Just prior to farrowing, pregnant animals are moved to individual pens in the farrowing barn which is still part of the breeding and gestation facility. Farrowing and lactation occur in the same facilities until the piglets are weaned. Weaned piglets are moved to either a nursery facility or a wean-to-finish building. In either case, both types of facilities are often on separate sites from the farrowing facility and may require interstate transport of the pigs. Following weaning, sows either return to the breeding facility or are removed from the herd and sent to market.

Nursery pigs are eventually sent to a finishing building where they are raised until they reach market weight. Most finishing facilities are on a separate site from the nursery which may again require the interstate transport of the pigs. At the time pigs reach market weight, gilts are selected to become replacements and will be housed in a breeding/gestation facility. The remainder of the market weight pigs will then be sent to slaughter. Transport to slaughter often requires interstate movement of the pigs.

Each production phase has facilities to house a certain number and size of animals. A producer plans the number of gilts/sows to breed, and knows how many sows will farrow and the approximate number of piglets born in a given time frame. The breeding and farrowing process is done with relative accuracy so that the next production phase receives the right number of animals. A change in pig flow in one area can affect multiple facilities, producers, and how many animals reach market.

Breeding Facility

Farrowing Crate

Finishing Facility

2.2 Breeding Adults: Sows, Boars

2.2.1 Sows

Breeding is an essential phase of swine production. There is no defined 'breeding season' in the domestic pig. Gilts reach puberty around 6 to 8 months of age and post-pubertal females generally exhibit estrus every 21 days. After weaning, sows usually return to estrus within 5 to 7 days. Intensive management systems generally set annual goals of approximately 2.5 litters per sow. Many elements comprise the breeding process such as genetics, timing, and natural or artificial mating.

2.2.2 Genetics

Genetic selection varies among producers but important criteria are reproductive traits (e.g., number of pigs born, number of pigs weaned, litter weights, etc.) and performance traits (e.g., growth rate, feed efficiency, backfat, etc.), and the heritability of these traits. Most, if not all, commercial production in the U.S. utilizes a crossbred female bred to a purebred boar.

2.2.3 Timing

The timing of mating is critical for optimal fertilization, to reduce the incidence of nonproductive sows, and to maintain production/movement schedules. Sows and gilts are often induced to farrow at a specific time to facilitate a narrow range between piglet ages within a farrowing group.

2.2.4 Natural Mating

There are two types of natural mating in swine production – pen mating and hand mating. Pen mating, where one or more boars is placed with a group of sows, is frequently used in pasture systems. This approach requires less labor for the producer but provides little information about when, or if, a sow is bred, making it difficult to predict farrowing times.

Hand mating involves placing one boar with one sow and observing to make sure mating occurs. This is commonly used in controlled-environment facilities as well as outdoor facilities that have a boar on site. This method requires more labor and time but provides very accurate information upon which to base future management decisions.

2.2.5 Semen Handling and Artificial Insemination

Artificial insemination (AI) does not require a boar on site; rather semen is obtained from a boar stud. For biosecurity reasons, semen is either delivered to the farm by a private courier or a farm employee picks it up at a designated collection site. Semen is often transported interstate from boar stud to breeding/gestation facility. The only adult male pigs on the breeding/gestation farm are a minimal number of sterile males (vasectomized or epididymized) used to stimulate the females and verify pregnancy in bred females. Semen collection is described under 3.1.7: Boar Stud.

AI requires the highest level of management expertise and labor of all the mating systems. Insemination of the sow or gilt begins by stimulating the animal with adjacent boars. Once the sow/gilt is stimulated, an insemination rod is inserted into the cervix and semen is deposited. This mating process takes about 2 to 5 minutes per female.

AI has become the predominate method of breeding swine on U.S. farms of all sizes, especially in controlled-environment facilities where breeding efficiency is a major factor affecting production. This method enables more rapid genetic advancement than natural options while minimizing the risk of disease transmission.

2.2.6 Boars

Boars reach puberty around 5½ - 6 months of age. Boars of high genetic merit are used for natural mating and in semen collection facilities for use in AI. Semen is collected from boars 2 or 3 times a week to maximize the volume and sperm concentration obtained from each boar.

2.2.7 Quality Control

The sperm concentration of an individual boar's ejaculate will be determined using specialized equipment (calibrated spectrophotometer). If the semen passes internal quality standards, it is then mixed with a semen extender that provides nutrients and antibiotics to extend the life of the semen. Extended semen can then be stored at 63°F (17°C) for a maximum of 5 -7 days. The goal is to use the semen as fresh as possible to maximize conception rates and litter size.

2.2.8 Genetics

Most commercial boar studs will mix semen from several boars in a single batch. Knowing the exact sire of a litter is not a priority since genetic advancements are made by sire "lines" rather than a particular individual sire. A typical boar may produce thousands of doses of semen per year. Therefore, semen quality from a single sire influences a large number of offspring.

2.2.9 Disease Testing

At a boar stud, a subset of boars is usually monitored on a weekly basis to confirm virus-negative status for porcine reproductive and respiratory syndrome (PRRS). Some boar studs will also test each batch of semen for PRRS. A single boar stud can supply all the semen needs for thousands of sows in several dozen different facilities. Detailed records are kept at the boar stud for each batch of semen produced, including boar identification so that a trace back could be implemented if needed. This could be helpful information in the event of a highly contagious FAD spread via semen.

2.3 Gestation

Gestation ranges from 112 to 116 days depending on the breed, litter size, and season. It is often stated as 3 months, 3 weeks, and 3 days (114 days). It is important that animal movement and stress are kept to a minimum in the first 5-30 days of pregnancy to prevent early embryonic death.

2.4 Farrowing

Farrowing is the term used to describe the production phase between birth and weaning of the piglets. After birth, several procedures may be performed on piglets to improve their survival chances and/or to prevent future problems. These procedures include disinfecting navels to prevent infections, clipping needle teeth to prevent injuries to other pigs or the sow, giving supplemental iron injections to improve the blood's oxygen carrying capacity, docking tails to prevent future injury, and castrating boars to prevent off-flavored meat (boar taint). Vaccinations may coincide with some of these procedures, but will vary by operation. Antibiotics may also be given for the more invasive procedures, but again will vary. Weaning usually occurs at 18-21 days of age. Facilities that are less intensively managed (i.e., non-confinement) will often wean later than 21 days of age.

Table 3. Common Procedures Performed on Piglets by Day of Age

Common Procedures	*Days of Age*
Disinfecting navel	1 (Birth)
Clipping needle teeth	2 - 5
Iron injections	2 - 5
Docking tails	2 - 5
Castration	2 - 5

2.5 Nursery

After weaning, pigs can be placed in a nursery facility separate from the farrowing facility. This environment accommodates the young pigs' needs and allows them to acclimate to dry feed. Group sizes in nurseries vary depending upon the facility setup. Pigs remain in the nursery until they are 8 to 10 weeks of age (45-75 pounds).

2.6 Grow-Finish

Growing and finishing were once thought of as distinct phases in the pork production process. The difference in terminology dates back to the time when growing pigs (up to 120 pounds) were housed separately from finishing pigs (120 pounds to market weight). Today, pigs are seldom moved at 120 pounds and the "grow-finish" phase is actually comprised of two to nine phases in which unique diets are fed to closely match the pigs' nutritional requirements. In addition, barrows and gilts are frequently fed separately during the grow-finish phase because their nutritional requirements are significantly different.

In the United States, hogs are generally fed ad libitum which facilitates high growth rates. Market weight, averaging 240-280 pounds, is generally achieved by 5 to 6 months of age. At this time, barrows and gilts not kept as breeding herd replacements are sent to slaughter.

2.7 Production Records

The quality and extent of records kept on swine farms varies. As a general rule, financial and production records are maintained separately, although software packages that integrate these functions are becoming more widely available. This section briefly describes the management information recorded on most swine farms. Several computerized production record systems are available.

Common data recorded in the Breeding/Gestation and Farrowing production stages includes:

- Mating information (dates, boar ID);
- Pregnancy testing (date, result);
- Farrowing date;

- Feed intake during lactation;
- Litter information (number born alive/dead, neonatal mortality); and
- Weaning information (date, number, weight).

The Nursery and Grow-Finish production stages often have less intensive record keeping systems. The "continuous-flow" nature of these production stages creates challenges for maintaining concise growth and performance data. An increasing number of farms have chosen to create "batches" or "groups" of pigs (identified by pen, room, or building) that provides an opportunity for thorough collection of data. In these situations, a group is established by an "all-in-all-out" procedure accounting for all inputs allocated to the group.

Data collected in most Nursery and Grow-Finish stages includes:
- Number of pigs in a group;
- Starting weight;
- Mortality;
- Sale weight;
- Amount of feed delivered; and
- Individual animal treatment.

3. SWINE FACILITIES

Whether pigs are raised in pastures or in totally enclosed barns, systems approaches are becoming the norm in pork production. Repeatable management methods and specialization characterize the modern pork producer regardless of the type of facilities used. The facility type is often based on capital investment, labor requirement, and management expertise. Animal and worker welfare are primary concerns to producers. The key to good swine care depends more on the producer's ability to properly manage housing than it does on the specific type of housing provided.

3.1 Controlled Environment/Confinement

Controlled-environment buildings require much higher initial investment but lower labor per unit of output. These facilities make handling hogs easier, provide for more direct observation of animals, allow greater control of the production process, protect animals and workers from the heat, cold, rain, and snow, and usually result in more efficient growth.

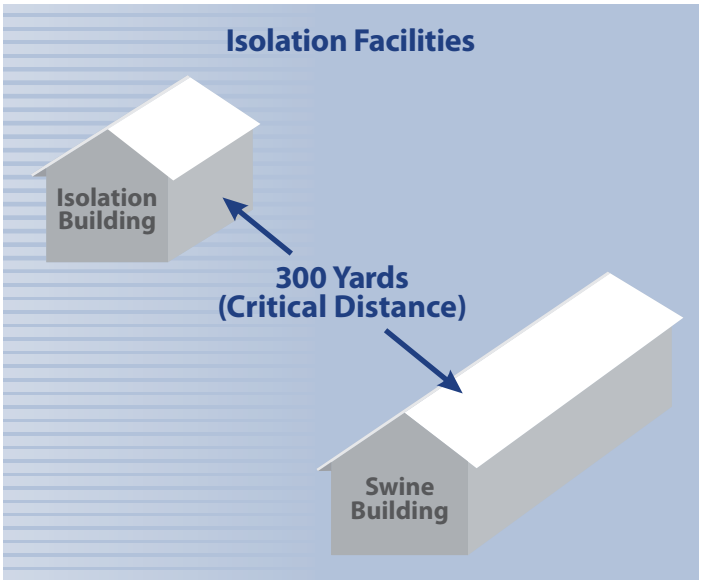
A controlled environment uses specialized computer controllers which allow for the regulation of temperature and humidity. These computer controllers can be very simple or quite sophisticated. Electric fans provide ventilation and heaters provide warmth in the winter season. Many controlled environment buildings have flexible curtains on the side walls that can be automatically opened and closed to allow circulation of fresh air. Some may also have cool cell systems which are evaporative coolers through which intake air passes, lowering the temperature of the air entering the facility. A few high biosecurity facilities (e.g., genetic suppliers) are experimentally installing virus particle air filtering systems for all intake air.

Confinement Building

Manure Pit Fans and Side Curtains

3.1.1 Isolation and Acclimation

The most likely route of disease entry into a swine production system is the introduction of an infectious agent via infected carrier pigs. Direct contact between infected and susceptible pigs is the most efficient way to spread disease. Isolation of incoming stock provides a safeguard against such transmission. Isolation gives the producer the opportunity to test animals for certain pathogens and observe them for clinical signs of disease before herd introduction.



The isolation facility should be located as far from other swine as possible (300 yards is considered the critical distance to achieve), follow "all-in-all-out" procedures, and be thoroughly cleaned and disinfected between groups. Pigs should remain in isolation for at least 30-60 days. In most cases, isolation is only practiced for new additions to Breeding-Gestation-Farrowing (BGF) farms and Boar Studs.

Acclimation occurs in the same facility as isolation. The acclimation period begins shortly after arrival and overlaps with isolation. Many times this phase is referred to as the isolation/acclimation period. The purpose of acclimation is to provide an opportunity for the new animals to booster or develop an immune response to organisms that may be unique/specific to that particular farm. This can be achieved through routine vaccination, with either commercial products or farm specific vaccines (autogenous), or natural exposure. The natural exposure process may involve mixing cull animals with new replacements, introducing placentas or feces from the farrowing house, or other means.

3.1.2 Breeding and Gestation

After the pigs are weaned, sows are brought into the breeding room and are usually bred within 7 days. This area can have either feeding stalls with sows grouped together or individual confinement stalls. Boar pens are placed adjacent to the sows to help detect heat (estrus). After breeding, sows are moved to the partially slotted floor gestation pens. Gestation pens can be individual stalls or group housing in pens. Feeding may be done on the floor or in a trough, by hand or with a mechanical feeder. A common feed and water trough may also be used.

3.1.3 Farrowing/Nursing

Farrowing houses contain individual farrowing pens or stalls designed to provide a comfortable place for the sow to farrow and to protect the newborn pigs. These facilities reduce the risk newborn pigs will be crushed by sows (by accidentally laying on them) and prevents injury to pigs or workers if the sow's protective mothering instincts cause aggressive behavior. Heat lamps and mats are commonly used to keep the newborn piglets warm without altering the ambient temperature for the sow. Farrowing rooms are thoroughly cleaned and disinfected before a new group of sows enter.

3.1.4 Nursery

Swine nurseries provide pen housing with multiple pens in one room and often multiple rooms in one barn. The number of animals in one pen varies, but is often 20 to 30 head. Biosecurity between rooms can be extensive to limit disease spread between animal groups. Most housing for newly-weaned pigs has slotted floors to allow the pigs' waste to fall through into a holding pit or gutter. This keeps floors drier and cleaner to keep pigs comfortable and growing. The slotted floors are made of easily cleaned, easily maintained, and comfortable materials.

Breeding & Gestation

Farrowing

Nursery Flooring

3.1.5 Grow-Finish

Grow-finish housing is pen housing with multiple pens in one room and usually more than one room in a barn. Biosecurity between rooms is often minimal but biosecurity between barns may be more extensive. Slotted floors are commonly used in grow-finish facilities to aid in manure removal and to keep the pigs in a cleaner environment. Group sizes vary in grow-finish facilities with pens commonly containing 30 to 50 animals. Pigs are usually in this phase for 17–20 weeks; entering as feeder pigs (45–55 pounds) and leaving as market weight pigs (240–280 pounds).

3.1.6 Wean-to-Finish

Wean-to-finish is a type of production system that combines the nursery and grow-finish stages into one production phase. Pigs are moved to a special finishing barn at weaning (16–23 days of age) and remain in this facility until they reach market weight. There are multiple pens per room and multiple rooms per barn. To accommodate the younger pigs, additional heating equipment may be used in the pens.

3.1.7 Boar Stud

A boar stud is a specific area or building used for holding boars and collecting semen for artificial insemination (AI). Boars are often housed in individual stalls. Boar studs may be housed within a Breeding-Gestation-Farrowing (BGF) barn with the semen produced subsequently used within that BGF, or a production system may have a stand-alone boar stud that produces semen for use at multiple BGF farms. There are also commercial boar studs that produce semen for retail sale to multiple customers. In most cases, the biosecurity programs used at boar studs are very strict because the use of AI creates the potential for rapid and extensive spread of any disease transmitted via semen.

Outdoor Rearing Systems

Farrowing Huts

Hoop Buildings

3.2 Outdoor Rearing Systems

Pasture or outdoor production systems generally require a lower capital investment, especially when marginal land can be used, but they usually generate lower productivity in terms of output per unit of land, labor, or feed. These systems also use more land and more labor per unit of output. Interest in outdoor or pasture facilities has increased in recent years as niche markets for meat from pasture-raised pigs have developed.

3.2.1 Farrowing Huts

Farrowing on pasture usually involves individual houses also known as farrowing huts. These house types range from A-frames without floors to larger houses with floors and areas to feed the animals. Huts are bedded with straw for nesting purposes and insulated to help with temperature regulation. To encourage the sow to nest in the hut rather than out in the open, only 10-15 farrowing huts should be placed on one acre of land. Self feeders are used for the sows and creep feeders are generally used for the piglets.

3.2.2 Shade Structures

Pigs are susceptible to heat stress, making shade structures necessary for the pigs welfare in outdoor systems. During warm weather months, shade structures protect pigs from the direct heat from the sun which could result in heat stress, slower growth, and lower conception rates.

3.2.3 Hoop Buildings

Hoop facilities can be used successfully for gestation and finishing pigs. Hoop buildings have wooden or concrete sidewalls 3-4 feet high upon which are mounted hoops that support covers made of specially treated fabric or plastic. The ends of the building are left open during the warmer seasons and may include penning outside of the structure. Straw or cornstalks are used for bedding over the dirt or concrete floors inside. Hoop buildings used for finishing pigs require slightly more space per head than controlled environment facilities.

3.3 Feeding

Feed is the major production input to the pork production process and can account for over 65 percent of all production expenses. A variety of feed ingredients are used to produce "balanced" diets for pigs at each stage of their lives. Corn, barley, milo (grain sorghum), oats, and, sometimes, wheat are used to provide dietary energy in the form of carbohydrates and fat. Oilseed meals (mainly soybean meal) are the major source of protein. Vitamins and minerals such as calcium and phosphorous are also included in balanced diets. The average whole-herd feed conversion ratio (pounds of feed required per pound of live weight produced) for the U.S. pork industry is about 3.6 to 3.8 (including feed fed to sows and boars) and is steadily improving (getting lower).

Creep Feeder

Pelleted Feed

Meal Feed

3.3.1 Delivery to Farm

Nearly all swine farms require some amount of feed or feed ingredient purchases from an outside vendor. Smaller farms often have their own feed mixing equipment and use home-grown crops (feed/grains such as corn, wheat, or barley) in combination with purchased feed supplements (protein sources, vitamins, and minerals) to create customized diets for their pigs. Other farms choose to purchase "complete feeds" that do not require further preparation on farm and can be fed directly to the pigs upon delivery from a vendor. Some large production systems construct large, centrally-located feed mills to deliver complete feeds to their farms. On large operations, feed deliveries can be a daily occurrence, due to the large amount of feed that may be consumed. Each system of feed manufacture has tradeoffs including biosecurity considerations, diet flexibility, degree of management and expertise required, and quality control. For many farms, any halt in feed deliveries will result in a welfare situation within days.

Delivery to Farm

3.3.2 On-Site Storage

Some producers have on-farm feed mills and mix feed from individual ingredients, which is then transported to feed bins next to the animal barns. Others use homegrown grain and, either a commercial protein supplement containing the needed protein, vitamins and minerals, or add a protein meal (soybean, canola, peas, etc.) and a premix that contains only vitamins and minerals. Many farms purchase "complete feeds" from commercial manufacturers. These diets require no further processing or mixing, but require storage on-site.

On-Site Storage

3.3.3 Delivery to Animals

The feed delivery system used on a particular site depends upon the management style, the facility layout, and the social interactions between pigs. Common methods of feed delivery include automated systems and hand delivery.

Automated Feed Delivery

3.3.3.1 Automated Systems

Feed is pulled from the feed bin using an auger and delivered to pigs via feed lines. The feed is automatically dispensed into a feed holding tub or feeder. Feed delivery can be triggered by feed consumption from a designated feeder, typically at the end of the barn, or manually turned on by a worker. If a barn of pigs needs to be emptied, ensure that the pen with the designated feeder is emptied last to ensure all other pens continue to receive feed. This automated system requires a power source (i.e., electricity) to get the feed from the storage facility to the pigs.

3.3.3.2 Hand Delivery

Hand feeding is more labor intensive than other feed delivery systems. Workers are responsible for visually monitoring feed intake and delivering feed to the pens. This method is designed to meet individual nutritional needs of pigs and allows for increased accuracy in feed records. Hand feeding is usually used in outdoor rearing systems and in farrowing rooms where individual sow feed intake needs to be regulated.

3.3.4 Records

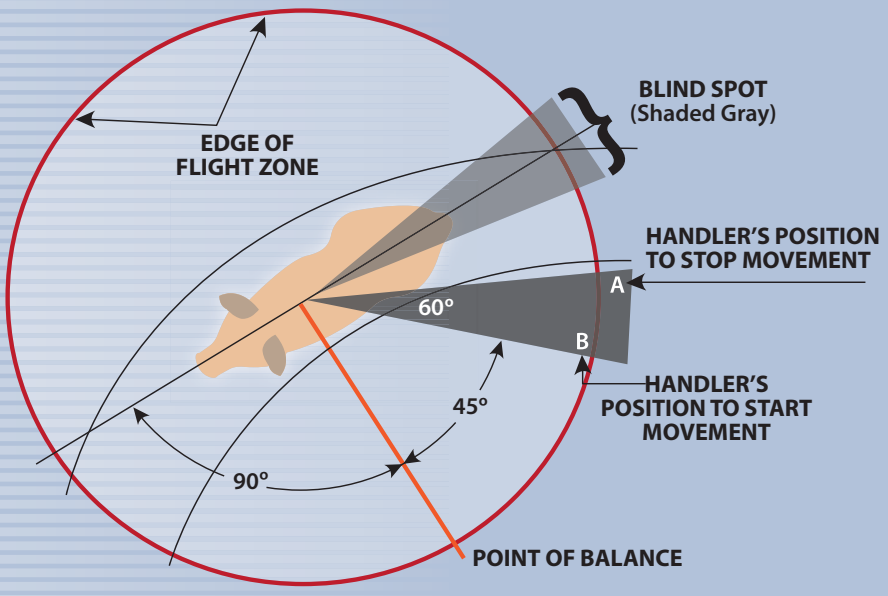
Feed records are important to monitor animal production, feed use, feed quality, and for tracing purposes. Important data recorded includes:

- Amount of feed delivered;
- Feed ingredients (grain, protein, minerals, vitamins);
- Antibiotics used including type, dose, dates fed, which group(s);
- Company that delivered feed; and
- Date feed was delivered.

4. ANIMAL MOVEMENT AND HANDLING

Swine production requires frequent movement of animals within a given facility. Quiet handling by well-trained people is essential. Transportation of pigs between facilities or to market is another aspect of swine production. Animal handlers should be trained to use behavioral principles of handling such as flight zone and point of balance, as illustrated in Figure 5. Flags, plastic paddles or panels should be used as the primary movement aids. Frequent use of electric prods is detrimental to pig welfare because shocking increases body temperature, heart rate, and the incidence of stressed or non-ambulatory pigs. Proper animal handling plays a key role in the health and welfare of the pig as well as the quality of the final product. The National Pork Board advises that sows and pigs that are unable to walk or those that are ill and will not recover be humanely euthanized on the farm by properly trained personnel and not transported to market channels.

Figure 5. A Pig's Flight Zone, Point of Balance, and Blind Spot



Source: Transport Quality Assurance™ Handbook, National Pork Board, 2008

For additional information, refer to:

- Transport Quality Assurance Manual, National Pork Board (*http://www.pork.org/Producers/docs/TQA_08.pdf*)
- On-Farm Euthanasia of Swine – Options for the Producer, National Pork Board/American Association of Swine Veterinarians joint publication (*www.pork.org*)

4.1 Movement Within the Same Premises

Movement of animals within the same premises can be a daily occurrence for some operations. When pigs are loaded out of either a segregated weaning facility or a finishing barn, it is best to move small groups directly from the home pens to the truck. For finishing pigs 150 pounds or greater, it is recommended that 3 to 6 pigs be moved at a time. For smaller pigs, larger numbers may be moved. Pigs should be moved in a manner that does not cause them to bunch or pile up. Pigs are very sensitive to distractions such as shadows, reflections, and small moving objects. These small distractions can impede pig movement through single file races, alleys, truck loading ramps, and into conveyor restrainers or carbon dioxide chambers. Common distractions on farm sites are poor lighting, air drafts, people, and noises.

4.2 Movement Off-Farm/Off-Premises

Transportation of pigs off the premises is most commonly done by truck and trailer. These can be owned by the operation or hired from a commercial entity to haul pigs. In either case, the trailer should have adequate ventilation, a non-slip floor with proper drainage, and protection from the outside environment. Loading pigs onto the trailer requires a ramp with no more than a 20 degree incline with non-slip flooring and cleats spaced 3 inches apart for piglets and 8 inches apart for adult pigs.

Transport space recommendations differ depending on the production phase of the pig (Table 4). The trailer should be equipped with dividers to limit the number of pigs within a given area. Weather conditions and animal size should be considered when deciding space requirements per pig.

Herding Panel

Livestock Trailer

Loading Ramp

Table 4. Transport Space Recommendations for Pigs in Normal Weather Conditions

Average Weight (lbs.)	*Square Feet Per Head*	*Average Weight (lbs.)*	*Square Feet Per Head*
12	0.65	250	4.26
50	1.53	300	4.79
100	2.32	350	5.48
150	2.95	400	6.39
200	3.48		

Source: Transport Quality Assurance, National Pork Board, 2008.

Weather conditions affect how the transport vehicle is prepared for the well being of the pigs (Table 5). In cold weather, vents should be closed (slats placed inside the trailer to block the wind), the trailer should be loaded at the upper end of space recommendations to maximize body heat, and extra bedding provided. For hot weather, keep pigs cool by opening vents, scheduling transportation in the early morning or late evening, providing wet shavings, and loading fewer pigs. Continuous truck movement is essential for fresh air movement inside trailers.

Table 5. Truck Setup Procedures During Extreme Temperatures for Market Hogs

Air Temp (°F)	*Bedding*	*Side Slats*	
<10	Heavy	90% Closed	10% Open*
10 - 19	Medium	75% Closed	25% Open*
20 - 39	Medium	50% Closed	50% Open
40 - 49	Light	25% Closed	75% Open
>50	Light	0% Closed	100% Open
*Minimum openings are needed for ventilation even in the coldest weather			

Source: Transport Quality Assurance, National Pork Board, 2008.

Some of the protocols in place for transport between farms are:

1. Truck Wash Facility Requirements – These are physical facilities, commercial or private, dedicated to cleaning and disinfecting trailers and tractors used for transporting livestock. Private truck wash facilities are internal to the operation where only trucks/trailers belonging to the farm are cleaned. Commercial truck washes are facilities where several farms use the same wash bays.
2. Inspection Checklists for Trailers – A third party is dedicated to making sure cleaning and disinfection methods are properly followed and that the trailer is properly dried.
3. Delivery Coveralls and Boot Wash – Coveralls and boots worn by farm employees unloading pigs during a delivery must be completely cleaned after each use to eliminate the possibility of cross-contamination between farms.

4.2.1 Farrowing and Nursery

Weaned piglets can be moved by herding or picking them up and carrying them. Piglets have sharp teeth and can bite; exercise caution when picking them up (scooping/holding under the rib cage or lifting a rear leg above the hock, as shown in the photo on the right). The sow may become aggressive when piglets are removed; use care when reaching into the pen. Noise shakers are used to herd piglets down hallways and load them into truck or trailers.

At a nursery, pigs are usually unloaded by herding them out of the trailer in groups and sorting them by number and size into pens. Towards the end of the nursery phase, pigs may become too large to lift and should be moved using a sorting board, relying on their flight zone as illustrated in Figure 5. When loading or unloading, provide extra time for the animals to move to avoid injury.

4.2.2 Grow-Finish

Transport to market is the most common reason grow-finish pigs are moved. The most effective technique for loading and unloading is to work in pairs and use the flight zone (Figure 5). Use a sorting board to turn or stop market pigs. It is also important to watch for signs of fatigue such as open mouthed breathing, inability to move, or splotchy skin. Careful and proper handling to reduce stress will minimize the risk of animals becoming fatigued.

4.2.3 Boar Stud

Once boars are at a boar stud they typically will not be moved off the farm until they are sent to market. Take precautions to minimize aggression when transporting boars. Allow extra time for them to become comfortable with their new environment. Due to the boars' size, they should be loaded individually. Boars should be penned separately to prevent injuries from fighting with finisher pigs or other boars.

4.2.4 Sow Farm

Sows are moved to market when they become unproductive in a breeding operation. They are often older and large in size requiring extra time for movement and to become comfortable with their environment. Sows should be marketed when they are still fit for travel.

4.2.5 Auction Markets/Buying Station

When pigs reach approximately 240-280 pounds, producers sell them on either a live-weight basis at terminal markets or auctions, or on a live-weight or carcass-weight (most common) basis direct to slaughter houses and meatpackers. Some producers also use livestock exchanges or producer-owned marketing networks for price negotiation and transportation.

Market Weight Hog

Sow with Backtag

Terminal markets developed in the late 1800s near slaughter plants in major metropolitan areas and played a major role in the development of the U.S. livestock industry. Currently, less than one percent of all pigs are sold through terminal markets due to improved communication systems about when pigs are ready for market.

Auction markets were organized in many rural communities to provide a point of sale for small groups of livestock from relatively small geographic areas. Like terminal markets, these markets are less numerous and handle fewer pigs today. However, they still provide needed market price discovery and livestock assembly services in some areas, especially those distant from packing plants or terminal markets.

Directly selling to slaughter houses/meatpackers is the primary marketing option for the majority of the pigs produced. Pigs are delivered directly to the plant or to buying stations. Over 70% of the pigs produced in the U.S. are now sold on "carcass merit" pricing systems in which a portion of the price is determined by certain characteristics of the animal. Based on consumer demand, packers pay premiums for pigs with low amounts of fat and high amounts of muscle.

Specialty packers purchase under-performing pigs that are often sold at lighter than normal slaughter weights when the producer determines that the pig is no longer growing at a profitable rate. These pigs are often collected at buying stations from multiple owners for delivery to the specialty packers. These are often referred to as "roaster pigs". Adult sows and boars at the end of their useful reproductive life also go to specialty packers. These animals are sold on a daily basis to consolidators. As the sows/boars are off-loaded, an official USDA backtag is applied. This generates a record linking the backtag to the previous owner/producer. The sows and boars are sorted into separate loads based on specification set by the packers and sent to slaughter as commingled lots.

The marketing chain for pigs consists of packers, processors, purveyors, retailers, and foodservice operators. All play an important role in adding value to pigs by producing pork products that meet the needs and desires of consumers worldwide.

4.2.6 Mortalities

The disposal of livestock mortalities is regulated by the respective state in which the farm is located. The four most common methods include: burial, rendering, incineration, and composting. It is important to realize that each State has specific laws regulating the proper disposal of livestock.

1. Animal burial is a common procedure on some farms, particularly smaller facilities. Timeliness of burying, impermeable soil, greater depth to water table from trench/pit bottom, and prompt covering of the carcasses are critical to maintaining a biosecure and aesthetically acceptable burial site.Most states regulate separation distances of burial site from wells, surface water and the property line, and limit the number of animals that can be buried in an area. Some states have maps that show where animals can be buried safely and lawfully. In a large-scale disease outbreak, this may be the method of choice for the disposal of large numbers of cattle depending on risk to groundwater contamination and available land. Alternatively, Type I landfills may be suitable for burial of massive mortality. However, prior arrangements with the landfill operator to accept non-contagious carcasses should be made during planning for this disposal method.
2. Rendering of carcasses is a common method for farms located in an area where the service is available. This can be an expensive option, but is offset by the benefit of having a third party take the responsibility for managing the carcasses in an environmentally sound manner. Rendering is nearly always carried out by a business independent from the farm and often includes "pickup" service at a designated location on the farm; preferably at the edge of the farm away from main traffic area. Rendering collection trucks going from farm-to-farm can present a biosecurity risk. Rendering services are not available in all areas. In situations involving massive depopulation, rendering services can be quickly overwhelmed. If a highly contagious FAD was involved, this will likely not be an option.

Rendering Truck

Incinerator

Compost Pile

3. Controlled incineration of the carcass on farm works well for a small number of animals. The process of incineration takes several hours to complete and the burning odor and smoke pollution can be a public concern. Thus open pyre burning should be the method of last resort. Incineration is often not suitable or cost-effective for larger animals but it will destroy most of the pathogen and leave minimal byproducts.
4. Composting on farm is an inexpensive option in some climates/localities and it may require a large space, access to water, and co-composting materials (carbon-rich sources such as sawdust, wood shavings, hay bales, etc.) when incorporated into a sizable swine farm. Well-described techniques are available at *http://www.extension.iastate.edu/Publications/PM1917.pdf* and *http://www.cast-science.org/websiteUploads/publicationPDFs/CAST%20Issue%20Paper%2039%20FINAL155.pdf*; equipment needed and protocols will vary. States will regulate whether this is an allowable disposal method; proximity to groundwater and prevention of run on to and runoff from the composting area must be considered. Producers using this method must have a plan in place for utilizing the finished compost (spread on crop ground, bedding). When done properly, composting can destroy most infectious disease agents.

Please refer to the *FAD PReP/NAHEMS Guidelines and SOP: Disposal (2011)* for specific details on each of the above described options in the event of a highly contagious FAD outbreak. Other resources on animal mortality management includes Managing Contaminated Animal and Plant Materials: A Field Guide on Best Practices available at: *http://tammi.tamu.edu/MortalityTSWGguide-2008.pdf* and On-Farm Euthanasia of Swine - Options for the Producer, National Pork Board/American Association of Swine Veterinarians joint publication (*www.pork.org*)

4.2.7 Records

The quality of transportation and movement records can vary widely between farms. Large farms and breeding stock suppliers that utilize contract haulers or conduct animal movements that utilize interstate Certificates of Veterinary Inspection (for individually identified animals) or interstate swine movement reports (for group/lot identified animals) often have extensive databases to manage the process. The interstate swine movement report includes:

- The name of the swine production system;
- The name, location, and premises identification number of the premises from which the swine are to be moved;
- The name, location, and premises identification number of the premises to which the swine are to be moved;
- The date of movement;
- The number, age, and type of swine to be moved;
- A description of any individual or group identification associated with the swine;
- The name of the swine production system's USDA Accredited Veterinarian(s);
- The health status of the herd from which the swine are to be moved, including any disease of regulatory concern to APHIS or to the States involved; and
- A statement that swine on the premises from which the swine are to be moved have been inspected by the swine production system's accredited veterinarian(s) within 30 days prior to the interstate movement and are consistent with the dates specified by the premises' swine production health plan and found free from signs of communicable disease.

Source:

- *Code of Federal Regulations, Title 9, Chapter I, Part 71.1 Definitions*

Farms located on a single site, selling only to terminal slaughter markets, or using only their own pig transportation may keep few written records. Slaughter facilities keep track of the farm of origin, number of pigs unloaded, and the trucking company.

5. PRODUCT MOVEMENT

Besides pigs moving to market, other products move onto and off of swine operations.

5.1 Semen

Semen from boar studs is shipped both intrastate and interstate either by overnight shipment or delivery by a vehicle associated with the boar stud. In most cases, the biosecurity programs used at boar studs are very strict. The extensive use of artificial insemination creates the potential for the rapid and extensive spread of any disease transmitted via the semen. Semen doses should be identified with the premises identification number of the source herd for traceability.

5.2 Manure Handling

Manure is an inevitable by-product of pork production. It has been estimated that 500 finishing pigs produce nearly 3,000 cubic feet of manure in a month's time or 265,000 gallons of manure in a year. Swine manure contains nutrients that can support crop production and enhance the soil's chemical and physical properties. The plant nutrients in manure can reduce a producer's fertilizer costs. Thus, manure can be an asset to a pork production operation if its nutrient value is maximized.

Manure management has become a major factor in determining the location and population limits of operations. Poor manure management can result in increased disease in the pigs, odor issues, and declining water quality. Pork producers select a manure handling system based on state regulations as well as factors such as location, size, type, and use of their cropland, the number of animals they have on site, and the type of animal housing. When the animals are housed outside, the manure is commonly stored as a concentrated manure pack. Manure is scraped from the animal housing area and routinely applied

to cropland. When the animals are housed in controlled environment facilities, the manure is often stored in a liquid form in one of the following ways:

- Anaerobic deep pit
- Above ground storage
- Earthen storage pit
- Lagoon

The capacity of the above types of storage facilities are determined by state regulations which are based on their size and the estimated amount of manure being produced by the pigs. They generally allow for removal and draining twice a year, when convenient for crop and pig production. Crop types and harvest times greatly affect the timing of manure application. The manure/water mixture is applied to the soil by direct injection or through spray from an irrigation sprayer, a spreader, or injector. The amount of manure that can be applied to any specific area of ground is regulated by the state's environmental regulatory agency.

5.3 Records

5.3.1 Semen

Records are kept both by the receiving farm and by the boar stud. Farm records usually include:

- Date delivered;
- Time delivered;
- Number of doses; and
- Source (premises identification number).

5.3.2 Boar Studs

Records usually include:

- Date delivered;
- Doses;
- Customer (premises identification number); and
- Boars that produced semen.

5.3.3 Manure

Manure records usually include the amount of manure spread and the location of the field it was applied to. Each state's environmental regulatory agency has specific requirements about the type of records that need to be kept as part of an official manure management plan.

PART II: RESPONSE TO A HIGHLY CONTAGIOUS FOREIGN ANIMAL DISEASE

6. DESIGNATION OF ZONES, AREAS, AND PREMISES

A critical component for FAD response is the designation of zones, areas, and premises. Epidemiological investigation and tracing will be used to classify premises. It is the responsibility of the Incident Management Team to designate zones and premises in an FAD outbreak. These zones, areas, and premises designations will be used in quarantine and movement control efforts.

Table 6 summarizes the premises designations that would be employed in an FAD outbreak response. Table 7 summarizes the zone and area designations that would be used in an FAD outbreak response.

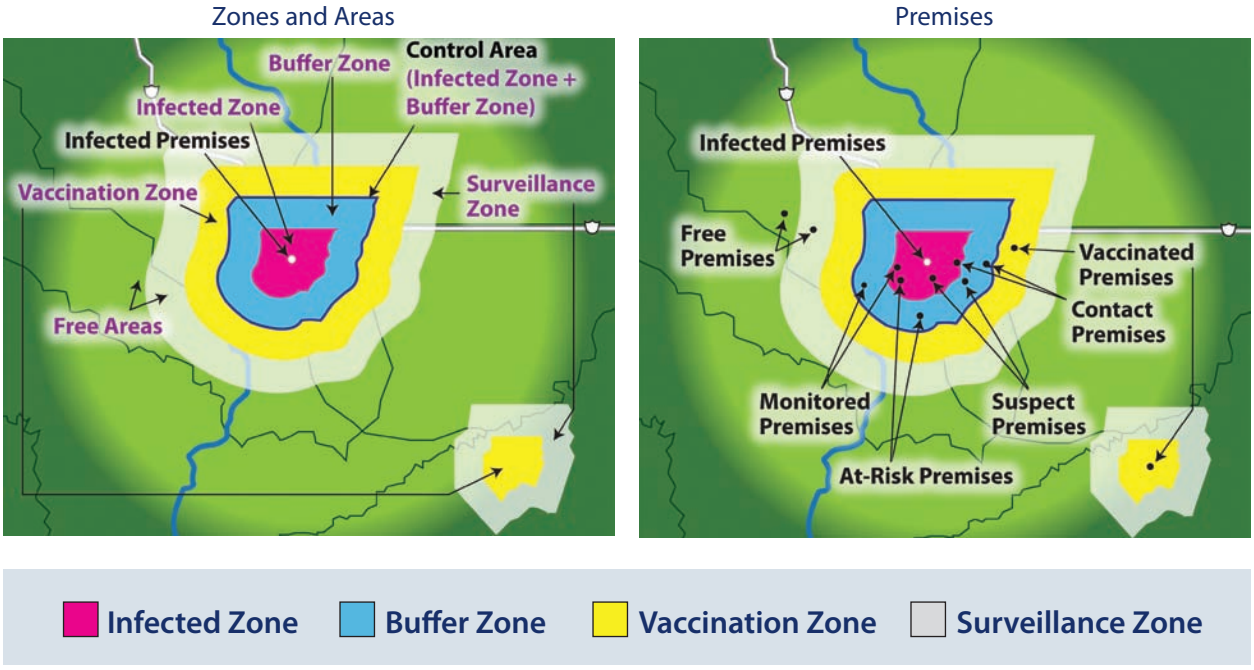
Table 6. Summary of Premises Designations

Animal Category	*Definitions*	*Zone*
Infected Premises (IP)	Premises where a presumptive positive case or confirmed positive case exists based on laboratory results, compatible clinical signs, case definition, and international standards.	Infected Zone
Contact Premises (CP)	Premises with susceptible animals that may have been exposed to the FAD agent, either directly or indirectly, including but not limited to exposure to animals, animal products, fomites, or people from Infected Premises.	Infected Zone, Buffer Zone
Suspect Premises (SP)	Premises under investigation due to the presence of susceptible animals reported to have clinical signs compatible with the FAD. This is intended to be a short-term premises designation.	Infected Zone, Buffer Zone, Surveillance Zone, Vaccination Zone
At-Risk Premises (ARP)	Premises with susceptible animals, but none have clinical signs compatible with the FAD. Premises objectively demonstrates that it is not an Infected Premises, Contact Premises or Suspect Premises. At-Risk Premises seek to move susceptible animals or products within the Control Area by permit. Only At-Risk Premises are eligible to be Monitored Premises.	Infected Zone, Buffer Zone
Monitored Premises (MP)	Premises objectively demonstrates that it is not an Infected Premises, Contact Premises, or Suspect Premises. Only At-Risk Premises are eligible to become Monitored Premises. Monitored Premises meet a set of defined criteria in seeking to move susceptible animals or products out of the Control Area by permit.	Infected Zone, Buffer Zone
Free Premises (FP)	Premises outside of a Control Area and not a Contact or Suspect Premises.	Surveillance Zone, Free Area
Vaccinated Premises (VP)	Premises where emergency vaccination has been performed. This is a secondary premises designation.	Containment Vaccination Zone, Protection Vaccination Zone

Table 7. Summary of Zone and Area Designations	
Zone	***Definition***
Infected Zone (IZ)	Zone that immediately surrounds an Infected Premises.
Buffer Zone (BZ)	Zone that immediately surrounds an Infected Zone or a Contact Premises.
Control Area (CA)	Consists of an Infected Zone and a Buffer Zone.
Surveillance Zone (SZ)	Zone outside and along the border of a Control Area.
Free Area (FA)	Area not included in any Control Area.
Vaccination Zone (VZ)	Emergency Vaccination Zone classified as either Containment Vaccination Zone (typically inside the Control Area) or Protection Vaccination Zone (typically outside Control Area). This is a secondary zone designation.

Figure 6 illustrates all the zones and premises. Note: Figures are not to scale. The Vaccination Zone can be either a Protection Vaccination Zone or Containment Vaccination Zone.

Figure 6. Control Zones



For details on the zones, areas, and premises, please see the *APHIS Framework for Foreign Animal Disease Preparedness and Response*. For additional information integrating the zones, areas, and premises designations with specific FAD response strategies, please see the disease specific response plans, such as the *FMD Response Plan: The Red Book*.

These documents are available on the following sites:

- FAD PReP collaboration website at: *https://fadprep.lmi.org*.
- APHIS FAD PReP website (for APHIS employees) at: *http://inside.aphis.usda.gov/vs/em/fadprep.shtml*.

7. DISEASE SPECIFIC BIOSECURITY MEASURES

In the event of a highly contagious FAD outbreak, biosecurity measures must be enhanced and more strictly enforced to minimize the risk of introduction. Exposure to disease can occur through five main routes of transmission: aerosol, direct contact, fomite, oral, and vector borne. Humans are exposed to zoonotic diseases via the same five routes of transmission. Disease specific biosecurity measures aimed at preventing exposure to FMD and CSF are provided as appendices. These biosecurity measures can also be applied to other diseases with similar exposure routes.

- *Swine Routes of Transmission – Appendix A*
- *FMD (spread by aerosol, direct contact, fomite, oral) – Appendix B*
- *CSF (spread by aerosol, direct contact, fomite, oral, vector) – Appendix C*

In order for an epidemiological investigation to determine potential exposures during a highly contagious FAD event, operations should keep an inventory of animals in the herd including identification numbers, breed, age, origin, and location. Animal movement to and from the farm should also be recorded including date, animal ID, origin, destination, reason for movement, driver, vehicle used, previous owners name and phone number. Likewise, movement logs for equipment, feed, and semen should include dates, origins, destinations, delivery person, salesman, and the inseminator's name. Finally, pets and other animals located on the premises should be documented. While ideal, this may not be achievable on U.S. swine operations; the depth of record keeping really varies by operation.

8. PROVIDING ANIMAL CARE

During a disease response, producers may experience disruptions in supply deliveries and animal transportation. Producers and support industry personnel should develop plans prior to an outbreak to ensure animals continue to receive proper care during a disease response.

Table 8. General Estimates on Average Feed Consumption

Animal Category	*Pounds of Feed Consumed Per Day*
Boars	5-6
Gestating Sows	5
Farrowing Sows	12
25 to 75 lb Pigs	1.3 to 3.5
100 to 200 lb Pigs	4.5 to 6.2
225 lb to Market	6.5 to 7.0

8.1 Feeding

During a disease response, the on-farm inventory of feed must be promptly ascertained along with the rate at which it will be depleted in order to determine when more feed will be needed. Table 8 provides general estimates of the amount of feed consumed per day by each animal in various life stages on an as-fed basis. Transportation routes may be disrupted, so plans for alternate feed sources and delivery routes should be made before the situation arises. Depending on the feeding system in place, manual feeding may be required. Recording the origin of the feed delivery, the date, and the amount is necessary to maintain operation records.

8.2 Breeding

Breeding is an extremely time sensitive situation and planning for how it will be handled needs to occur early in an outbreak situation. Most sows will return to estrus around 5 days after weaning and, therefore, the timing of weaning is scheduled to minimize matings over the weekend when labor is limited. Sows in estrus after weaning will only stay in heat for 2-3 days. Therefore, it is imperative to get semen onto the farm as soon as possible to breed the animals. Most farms do not have breeding boars available on site and semen is scheduled for delivery twice a week. Plans should be in place to accomplish this in the event transportation routes are disrupted. This is critical to maintaining the operation's pig flow and continuity of business.

8.3 Farrowing

Farrowing space per animal and facilities are designed based on a given number of animals on farm and the management's plan for breeding, farrowing, and movement of pigs to the next stage. A disease outbreak that disrupts movement off the farm will greatly affect farrowing operations. If pig movement is stopped, facilities need plans for housing newly weaned pigs to make space in the farrowing facility for the next litters of pigs. Sows can be moved back into the breeding facility but the piglets, due to their small size and specific housing requirements, need to be housed separately from older animals. Over time, this designated space on the farm may fill up and piglets may need to remain in the farrowing stall. This limits the available space for subsequent groups of sows due to farrow. A stop in movement for more than 4-7 days could cause significant welfare problems for piglets and/or sows.

8.4 Nursery and Finishing

The most important considerations for nurseries and finishers during a disease response are the age and weight of the pigs in the facility as well as the amount of time that off-farm movement is halted. For pigs that just entered the facility, space allocation, flooring weight limits (nurseries only), height of the pens, ventilation systems, and feedstuffs can accommodate their needs while growing. However, off-farm movement restrictions could have a sizeable impact on pigs that are a few days from moving from the nursery to the finisher or are a few days from reaching market weight due to the design and flow of the facility. The animals' well being and health could be negatively affected due to the movement delays. Controlled movement plans should be implemented so that the welfare of the animals is not adversely affected.

8.5 Vaccination

8.5.1 Routine, Personnel, Records

Vaccines are generally purchased when they are needed for nursery and finisher pigs. In the event vaccines are needed during a disease response, the operation should contact its normal distributor to ensure the vaccines can still be delivered or to make other arrangements. Breeding and gestation facilities are not as restricted to pre-determined vaccination schedules. A delay of 1-2 weeks of incoming vaccines can be tolerated and the normal vaccination structure should stay intact.

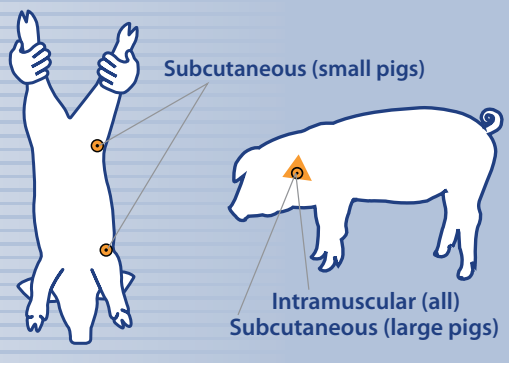
Vaccination crews, either company-owned or for hire, have the potential to introduce or spread disease among operations. If this service is used for routine vaccinations during a disease outbreak, biosecurity precautions should be followed and strict records should be kept pertaining to the crew. Details such as company name (if for hire), crew member names and contact information, exposure to other swine units in the previous 5 days, the identity of animal buildings they entered on the operation, name(s) of products, and date(s) administered. This information may be needed in the event of a traceback.

8.5.2 Specific to Disease Event

Depending on the type of disease outbreak, the response may include vaccinating the animals in an attempt to limit spread. Optimal vaccination strategies will vary greatly by region of the country infected and depend on impacts to both the domestic economy and foreign trade. This decision will be made by the Chief Veterinary Officer (CVO) at the federal level. Proactive discussions as to the optimal vaccination strategies in a given region based upon livestock demographics and foreign trade impacts will better prepare decision makers and industry for real time decisions of this nature. It is prudent to keep in mind that for vaccination-to-live strategies, tracking, and permitting of vaccinated animals will likely need to occur for the life of the animal and may impact movement of other unvaccinated livestock in that vaccinated region.

If vaccination is implemented, the product will be made available by regulatory officials. Guidance as to dose, delivery method, and how to administer the product will be provided. In some cases, the regulatory officials may require administration by state/federal personnel rather than commercial or in-house vaccination crews. In other situations, these crews may be utilized. Individual situations will be taken into consideration and may vary among operations depending on their proximity to the Infected Premises and Control Area.

Figure 7. Injection Sites in Swine



Whenever vaccines need to be administered, follow the dosage and injection site recommendations provided with the vaccine. Ensure the animal is properly restrained and change the needle as appropriate to maintain cleanliness and sharpness. Intramuscular injections should be given in the neck just behind and below the ear, but in front of the shoulder. Subcutaneous injections should be given in the loose flaps of flank skin or behind the elbow in small pigs and in the neck behind the ear at the same location as intramuscular injections in larger pigs (Figure 7). Slide the needle under the skin and away from the site of skin puncture before depositing the vaccine. When using needles, ensure they are all accounted for before and after administration.

Follow recommended guidelines for needle size and length in Table 9. Some vaccines are quite viscous; using the recommended larger gauge needle is needed for delivery. Properly dispose of all used needles in a puncture proof container. Needle-free injection systems have been researched in pigs and may be an option in an outbreak situation, depending on the type of vaccine and availability of resources. Vaccines for highly contagious FADs are likely to have a withdrawal time before animals can go to slaughter for human consumption and will be indicated on the vaccine label. Please refer to the *FAD PReP/NAHEMS Guidelines and SOP: Vaccination for Contagious Diseases (2011) and Appendix A: FMD Considerations and Strategies (2011)* for additional details.

Table 9. Recommended Needle Sizes for Swine

Intramuscular Injection	***Gauge***	***Length (inches)***
Baby Pigs	18 or 20	5/8″ or ½″
Nursery	16 or 18	¾″ or 5/8″
Finisher	16	1″
Breeding Stock	14, 15, or 16	1″ or 1½″
Subcutaneous Injection	***Gauge***	***Length (inches)***
Nursery	16 or 18	½″
Finisher	16	¾″
Breeding Stock	14 or 16	1″

Source: PQA Plus™ Producer Certification Book, National Pork Board

9. PRODUCT HANDLING

9.1 Market Weight Animals

Pigs raised in the U.S. have been genetically designed to maximize performance at a specific end weight. Most pigs are marketed at 240–280 pounds and are sold under a carcass merit program. Each slaughter house (packing plant) sells its product into specific meat markets and thus targets specific market weights. In the event of a disease response, moving pigs to market at heavier than normal weights can impact the animals because housing requirements change as they get larger. Producers and packing plants also have contractual obligations to meet.

Most pigs are taken to market in groups of 170–200 (one semi-trailer load). As a general rule, packing plants either process smaller pigs (220–260 pounds) or larger pigs (250–290 pounds). Slaughter plants have been designed to accommodate a particular carcass weight. The average chain speed of a U.S. packing plant is 1,000 pigs per hour and there is not time to make slight adjustments for different sized animals. Operations that provide pigs that do not meet a particular packing plant target weight (too small or too big) are financially penalized. The delivery of pigs to each packing plant is also tightly scheduled to keep the proper flow of pigs (chain speed) in the system. Many times truckers delivering pigs only have a 2 hour window to meet their contract.

Most of today's pigs are marketed to a packing plant based on a specific contract that dictates the number of pigs to be delivered to a particular company in a specified timeframe. These are legal contracts requiring agreement by both parties before any changes can be made. In the event of a highly contagious FAD outbreak, transportation may be disrupted and the contract packing plants may be outside the permitted travel area.

Given the type of equipment required to process pigs of different sizes, redirecting market pigs from packing plant A to plant B is not an easy task. Producers will need reassurance that plant A will allow them to void their contractual obligations without severe financial penalties. Likewise, plant B must be willing and able to process the pigs and

compensate producers for their pigs. Re-routing market weight pigs requires consideration by the packing plants, producers, and regulatory officials so as not to cause undue financial hardship to any one sector.

9.2 Nursery Pigs

There is more flexibility in the movement of pigs in and out of a nursery. Nursery facilities are designed based on the pigs' weight at the end of the nursery phase (45–75 lbs) and pigs are much smaller coming in (12–15 lbs). This smaller size can allow an operation to double-stock them initially (i.e., placing twice as many pigs into the pens until they grow to a larger size). Double-stocking will not adversely affect pigs as long as it is only done for 2–3 weeks and adequate feed and water are provided.

At the end of the nursery phase there is less of a window of opportunity to move pigs to the next phase. Pigs will become too big (size and weight) for the facility. Buildings reach their maximum ventilation capacity by this time. In most nurseries, holding pigs longer than one week past the scheduled exit date will create significant health and welfare problems for the pigs.

9.3 Culls

Pig cull markets and slaughter facilities are totally different than those used for normal market weight pigs. Most swine producers hire a cull market company (consolidators) to take cull animals and sell them in larger groups to a slaughter facility. Some slaughter facilities process thin cull sows while others can process a very large sow. There are only a small number of facilities that can process cull animals in the U.S., making it impossible for them to handle large volumes of animals at any one time.

9.4 Mortalities

It is important to remember that most facilities have designed/sized their method of carcass disposal based on "usual" mortality rates. If a FAD causes higher than average mortality rates, only operations utilizing rendering companies may be able to adjust operations to handle a high number of carcasses, if the rendering company can accommodate them. If the disease is highly contagious, rendering will not be used. Burying large numbers of animals on a particular site requires special permission and is usually under the jurisdiction of the state's environmental regulatory agency. Incinerators can only burn so many carcasses at a time and compost piles would require additional space and compost materials.

9.5 Manure

Many disease organisms are shed in bodily secretions, including manure. Pathogen survival in manure varies and is affected by environmental temperatures. Cold weather usually increases pathogen survival. Solid manure can be composted to increase core temperature and kill most pathogens. However, most U.S. swine operations store manure in a liquid form which cannot be composted. Many operations contract with manure pumping services which increases the possibility of exposure to many different operations in the area. Manure application/movement logs should be kept including dates, origin, application sites, volume applied per site, and application method.

During and after a disease outbreak, decisions will have to be made on how to decontaminate and dispose of manure. The future application of this manure on crop ground must be considered as disinfectants and chemicals that change manure pH may affect subsequent plant growth. Returning decontaminated manure to a stable pH prior to application is an option with associated costs but may be the best option in certain situations. The application of untreated manure has the potential to spread disease to other pigs, livestock (e.g., cattle grazing), and possibly wildlife. Manure handling equipment must be considered a biosecurity risk and should be properly cleaned and disinfected between operations.

10. SURVEILLANCE

Within 48 hours of the identification of the index case, a surveillance plan will be implemented to define the extent of the highly contagious FAD outbreak and to detect unknown but Infected Premises and new cases quickly through a combination of observation and laboratory testing. This surveillance plan may include the susceptible wildlife population in the area. Information will also be gathered for a surveillance plan to identify disease-free zones so that this portion of the plan can be implemented within seven days of the identification of the index case.

Infected, Contact, Suspect and At-Risk Premises will all be involved in some level of surveillance in an effort to control and contain disease spread or determine freedom from disease. Initial surveillance of susceptible animals will be visual inspection. As soon as practical, surveillance will include laboratory testing of susceptible animals. Contact and Suspect Premises should be inspected at least three times per maximum incubation period for the disease under investigation. During the highly contagious FAD event, surveillance could include on-farm observation, testing market animals, and at slaughter. Please refer to the *FAD PReP/NAHEMS Guidelines and SOP: Surveillance, Epidemiology, and Tracing (2011)* for additional details.

10.1 People

Visitors and employees can introduce or spread disease to susceptible animals if steps are not taken to mitigate these risks prior to entry. Sanitation and hygiene practices are important to prevent disease agent spread and include wearing clean clothing, coveralls, footwear, and washing hands before and after animal contact or glove removal. If the highly contagious FAD is zoonotic, additional personal protective equipment must be worn by all those handling animals.

The movement of people on and off the farm during a disease event must be documented to aid exposure assessments. Using a written log to record name, contact information, last contact with a susceptible animal species, and reason for being on farm including facilities entered/animals contacted is crucial. Prior to a disease event, records of this information may not be as readily available on all operations. Visitor logs are available in the Appendices. During an outbreak, personnel on farm should be limited to those essential for the day-to-day operation, making it easier to trace and minimize the risk of disease introduction. For all employees, records should be kept that includes their name, address, phone numbers, emergency contact, and information pertaining to off-site animal contact. In the event of a zoonotic highly contagious FAD, public health officials may recommend human surveillance via diagnostic testing. Contacting employees will be critical.

Higher risk personnel on a swine operation are those individuals that visit multiple premises within a given day and have contact with animals or their housing areas. This includes employees having off-farm animal contact, veterinarians, and service providers such as AI technicians, equipment repair personnel, rendering trucks, feed delivery persons, and sales persons. Strict adherence to biosecurity protocols should be required for farm entry and animal contact during an highly contagious FAD event.

10.2 Vehicle Traffic

Vehicles and equipment can indirectly expose susceptible animals through mechanical disease transmission. Installing a barrier that requires vehicles to stop before entering the premises provides an additional control point and can facilitate monitoring and recording vehicle details. Cleaning and disinfecting tires, wheel wells, and the undercarriage of all vehicles which enter or leave a farm will likely be required on all Infected or Monitored Premises. It may be prudent to park vehicles that are not required on farm off-site. People and vehicle traffic on and off an operation during a disease outbreak should be documented. A written or electronic record describing the vehicle, driver name and contact information, last farm(s) visited, and reason for visit should be maintained for tracking purposes. This could be challenging for operations without personnel living on-site.

10.3 Disease Monitoring

During an outbreak situation, susceptible animals on all operations must be closely monitored for clinical signs of the highly contagious FAD that meet the case definition. Animal caretakers, especially on Contact, Suspect, or At-Risk Premises should be aware of the clinical signs and who to contact if disease is suspected. Examples of clinical signs for FMD and CSF are found in the Appendices. Accurate and rapid public awareness campaigns will be used to disseminate disease recognition and reporting information to animal producers and caretakers within the Control Area and Surveillance Zone.

Livestock operations within the Buffer Zone will be routinely monitored utilizing slaughter surveillance, serological surveys, and investigation of reports of suspect disease. Slaughter surveillance will also occur in the Surveillance Zone. Free Area surveillance will occur through normal surveillance channels. Surveillance results and approved biosecurity protocols as a "proof of negative" status may be required for permitted movements of susceptible animals within the Control Area.

10.4 Sample Collection

Premises with the highest risk of infection will have animals sampled for disease testing. Handling tissues and fluids from these operations requires strict adherence to biosecurity and infection control procedures. Pigs at harvest facilities may also have samples collected. Unless otherwise specified, samples will be collected by trained animal health personnel (veterinarians, animal health technicians – private or government). Depending on the disease, specific tissues and/or fluids will be obtained on farm after performing a full post-mortem exam (whenever possible). Guidelines will be provided regarding the specific type of tissues needed, fresh or fixed, fluids (serum, whole blood, vesicular fluids), and details related to how to label and package them appropriately. See *VS Memo 580.4 Procedures for Investigating a Foreign Animal Disease/Emerging Disease Incident (FAD/EDI) October 2008* for more information.

Personal protective equipment (PPE) such as coveralls and gloves must be worn by personnel handling the animals, tissues, and fluids. If the disease is zoonotic, enhanced PPE should include goggles and an appropriate respirator (N-95 or N-99) or a full face shield if aerosolization is not a route of human exposure. All equipment used on farm to collect and transport samples and protect the personnel should be properly cleaned and disinfected in the designated area prior to leaving the farm. Care should be taken not to contaminate diagnostic samples with disinfectant as the highly contagious FAD will be inactivated providing false negative results. See the *FAD PReP/NAHEMS Guidelines and SOP: Personal Protective Equipment (2011), Biosecurity (2011), and Cleaning and Disinfection (2011)* for more information.

10.5 Sample Submission

Early in the disease outbreak there may be a single laboratory or a select group of laboratories that can perform the diagnostic testing. Guidance will be provided regarding sample submissions to laboratories. This may change as the outbreak continues and other laboratories are able to perform the specific tests. Contact personnel at the receiving laboratory will provide specifics related to sample submission. There are some fundamental principles that must be adhered to in the event of a highly contagious FAD investigation to ensure accurate, rapid results.

Once samples are obtained, proper labeling is PARAMOUNT to ensure results are correctly reported. Submit samples with the appropriate paperwork (hard copy or electronic). This may consist of forms provided by the laboratory or animal health authority. The premises must be properly identified on all paperwork and sample packaging using a premises identification number, if available. Again, proper completion of the paperwork is essential so that the results are accurately reported to the submitting veterinarian or animal health authority. In some cases, samples could be submitted to demonstrate absence of the disease for permitted animal movement and accurate, timely result reporting is essential.

Samples obtained in the field should be properly packaged to prevent leakage (individually sealed plastic bags around each fluid tube) and thus contamination of samples within or external to the box/cooler. Completed paperwork should also be placed in a sealed plastic bag. Cold packs are recommended instead of ice for transporting samples. Be aware of environmental temperatures and provide enough cold packs to keep tissues from degrading in transport.

11. APPRAISAL AND COMPENSATION (FAD PREP/NAHEMS GUIDELINES AND SOP)

Animal health regulatory officials will create an inventory of animals designated for depopulation and appraise their fair-market value in order for compensation to be paid. Contaminated materials on farm (feed, bedding) will also be appraised as they may need to be disposed of in an effort to control disease spread. Facilities and equipment that cannot be properly disinfected must also be destroyed and fair market value assessed. Please refer to the *FAD PReP/NAHEMS Guidelines and SOP: Appraisal and Compensation (2011)* for specific details on this process.

12. MASS DEPOPULATION AND EUTHANASIA (FAD PREP/NAHEMS GUIDELINES AND SOP)

To control disease spread, infected and exposed animals may be depopulated by qualified personnel according to USDA-APHIS and AVMA guidelines. The method and procedures used for depopulation will depend on available resources and the population dynamics of susceptible animals on the premises. This requires location-specific planning and preparation which is addressed in the *FAD PReP/NAHEMS Guidelines and SOP: Mass Depopulation and Euthanasia (2011)*.

13. DISPOSAL (FAD PREP/NAHEMS GUIDELINES AND SOP)

Animal carcasses and associated contaminated materials (e.g., feed, bedding) must be disposed of in a way to limit disease spread, using State or municipality approved methods. Once euthanasia is complete, specific personnel will be assigned to an operation to carry out these activities. For additional information, see *FAD PReP/NAHEMS Guidelines and SOP: Disposal (2011)*.

14. CLEANING AND DISINFECTION (FAD PREP/NAHEMS GUIDELINES AND SOP)

Facilities that housed infected animals and equipment used in their daily care must be cleaned and disinfected to prevent the spread of disease to live animals returned to the operation. Coordination of equipment, supplies, scheduling, and certifying work completed by the producer, contractors, or animal health response teams will be carried out by USDA-APHIS-VS. Items that cannot be adequately cleaned and disinfected will be properly disposed of once their value is determined. For additional information, see *FAD PReP/NAHEMS Guidelines and SOP: Cleaning and Disinfection (2011)*.

15. WILDLIFE MANAGEMENT AND VECTOR CONTROL (FAD PREP/NAHEMS GUIDELINES AND SOP)

Wildlife susceptible to the highly contagious FAD can complicate disease eradication or control efforts. A coordinated effort between local, State, Tribal and federal agencies including the U.S. Fish and Wildlife Service, the Department of the Interior and State wildlife agencies is necessary to accomplish control without jeopardizing environmental ecosystems. Producers' knowledge of area wildlife and potential exposure will be vital in this assessment and management process. For additional information, see *FAD PReP/NAHEMS Guidelines and SOP: Wildlife Management and Vector Control (2011)*.

16. INTERNATIONAL TRADE

In 2009, international exports of pork totaled nearly 4.1 billion pounds valued at over $4 billion USD. The top four countries receiving U.S. pork exports included Mexico, Japan, Hong Kong/China, and Canada. These markets are vital to the swine industry. In the event of a highly contagious FAD outbreak affecting swine, international trade of animals and animal products would be halted for the affected zones or regions.

Source:

- U.S. Meat Export Federation, 2000-2009 Pork Exports Data accessed March 3, 2011 at: http://www.usmef.org/downloads/Pork_2000_to_2009.pdf

Regionalization, also known as zoning, separates animal subpopulations to maintain disease-free status in one or more zones. Regionalization defines animal subpopulations primarily on a geographical basis. As an FAD response tool, regionalization can facilitate international trade, as well as FAD eradication.

For more information on regionalization, please see the *FAD PReP SOP: Overview of Regionalization for International Trade (2011)*, as well as 9 CFR 92.2, which lists 11 factors that should be evaluated in establishing a region.

Compartmentalization, which distinguishes between animal subpopulations by "management and husbandry practices related to biosecurity," has not yet been implemented within the United States with any trading partners (*OIE, Chapter 4.4*). Disease-free compartments must be recognized by trading partners prior to an outbreak for product movement. For further information on compartmentalization, please see the *OIE Terrestrial Animal Health Code (2010), Chapter 4.4*, as well as sections on compartmentalization in disease-specific chapters (for example, see Chapter 8.5, Article 8.5.6 on foot-and-mouth disease).

Acknowledgements

In addition to the sources throughout the manual, portions of this document were obtained from:

- Swine Production Facilities Manual, Emergency Preparedness and Response Plan for Pork Facilities, draft August 2005, FMD Working Group
- Highly Contagious Foreign Animal Diseases of Swine Strategy Document, draft June 2008 by P. Webb on behalf of National Pork Board
- APHIS Framework for Foreign Animal Disease Preparedness and Response Plan (FAD PReP), Chapter 3, USDA-APHIS, Draft July 2010

This FAD PReP Industry Manual was produced in collaboration with USDA-APHIS-VS National Center for Animal Health and Emergency Management by the Center for Food Security and Public Health, Iowa State University of Science and Technology, College of Veterinary Medicine through a cooperative agreement. Authors include:

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Photo and Illustration Credits

Page ii Photo strip: Left to right: Landrace pigs; Red Angus/Simmental cross beef cow with calf; Holstein heifers; chicks; and feedlot cattle. *Photo sources: Iowa State University; Beth Carlson, North Dakota; Mark Kirkpatrick, Idaho; USDA; and Danelle Bickett-Weddle, Iowa State University.*

Page iii FAD PReP Suite of Documents and Materials *Graphic illustration by: USDA*

Page 1 The official logos of USDA, APHIS and OIE. *Graphic illustration of the USDA, APHIS, and OIE logos by: Dani Ausen, Iowa State University*

Page 2 ***(Top)*** Figure 1. Products and Byproducts of Swine. Many different products that can be produced from pigs such as meat, heart valves, suede, insulin, etc. *Graphic illustration by: Dani Ausen, Iowa State University*

(Bottom) Illustration depicts the billions of pounds of imports and exports of pork production. *Graphic illustration by: Dani Ausen, Iowa State University*

Page 3 ***(Top)*** Figure 2. Potential Movement of Swine. Arrows depict the movement of swine under the control of a single owner or group of contractually connected owners from one site of production to another such as sow herds, nursery herds, growing or finishing herds, but does not include slaughter plants or livestock markets. *Content provided by: Spencer Wayne; Graphic illustration by: Dani Ausen, Iowa State University*

(Bottom) Definition of inshipments. *Graphic illustration by: Dani Ausen, Iowa State University*

Page 4 Table 1. Total Number of Inshipments by State in 2007. *Content provided by: USDA NASS; Graphic illustration by: Dani Ausen, Iowa State University*

Page 5 Table 2. Type and Frequency of Vehicle/Personnel Movement onto Swine Operations. *Content provided by: Alex Ramirez, Veterinary Diagnostic and Production Animal Medicine, Iowa State University; Graphic illustration by: Dani Ausen, Iowa State University*

Page 6 Figure 3. Animal Identification: Tattoos. Graphic illustration of a pig with photo closeups of the ears denoting tattoos assigned to their farm and a 4-digit slap tattoo on the shoulder. *Photo sources: Cargill (left), Tyson Foods (center), USDA Food Safety and Inspection Service (right); Graphic illustration by: Dani Ausen, Iowa State University*

Page 7 Figure 4. Concept of Pig Flow. Pig flow ultimately begins with breeding and gestation which includes gilts, brought in for their initial breeding, and sows. Semen is brought in from boar studs to inseminate the gilts/sows. The pigs are moved to individual farms right before farrowing. The piglets are then either moved to the nursery or a wean to finish building. Nursery pigs are eventually sent off to a finishing barn until they reach market weight. Gilts are then selected as replacements and sent to the breeding/gestation barn and the cycle starts all over again. *Content provided by: Dan Whitney, Iowa State University; Graphic illustration by: Dani Ausen, Iowa State University*

Page 8 ***(Top)*** These photos depict different phases of swine production. A breeding/gestation facility where sows/gilts are kept until they are almost ready to farrow (left). Piglets in farrowing crates side by side (center). Pigs kept in a finishing facility until they reach market weight (right). *Photo source: Iowa State University Veterinary Diagnostic and Production Animal Medicine (all)*

(Bottom) Sow. *Photo source: Iowa State University Veterinary Diagnostic and Production Animal Medicine*

Page 9 ***(Top)*** Insemination of the sow or gilt begins by stimulating the animal with adjacent boars. Once the sow/gilt is stimulated, an insemination rod is inserted into the cervix and semen is deposited by a trained professional. *Photo source: Iowa State University Veterinary Diagnostic and Production Animal Medicine*

(Center) Boar. *Photo source: Iowa State University Veterinary Diagnostic and Production Animal Medicine*

(Bottom) Semen doses are extended with an extender that provides nutrients and antibiotics to extend the life of the semen. Extended semen can be stored at 63 degrees Farenheit for a maximum of five to seven days in a shipping container such as the one shown in the photograph. *Photo source: Iowa State University Veterinary Diagnostic and Production Animal Medicine*

Page 10 ***(Top)*** Piglets nursing from their mother in a farrowing crate which keeps the mother from lying on her piglets. *Photo source: Iowa State University Veterinary Diagnostic and Production Animal Medicine*

Photo and Illustration Credits

(Center) Table 3. Common Procedures Performed on Piglets by Day of Age. Photo of piglets in a pen. *Content provided by: Alex Ramirez, Veterinary Diagnostic and Production Animal Medicine, Iowa State University; Photo source: Veterinary Diagnostic and Production Animal Medicine, Iowa State University; Graphic illustration by: Dani Ausen, Iowa State University*

(Bottom) An example of a grow to finish facility in which animals are kept until they reach market weight. *Photo source: Iowa State University Veterinary Diagnostic and Production Animal Medicine*

Page 11 A typical hog confinement building (left). A close up of manure pit fans and side curtains on a confinement building (right). *Photo source: Iowa State University Veterinary Diagnostic and Production Animal Medicine (all)*

Page 12 ***(Top)*** Graphic illustration of an isolation building situated 300 yards away from a swine building in order for it to be effective. *Graphic illustration by: Dani Ausen, Iowa State University*

(Bottom) There are multiple different phases of production in the swine industry. Sows/gilts in a breeding/gestation barn where they stay until they are close to farrowing (top). Piglets in a farrowing crate which prevents the mother from lying on her piglets and protects handlers from a mother's aggressive behavior (center). Most housing for newly-weaned pigs has slotted floors to allow the pigs' waste to fall through into a holding pit or gutter. This keeps floors drier and cleaner to keep pigs comfortable and growing (bottom). *Photo source: Iowa State University Veterinary Diagnostic and Production Animal Medicine (all)*

Page 13 An outdoor rearing system (top). Individual farrowing houses known as farrowing huts (center). A typical hoop building which can be used for gestation or finishing pigs (bottom). *Photo source: Iowa State University Veterinary Diagnostic and Production Animal Medicine (all)*

Page 14 ***(Top)*** A typical creep feeder used for piglets (left). Pelleted feed (center). Meal feed (right). *Photo source: Iowa State University Veterinary Diagnostic and Production Animal Medicine (all)*

(Bottom) A feed truck emptying feed into a farm's onsite storage bins (top). A typical row of feed bins next to a swine building (center). An example of an automated feeding and watering system (bottom). *Photo sources: Iowa State University Veterinary Diagnostic and Production Animal Medicine (top & center), National Pork Board (bottom)*

Page 15 Figure 5. A Pig's Flight Zone, Point of Balance, and Blind Spot. This illustration shows where the handler should stand to start and stop animal movement. *Content and graphic illustration provided by: Transport Quality Assurance™ Handbook, National Pork Board, 2008; Interpreted by: Dani Ausen, Iowa State University*

Page 16 ***(Top)*** A trained handler using a herding panel to move animals (top). A 2-tier livestock trailer used to move pigs (center). A typical ramp with cleats used for loading pigs onto a truck (bottom). *Photo sources: National Pork Board (top), Iowa State University Veterinary Diagnostic and Production Animal Medicine (center and bottom)*

(Bottom) Table 4. Transport Space Recommendations for Pigs in Normal Weather Conditions. *Content provided by: Transport Quality Assurance, National Pork Board; Graphic illustration by: Dani Ausen, Iowa State University*

Page 17 ***(Top)*** Table 5. Truck Setup Procedures During Extreme Temperatures for Market Hogs. *Content provided by: Transport Quality Assurance, National Pork Board; Graphic illustration by: Dani Ausen, Iowa State University*

(Center) Using a pressure washer to clean and disinfect a livestock trailer in a truck wash facility. *Photo source: Danelle Bickett- Weddle, Iowa State University*

(Bottom) The proper way to pick up a piglet out of a farrowing pen is to lift them by their rear leg above the hock. *Photo Source: Alex Ramirez, Veterinary Diagnostic and Production Animal Medicine, Iowa State University*

Page 18 ***(Top)*** Photo depicting sows being off loaded. *Photo Source: Danelle Bickett-Weddle, Iowa State University*

(Bottom) A carcass of a market weight hog sold to slaughter (top). A USDA backtag applied to a sow at a slaughter facility. (bottom). *Photo Source: USDA Food Safety and Inspection Service (top), Dr. Stephen Lewis, Supervisory Public Health Veterinarian, Food Safety and Inspection Service (bottom)*

Photo and Illustration Credits

Page 19 Four methods of disposal are permitted: burial, rendering, incineration, and composting. A rendering truck picking up hogs from multiple farms (top). A photo of an incarcinator which typically works best on small farms due to the fact that it takes a few hours to complete (center). A compost pile (bottom). *Photo source: Iowa State University Veterinary Diagnostic and Production Animal Medicine (all)*

Page 20 Tractor pulling a manure wagon that is used to haul liquid manure to the field to be injected into the ground. *Photo source: Iowa State University Veterinary Diagnostic and Production Animal Medicine*

Page 21 Concrete lined storage pit holding pig manure with a fence around it to prevent entry. *Photo source: Iowa State University Veterinary Diagnostic and Production Animal Medicine*

Page 22 Table 6. Summary of Premises Designations. *Content provided by: USDA-APHIS Graphic illustration by: Dani Ausen, Iowa State University*

Page 23 ***(Top)*** Table 7. Summary of Zone and Area Designations. *Content provided by: USDA-APHIS Graphic illustration by: Dani Ausen, Iowa State University*
(Bottom) Figure 6. Control Zones. *Graphic illustration by: USDA-APHIS*

Page 24 Table 8. General Estimates on Average Feed Consumption. *Content provided by: Alex Ramirez, Veterinary Diagnostic and Production Animal Medicine, Iowa State University; Graphic illustration by: Dani Ausen, Iowa State University*

Page 25 ***(Top)*** An automatic dosing syringe, often called a vaccine gun, consistently releases the same amount of vaccine in every use and is very useful when vaccinating livestock. *Photo source: National Pork Board*
(Bottom) Figure 7. Injection Sites in Swine. This illustration depicts the various injection sites used in swine based on size and whether the injection is to be given subcutaneously or intramuscular. Subcutaneous injections should be given in the loose flaps of flank skin or behind the elbow in small pigs and in the neck behind the ear at the same location as intramuscular injections in larger pigs. Slide the needle under the skin and away from the site of skin puncture before depositing the vaccine. *Content provided by: National Pork Board; Graphic illustration by: Andrew Kingsbury, Iowa State University*

Page 26 ***(Top)*** Table 9. Recommended Needle Sizes for Swine. *Content provided by: National Pork Board; Graphic illustration by: Dani Ausen, Iowa State University*
(Bottom) Off-loading grow-finish pigs from a livestock trailer. *Photo source: Alex Ramirez, Veterinary Diagnostic and Production Animal Medicine, Iowa State University*

Page 27 An example of a liquid manure injection system used on a swine production facility. *Photo source: Alex Ramirez, Veterinary Diagnostic and Production Animal Medicine, Iowa State University*

Page 28 Photo of signs located at the entrance of a swine facility warning of a disease control area and notifying visitors of the need to check in with management before entering the farm. *Photo source: Veterinary Diagnostic and Production Animal Medicine, Iowa State University*

Page 29 ***(Top)*** Photo depicting a veterinarian collecting blood to submit for testing. *Photo source: Alex Ramirez, Veterinary Diagnostic and Production Animal Medicine, Iowa State University*
(Bottom) Photo of the proper packaging and labeling of samples placed in a cooler with ice packs that will be submitted to a laboratory for testing. *Photo source: Danelle Bickett-Weddle, Iowa State University*

Acronyms

AI	Artificial Insemination
AI/AO	All-In-All-Out
APHIS	Animal and Plant Health Inspection Service
ARP	At-Risk Premises
AVIC	Area Veterinarian-in-Charge
AVMA	American Veterinary Medical Association
BGF	Breeding-Gestation-Farrowing
BZ	Buffer Zone
C & D	Cleaning and Disinfection
CA	Control Area
CFR	Code of Federal Regulations
CP	Contact Premises
CSF	Classical Swine Fever
CVI	Certificate of Veterinary Inspection
CVO	Chief Veterinary Officer
EDI	Emerging Disease Incident
EZ	Exclusion Zone
FAD	Foreign Animal Disease
FADD	Foreign Animal Disease Diagnostician
FAD PReP	Foreign Animal Disease Preparedness and Response Plan
FMD	Foot-and-Mouth Disease
FP	Free Premises
ID	Identification
IM	Intramuscular
IP	Infected Premises
IZ	Infected Zone

Acronyms

MP	Monitored Premises
NAHEMS	National Animal Health Emergency Management System
NAHERC	National Animal Health Emergency Response Corps
NASS	National Agricultural Statistics Service
NCAHEM	National Center for Animal Health Emergency Management
OIE	Office International des Epizooties' currently referred to as the World Organization for Animal Health
PPE	Personal Protective Equipment
SOP	Standard Operating Procedures
SP	Suspect Premises
SC	Subcutaneous
SZ	Surveillance Zone
USDA	United States Department of Agriculture
VP	Vaccinated Premises
VS	Veterinary Services; a division of APHIS

Glossary

All-in-all-out (AI/AO)
Completely filling a room, building or site with animals and then completely emptying it to allow for cleaning and disinfection before the next group of pigs arrives. This process breaks the disease cycle by preventing the mixing of pigs of different ages which can carry infectious disease agents to expose younger susceptible pigs.

Barrow
A castrated male pig.

Boar
An intact male pig.

Boar Stud
A specific area or building used for holding boars and collecting semen for artificial insemination. Boar studs may be housed on the same farm where their semen is used to inseminate gilts/sows. In these facilities boars are often housed in individual stalls. A production system may have a stand alone Boar Stud that produces semen for use at multiple farms within that production system. There are also commercial boar studs which produce semen for retail sale to multiple customers. Semen from Boar Studs is shipped both intrastate and interstate either by overnight shipment with a commercial courier or delivered by a vehicle associated with the boar stud.

Carbon Dioxide Chambers
An anesthesia chamber used to administer carbon dioxide gas for the humane slaughter of swine.

Conveyor Restrainers
A restraint mechanism used in slaughter houses to move pigs.

Corn Belt States
Traditional area in the Midwest (Indiana, Illinois, Iowa, Missouri, Nebraska, Kansas) in which corn and soybeans are the dominant crops.

Creep Areas
Areas where piglets can eat their feed away from the sows.

Epididymized
Excision of the epididymis that stores, allows semen to mature, and transports it from the testicles of a boar to render it sterile.

Farrowing
Giving birth to piglets. Farrowing is also the term used to describe the production phase between birth and weaning of the piglets.

Feed Bin
A metal upright storage tank that holds feed (grain, protein, minerals) which is often located near the barn for easy dispensing.

Flight Zone
The area around an animal that will cause alarm and escape behavior when encroached upon.

Gilt
A female pig that has not yet had piglets.

Grow-Finish
Production phase in which pigs are grown to market weights.

Glossary

Inshipments
The total number of hogs shipped into a state for feeding or breeding purposes; excludes animals brought in for immediate slaughter.

Needle Teeth
The sharp, pointed canine teeth of a piglet.

Nonproductive Sow
Sows that are neither gestating nor lactating.

Price Discovery
A method of determining the price paid for a certain weight of pig based on current market conditions.

Roaster Pigs
Underweight pigs within a group of market-ready pigs that are too small to be accepted by a traditional slaughter plant. These pigs are sent for sale for whole carcass roasting or barbequing.

Sale Barns
A location for buying, selling, or trading pigs.

Segregated Weaning Facility
A facility used to house piglets that are weaned early and moved to a separate site.

Single File Races
A walkway or path setup to only allow one pig through at a time.

Sow
An adult female pig which has had piglets.

Type I Landfill
Landfill that can accept household trash and industrial waste with authorization to do so.

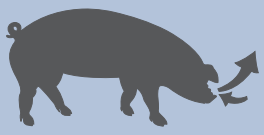
Vaccination Crew
A specialized group of individuals, either company employees or for commercial hire, that are trained to properly administer vaccines. Vaccination teams can cover a large geographical area and come in contact with many different pigs on many different farms.

Vasectomized
Excision of the vas (ductus) deferens that carries semen from the testicles of a boar to render it sterile.

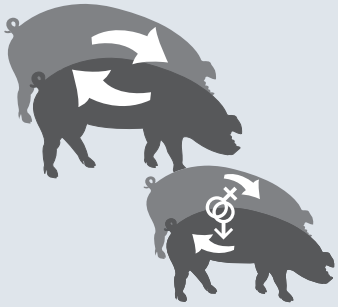
Zoonotic disease
Those diseases spread between animals and humans through direct contact with infectious fluids (at farrowing, during urination, defecation), eating undercooked pork or through vectors such as ticks or mosquitoes.

Swine Routes of Transmission and High Consequence Disease Examples

Disease causing agents can be spread from animal-to-animal or animal-to-human and vice versa, through a variety of transmission routes.

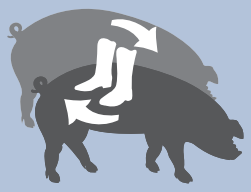


Aerosol: Droplets are passed through the air from one animal to another. Examples include foot-and-mouth disease (FMD), nipah, and rinderpest.



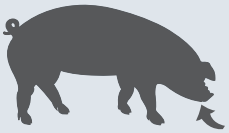
Direct Contact: A susceptible animal becomes exposed when the disease agent directly touches open wounds, mucous membranes, or the skin through blood, saliva, nose to nose contact, rubbing, or biting. Examples include African swine fever, FMD, nipah, classical swine fever (CSF), rinderpest, and vesicular stomatitis.

Reproductive: A subtype of direct contact that includes diseases spread through mating or to the fetus during pregnancy. An example would be CSF.

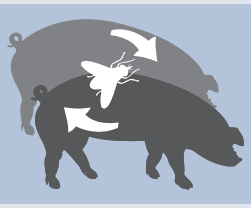


Fomite: An inanimate object carrying a disease agent from one susceptible animal to another. Examples include African swine fever, CSF, FMD, rinderpest, and vesicular stomatitis.

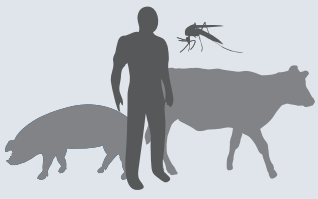
Traffic: A subtype of fomite transmission in which a vehicle, trailer, or human spreads organic material to another location.



Oral: Consuming disease causing agents in contaminated feed, water, or licking/chewing on contaminated environmental objects. Examples include African swine fever, CSF, FMD, and nipah.



Vector-borne: An insect acquires a disease agent from one animal and transmits it to another. Examples include African swine fever, CSF, Japanese encephalitis, equine encephalitis, and vesicular stomatitis.



Zoonotic: Diseases transmitted from animals to humans. Examples include nipah, Japanese encephalitis, and vesicular stomatitis (rarely).

Environmental Contamination: must always be taken into consideration.

This information was developed by staff veterinarians at the CFSPH. For more information on these diseases, visit: *www.cfsph.iastate.edu.*

the Center for Food Security & Public Health
Iowa State University

Prevention Practices for Foot-and-Mouth Disease (FMD) on U.S. Swine Operations

Foot-and-mouth disease (FMD) is a highly contagious viral disease of pigs and other cloven-hooved animals such as cattle, sheep, and goats. The last known outbreak in the United States was in 1929; however, the disease is common in other parts of the world and therefore poses a risk to U.S. swine herds.

If a case of FMD is confirmed anywhere in the United States, it could spread rapidly across the nation. If any animal on your farm is confirmed to have FMD, all may be euthanized and disposed of to control the further spread of the disease.

This document describes biosecurity practices you can take to prevent FMD from entering your farm. These measures should be put into place **IMMEDIATELY** on your farm *if FMD is confirmed anywhere in the U.S.* and continued until the U.S. is once again declared FMD free.

Transmission of the Disease

Understanding how FMD is spread to and between pigs can help highlight the importance of biosecurity measures needed on your farm and help you recognize areas that may need additional work to prevent disease introduction and spread.

FMD virus can be found in all body fluids of infected pigs, including nasal secretions, blood, urine, feces, saliva and even semen (see Appendix A). Pigs produce large quantities of **aerosolized** FMD virus, but pigs are less susceptible to this route of exposure than cattle or sheep. FMD can be spread **orally** by ingestion of contaminated feed including garbage (swill) or meat products. Transmission can also occur through **direct contact** with infected animals. The virus can also be spread reproductively. This can occur via semen (boar to sow) or during pregnancy (sow to piglet).

FMD virus can also survive in the environment, contaminating equipment, pens, buckets, even footwear and clothing of people in contact with infected pigs. These items (termed "**fomites**") can serve as an additional source of virus for susceptible pigs. If infected pigs are transported in vehicles or trailers, these items can also become contaminated and serve as a source of the virus on the farm or to other farms, if not properly cleaned and disinfected.

These exposure routes should be considered when implementing biosecurity measures to prevent the introduction of FMD onto your farm.

General Precautionary Measures

Prevention measures to minimize the introduction and spread of FMD on your farm fall into three general categories.

1. Use strict biosecurity measures for animals, animal products, vehicles, people and equipment.
2. Restrict or stop all animal movement to prevent entry or spread of the disease.
3. Detect and report any disease or unusual signs to your herd veterinarian as quickly as possible.

Specific steps to take if FMD is confirmed in the U.S. are listed below. Many should already be in place on your farm but should be enhanced and more strictly enforced if FMD is found in the U.S. These measures can help minimize the chance of FMD being introduced on your farm.

Farm Entrance

Limit access to your farm.

- The entrance to your farm is a major control point.
- Gates at farm entries should be locked when not in use.
- By having only one gated entrance to the farm, you can better control and monitor all visitors and vehicles arriving at your farm.

Post signs at the farm entrance (Appendix B).

Signs inform unauthorized visitors to not enter your farm. When entry is necessary, signs give specific rules and biosecurity measures to follow while on your farm.

Restrict or limit visitors on your farm.

- At all times, limit the number of visitors to the farm.
- Visitors who have traveled internationally within the past five days, should not be allowed to enter the farm.
- Post warning signs indicating entry onto the farm is not allowed without permission.

Strict biosecurity measures must be followed by any visitors to the farm.

Some visitors are essential for the continued operation of the farm. Establish strict biosecurity procedures for these individuals, then inform them of the measures to follow while on your farm.

This information was developed by staff veterinarians at the CFSPH for use as educational materials in the event of a Highly Contagious Foreign Animal Disease outbreak in the United States.

the Center for Food Security & Public Health
Iowa State University®

- Honk before getting out of their vehicle (to announce their arrival).
- Check-in with farm personnel upon arrival (direct visitors to "where" they should check in).
- Be accompanied by someone from the farm at all times to ensure biosecurity measures are being followed.
- Visitors and vehicles should avoid contact with animals or animal areas unless absolutely necessary
- If animal contact is necessary, wear clean farm-specific protective clothing (e.g., coveralls, boots) while on the farm. Guide visitors to where protective clothing is located. These items should remain on-farm when the visitor leaves.

Monitor and record all traffic on or off your farm.

Maintain a log sheet (Appendix C) of all visitors and vehicles that enter your farm. Accurate record keeping of traffic on your farm will help with disease surveillance and tracking if necessary. You should not rely on your ability to "recall" visitors and vehicles that were on your farm.

Vehicles

Minimize traffic onto your farm to only vehicles essential for continued operation.

- Vehicles should be parked at the farm entrance, away from animal areas, or in designated parking areas. These areas should preferably be concrete or paved areas.
- Off-farm vehicles should not be allowed to drive onto your farm unless necessary. If necessary, vehicles should be cleaned and disinfected or restricted to areas where vehicle traffic is allowed.
- Have deliveries left at the farm entrance whenever possible.

Clean and disinfect vehicles prior to entry and upon leaving.

- All vehicles entering the farm must first clean off then spray their wheels, wheel wells and under-carriage with disinfectant.
- Facilities for washing and disinfecting vehicles should be provided on-farm at the perimeter, accounting for drainage.

Do not share equipment or vehicles between farms or sites.

People

Limit employees to only those necessary for the continued operation of the farm.

Employees that have contact with swine, cattle, sheep or goats at other locations (including their own home) should use very strict biosecurity measures while on your farm.

Implement strict biosecurity measures for employees coming onto the farm.

- Clean boots, hats and coveralls must be worn while on the farm. These should be provided by your farm.
- Protective clothing should remain on your farm and be washed and/or disinfected before being worn again.
- Disinfect footwear **before entering** AND **after leaving** any animal housing area.
- Boot baths should be provided at the entrance/exit of all animal areas. The disinfectant solution should be changed at least daily or when visibly soiled.
- Hands must be washed with soap and warm water **before entering** AND **after leaving** animal areas even when gloves are used.
- Minimize contact with animals to only tasks necessary for the continued operation of the farm and health and well-being of the animals.

Educate your employees on their role in preventing disease introduction and spread. They should:

- Understand how FMD can be spread;
- Understand the farm's biosecurity procedures and how to prevent the spread of the disease;
- Know the signs of illness in pigs with FMD; and
- Know who to contact if signs of disease are seen.

Animal Movement

If FMD is confirmed in the U.S., movement restrictions may be implemented locally, regionally and possibly nationally. Restrictions will depend on the scope of the outbreak.

Know the health status and the source of any animal(s) brought onto your farm.

If animal movement is allowed in your area, thoroughly clean and disinfect the vehicle and trailer before loading and after unloading.

- Pay special attention to the tires and wheel wells.
- Avoid mixing pigs from different sources when transporting.

Maintain thorough and accurate records of animal movement.

- Document all animal movements, including the dates of introduction into the herd, where they came from and movements between separate units.
- Each farm location must be treated as a separate unit or premises. This information will be essential to help trace where the disease came from.

Animals

Do not feed meat products or unpasteurized milk to swine.

Where licensed garbage feeding has been permitted in the past, contact the state regulatory agency before feeding cooked garbage to swine to determine if regulations have changed.

Do not allow your animals to have contact with wildlife.

- Feral swine are also susceptible to FMD and, if infected, could potentially spread the virus to domestic swine.

Monitor animals closely and frequently for any developing illness or signs of disease.

Educate yourself and train your employees about FMD and the signs of illness (Appendix D).

- Blistering or ulcers on feet causing lameness
- Refusal to walk or move
- Blanching of skin at coronary band
- Blistering or ulcers on the mouth, tongue, or teats
- Fever (mild, inconsistent)
- Dullness or weakness
- Decreased appetite

Isolate any sick animals showing the signs above and contact your herd veterinarian immediately to examine sick animals.

Use separate facilities, equipment and staff to handle isolated livestock.

- If this is not possible, at a minimum, handle or visit the isolated animals LAST.
- Clean and disinfect all equipment, clothing, boots, etc. that come into contact with isolated animals.

Quarantine any newly purchased or newly arriving animals for at least 30 days.

- New or returning animals (e.g., shows, competitions) can be infected with a disease without showing any signs of illness right away.
- Quarantining the animal(s) before introducing them with the rest of the herd, allows time for any signs of disease to develop in the animal, **without exposing your entire herd** to the disease agent.
- Swine exposed to the FMD virus may take up to 14 days or more before signs of illness are seen.
- Quarantined animals should not share water, feed, facilities or bedding with your other animals.
- Ideally, animals should be quarantined at a separate location (premises).

Wildlife and Other Animals

Prevent contact with free roaming animals (wildlife, cats, dogs).

- Free roaming animals can potentially spread the FMD virus from infected to susceptible animals.
- Keep pets in a kennel or tied securely to avoid contact with livestock and feed areas.
- Ask your neighbors to do the same.

Control of wildlife will be difficult, but should be attempted.

- Keep farm access routes, parking areas, yards and storage areas clean and tidy to avoid attraction of birds or rodents.
- Implement rodent and vermin control measures to minimize the potential spread of disease by these animals (Appendix E).

Cleaning and Disinfection

The virus that causes FMD has shown to be stable in the environment. Virus stability increases at lower temperatures and with protection from sunlight. FMD virus is inactivated at pH below 6.5 or above 11. Effective disinfectants include sodium hydroxide (2%), sodium carbonate (4%), acetic acid (5%), sodium hypochlorite (6.0%) and proprietary products. In addition to selecting an effective disinfectant, proper cleaning and disinfecting procedures are essential in order to adequately and effectively control the spread of the virus.

Proper Cleaning Procedures

1. **Wear personal protective equipment:** Gloves, coveralls, rubber boots (or disposable boots) and possibly a mask if you are cleaning an area that will generate dust.

2. **Dry clean:** Remove all visible material by brush ing, scraping and/or sweeping. This is the most important step as organic matter prevents many disinfectants from working effectively. Disposal of waste material should be handled in such a way as to prevent contamination of other areas such as feed, water or other animals.
3. **Soak:** Soak the area with hot water and a detergent or cleaning agent. Be sure to wash and soap down all equipment in the area: waterers, feed troughs, pails, etc.
4. **Wash:** Wipe, spray or scrub the area, starting with the dirtiest or highest area (ceiling), after it has soaked for a period of time. This step can be enhanced by the use of pressure washers when cleaning wood, cement, or other porous surfaces. Use caution when using high pressure washers (200-1000 psi) as they can aerosolize disease organisms and spread them to other areas.
5. **Rinse:** Remove all detergent residue by applying a low pressure water rinse on all surfaces, starting with the highest area and working your way to the floor. This is especially important as certain disinfectants are inactivated by detergents and soaps.
6. **Dry:** Allow the area to dry completely before applying a disinfectant so that it can work effectively.

Proper Disinfecting Procedures

1. **Read the product label:** This is important to make sure the solution is handled correctly. Personal protective equipment (gloves, mask) should be used when mixing up solutions. Other considerations to review before applying solutions to fomites include specific dilutions, water temperature, environmental temperature, the need for ventilation and the disease organisms killed by the disinfectant.
2. **Disinfect:** Apply the product at the correct dilution and let it "sit and work" for the suggested amount of time. Contact time of the disinfectant is important for the product to inactivate or kill the microorganism present.
3. **Final rinse:** Remove all disinfectant by applying a low pressure water rinse on all surfaces, starting with the highest area and working your way to the floor.
4. **Dry:** Allow the area to completely dry before allowing animals to contact the area or item that was just cleaned and disinfected.

Proper Boot Bath Procedures

1. Mix solution to the proper concentration according to the label instructions.
2. Clean all dirt, manure and debris off of boots BEFORE stepping into the disinfectant solution. The presence of organic material (dirt, manure, etc.) will prevent most disinfectants from working.
3. Allow the disinfectant solution to have ample contact time with the boot surface. This will vary with the disinfectant selected. Consult the product label.
4. Change solutions at least daily or when visibly dirty.

Proper Storage

If the equipment or area will not be used immediately, it is important to avoid contamination between uses. Small items can be placed into plastic bags and sealed; larger items can be placed into closed cabinets. Equipment and housing areas are more difficult to protect for long periods of time and may need to be rinsed again before allowing animal contact.

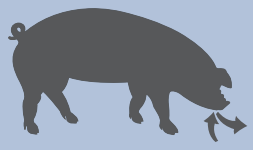
Barns and Buildings

Clean and disinfect anything that has had contact with animals, manure or animal secretions.

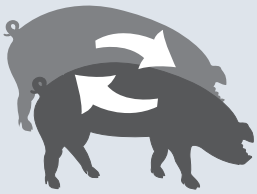
- This includes barns and buildings, vehicles, trailers, equipment, and supplies.
- Tires and wheel wells of vehicles and trailers are especially important.
- Surfaces should be scraped, cleaned with high pressure hot water and detergent, and rinsed.
- The disinfectant should then be applied and allowed to "sit" for the optimal contact time.

Appendix A - Disease Transmission Routes

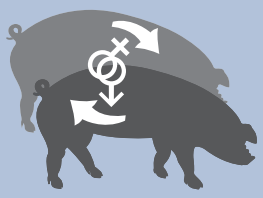
Foot-and-Mouth Disease (FMD) is a highly contagious disease of swine. The virus is shed in expired air, saliva, blood, urine, feces and semen. The various routes of transmission for the virus are listed below. FMD is not zoonotic - it does not affect humans.



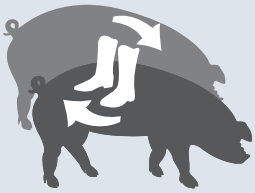
Oral: Pigs may ingest the FMD virus in contaminated feed (such as unpasteurized milk or uncooked meat products) or by licking or chewing on contaminated environmental objects.



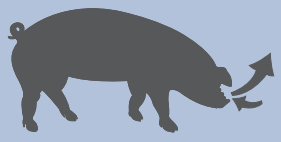
Direct Contact: Pigs can be exposed by contact with infected pigs. The virus can enter through open wounds or mucous membranes (e.g., eyes, nose, mouth) following nose-to-nose contact, rubbing or biting.



Reproductive: The FMD virus can be shed in semen during mating.



Fomites: Objects contaminated by infected pigs (e.g., equipment, buckets, feeders) can transfer the virus from one susceptible animal to another. This includes vehicles, trailers and clothing/boots worn by people because they can transfer the virus to another location.

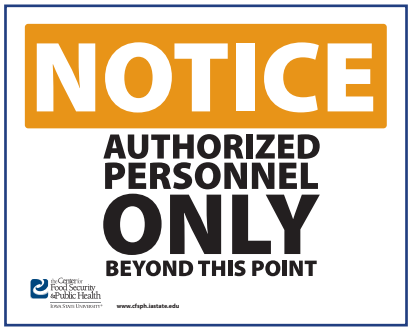


Aerosol: The virus can be carried short distances in droplets passed through the air from one animal to another.

Appendix B - Sample Signs

Sample signs to post at the farm entrance in the event of a FMD outbreak in the U.S.

(Available from the CFSPH web site at *www.cfsph.iastate.edu*)



Signage is also available from private companies such as Gempler's.

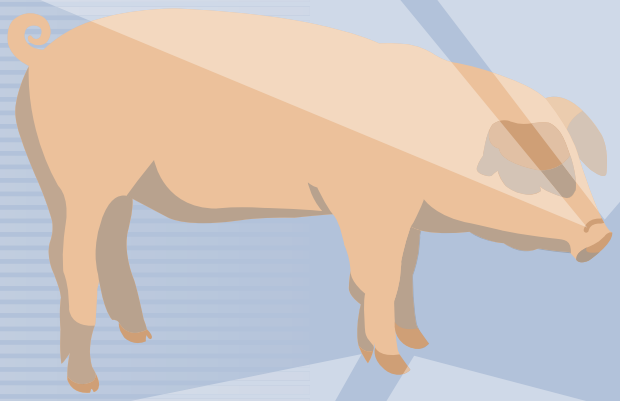
Appendix C - Daily Visitor Log

Visit Date	Name and Phone Number	Reason for Visit	Date of Last Contact with Livestock	Time In	Time Out

Appendix D - Signs of Illness in Swine

Vesicles on snout
Source: USDA

Ulcers on snout
Source: Plum Island Animal Disease Center



Epithelial lesion on foot
Source: Plum Island Animal Disease Center

Ulcer between the toes
Source: Plum Island Animal Disease Center

Appendix E - Bird and Rodent Control Measures

FMD virus may be spread on the fur, feathers, or feet of some animals. Birds and rodents may spread FMD for a short time and distance during an outbreak and can also contaminate feed and water sources. Control programs should be implemented to minimize their numbers and the risk of disease spread on your farm.

Eliminate openings for rodents or birds to enter, especially feed storage or processing areas.

- Seal any opening greater than ¼ to ½ inch with a durable material such as steel wool packed tightly into openings.
- Use materials that cannot be easily gnawed or pecked through such as concrete, sheet metal, wire mesh, aluminum or brick. Plastic sheeting, wood, rubber will not be adequate.
- Check openings around augers, pipes and wires. Use mortar, masonry or metal collars in these areas.
- Doors, windows and screens should fit tightly. The distance between the bottom of the door and threshold should not exceed ¼ inch.
- Drainage pipes or sewage systems may be used by rodents as routes to enter buildings. Equip floor drains with metal grates (openings less than ¼").

Remove potential hiding, resting and nesting sites.

- Equipment (e.g., refrigerators, powerwashers, etc.) should be raised and easily movable to allow for easy cleaning behind and underneath them.
- Sacked feed should be stacked on pallets with adequate space around and under them to allow easy inspection for signs of rodent activity and trap or bait placement.
- Rats can burrow and nest under feed bunks placed directly on the ground. Use of a concrete base around feed bunks can eliminate habitat.
- Maintain the water level in livestock waterers so it is deep enough that birds cannot stand in it.
- Hanging strips of heavy plastic vertically in doorways of buildings will allow machinery and people to pass through but keeps birds out. This will not prevent rodent entry.
- Cover the undersides of rafters with netting to exclude birds from nesting sites.

Eliminate potential food sources.

- Store feed in well sealed containers (preferably metal with tight fitting lids).
- Use covered feeders that exclude birds.
- Clean up any spilled feed immediately.

Establish a rodent barrier around buildings.

- A 3 foot wide weed-free area with a gravel rock perimeter can be used to prevent weed growth and discourage rodents from burrowing.
- Gravel (at least 1 inch diameter) should be placed in a band at least 3 foot wide and 6 inches deep.

Trap rodents to reduce vector transmission.

- Proper placement of traps and baits is important. Set traps close to walls, behind objects, in dark corners, in places where rodent activity is evident.
- Use talc or flour patches to track where rodents are active.

Bait rodents when trapping is not possible or effective.

- When using rodenticide baits, first read the label carefully and fully follow the directions.
- Use the amount of bait indicated on the package. Requirements differ between products.
- Protect baits from the weather.
- Be sure baits are not accessible to children, farm or domestic animals and birds.
- Inspect baits regularly. Check often for dead rodents and burn or bury those you find.

Contact a wildlife pest control operator in your state for further assistance. Other control methods are available, but beyond the scope of this document.

Check local legislation for allowable bird control measures. Many birds are protected by state and/or federal law.

Appendix E - Bird and Rodent Control Measures

For More Information

- Pierce RA. Bait Stations for Controlling Rats and Mice. University of Missouri Extension. *http://muextension.missouri.edu/explore/agguidees/wildlife/g09444.htm.*

- Brittingham MC, Falker ST. Controlling birds around farm buildings. Pennsylvania State University Extension. *http://pubs.cas.psu.edu/FreePubs/pdfs/uh126.pdf.*

- See T. Controlling rodents. North Carolina State University Extension. *http://www.thepigsite.com/Featured Article/Default.asp?Display=1015.*

- Baker RO, Bodman GR, Timm RM. Rodent- proof construction and exclusion methods. University of Nebraska. *http://www.ces.ncsu.edu/nreos/wild/pdf/wildilfe/RODENT_PROOF_CONSTRUCT.PDF.*

Appendix F - EPA and USDA Approved Disinfectants for FMDV

Note: Before disinfecting, all surfaces must be cleaned. This includes removing any visible material such as manure, bedding, and feed.

Product	*Dilution*	*Mixing Instructions*	*Comments*
Acetic acid* (vinegar)	5%	Add 8 ounces of glacial aceticl acid to 1 gallon of water. Mix thoroughly.	Household vinegar is a 5% solution of acetic acid. Always add acid to water - NEVER add water to acid.
Sodium carbonate* (soda ash)	4%	Add 5.33 ounces sodium carbonate to 1 gallon of hot water (or 1 pound to 3 gallons). Mix thoroughly.	Can be deactivated by hard water. Mildly caustic (irritate skin) and dull paint/varnished surfaces.
Sodium hydroxide* (lye, NaOH)	2%	Add 1/3 cup of NaOH pellets (2.7 ounces of lye) to 1 gallon of cold water.	Highly caustic (skin burns, damages metals). Use water-resistant protective clothing, gloves, safety glasses. **Warning: Always add the lye to water** - NEVER pour water over lye.
Sodium hypchlorite 6.0%* (NaOCl) (household bleach)	1:10	Add 1.5 cups of chlorine bleach to 1 gallon of water. Mix thoroughly.	Must be mixed fresh prior to each application; unstable in warm, sunny conditions (above 59°F).
Proprietary products		Follow label directions.	As of August 2010, there are 7 products registered by EPA with a claim to inactivate FMD virus.

*USDA-APHIS has an exemption for use of this chemical to inactivate FMD and only USDA personnel may use it as described.

Sources: USDA. National Emergency Response to a HIghly Contagious Animal Disease, Executive Summary. Appendix III - Disinfectants for Foot-and-Mouth Disease, Field Use. March 30, 2001. At *http://www.aphis.usda.gov/emergency_response/tools/cleaning/htdocs/images/Annex09_Cleaning.pdf*
Personal communication, Jeff Kempter, Senior Advisor Antimicrobials Division, Office of Pesticide Programs, Environmental Protection Agency
Proprietary products are listed at: *http://www.aphis.usda.gov/emergency_response/downloads/nahems/Selected%20FAD%20table%20Oct%2008.pdf*

Prevention Practices for Classical Swine Fever (CSF)

Classical Swine Fever (CSF), also known as hog cholera, is a highly contagious viral disease of pigs. Eradicated from the United States in 1978, the disease is common in other parts of the world and therefore poses a risk to U.S. swine herds.

If CSF is confirmed anywhere in the U.S., it could spread rapidly across the nation. Pigs and herds confirmed to have CSF may need to be euthanized to control the further spread of the disease.

This document describes biosecurity practices you can take to prevent CSF from entering your farm. These measures should be immediately put into place on your farm if CSF is confirmed anywhere in the U.S. and continued until the U.S. is once again declared CSF free.

Transmission of the Disease

Understanding how CSF is spread to and between pigs can help highlight the importance of biosecurity measures needed on your farm and help you recognize areas that may need additional work to prevent disease introduction and spread (see Appendix A).

CSF is primarily spread **orally** by ingestion of contaminated garbage (swill) or meat products. Once swine become infected, the virus is rapidly spread to other pigs through **direct contact**. The virus can be found in all body fluids of infected pigs, including nasal secretions, blood, urine, feces, saliva and even semen. The virus can also be spread reproductively. This can occur via semen (boar to sow) or during pregnancy (sow to piglet).

The virus can also survive in the environment, contaminating equipment, pens, buckets, even footwear and clothing of people in contact with infected pigs. These items (termed "**fomites**") can serve as an additional source of virus for susceptible pigs. If infected pigs are transported in vehicles or trailers, these items can also become contaminated and serve as a source of the virus on the farm or to other farms, if not properly cleaned and disinfected.

Other less common routes of transmission include **aerosol** spread in closed areas or mechanical transfer of the virus by insect **vectors** (e.g., flies). These areas should also be considered when implementing biosecurity measures to prevent the introduction of CSF onto your farm.

General Precautionary Measures

Prevention measures to minimize the introduction and spread of CSF on your farm fall into three general categories.

1. Use strict biosecurity measures for animals, animal products, vehicles, people and equipment.
2. Restrict or stop all animal movement to prevent entry or spread of the disease.
3. Detect and report any disease or unusual signs to your herd veterinarian as quickly as possible.

Specific steps to take if CSF is confirmed in the U.S. are listed below. Many should already be in place on your farm but should be enhanced and more strictly enforced if CSF is found in the U.S. These measures can help minimize the chance of CSF being introduced on your farm.

Farm Entrance

Limit access to your farm.

- The entrance to your farm is a major control point.
- Gates at farm entries should be locked when not in use.
- By having only one gated entrance to the farm, you can better control and monitor all visitors and vehicles arriving at your farm.

Post signs at the farm entrance (Appendix B).

Signs inform unauthorized visitors to not enter your farm. When entry is necessary, signs give specific rules and biosecurity measures to follow while on your farm.

Restrict or limit visitors on your farm.

- At all times, limit the number of visitors to the farm.
- Visitors who have traveled internationally within the past five days, should not be allowed to enter the farm.
- Post warning signs indicating entry onto the farm is not allowed without permission.

Strict biosecurity measures must be followed by any visitors to the farm.

Some visitors are essential for the continued operation of the farm. Establish strict biosecurity procedures for these individuals, then inform them of the measures to follow while on your farm.

- Honk before getting out of their vehicle (to announce their arrival).
- Check-in with farm personnel upon arrival (direct visitors to "where" they should check in).
- Be accompanied by someone from the farm at all times (to ensure biosecurity measures are being followed).
- Visitors and vehicles should avoid contact with animals or animal areas unless absolutely necessary.
- If animal contact is necessary, wear clean farm-specific protective clothing (e.g., coveralls, boots) while on the farm. Guide visitors to where protective clothing is located. These items should remain on-farm when the visitor leaves.

Monitor and record all traffic on or off your farm.

Maintain a log sheet (Appendix C) of all visitors and vehicles that enter your farm. Accurate record keeping of traffic on your farm will help with disease surveillance and tracking if necessary. You should not rely on your ability to "recall" visitors and vehicles that were on your farm.

Vehicles

Minimize traffic onto your farm to only vehicles essential for continued operation.

- Vehicles should be parked at the farm entrance, away from animal areas, or in designated parking areas, preferably concrete or paved.
- Off-farm vehicles should not be allowed to drive onto your farm unless necessary. If necessary, vehicles should be cleaned and disinfected or restricted to areas where vehicle traffic is allowed.
- Have deliveries left at the farm entrance whenever possible.

Clean and disinfect vehicles prior to entry and upon leaving.

- All vehicles entering the farm must first clean off then spray their wheels, wheel wells and under-carriage with disinfectant.
- Facilities for washing and disinfecting vehicles should be provided on-farm at the perimeter, accounting for drainage.

Do not share equipment or vehicles between farms or sites.

People

Limit employees to only those necessary for the continued operation of the farm.

Employees that have contact with swine at other locations (including their own home) should use very strict biosecurity measures while on your farm.

Implement strict biosecurity measures for employees coming onto the farm.

- Clean boots, hats and coveralls must be worn while on the farm. These should be provided by your farm.
- Protective clothing should remain on your farm and be washed and/or disinfected before being worn again.
- Disinfect footwear **before entering** AND **after leaving** any animal housing area.
- Boot baths should be provided at the entrance/exit of all animal areas. The disinfectant solution should be changed at least daily or when visibly soiled.
- Hands must be washed with soap and warm water **before entering** AND **after leaving** animal areas even when gloves are used.
- Minimize contact with animals to only tasks necessary for the continued operation of the farm and health and well-being of the animals.

Educate your employees on their role in preventing disease introduction and spread. They should:

- Understand how CSF can be spread;
- Understand the farm's biosecurity procedures and how to prevent the spread of the disease;
- Know the signs of illness in pigs with CSF; and
- Know who to contact if signs of disease are seen.

Animal Movement

If CSF is confirmed in the U.S., movement restrictions may be implemented locally, regionally and possibly nationally. Restrictions will depend on the scope of the outbreak.

Know the health status and the source of any animal(s) brought onto your farm.

If animal movement is allowed in your area, thoroughly clean and disinfect the vehicle and trailer before loading and after unloading.

- Pay special attention to the tires and wheel wells.
- Avoid mixing pigs from different sources when transporting.

Prevention Practices for Classical Swine Fever (CSF)

Maintain thorough and accurate records of animal movement.

- Document all animal movements, including the dates of introduction into the herd, where they came from and movements between separate units.
- Each farm location must be treated as a separate unit or premise. This information will be essential to help trace where the disease came from.

Animals

Where licensed garbage feeding has been permitted in the past, contact the state regulatory agency before feeding cooked garbage to swine to determine if regulations have changed.

Do not allow your animals to have contact with wildlife.

- Feral swine are also susceptible to CSF and, if infected, could potentially spread the virus to domestic swine.

Monitor animals closely and frequently for any developing illness or signs of disease.

Educate yourself and train your employees about CSF and the signs of illness (Appendix D).

- Disease signs may vary from mild to severe
- High fever (41°C/105°F)
- Dullness or weakness
- Purple discoloration of the skin
- Conjunctivitis
- Abortions and/or congenital deformities (piglets)
- Death; Mortality rates may be low

Isolate any sick animals from the herd and contact your herd veterinarian immediately to examine sick animals.

Use separate facilities, equipment and staff to handle isolated livestock.

- If this is not possible, at a minimum, handle or visit the isolated animals LAST.
- Clean and disinfect all equipment, clothing, boots, etc. that come into contact with isolated animals.

Quarantine any newly purchased or newly arriving animals for at least 30 days.

- New or returning animals (e.g., shows, competitions) can be infected with a disease without showing any signs of illness right away.
- Quarantining the animal(s) before introducing them with the rest of the herd, allows time for any signs of disease to develop in the animal, without exposing your entire herd to the disease agent.
- Swine exposed to the CSF virus may take as long as 14 days before signs of illness are seen.
- Quarantined animals should not share water, feed, facilities or bedding with your other animals.
- Ideally, animals should be quarantined at a separate location (premises).

Cleaning and Disinfection

The virus that causes CSF is sensitive to drying and sunlight. It can also be inactivated at pH of 3 or less or pH greater than 10. Effective disinfectants include sodium hypochlorite (household bleach) and phenolic compounds. Some quaternary ammonium compounds ("quats") may also be effective. In addition to selecting an effective disinfectant, proper cleaning and disinfecting procedures are essential in order to adequately and effectively control the spread of the virus.

Proper Cleaning Procedures

1. **Wear personal protective equipment:** Gloves, coveralls, rubber boots (or disposable boots) and possibly a mask if you are cleaning an area that will generate dust.
2. **Dry clean:** Remove all visible material by brushing, scraping and/or sweeping. This is the most important step as organic matter prevents many disinfectants from working effectively. Disposal of waste material should be handled in such a way as to prevent contamination of other areas such as feed, water or other animals.
3. **Soak:** Soak the area with hot water and a detergent or cleaning agent. Be sure to wash and soap down all equipment in the area- waterers, feed troughs, pails, etc.
4. **Wash:** Wipe, spray or scrub the area, starting with the dirtiest or highest area (ceiling), after it has soaked for a period of time. This step can be enhanced by the use of pressure washers when cleaning wood, cement, or other porous surfaces. Use caution when using high pressure washers (200-1000 psi) as they can aerosolize disease organisms and spread them to other areas.
5. **Rinse:** Remove all detergent residue by applying a low pressure water rinse on all surfaces, starting with the highest area and working your way to the floor. This is especially important as certain disinfectants are inactivated by detergents and soap

6. **Dry:** Allow the area to dry completely before applying a disinfectant so that it can work effectively.

Proper Disinfecting Procedures

1. **Read the product label:** This is important to make sure the solution is handled correctly. Personal protective equipment (gloves, mask) should be used when mixing up solutions. Other considerations to review before applying solutions to fomites include specific dilutions, water temperature, environmental temperature, the need for ventilation and the disease organisms killed by the disinfectant.
2. **Disinfect:** Apply the product at the correct dilution and let it "sit and work" for the suggested amount of time. Contact time of the disinfectant is important for the product to inactivate or kill the microorganism present.
3. **Final rinse:** Remove all disinfectant by applying a low pressure water rinse on all surfaces, starting with the highest area and working your way to the floor.
4. **Dry:** Allow the area to completely dry before allowing animals to contact the area or item that was just cleaned and disinfected.

Proper Boot Bath Procedures

1. Mix solution to the proper concentration according to the label instructions.
2. Clean all dirt, manure and debris off of boots BEFORE stepping into the disinfectant solution. The presence of organic material (dirt, manure, etc.) will prevent most disinfectants from working.
3. Allow the disinfectant solution to have ample contact time with the boot surface. This will vary with the disinfectant selected. Consult the product label.
4. Change solutions at least daily or when visibly dirty.

Proper Storage

If the equipment or area will not be used immediately, it is important to avoid contamination between uses. Small items can be placed into plastic bags and sealed; larger items can be placed into closed cabinets. Equipment and housing areas are more difficult to protect for long periods of time and may need to be rinsed again before allowing animal contact.

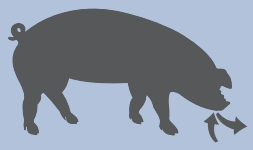
Barns and Buildings

Clean and disinfect anything that has had contact with animals, manure or animal secretions.

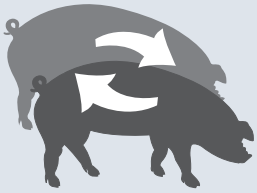
- This includes barns and buildings, vehicles, trailers, equipment, and supplies.
- Tires and wheel wells of vehicles and trailers are especially important.
- Surfaces should be scraped, cleaned with high pressure hot water and detergent, and rinsed.
- The disinfectant should then be applied and allowed to "sit" for the optimal contact time.

Appendix A - Disease Transmission Routes

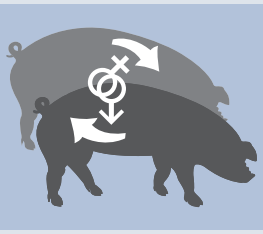
Classical Swine Fever (CSF) is a highly contagious disease of swine. The various routes of transmission for the virus are listed below. CSF is not zoonotic - it does not affect humans.



Oral: Pigs may ingest the CSF virus in contaminated feed (such as uncooked garbage or meat products) or by licking or chewing on contaminated environmental objects.

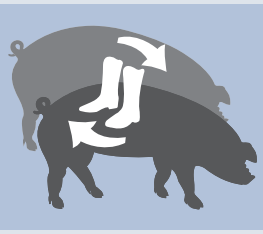


Direct Contact: Pigs can be exposed by contact with infected pigs. The virus can enter through open wounds or mucous membranes (e.g., eyes, nose, mouth) following nose-to-nose contact, rubbing or biting.



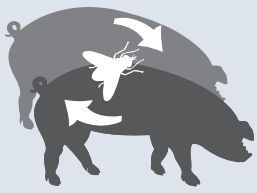
Reproductive: The CSF virus can be transmitted through semen during mating or to the fetus during pregnancy.

Aerosol: The virus can be carried short distances in droplets passed through the air from one animal to another.



Environmental Contamination: The virus is shed in nasal secretions, blood, saliva, urine, feces or can be found in the tissues of infected pigs.

- **Fomites:** Objects contaminated by infected pigs can transfer the virus from one susceptible animal to another.
- **Traffic:** Vehicles, trailers or humans (by clothing, boots, or hands) can transfer the virus to another location.

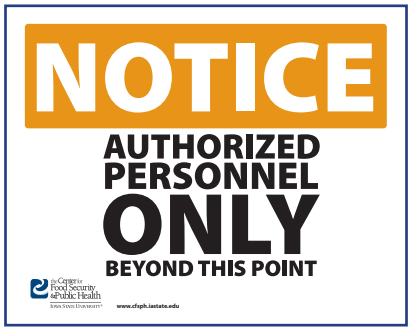


Vector-borne: Insects, such as flies, may carry the virus from one animal to another.

Appendix B - Sample Signs

Sample signs to post at the farm entrance in the event of a CSF outbreak in the U.S.

(Available from the CFSPH web site at *www.cfsph.iastate.edu*)



Signage is also available from private companies such as Gempler's.

Appendix C - Daily Visitor Log

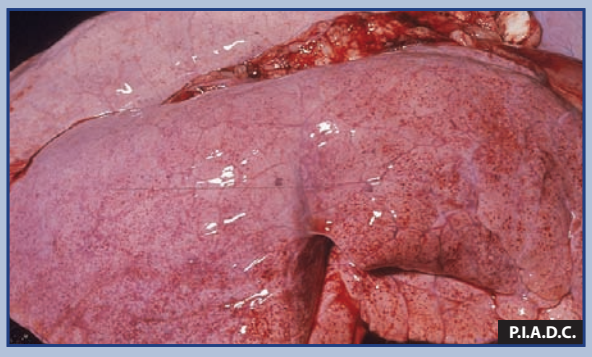
Visit Date	Name and Phone Number	Reason for Visit	Date of Last Contact with Livestock	Time In	Time Out

Appendix D - Signs of Illness in Swine

Purple skin discoloration - body
Source: Dr. R. Thanawongnuwech, Veterinary Pathology - Chulalongkorn University

Purple skin discoloration - ears
Source: Dr. R. Thanawongnuwech, Veterinary Pathology - Chulalongkorn University

Hemorrhages on the kidney
Source: Plum Island Animal Disease Center



Hemorrhages on the lung
Source: Plum Island Animal Disease Center

Sick pigs huddling
Source: Dr. R. Thanawongnuwech, Veterinary Pathology - Chulalongkorn University