

NAHEMS GUIDELINES: VACCINATION FOR CONTAGIOUS DISEASES

FAD PReP

**Foreign Animal Disease
Preparedness & Response Plan**



NAHEMS

**National Animal Health
Emergency Management System**



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

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The Foreign Animal Disease Preparedness and Response Plan (FAD PReP)/National Animal Health Emergency Management System (NAHEMS) Guidelines provide a framework for use in dealing with an animal health emergency in the United States.

This FAD PReP/NAHEMS Guidelines 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.

This document was last updated October 2014. Please send questions or comments to:

Center for Food Security and Public Health
2160 Veterinary Medicine
Iowa State University of Science and Technology
Ames, IA 50011
Phone: (515) 294-1492
Fax: (515) 294-8259
Email: cfsph@iastate.edu
Subject line: FAD PReP/NAHEMS Guidelines

National Preparedness and Incident Coordination
Animal and Plant Health Inspection Service
U.S. Department of Agriculture
4700 River Road, Unit 41
Riverdale, Maryland 20737
Telephone: (301) 851-3595
Fax: (301) 734-7817
E-mail: FAD.PReP.Comments@aphis.usda.gov

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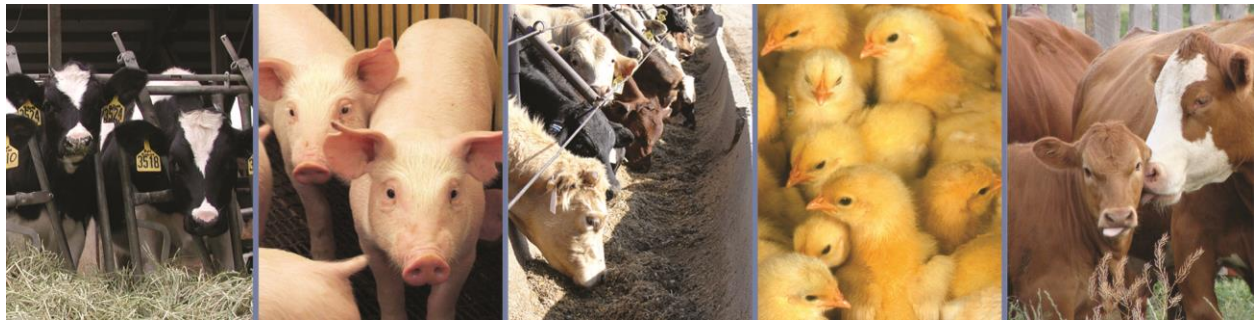
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THE IMPERATIVE FOR FOREIGN ANIMAL DISEASE PREPAREDNESS AND RESPONSE

Why Foreign Animal Diseases Matter

Preparing for and responding to foreign animal diseases (FADs)—such as highly pathogenic avian influenza (HPAI) and foot-and-mouth disease (FMD)—are critical actions to safeguard the nation’s animal health, food system, public health, environment, and economy. FAD PReP, or the *Foreign Animal Disease Preparedness and Response Plan*, prepares for such events.

Studies have estimated a likely national welfare loss between \$2.3–69 billion¹ for an FMD outbreak in California, depending on delay in diagnosing the disease.² The economic impact would result from lost international trade and disrupted interstate trade, as well as from costs directly associated with the eradication effort, such as depopulation, indemnity, carcass disposal, and cleaning and disinfection. In addition, there would be direct and indirect costs related to foregone production, unemployment, and losses in related businesses. The social and psychological impact on owners and growers would be severe. Zoonotic diseases, such as HPAI and Nipah/Hendra may also pose a threat to public health.



Challenges of Responding to an FAD Event

Responding to an FAD event—large or small—may be complex and difficult, challenging all stakeholders involved. Response activities require significant prior preparation. There will be imminent and problematic disruptions to interstate commerce and international trade.

A response effort must have the capability to be rapidly scaled according to the incident. This may involve many resources, personnel, and countermeasures. Not all emergency responders may have the specific food and agriculture skills required in areas such as biosecurity, quarantine and movement control, epidemiological investigation, diagnostic testing, depopulation, disposal, and possibly emergency vaccination.

Establishing commonly accepted and understood response goals and guidelines, as accomplished by the FAD PReP materials, will help to broaden awareness of accepted objectives as well as potential problems.

¹ Carpenter TE, O'Brien JM, Hagerman AD, & McCarl BA. 2011. "Epidemic and economic impacts of delayed detection of foot-and-mouth disease: a case study of a simulated outbreak in California." *J Vet Diagn Invest.* 23:26-33.

² Estimates based on models may vary: Ekboir (1999) estimated a loss of between \$8.5 and \$13.5 billion for an FMD outbreak in California. Ekboir JM. 1999. "Potential Impact of Foot-and-Mouth Disease in California: the Role and Contribution of Animal Health Surveillance and Monitoring Services." *Agricultural Issues Center.* University of California, Davis.

Lessons Learned from Past FAD Outbreaks

The foundation of FAD PReP is lessons learned in managing past FAD incidents. FAD PReP is based on the following:

- Providing processes for emergency planning that respect local knowledge.
- Integrating State-Federal-Tribal-industry planning processes.
- Ensuring that there are clearly defined, obtainable, and unified goals for response.
- Having a Unified Command with a proper delegation of authority that is able to act with speed and certainty.
- Employing science- and risk-based management approaches to FAD response.
- Ensuring that all guidelines, strategies, and procedures are communicated effectively to responders and stakeholders.
- Identifying resources and trained personnel required for an effective incident response.
- Trying to resolve competing interests prior to an outbreak and addressing them quickly during an outbreak.
- Achieving rapid FAD detection and tracing.

FAD PReP Mission and Goals

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 deconflict 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 to protect public health and the environment*; and (3) *provide science- and risk-based approaches and systems to facilitate continuity of business for non-infected animals and non-contaminated animal products*. Achieving these three goals will allow individual livestock facilities, States, Tribes, regions, and industries to resume normal production as quickly as possible. They will also allow the United States to regain FAD-free status without the response effort causing more disruption and damage than the disease outbreak itself.

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, both zoonotic and non-zoonotic. The following section provides examples of the different types of FAD PReP documents available.

- Strategic Plans—Concept of Operations
 - *APHIS Foreign Animal Disease Framework: Roles and Coordination* (FAD PReP Manual 1-0): This document provides an overall concept of operations for FAD preparedness and response for APHIS, explaining the framework of existing approaches, systems, and relationships.
 - *APHIS Foreign Animal Disease Framework: Response Strategies* (FAD PReP Manual 2-0): This document provides significant detail on response strategies that will be conducted in an FAD outbreak.
 - *Incident Coordination Group Plan* (FAD PReP Manual 3-0): This document explains how APHIS headquarters will organize in the event of an animal health emergency.
 - *FAD Investigation Manual* (FAD PReP Manual 4-0): This field-ready manual provides detailed information on completing an FAD investigation from start to finish.

- *A Partial List of FAD Stakeholders* (FAD PReP Manual 5-0): This guide identifies key stakeholders with whom the National Preparedness and Incident Coordination (NPIC) Center collaborates.
- 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.
- 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. They offer guidance to all stakeholders on capabilities and critical activities that would be required to respond to an FAD outbreak.
- Standard Operating Procedures (SOPs) for Critical Activities
 - For planners and responders, these SOPs provide details for conducting 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 strategy documents or disease-specific response plans.
- Continuity of Business Plans (commodity specific plans developed by public-private-academic partnerships)
 - Known as the Secure Food Supply Plans, these materials use science- and risk-based information to facilitate market continuity for specific products in an outbreak.
 - More information on these plans can be found at the following: www.secureeggssupply.com, www.securepork.org, www.securemilksupply.org, www.securebroilersupply.com.
- APHIS Emergency Management
 - APHIS Directives and Veterinary Services (VS) Guidance Documents provide important emergency management policy. These documents provide guidance on topics ranging from emergency mobilization, to FAD investigations, to protecting personnel from HPAI.

For those with 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>. Most documents are available publicly, at <http://www.aphis.usda.gov/fadprep>.

PREFACE

The Foreign Animal Disease Preparedness and Response Plan (FAD PReP)/National Animal Health Emergency Management System (NAHEMS) Guidelines provide the foundation for a coordinated national, regional, State, and local response in an emergency, complementing non-Federal preparedness activities. These guidelines may be integrated into preparedness plans of other Federal agencies, State and local agencies, Tribal Nations, and additional groups involved in animal health emergency management.

The Vaccination for Contagious Diseases Guidelines are a component of APHIS' FAD PReP/NAHEMS Guidelines Series, and are designed for use by APHIS Veterinary Services (VS), and other official response personnel in the event of an animal health emergency in domestic livestock, such as the natural occurrence or intentional introduction of a highly contagious foreign animal disease in the United States.

The Vaccination for Contagious Diseases Guidelines provide guidance for USDA employees, including National Animal Health Emergency Response Corps (NAHERC) members, on vaccination principles for animal health emergency deployments. The general principles discussed in this document are intended to serve as a basis for making sound decisions regarding vaccination. As always, it is important to evaluate each situation and adjust procedures to the risks present in the situation.

The FAD PReP/NAHEMS Guidelines are designed for use as a preparedness resource rather than as a comprehensive response document. Further vaccination information is available in the Appendices covering disease-specific strategies and general considerations for vaccination.

- Appendix A: Vaccination for Foot-and-Mouth Disease
- Appendix B: Vaccination for Classical Swine Fever
- Appendix C: Vaccination for Highly Pathogenic Avian Influenza

Appendices A, B, and C are available as separate documents on the FAD PReP web site: <http://www.aphis.usda.gov/fadprep>.

Additional vaccination resources are included in the references at the end of this document.

APHIS DOCUMENTS

This *FAD PReP/NAHEMS Guidelines: Vaccination for Contagious Diseases* references other APHIS documents, including:

- FAD PReP/NAHEMS Guidelines:
 - Biosecurity
 - Cleaning and Disinfection
 - Personal Protective Equipment

- FAD PReP Industry Manuals:
 - Beef Feedlot
 - Dairy
 - Swine

- FAD PReP Manual 2-0, Foreign Animal Disease Framework: Response Strategies

- FAD PReP Strategy Document, Classification of Phases and Types of a Foot-and-Mouth Disease Outbreak and Response

- Several key APHIS documents complement this *FAD PReP/NAHEMS Guidelines: Vaccination for Contagious Diseases* and provide further details when necessary.
 - Appendix A: Vaccination for Foot-and-Mouth Disease
 - Appendix B: Vaccination for Classical Swine Fever
 - Appendix C: Vaccination for Highly Pathogenic Avian Influenza

These documents are available on the Inside APHIS website for APHIS employees, at <http://inside.aphis.usda.gov/vs/em/fadprep.shtml>, and also at <http://www.aphis.usda.gov/fadprep>.

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Guidelines: Vaccination for Contagious Diseases

1. INTRODUCTION

In the event of an incursion of a foreign animal disease (FAD) in the United States, the U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) has the authority to manage the response effort, including the deployment of personnel to assist with response and recovery. APHIS employees as well as members of the National Animal Health Emergency Response Corps (NAHERC) may be deployed to assist during an emergency.

The control of an FAD outbreak may require large-scale vaccination of livestock to minimize the impact on animal and public health, ensure continuity of the U.S. food supply, and minimize the the impact on the economy and the environment. Emergency vaccination strategies are tools under consideration to use early in an FAD response, if appropriate vaccines are available in sufficient quantities. This *FAD PRoP/NAHEMS Guidelines: Vaccination for Contagious Diseases* is intended to provide responders with the necessary general information to conduct large-scale vaccination of a variety of domestic animal species as may be required in an animal health emergency. Decisions regarding which vaccines to use and which animals to vaccinate will vary with the disease involved, species affected, and stage of the outbreak. These decisions may change based on evolving information about the situation.

2. NATIONAL VETERINARY STOCKPILE

The National Veterinary Stockpile (NVS) is a USDA APHIS Veterinary Services resource. The NVS is organized as part of the Surveillance, Preparedness and Response Services Unit as a program within the Logistics Center. The NVS is the nation's repository of veterinary countermeasures, including animal vaccines, antivirals, supplies, equipment, and response support services.

The NVS mission is to augment State resources and provide States with the deployable countermeasures they need to respond to catastrophic animal disease outbreaks that nature or intentional introduction may create. Homeland Security Presidential Directive 9 established the NVS in 2004 to protect the nation's food supply by holding sufficient quantities of countermeasures to respond to the most damaging animal diseases affecting human health and/or the economy.

As part of the efforts to ensure the continued health and welfare of our nation's livestock and poultry populations, APHIS' animal health officials identify "high-consequence" foreign animal diseases and pests. These are serious diseases and pests that do not currently exist in the United States. If introduced here, they pose a severe threat to animal health and, in some cases, the economy and human health as well. The list of diseases and pests is divided into tiers according to risk level. Some of these diseases are biological threats that need to be considered in program priorities and countermeasure stockpile requirements. This includes future procurement of vaccines. A web link for the APHIS VS Factsheet, *High-Consequence Foreign Animal Diseases and Pests* can be found in the For More Information section at the end of this document.

The NVS program does provide logistical support for the North American Foot-and-Mouth Disease Vaccine Bank. The NVS can also arrange service contracts for mass depopulation, disposal, and disinfection of animal production facilities if required. In addition to providing resources and materials

when outbreaks occur, NVS personnel help States, Tribes, and Territories prepare for future outbreaks through careful advance planning, training, and exercises.

NVS will be deployed as needed through coordination efforts with State Animal Health Officials, VS Assistant District Directors, the VS District Offices, and the NVS Director. A web link for the National Veterinary Stockpile can be found in the For More Information section at the end of this document.

3. VETERINARY VACCINES

3.1 Regulation of Veterinary Vaccines

The USDA APHIS Center for Veterinary Biologics (CVB) regulates veterinary biologics (including vaccines, bacterins, antisera, diagnostic kits, and other products of biological origin) to ensure that the veterinary biologics available for the diagnosis, prevention, and treatment of animal diseases are pure, safe, potent, and effective. The regulation is built upon enforcement of the Virus Serum Toxin Act. The Center for Veterinary Biologics–Policy, Evaluation and Licensing (PEL) unit establishes licensing standards; reviews all prelicense documentation; reviews test methods and labels; and issues, suspends, or revokes licenses and permits. CVB-PEL also performs prelicense and surveillance testing; tests products associated with field problems; and develops references, reagents, and test methods. The Center for Veterinary Biologics–Inspection & Compliance (IC) unit inspects production facilities, methods, and records, and investigates suspected legal violations and consumer complaints.

Key licensing elements include characterization of the master seed organism, characterization of the master cell stock, host animal efficacy, back passage tests for live vaccine candidates, field safety, submission of three consecutive serials, and serial release testing (purity, safety, potency, and stability). The product must be made in accordance with the outline of production in a licensed production facility. Supporting data must demonstrate purity of master seed, master cell stock, other ingredients, and the completed product. Supporting data must confirm safety of the prelicense experimental product in laboratory animals, the environment, and host animals. Data on potency and efficacy must demonstrate support of label claims, established laboratory animal or in vitro minimum potency levels, master seed immunogenicity, duration of immunity, stability, and completed product potency.

3.2 Types of Vaccines

There are two main types of conventional vaccines: modified live vaccines (MLV) and killed inactivated vaccines. Modified live vaccines replicate in the host but should produce no or only very mild clinical signs. They induce the animal to mount an immune response that will provide protection from severe disease caused by the natural pathogen. Killed vaccines contain part or all of an inactivated pathogen. Killed vaccines generally require an adjuvant to stimulate the host's immune response and provide protection from disease. An adjuvant is a substance added to vaccines to enhance the capacity to stimulate the production of antibodies or cell-mediated immune responses. In addition, there are several types of novel vaccines developed using new technologies. These include live vectored vaccines, chimeric vaccines, plant-derived vaccines, and DNA vaccines.

Both modified live vaccines and killed vaccines, when used in food animals, are subject to mandatory withdrawal times determined by the country in which they are licensed. These withdrawal times are stated in the product license. This means that vaccinated animals or products from those animals may not enter the food chain in the time between when the vaccine is administered and before the withdrawal time has elapsed. Withdrawal times are intended to ensure meat, milk, or other products from the vaccinated animal are free from adjuvant or vaccine organism contamination. Modified live vaccines replicate in the host; and during the withdrawal time, live vaccine strain virus may be found in animal products or tissues. Animal products from killed vaccines do not pose an infectious risk, but withdrawal times are imposed to allow the adjuvants to clear from the tissues.

3.2.1 Modified Live Vaccines

Modified live vaccines are derived from the original pathogen or from a closely related pathogen. These vaccines generally rely on the vaccine organism replicating in the host to produce a protective immune response. Because they contain live organisms, these vaccines are sensitive to damage by improper handling or storage and must be handled carefully to maintain viability. If the organism in the vaccine loses viability, it will not induce an effective immune response. In stressed or immunocompromised animals, some modified live vaccines may cause disease. Modified live vaccines should not be used in pregnant animals unless they specifically state on the label that they are safe for pregnant animals. Finally, some modified live vaccines can cause significant disease if given by the wrong route.

3.2.2 Killed Vaccines

Killed vaccines can be a whole organism that has been inactivated by heating or chemical denaturation, or they can contain a portion of the organism (subunit vaccine) capable of inducing an effective immune response. This type of vaccine generally needs to be combined with an adjuvant by the manufacturer in order to induce a sufficient protective immune response. Killed vaccines often (but not always) require two doses to induce protective immunity on first vaccination.

3.2.3 Gene-Deleted Vaccines

Gene-deleted vaccines are made from organisms that have had a specific gene or genes deleted or inactivated. To develop a gene-deleted vaccine, it is essential to first identify and remove or inactivate a gene or genes which are not essential for replication or immunity.

3.2.4 Live Vectored Vaccines

Live vectored vaccines are produced by identifying a protective antigen or antigens for a particular pathogen and then engineering the genes coding for those antigens into another organism that may safely replicate and express the antigen in the target species.

3.2.5 Plant-Derived Vaccines

Genes from animal pathogens can be genetically engineered into a plant so that the transgenic plant produces large amounts of antigen that can be used as a vaccine. Pathogen genes can also be cloned into plant viruses that cause the plant infected with the plant virus to produce large amounts of vaccine antigen.

3.2.6 DNA Vaccines

DNA vaccines are produced by engineering genes for protective antigens into bacterial plasmids, which are circular pieces of DNA. This plasmid DNA is then purified from that of the bacterial expression host and directly administered to animals. The plasmid DNA must be transported into cells and transcribed by the host cell machinery into messenger RNA, which is translated into protein. The protein then may induce an antibody and T cell-mediated immune response.

3.2.7 Differentiating Infected from Vaccinated Animals (DIVA) Vaccines

Conventional vaccines induce antibodies to all of the antigens associated with an infectious agent. This masks the ability to detect animals that are actually infected with the agent and complicates efforts to eradicate a given disease or to declare an area disease-free. During a disease outbreak, use of vaccines has been avoided in many instances to prevent confusion and resulting trade restrictions. DIVA (Differentiating Infected from Vaccinated Animals) vaccines can facilitate the rapid elimination of a pathogen during an outbreak, while minimizing interruptions in animal trade.

DIVA vaccines may be either live or killed vaccines, and they are developed along with a companion diagnostic kit that can identify vaccinated animals which have become infected. DIVA vaccines provide a protective immune response, but they lack specific antigens associated with the virulent pathogen. The companion diagnostic kit is then designed to detect antibody against the antigen that is present in the pathogen but absent in the vaccine. Thus, animals or herds of animals that have been infected with the

naturally occurring pathogen (and therefore serve as a reservoir of infection) can be identified and removed. These vaccines are pivotal to some disease eradication programs.

3.3 Vaccine Delivery

There are numerous methods to deliver vaccines to animals, and each licensed vaccine is intended only for delivery by the routes stated on its label. Vaccines may be packed in individual dose vials or multiple dose vials. Always refer to the vaccine label and/or insert to determine the volume of a single dose and the route by which it should be given.

3.3.1 Parenteral Injection

Parenteral vaccines are delivered with a syringe and needle, and may be given in the muscle (intramuscularly) or under the skin (subcutaneously). The syringe and needle size should be selected according to what is appropriate for the dose, species, and number of animals to be vaccinated. To prevent cross-contamination and disease spread, a new needle is used for each animal vaccinated parenterally.

3.3.2 Needle-Free (Transdermal) Injection

Needle-free vaccines must be delivered with a specialized system, which usually drives the vaccine into the skin with a burst of compressed air or gas. The main advantage of needle-free vaccines is that there is minimal contamination of the vaccine delivery device from bodily fluid. Therefore, the risk of spreading disease from one animal to another by vaccination equipment is low. Another advantage is that there are no needles that require changing between animals. Also, needle-free systems deliver some vaccine to the dermis, which may enhance efficacy of the vaccine.

3.3.3 Intranasal

Intranasal vaccines are delivered with a squeeze bulb attached to an intranasal delivery device, or with a syringe attached to a plastic intranasal applicator. Intranasal vaccination mimics a more natural route of infection for some diseases and may produce a more appropriate immune response.

3.3.4 Ocular

Ocular vaccines are primarily used for chickens and other fowl. The vaccine is diluted in a colored diluent and applied to the surface of the eye. As with intranasal vaccines, ocular vaccination may mimic a natural route of infection for some pathogens and produce a more appropriate immune response.

3.3.5 Oral

Oral vaccines may be diluted in drinking water or sprayed onto food. Oral vaccines must be consumed within an allotted time frame to ensure efficacy, and care must be taken to avoid vaccine inactivation by water, disinfectants, or inappropriate water temperatures. Oral vaccines delivered through automatic waterers are convenient for mass vaccination but are usually limited to use in chickens, other fowl, and pigs. Oral vaccination relies on the animal's willingness to eat or drink the vaccine, and it must be accepted that some animals in a group will not receive a therapeutic dose of vaccine by this method. The aim is to vaccinate a sufficient percentage of animals to protect the group from serious disease.

3.3.6 Spray/Topical

Spray vaccinations are diluted in water or diluent and misted, sprayed, or nebulized onto a large group of animals. Spray vaccines, like oral vaccines, are convenient for mass vaccination. As with oral vaccines, not every animal in a group vaccinated by spray will receive a therapeutic dose of vaccine. The aim is to vaccinate a sufficient percentage of animals to protect the group from serious disease.

4. VACCINE HANDLING

Proper handling of vaccines during transport, storage, and reconstitution (when appropriate), and between administrations is critical to ensuring the safety and efficacy. Should an emergency vaccination program be implemented as a response strategy in an FAD outbreak, vaccine supplies may need to be transported into the field for administration into the animals. Vaccine may be delivered to a central location, assembled into smaller lots, repackaged and transported to individual locations. The vaccine may be reconstituted on site before administration. All conditions and handling of the vaccine will need to be appropriate to maintain efficacy.

Requirements for individual vaccines vary, but understanding and following general principles of vaccine handling will maximize the likelihood that vaccines will perform as expected. Always refer to the vaccine manufacturer's recommendations for the specific handling requirements of each vaccine. If a vaccination strategy is used in an FAD response, guidance will be provided by Incident Command.

Much of the information presented here is derived from the *Vaccine Storage and Handling Toolkit* produced by the Centers for Disease Control and Prevention (CDC). A web link for the *Vaccine Storage and Handling Toolkit* which also contains signs, charts and conversion tables can be found in the For More Information section at the end of this document.

4.1 Maintaining a Cold Chain

Vaccines must be transported and stored within a relatively narrow range of temperatures. Excessive heat or cold can damage a vaccine and reduce its potency or render it completely ineffective. Once potency has been lost, it can never be restored. Most vaccines do not have any readily detectable changes to their appearance to indicate that they have been damaged or stored improperly. Therefore, it is critical that vaccines are transported and stored at appropriate temperatures. The system used to ensure that vaccines stay within an appropriate temperature range from the manufacturer to the point of administration is commonly called the cold chain. Most vaccines require either refrigeration or freezing. Vaccines intended to be refrigerated should never be frozen, and no vaccines should be subjected to freeze-thaw cycles. Some vaccines are sensitive to light, so they should be stored in their box until they are needed.



4.2 Vaccine Storage Units

Refrigeration and freezing units used for the storage of vaccines should ideally be dedicated to the storage of vaccines and should never be used for the storage of food or beverages. Dormitory-style refrigerators with an internal freezer compartment are not acceptable for the long-term storage of either refrigerated or frozen vaccines.

Vaccines requiring a storage temperature of 35 to 46°F (2 to 8°C) can be kept in the refrigerator compartment of a standard household or commercial refrigerator. Those requiring maintenance at 5° F (-15°C) or lower can be kept in a household or commercial freezer. Care must be taken to prevent overfilling of any type of cooling unit, as this impedes the circulation of cold air. The temperature inside the storage unit should be measured with a calibrated internal thermometer and recorded at least once per day. The temperature of circulating air inside of a refrigeration unit may not accurately reflect the temperature of packaged product. For more accurate readings, consider placing the bulb of the thermometer inside a container of simulated vaccine. Temperature logs for freezers and refrigerators in both Fahrenheit and Celcius are available for download from the Immunization Action Coalition (IAC),

under Clinic Resources, Storage and Handling. A web link for the IAC temperature logs can be found in the For More Information section at the end of this document.

To avoid temperature fluctuations inside the unit, limit the number of times the door is opened, and do not leave the door open longer than necessary. Always ensure that the doors are properly closed and sealed. Perform regular maintenance on the vaccine storage unit, keep the storage unit clean, dusting the coils and cleaning beneath it every 3–6 months.

Do not plug a cooling unit into an outlet controlled by a wall switch or a power strip, as these switches may be turned off inadvertently. Consider placing a “Do Not Unplug” sign near the outlet and/or on the cooling unit. Signs are available from the IAC. A web link for the IAC “Do Not Unplug” Signs can be found in the For More Information section at the end of this document.

Label the circuit or fuse controlling the vaccine storage units so that these circuits are not shut off. If possible, cooling units should have an emergency backup power supply or generator to ensure temperature is maintained in the event of a power failure. Consider installing a temperature alarm on cooling units. Plan for a back-up storage unit(s) in the event of a power failure or other unforeseen event.



Vaccines should not be kept in the doors of refrigerators or freezers or in the vegetable bins of household refrigerators. Temperatures in these areas vary from the main compartment. The top shelf of many combination refrigerator-freezer units is colder than the main refrigerator compartment because this is where cold air from the freezer compartment vents into the refrigerator unit. Items kept in this area may be subject to freezing temperatures. If you are unsure whether a specific area inside a refrigerator or freezer is suitable for vaccine storage, place a calibrated thermometer in that area and check it regularly.

4.3 Diluents

Many vaccines arrive from the manufacturer as a lyophilized (dried powder) component and an accompanying sterile diluent. The dried vaccine must be reconstituted with the diluent provided by the manufacturer for that specific vaccine. The diluents of different vaccines, vaccines from different manufacturers, and even different lot numbers of the same vaccine ARE NOT interchangeable. Always use the diluent provided for the specific vaccine lot.

Diluents often do not require refrigeration, so unless a vaccine and its diluent are packaged together, they may be stored separately to save refrigerator or freezer space. Alternatively, diluents not requiring refrigeration can be stored in areas of the refrigerator or freezer that are not suitable for long-term vaccine storage, such as the doors or vegetable bins. Make sure that all personnel who will use the vaccine know where the appropriate diluent for each vaccine is kept and that diluents are never switched. If multiple vaccines are kept in one cooling unit, be sure to clearly label vaccine diluents to avoid confusion.

4.3.1 Guidelines for Reconstituting Dried (Lyophilized) Vaccines

The following guidelines are modified from the CDC *Vaccine Storage and Handling Toolkit* which can be accessed by the web link found in the For More Information section at the end of this document.

Check the diluent label and lot number to be sure it is for use with the vaccine selected. Make sure that neither the diluent nor the vaccine has passed the expiration date. Remove the protective caps from the vaccine and diluent vials and wipe the rubber tops with an alcohol swab.

Using a sterile single-use syringe and needle, insert the needle into the diluent vial and withdraw the entire contents. Inject all of the diluent into the lyophilized vaccine vial and mix by rotating or agitation (according to the insert for the specific vaccine). Vaccines should not be allowed to warm up before or during reconstitution, nor should live vaccines be exposed to light longer than necessary for their handling.

Single-dose lyophilized vaccines should not be reconstituted until immediately prior to use. For single-use vaccines, withdraw the entire contents of the reconstituted vaccine into an appropriate syringe. Administer the vaccine promptly to minimize loss of potency.

For multi-dose vials, draw up the volume indicated for a single dose and withdraw the needle. Change to a new needle before administration. If using a multi-dose syringe, draw up the desired amount of vaccine, set the dial to the volume indicated for a single dose, and change the needle between each animal if there is concern about transmission of disease between animals.

Multi-dose vaccine vials should be marked with the date they were reconstituted and discarded before the time interval indicated by the manufacturer. Multi-dose vaccines should be used or discarded on the premises on which they are reconstituted. In order to reduce disease spread or mishandling, multi-dose vials of vaccine should not be moved from one animal facility to another.

The expiration date and time after reconstitution varies by vaccines. See the package insert for information about the specific vaccine.

4.4 Maintaining Sterility in Multi-Dose Vials

While many vaccines are packaged as a single dose, some vaccines, particularly livestock vaccines, are packaged in multi-dose vials. To ensure each dose is safe and effective, it is important to prevent contamination of the bottle and to store each bottle as recommended by the manufacturer between uses. Sterile technique should be used to withdraw each dose of vaccine. The rubber stopper should never be removed from the bottle top, and it should be wiped with an alcohol swab or appropriate antiseptic before piercing.

A new sterile needle should be used each time the rubber stopper is pierced. Self-contained ice-packs should be used to keep vaccines cool rather than placing the vaccine vials directly into ice, as submerging the vial into partially melted ice or water can contaminate the rubber stopper.

Clearly mark multi-dose vials of vaccine with the date and time they were first opened or reconstituted and the initials of the user. Many multi-dose vials of vaccine expire within a specified time frame after they have been opened or reconstituted, and this date will differ from the expiration date indicated on the vial by the manufacturer. Dating the vials also helps to identify which vials of vaccine should be used first.

4.5 Receiving and Transporting Vaccines

4.5.1 Receiving Shipments

Vaccine shipments should be inspected immediately upon arrival. Check the shipping container and contents for signs of physical damage. Ensure that the vaccines are not expired or close to their expiration date, and make sure that lyophilized vaccines have been shipped with sufficient diluent for their reconstitution. If cold chain monitors were included in the shipment, check them to determine if the vaccines have been exposed to temperatures outside the recommended range during transport.

4.5.2 Transporting Vaccines

Minimize the number of times a vaccine is transported because transport increases the risk that a vaccine will be exposed to inappropriate conditions. During transportation, it is critical that appropriate storage temperatures are maintained to preserve the cold chain and thus vaccine efficacy. A standard calibrated thermometer may be used to monitor temperature on delivery or a cold chain monitoring device may be used. Diluents should travel with their corresponding vaccines at all times.

4.5.2.1 To Package a Vaccine for Shipment

These guidelines are modified from the CDC *Vaccine Storage and Handling Toolkit* which can be accessed by the web link found in the For More Information section at the end of this document.

1. **Delay opening the refrigerator or freezer door** until you have made all preparations for packing.
2. **Pack refrigerated vaccines first** if you are transporting both refrigerated and frozen vaccines.
3. **Use properly insulated containers.** This may include the package the vaccines arrived in, a hard-sided plastic cooler, or a Styrofoam cooler with walls at least two inches thick.
4. **Pack enough refrigerated/frozen packs to maintain the cold chain.** Loose or bagged ice is not considered adequate. Refrigerated vaccines should use freezer packs, while vaccines that must remain frozen should use a minimum of six pounds of dry ice.
5. **Place an insulating barrier between the refrigerated/frozen packs and the vaccines to prevent accidental freezing.** This may include bubble wrap, crumpled brown packing paper, or Styrofoam peanuts. The container should be layered as follows inside the insulated container:
 - Refrigerator/freezer packs
 - Barrier i.e. bubble wrap, crumpled brown packing paper, Styrofoam peanuts
 - Vaccines
 - Thermometer or cold chain monitoring device
 - Barrier
 - Additional refrigerator/freezer packs
6. **Pack vaccines in original packaging.** Do not remove vaccines from vials or boxes, and do not draw up vaccines in advance.
7. **Thermometer or cold chain device** should be placed next to the vaccines and not in direct contact with the refrigerator or freezer packs.
8. **Note the packing time** on the outside of the package so that the time vaccines spent in transit is known on arrival.
9. **Affix labels** to the outside of the package to clearly identify the contents as fragile and perishable.
10. **If travelling by car** stow the packed vaccines in the passenger compartment, not in the trunk of the vehicle. The temperature in the trunk of the vehicle is highly dependent on weather.



4.5.3 Cold Chain Monitors

Devices are available for shipment with vaccines to indicate that temperatures have either exceeded or dropped below recommended ranges.

4.5.3.1 Heat Indicators

Heat indicators, also known as time and temperature indicators (TTIs), are made for a single use not exceeding 48 hours. Those appropriate for vaccine shipment indicate that temperatures have exceeded 50°F, and also indicate how long (up to 48 hours) the time was above this temperature. Heat indicators should be pre-conditioned by placing them with the vaccines until they have equilibrated temperatures. Once they are in the shipment box with the vaccines and equilibrated, pull the activation tab to begin the monitoring process.

4.5.3.2 Freeze Indicators

Freeze indicators are for a single use. They do not indicate the length of time exposed to freezing temperatures. They indicate that the contents of a shipment have dropped below 32°F (0°C). Refer to the instructions for use for each type of freeze indicator.

4.6 If the Cold Chain is Broken

If there is indication that a vaccine has been subject to temperature excursions beyond the acceptable range either during shipment or storage, clearly mark the vaccine “DO NOT USE” and immediately return it to proper storage conditions. **DO NOT IMMEDIATELY DISCARD THE VACCINE.** Contact your supervisor for guidance. In an animal disease emergency, vaccines may be in short supply. Your supervisor, an APHIS VS official within Incident Command, or the Center for Veterinary Biologics program official will provide instructions on how to proceed.

4.7 Personal Safety: A Few Modified Live Vaccines Can Infect Personnel

Some vaccines, particularly modified live vaccines, have the potential to cause serious illness or infection in humans if they are accidentally injected or stuck with a needle. Use caution when handling any vaccine, particularly modified live vaccines, to avoid exposure to vaccines and needle sticks. Many killed vaccines for use in animals have potent adjuvants that may cause severe tissue reactivity in humans, especially if injected into a joint such as a finger joint. Always seek attention from a physician if vaccine exposure is suspected.

5. SYRINGES, NEEDLES, AND OTHER VACCINE DELIVERY DEVICES

Selecting the appropriate instrument to deliver a vaccine is critical to the success of a vaccination program. Always consult the vaccine insert for the appropriate dose and route of delivery for a particular vaccine.

5.1 Single-Use Disposable Syringes

Single-use disposable syringes come in a variety of sizes, from one to 60cc. They are relatively inexpensive and meant to be discarded after a single use. Single-use syringes are appropriate for parenteral vaccination of small numbers of animals, and for vaccines that come in single-dose vials. Select a needle size appropriate for the species in question and the route of administration. Further guidelines on vaccination needle size can be found in the vaccine administration sections for each species.



5.2 Automatic Multi-Dose Syringes

Automatic multi-dose syringes usually hold a maximum of 50cc of vaccine. They can be adjusted to deliver one to five cc, depending on the appropriate dose for the vaccine being used. Clean and maintain syringes between uses. Thoroughly rinse any detergents or disinfectants from the syringe after each use to prevent inactivation of vaccines, particularly modified live vaccines. These syringes are considerably more expensive than single-use disposable syringes. Plastic versions are available at a lower cost, but replacement parts for these models are harder to find. Label the plastic automatic multi-dose syringes when first used with the user's initials and date of first use; discard after approximately of month of use. Automatic multi-dose syringes are appropriate for vaccinating large numbers of livestock, such as cattle being run through a chute. Reload the syringe after 10-25 animals, as needed depending on the volume used. The nature of multi-dose syringes makes it easy to forget to change needles, but, like single-use syringes, the needle should be changed before puncturing the seal of the vaccine vial and between each animal if there is concern about transmission of diseases between animals.



5.3 Bottle-Mount or Draw-Off Multi-Dose Syringes

Like automatic multi-dose syringes, bottle-mount or draw-off multi-dose syringes are convenient for vaccinating large numbers of livestock. This type of syringe attaches directly to the vaccine vial via a length of flexible tubing, making repeated puncture of the vaccine vial unnecessary. This also reduces the chances that the vaccine vial will be contaminated by repeated punctures. This type of syringe requires careful cleaning and maintenance between uses, and any detergents or disinfectants should be thoroughly rinsed out after cleaning. Bottle-mount syringes may be broken during use around fractious animals, so holster-mounted bottles that attach the vaccine vial to the person administering the vaccine may be preferable.

5.4 Needle-Free Injection Systems (Intradermal or Transdermal)

Needle-free injection systems are available for some vaccines from the vaccine manufacturer. This type of device uses compressed air or gas and a pressure amplifier to inject the vaccine into the skin of the animal without using a needle. The obvious advantage to this type of system is that bodily fluids are less likely to contaminate the delivery device, thus reducing the risk of disease spread between animals and obviating the need to replace needles between animals. These devices are relatively expensive to purchase and are more difficult to maintain. Needle-free injection is not yet licensed for the majority of parenteral vaccines.



5.5 Intranasal Pipettes

Intranasal delivery devices are meant for a single use and are usually supplied by the manufacturer with the vaccine and diluent. They may be stand-alone squeeze pipettes or plastic tubes that can attach to a disposable syringe. In lieu of a provided intranasal pipette, intranasal vaccines can be administered drop-wise to dogs and cats with a disposable syringe.

5.6 Ocular Drop Bulbs

Ocular vaccine delivery devices are usually supplied by the manufacturer with the vaccine and diluent. The dropper bottle makes it easy to deliver a single drop to the eye. This type of delivery device is most commonly used for fowl.

5.7 Spray Vaccine Delivery Systems

Spray vaccines are sometimes used to inoculate birds in one of two ways: either by inhalation of small particles or by ingestion and mucous membrane contact.

6. ANIMAL IDENTIFICATION

If emergency vaccination is necessary in the face of a disease threat, particularly an FAD event, identifying each individual animal with a nationally unique animal identification number (AIN) and associating that individual with a standardized location identifier at a point in time may be critical. In some circumstances, an alternative may be to identify a group of animals rather than identifying each individual, for example in swine and poultry. It is essential to have accurate information on which animals have been vaccinated in order to manage a disease outbreak. Keeping accurate records such as date, geographic location of the animal, and type of vaccine hinges on the ability to identify to which animal(s) the record refers. In the case of livestock, uniquely identifying individuals, pens, lots, groups, or herds of animals may be necessary to track vaccination records, testing results, or other information for the emergency response. Many, but not all, locations where livestock are housed are uniquely identified with their State or Tribal Nation.

The United States has a flexible, effective animal disease traceability system for livestock moving interstate under routine circumstances. Unless specifically exempted, livestock moved interstate need to be officially identified and accompanied by an Interstate Certificate of Veterinary Inspection (ICVI). When agreed upon by the shipping and receiving States, other movement documentation and methods of identification may be used. Some livestock identification methods and devices used for interstate movement and disease control programs are recognized as official, and some are used only for herd management purposes. Some official devices and methods are used in multiple species, while others are species-specific. It is required to record all official identification on official animal disease control documents such as test charts, vaccination records, movement permits, sample submission forms, etc. so the animal's location can be traced through time. It is important to note that some of the ID methods are considered official only when approved and agreed upon by the animal health officials in the shipping and receiving States or Tribes. Other methods may be approved by the APHIS Administrator.

However, if emergency vaccination is going to be used as part of an FAD response, official, permanent identification of all vaccinated animals may be necessary. Temporary forms of identification of livestock are not official but may be used for on-farm management and as a supplemental form of ID. Any form of temporary ID should be linked to the official identification device in the records. Based on the circumstances and the nature of the outbreak, guidance will be provided by Incident Command; any action will be in compliance with relevant Federal and State regulations. The following section discusses forms of animal identification, whether permanent or non-permanent.

In the United States, eartag identification devices for livestock marked with the United States' three-digit country code, 840, can be purchased to individually identify animals. These devices may be visual tags, radio frequency identification devices (RFID) read by an electronic scanner, or both. A variety of devices for different species are available, including ear tags and ear buttons, and RFID injectable transponders, also called microchips. Ear tags are for use in cattle, pigs, bison, elk, and deer. Ear buttons are for use in cattle, pigs, sheep, goats, bison, elk, and deer. RFID ear tags emit at 134.2 kHz (low frequency) or 860-960 MHz (ultra-high frequency). Injectable transponders are manufactured for implantation in horses,

alpacas, llamas, deer, and elk and emit at 134.2 kHz. In contrast, microchips manufactured for companion animals emit at 125 kHz, 128 kHz, or 134.2 kHz.

There are multiple animal identification methods and technologies available for livestock, described below. The minimum standard for official identification of some species is a visual eartag. For example, when using the 840 AIN for cattle, the minimum identification standard is the visual AIN eartag.

Eartags with the AIN are USDA official tags and are:

- Designed for one-time use (tamper evident)
- Imprinted with
 - AIN (15-digit number starting with 840)
 - Official Eartag Shield
 - Unlawful to Remove
 - Manufacturer's Logo or Trademark (printed or impression of)

A web link for information on USDA official identification devices, and species-specific identification and documentation requirements can be found under USDA Animal Disease Traceability in the Resources/Web Links section at the end of this document.



6.1 Horses

Horses may be involved in an animal disease event either as a susceptible species or as having exposure to or contact with an infected animal. Identification may be needed if the individual has been included in emergency vaccination or if the individual is potentially involved in indirect disease transmission. Microchips, tattoos, and brands are considered forms of permanent identification in horses. Temporary identification includes collars, stall cards, and photos.

6.1.1 Permanent Identification

6.1.1.1 Radio Frequency Identification (RFID)

Radio frequency identification (RFID) injectable transponders are manufactured for use in horses, alpacas, llamas, deer and elk. These transponders, also called microchips, serve as a permanent and long-term method of identification in horses. The microchip is intended to be implanted in the nuchal ligament from the left side, in the middle third of the neck, halfway between the ears and withers.



6.1.1.2 Tattoos

Horses, particularly thoroughbreds, are typically tattooed inside the upper lip. The Thoroughbred Racing Protective Bureau maintains a registry of thoroughbred horse lip-tattoos. For matters relating to Standardbred tattooing, please contact the United States Trotting Association (USTA), and for Quarter Horse tattooing, please contact the American Quarter Horse Association (AQHA). Other registries may track tattoo numbers for other breeds.

6.1.1.3 Brands

Brands on horses typically appear as an identifiable bald area or area of white hair, commonly on the crest of the neck, the hip, or the shoulder. Be sure to check for brands beneath a horse's mane. When recording identifying brands, note both the brand and the location of the brand on the animal (e.g., left hip or right shoulder), as the brand location will also be registered. Note that many equine brands do not identify individual horses, but instead identify the horse's ranch, owner, breed, or herd of origin. All American

mustangs captured by the U.S. Department of the Interior Bureau of Land Management (BLM) are freeze-branded on the left side of the crest of the neck with a brand that can identify the individual horse. The BLM brands are coded with the alpha angle symbol system. A web link for decoding the BLM alpha angle symbol system can be found in the For More Information section at the end of this document.

6.1.2 Temporary Identification

Temporary identification methods for horses include collars, stall cards, USDA back tags and photos. In addition, horses may have information tags attached to their halter, luggage tags braided into their mane or tail, information painted or etched into a hoof, or information painted or written on their side with water-proof paint or ink. A complete physical description should include breed, sex, age, height, weight, color, and markings such as leg and face markings, hair whorls, and scars, and any RFID number, brand, or tattoo.



6.2 Swine

Swine raised in large production systems are typically identified by group or lot, rather than individually. Group/lot numbers are associated to the animals through records maintained by individuals responsible for the group throughout the production chain. Swine can be identified by tattoo, ear notching, ear tags, or some combination thereof. The methods of identification vary between operations. For most grow-finish pigs, sows, and boars, unique individual animal identification is not necessary for movements within a State. Under normal circumstances, unique individual identification for pigs is only required when pigs are commingled with animals from other sources (feeder swine markets, sale barns, cull markets, etc.).

USDA official 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 with other species that may be included in an emergency vaccination program, identification, along with the vaccination records will help to properly account for all vaccinated animals.

6.2.1 Permanent Identification

6.2.1.1 Ear Tattoos

Most nursery and grow-finish pigs are identified as a group or lot. This is usually done through a unique tattoo that has been registered and assigned to a particular farm by the State of origin or recorded by a swine registry association. This tattoo is identical for all pigs produced by that particular farm and is usually applied to the inside of one of the pig's ears in the first few days of life. Tattoos can also be applied to the inner flank.

6.2.1.2 Ear Notches

Ear notches are a form of on-farm animal identification used for animal health management and husbandry purposes. When baby pigs 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*.



6.2.1.3 Ear Tags

Ear tags for swine can be small plastic dangle tags and may be marked with homemade numbers or USDA premises identification number, and may be pre-printed through a commercial source, or purchased from a registered breed association. Radio frequency identification (RFID) button tags can also be used as individual identification in swine. Like other species, these require a special scanner to be read. Metal clip tags are yet another form of individual identification and should be placed prior to commingling multiple sources.

6.2.3 Temporary Identification

Swine can be temporarily marked with a wax marker or permanent marker to indicate which animals have been vaccinated or treated.

6.3 Cattle

Cattle can be identified with brands, ear tags which may be radio frequency identification (RFID) tags, visual button tag, plastic dangle tags, or some combination thereof. Some States also allow identification by an orange metal brucellosis vaccination tag or a silver metal tag in the right ear. The methods of identification vary between operations. Young animals on a farm, such as pre-breeding age calves, may or may not be individually identified.

6.3.1 Permanent Identification

6.3.1.1 Ear Tattoos

While not unique to the farm or the animal, animals that have received a brucellosis vaccine should have a tattoo in their right ear. Some purebred cattle will have a unique registration number tattooed in their left and/or right ear that is registered with the breed association. This is an official form of identification only when its use is agreed upon by the shipping and receiving State animal health officials. Some non-registered cattle may be identified with a numbering system that is specific to a facility rather than a national registry, and thus is not an individual form of identification.

6.3.1.2 Brands

Cattle residing on premises west of the Missouri River are often branded with a symbol registered to their ranch or herd of origin. A brand may be registered with a brand inspection agency and accompanied by a brand inspection certificate. When recording identifying brands, note both the brand and the location of the brand (e.g., right hip as pictured), as the brand location will also be registered in some States or Tribes. Note that ranch brands do not distinguish individual cattle originating from the same ranch, so additional systems must be used to identify individual animals. Brands are official identification only when their use is agreed upon by the shipping and receiving State animal health officials.

6.3.1.3 Ear Tags

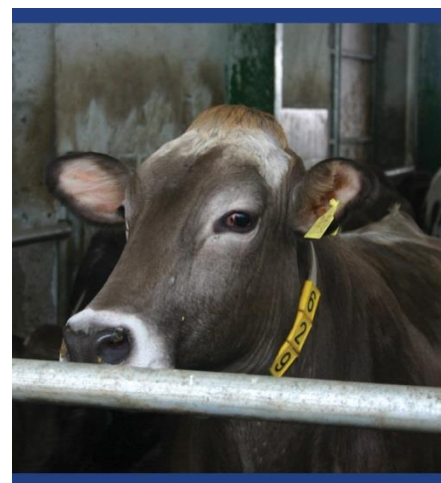
Both beef and dairy cattle are commonly identified individually with visual ear tags. Often, cattle will have an identical tag in each ear, so that the animal can still be identified should one of its ear tags be lost. The shape, color, size, and numbering system of these tags will vary by facility. Plastic dangle tags may be marked with homemade numbers, pre-printed numbers through a commercial source, or may be purchased from a registered breed association. Many facilities will reuse tag numbers from non-registered animals after an animal has been moved off the premises. Because each premises uses its own ear tag numbering system, numbers may be duplicated when animals from multiple premises are mixed. In this case, additional identifying information should be recorded for each animal or a nationally unique, USDA official identification device should be affixed to the animal. Official visual eartags or RFID tags may be purchased from approved manufacturers, from tag managers, or from animal health officials.

6.3.2 Temporary Identification

Cattle can be identified with several of the temporary identification methods used for horses, including collars, photos, information painted or etched into a hoof, or information painted or written on the side of the animal with water-proof paint or ink. A physical description should include markings and any tag number or brand. It is worth repeating, the temporary forms of animal identification are not official but may be used for on-farm management and as a supplemental form of ID. However, they should be linked to the the official identification device in the records.

6.3.2.1 Collars

Some dairy operations use cow neck collars with a visually identifiable number and/or a radio-frequency device that can be scanned with a specialized reader in the parlor to record milk production data or interface with automatic feeders. Collar numbers vary with the facility and are generally recycled to incoming replacement animals.



6.4 Sheep & Goats

6.4.1 Permanent Identification

6.4.1.1 Radio Frequency Identification (RFID)

Radio frequency identification (RFID) can be used in sheep and goats in the form of a microchip placed in an ear tag. The chip is programmed with the tag number and is read with a reader device with the data then being transferred to a computer. Producers in the United States are moving toward this form of identification due to advantages of automated data capture systems for eradicating diseases such as scrapie (a fatal transmissible spongiform encephalopathy).

6.4.1.2 Tattoos

Tattoos are commonly used to identify small ruminants because of their permanence. Sheep tattoos can be found on the inside of the ear and include a number and sometimes a letter or herd mark.

Tattoos are the most common form of permanent identification among goat herds. The most common places to tattoo a goat are on the inside of the ear flap and the tail web. Tattooing the tail web is often more desirable because certain breeds do not have big enough ear flaps to tattoo and because dairy goats are sometimes milked from the rear, where the tail web tattoos are more visible.

6.4.1.3 Ear Notches

Ear notches in sheep have a variety of meanings, which vary from flock to flock. Some producers use the notches to identify the type of birth (single or multiple) in one ear and the week or year of birth in the other ear. Others use ear notches to identify sheep that are going to be culled from the herd, usually for reproductive reasons. These are not considered an individual form of animal identification.

6.4.1.4 Ear Tags

Ear tags are the most common form of identification in sheep and goats. They come in a variety of shapes, sizes, and colors, and can be purchased either blank or pre-numbered. Each herd has its own numbering system.

Scrapie tags are now required by law for all sheep and goats entering into interstate commerce. This is part of the United States' effort to eradicate scrapie by ensuring that each and every animal can be traced back to its original herd. Scrapie tags are a premises ID tag, with a unique animal identification number and a unique herd identification number.



6.4.3 Temporary Identification

6.4.3.1 Paint Brands

Often used at sales and auctions, paint brands consist of large painted numbers on the back or the side of the animal. They allow for quick identification from a distance, especially during times like lambing or flock vaccinating.

6.4.3.2 Neck Straps

Neck straps are similar to a collar for a dog or a cat, but are larger and have a number printed on them. They are mainly used in dairy animals or for judging contests.

6.4.3.3 Auction or Hip Tags (Back Tags)

An auction or hip tag is a sticky tag sometimes placed on sheep or goats when they are taken to an auction market (commonly referred to as back tags). They are used to identify the animal and where it came from. Because they are temporary, they are usually used with other forms of identification.

6.4.3.4 Chalk, Paint Sticks, and Spray Paints

Chalk, paint sticks, and spray paints are commonly used to temporarily mark animals after they have been bred, pregnancy checked, or vaccinated.

6.5 Dogs and Cats

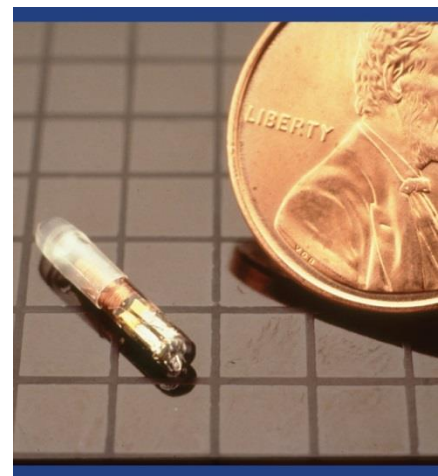
In an FAD outbreak, dogs and cats may be involved as susceptible species (e.g., Rift Valley fever, Hendra, and Nipah) or as mechanical vectors on livestock operations, posing a risk of disease spread. Identification of animals may be important in order to associate them with their home premises.

Some animals may have permanent identification such as microchips or tattoos. In emergency situations, temporary visual identification systems such as temporary collars and photos may be employed to identify each animal.

6.5.1 Permanent Identification

6.5.1.1 Microchips

The most reliable method of identifying companion animals is with a microchip, an injectable RFID transponder about the size of a grain of rice implanted beneath the skin. In dogs and cats, microchips are regularly placed between the shoulder blades, although some chips may migrate beneath the skin as far as the ventral chest. Microchips contain a unique multi-digit code that is not visible, but can be read with a handheld scanning device. This code can then be linked to a database containing information about the animal's owner, and making it possible to identify the home premises and other pertinent information.



Many brands of microchips are available for dogs and cats in the United States. The microchips emit at 125 kHz, 128 kHz, or 134 kHz. Scanners tend to be brand-specific and not capable of reading codes from other brands, even if they emit at the same frequency. Universal scanners capable of reading any brand of microchip are available, and are ideal.

6.5.1.2 Tattoos

Some companion animals may have identification tattoos on their inner thigh or inside flap of the ear. These tattoos may be tied to a national registry.



6.5.2 Temporary Identification

6.5.2.1 Temporary Collars

Similar to the wrist identification bands used in human hospitals, temporary disposable collars are readily available for animals. The collars are waterproof, inexpensive, disposable, and come in a variety of colors. The animal's information can be written directly onto the collar with permanent marker. At a minimum, the animal's name, the owner's name, and the owner's telephone number should be recorded on the collar.

6.5.2.2 Photos

Photographing dogs and cats can be a valuable method of animal identification. Four views of each animal are recommended: front, rear, and both sides.

7. RECORD KEEPING

Accurate and accessible record keeping is crucial to the success of any vaccination effort. Sufficient data must be recorded to determine which animal or herd was vaccinated on a particular date against which disease(s), and to trace the vaccine source and lot number. Recording unnecessary data can waste time and clutter data sheets. For an emergency vaccination effort, instructions will be provided as to what information should be recorded. A copy of the vaccination records may be kept with both the herdsman and a regional vaccine coordinator in the event of a highly contagious FAD outbreak. Appendix D provides a Sample Herd/Flock Vaccination Form that can be modified as needed for the event. The Emergency Management Response System (EMRS) 2.0 is the system of record for all FAD incidents. EMRS 2.0 is a web-based application used for the reporting of routine investigations of FADs, surveillance and control programs, State-specific disease outbreaks, and national animal health emergency responses (all-hazards).

7.1 Minimum Information in a Vaccination Record

- All individual animal identification devices and number(s)
- Name and mailing address of animal owner
- Signalment (species, age, sex, breed)
- Date of vaccination
- Route of vaccination (intramuscular [IM], subcutaneous [SC], intranasal [IN], oral) and location on the animal
- Vaccine information
- Brand or manufacturer
- Product name or number
- Lot number
- Expiration date
- Withdrawal date (for food-producing animals)

Maintaining careful records aids in ensuring each animal is vaccinated. See Appendix D, Sample Herd Vaccination Form.

8. VACCINES FOR FOREIGN ANIMAL DISEASES

USDA APHIS has identified key terrestrial FAD threats that if introduced to the United States, or its Territories, may pose a severe threat to animal health and, in some cases, the economy and/or human health. These FADs may infect one or more species of animals. Some of the vectors that transmit FADs are found in the United States, while others are foreign to the United States. The following table identifies some of the key terrestrial FADs that pose a risk to the United States and the primary type of animal affected. This following list is taken from *APHIS Foreign Animal Disease Framework: Response Strategies (FAD PRoP Manual 2-0)* and includes diseases most likely to occur based on known methods of transmission.

Key Terrestrial FAD Threats to the United States and its Territories

FAD	Primary type of animal affected	Highly contagious disease	Vector-borne disease	Zoonotic disease potential
Diseases with FAD PReP Response Plans (Red Books)				
Highly pathogenic avian influenza	Avian,others	Yes	No	Yes
Foot-and-mouth disease (FMD)	All cloven hoofed animals	Yes	No	No
Classical swine fever	Swine	Yes	No	No
Newcastle disease (ND) (virulent ND virus)	Avian	Yes	No	Yes Minor
Diseases with FAD PReP Disease Response Strategies				
African swine fever	Swine	Yes	Yes	No
Japanese encephalitis	Equine, swine	No	Yes	Yes
Peste des petits ruminants	Caprine, ovine	Yes	No	No
Rift Valley fever	Bovine, ovine, caprine	No	Yes	Yes
Diseases with VS Response Materials				
Contagious equine metritis	Equine	No	No	No
Equine piroplasmiasis	Equine	No	Yes	No
Schmallenberg virus	Bovine, caprine, ovine	No	Yes	No
Vesicular stomatitis virus	Equine, bovine, swine, ovine, caprine	No	Yes	Yes Rare
Other FAD Threats (Alphabetical Order)				
African horse sickness	Equine	No	Yes	No
Akabane	Bovine, ovine, caprine	No	Yes	No
Bovine babesiosis	Bovine	No	Yes	No
Contagious bovine pleuropneumonia	Bovine	Yes	No	No
Contagious caprine pleuropneumonia	Caprine	Yes	No	No
Dourine	Equine	No	No	No
Glanders	Equine	Yes	No	Yes
Heartwater (<i>Ehrlichia ruminantium</i>)	Bovine, ovine, caprine, other ruminants	No	Yes	No
Lumpy skin disease	Bovine	No	Yes	No
Nairobi sheep disease	Ovine, caprine	No	Yes	Yes Minor
Nipah, Hendra (Henipavirus)	Swine, equine respectively	Yes (Nipah)	No	Yes
Rabbit hemorrhagic disease	Wild and domestic rabbits (sp. <i>Oryctolagus cuniculus</i>)	Yes	No	No
Sheep pox, goat pox	Ovine, caprine	Yes	No	No
Surra (<i>Trypanosoma evansi</i>)	Equine, bovine, others	No	Yes	No
Swine vesicular disease	Swine	Yes	No	No
Theileriosis (East Coast fever)	Bovine	No	Yes	No
Venezuelan equine encephalitis	Equine, avian	No	Yes	Yes

There are three epidemiological principles that form the foundation of any response strategy to contain, control, and eradicate an FAD – in particular, a highly contagious FAD – in the United States.

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

Vaccines can be an important tool in an emergency response effort. In an emergency situation, instructions will be provided by Incident Command on which vaccines to administer, which populations are to be vaccinated, which route of administration is appropriate, and recommended withdrawal times (if applicable). However, vaccines do not exist for all animal diseases that are foreign to the United States.

Many vaccines are manufactured in the United States; all vaccines used in the United States must be licensed by USDA as described in Section 3.1. Additionally, it is important to remember that vaccine used in food animals has a mandatory withdrawal time (the number of days between when the vaccine is administered and the animal or its products enter the food chain).

There are some vaccines for FADs that are used in countries other than the United States to control endemic situations. However, they may or may not be licensed for use in the United States. There are many circumstances which broadly impact the potential use of these vaccines in the United States. These may include market demand, the manufacturer's cost to achieve licensing by USDA, the pathogen, the specificity of the vaccine to protect against a potential disease threat, trade implications should animals be vaccinated, and ultimately meeting the USDA criteria for licensure. Also, to be produced in the United States, the level of laboratory biosecurity and containment necessary for development and manufacturing may be elevated; biosecure laboratories may not be available, or their use may be economically cost prohibitive depending on the demand for the vaccine.

The Compendium of Veterinary Vaccines for Transboundary Diseases is intended to be an international web-based resource on the availability of vaccines for transboundary diseases. This website provides comprehensive information on the availability of vaccines worldwide. A web link for the Compendium of Veterinary Vaccines for Transboundary Diseases can be found in the For More Information section at the end of this document.

9. GUIDANCE ON VACCINE ADMINISTRATION

Vaccines licensed for use in the United States are approved for administration by a specific route stated on the label. The most common routes include subcutaneous injection, intramuscular injection, and intranasal. Vaccination of poultry may also use oral, spray (or nebulization), eye drop, cutaneous scarification, and in ovo injection routes; these are discussed in the poultry section.

Refer to the vaccine manufacturer's instructions for specific information on the appropriate dose and route of administration for individual vaccines. Recommended locations for administering injections vary among species. Withdrawal time, the number of days from the time a vaccine is administered until the animal or its products such as milk may enter the food chain, must be communicated and followed.

Proper handling and restraint of the animal is necessary to ensure the proper dose of vaccine is safely administered at the correct location. Safety involves avoiding injury to the vaccination crew, as well as to the animal. Some adult breeding animals, particularly males, may be dangerous and require proper restraint. Inappropriate vaccination technique may introduce contamination and infection into the animal.

Although it may be common practice to not change needles between livestock within the same group, to prevent cross-contamination and disease spread, use a new needle for each animal vaccinated parenterally. Properly dispose of all used needles in an approved biomedical sharps container.

Maintaining careful records helps ensure to that each animal is vaccinated. In some instances, marking the livestock temporarily with a wax marker can ensure that all animals receive the appropriate vaccination. See Appendix D, Sample Herd Vaccination Form.

In an emergency situation, instructions will be provided by Incident Command on which vaccines to administer, which population of animals are to be vaccinated, which route of administration is appropriate, and recommended withdrawal times (if applicable). The method of animal identification and record keeping will be clarified. Some livestock, such as cattle, may be targeted for emergency vaccination based on the pathogen, the concentration of cattle potentially exposed in an outbreak, and the value of the animals, either individually or collectively. Depending on the response strategy, vaccinated cattle may be allowed to live out their useful life, such as for breeding or milk production. Long term identification and record keeping may be essential.

A description of the more common methods of vaccine administration is provided below. Recommended guidelines for vaccination location and needle size and length are provided based on the species in the section that follows.

9.1 Subcutaneous Injection

The subcutaneous (SC) route injects the vaccine under a loose area of skin on the animal. Lift up a tent of skin and insert the needle of the vaccine syringe. Ensure that the needle has not penetrated through the other side of the skin tent. To ensure that the needle has not inadvertently punctured a blood vessel, draw back the plunger of the syringe to see if any blood appears in the hub of the needle. If blood does appear, simply withdraw the needle, replace it, and try again. As long as no blood appears, inject the entire dose of vaccine, withdraw the needle, and allow the skin tent to fall. Check the area for vaccine contamination of the hair coat, which may indicate that the needle punctured through the whole thickness of the skin tent and that the animal did not receive an adequate dose of vaccine. If vaccine is noted on the hair coat, wipe it off with an alcohol swab. If you suspect that the animal has not received a full dose of vaccine, revaccinate the animal.

9.2 Intramuscular Injection

The intramuscular (IM) route injects the vaccine deep into a muscle. Use the same precaution to avoid puncturing a blood vessel as in SC administration. Specific locations are recommended based on the species so that injury to large nerves coursing through the muscle will be prevented. In food animals, deep intramuscular injections may blemish the muscle, affecting carcass quality and value. Therefore, whenever permitted by the vaccine label, it is best to inject food animals subcutaneously rather than intramuscularly. Caution is used to avoid placing too much volume into one location. If multiple vaccines are to be administered, use both sides of the animal to separate the sites.

9.3 Intranasal Administration

The intranasal (IN) route administers the vaccine onto the mucous membranes of the nasal cavity. This protocol uses a syringe attached to a long plastic nasal applicator rather than a needle. Attach a new applicator to the syringe and draw up the indicated dose into the applicator. The vaccine should fill the applicator, but should not enter the attached syringe. Insert the full length of the applicator into the nasal cavity, with the entire syringe visible at the opening of the nostril. Depress the plunger over about one second, then withdraw and appropriately dispose of the applicator. This method is used for some vaccines in horses and companion animals. This application of vaccine more closely mimics the route of exposure to some pathogens, and therefore prompts a more protective immune response.

10. VACCINATION PROTOCOLS AND ANIMAL HANDLING

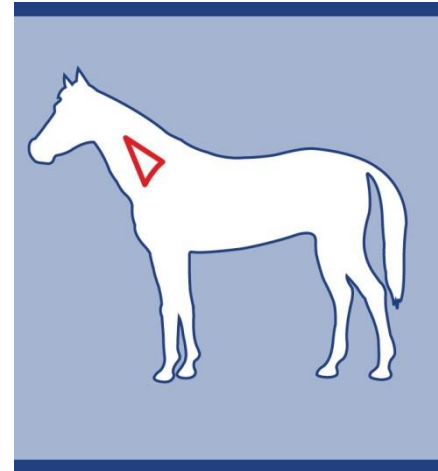
The following section is meant to be a general guide to familiarize the responder with common, appropriate restraint methods to safely handle domestic animal species during vaccination administration.

10.1 Horses

10.1.1 Vaccine Administration in Horses

10.1.1.1 Subcutaneous Injection

The neck is the preferred injection site for subcutaneous injection in horses because of the relatively loose skin in this area. Use a new 18 to 20 gauge, 1 to 1.5 inch needle for each animal. If giving multiple vaccinations to one animal, do not give them in the same site. For therapeutic treatments, do not administer more than 10mL in any one site, and separate injection sites by at least four inches.



10.1.1.2 Intramuscular Injection

Intramuscular vaccines should be given in the neck in the region indicated by the diagram. If giving multiple vaccinations to one animal, do not give them in the same site. Use a new 18 to 20 gauge 1 to 1.5 inch needle for each animal. Insert the needle at a 90 degree angle into the area indicated in the diagram above and inject the vaccine dose. For therapeutic treatments, do not administer more than 10mL in any one site and separate injection sites by at least four inches.

10.1.1.3 Intranasal

Intranasal route of administration more closely mimics the route of exposure to some pathogens, such as influenza. Therefore this introduction of the vaccine prompts a more protective immune response at the site of exposure. Proper restraint will be necessary, as some horses resist such activity around their nostrils.

10.1.2 Handling Horses

The following are general guidelines for safe equine handling. The ability to effectively handle and restrain animals for vaccination is critical to the success of any vaccination program. Horses are fearful by nature, and when startled they may bolt, kick, strike, or bite. Their size and strength makes them a danger to handlers. Unusually fearful, aggressive, or poorly-trained horses should be handled by experienced individuals. Wild, feral, or unhandled horses should be treated with extreme caution and handled with an alleyway and equine stocks rather than halters or other restraints.

Always allow a safe escape route for handlers when working with horses. If two or more people are handling a horse, they should stand on the same side of the horse so that the horse can move away from both people if it is startled. Do not stand directly in front a horse as it may run forward, strike with its front legs, or bite. When passing behind a horse, either pass directly behind the animal, with one hand on its rump as you pass around, or at least 10 to 12 feet behind the horse. Horses can kick very accurately with their hind feet with a reach of at least six to eight feet. Trained horses are accustomed to being led and handled primarily from their left side, so work on this side of the animal when feasible.

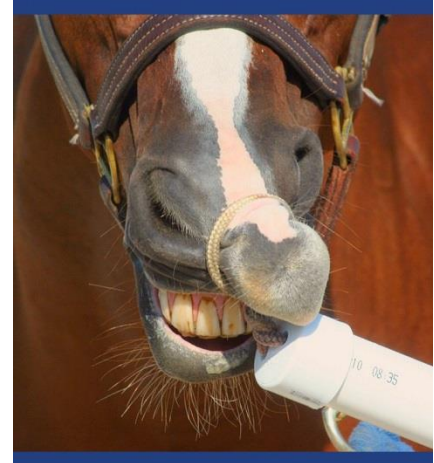
Several methods of restraint and restraining equipment are listed below.

10.1.2.1 Halters

A halter is the most basic piece of equipment for handling horses, and most are trained to be led with a halter and lead rope. Halters come in a variety of sizes and styles.

10.1.2.2 Twitches

A twitch is a device placed around a horse's upper lip that causes mild pain and release of endorphins, calming it and distracting it from mildly painful procedures. Care must be taken not to apply a twitch too tightly or for too long to prevent injury to the muzzle. To apply a chain or rope twitch, first place the twitch over your hand, then grasp the horse's nose firmly with the same hand. Fold the bottom of the upper lip together to protect the delicate mucous membranes. Slide the twitch over your hand and onto the horse's lip, twist the handle to apply an appropriate amount of pressure, and release your grip on the upper lip. The pressure may need to be altered during the procedure depending on the horse's response. Humane twitches are composed of two smooth metal rods hinged at the top. The twitch is clamped on to the upper lip by a method similar to applying a chain or rope twitch. Humane twitches are milder, but may not be as effective as a chain twitch.



10.1.2.3 Lead Shank or Stud Chain

A lead shank is a length of chain with a snap at one end and a ring at the other. It provides additional control when used with a halter, particularly for stallions. A lead shank can be used several ways. Most often, the snap end is brought through the left (near) cheek ring, brought over the bridge of the nose, and snapped to the right (off) cheek ring of the halter. The lead rope is then attached to the ring of the lead shank. The lead shank can instead be passed under the chin, although this may cause the horse to toss its head. Occasionally, the lead shank is passed through the mouth, either in front of the upper gums, or through the bars of mouth like a bit. Passing the lead shank in front of the upper gums is relatively harsh, and may cause tissue trauma if the lead rope is tugged roughly.

10.1.2.4 Stocks

Stocks for horses are different from those used for cattle in that the sides are mostly open and there is no head catch. Most stocks have moveable panels on each side of the horse, and are used for rectal or reproductive examinations. Usually, the back of the stocks are opened, the horse is led through the stocks with the lead rope passed around the poles, and the rear of the stocks are closed behind the horse after it has entered. For safety reasons, the handler should never enter the stocks with a horse.



10.1.2.5 Blindfolds

Blindfolds can be used to calm very fractious animals but may lead to injury. Blindfolded horses often become passive and reliant on the handler to guide them, but they may also freeze or panic when blindfolded.

10.1.2.6 Ear Twisting

Ear twisting is not a recommended method of restraint because it can break the cartilage of the ear and cause the horse to fear having its ears touched.

10.1.2.7 Eyelid Press

Gently pressing on the closed upper eyelids of a horse may calm the horse briefly for minor procedures such as vaccination.

10.1.2.8 Distraction

Firmly patting a horse or moving its loose skin before or during injection can distract a sensitive horse long enough to perform brief and minimally painful procedures such as vaccination.

10.2 Swine

10.2.1 Vaccine Administration in Swine

10.2.1.1 Subcutaneous Injection

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.

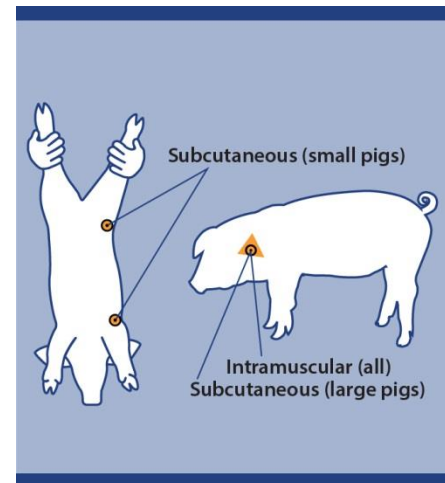
10.2.1.2 Intramuscular Injection

Intramuscular injections should be given in the neck just behind and below the ear, but in front of the shoulder.

10.2.1.3 Needle-Free Injection

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.

For the more common methods of vaccine injection in swine, see the table listing recommendations on size and length of needles.



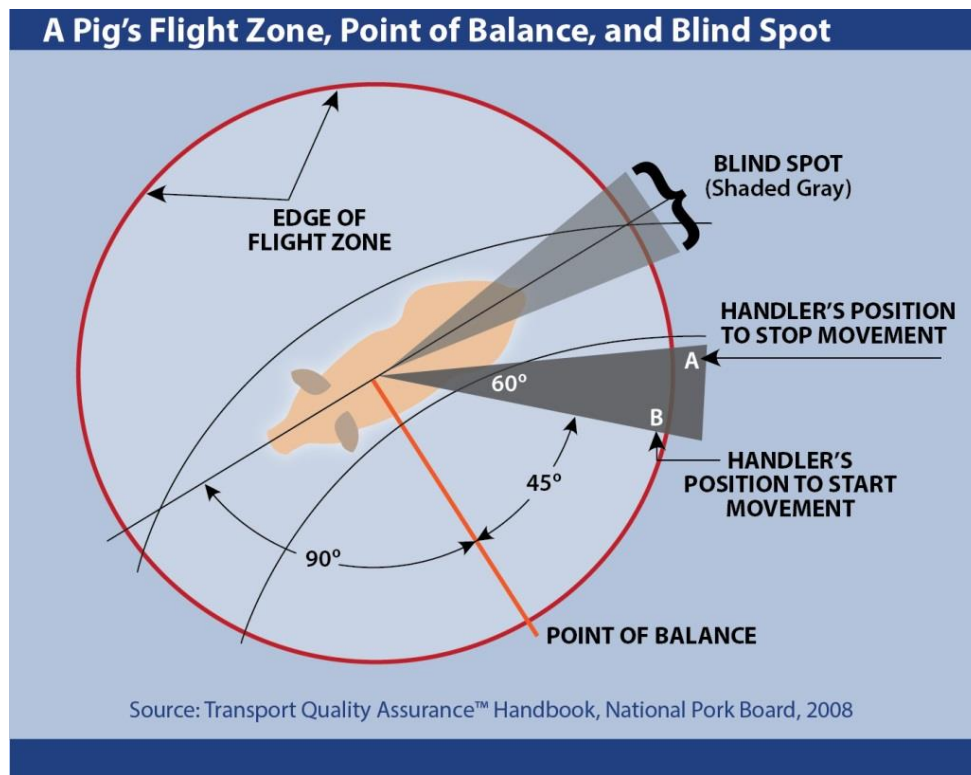
Recommended Needle Sizes for Swine Injections		
Intramuscular Injection	Gauge	Length
Baby Pigs	18 or 20	5/8" or 1/2"
Nursery	16 or 18	3/4" or 5/8"
Finisher	16	1"
Breeding Stock	14, 15 or 16	1" or 1 1/2"
Subcutaneous Injection	Gauge	Length
Nursery	16 or 18	1/2"
Finisher	16	3/4"
Breeding Stock	14 or 16	1"

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

10.2.2 Handling Swine

Transportation of pigs between facilities or to market is an important aspect of swine production. Quiet swine-handling by well-trained people is essential. Animal handlers should be trained to use behavioral principles of handling, such as flight zone and point of balance, as illustrated below. 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. Because pigs are seldom individually identified, marking swine temporarily with a wax marker can ensure that all animals in a pen receive the appropriate vaccination.

A good, practical understanding of a pig's flight zone will make moving and handling them much easier and less stressful for both handler and animal. When the handler is standing outside the flight zone, the animal will turn towards the handler. Once the flight zone is invaded, the animal will turn away. It is best to work on the outside of an animal's flight zone. Invading it too deeply can result in unpredictable behavior and possible injury to either the handler or the animal. The size of the flight zone varies depending on the animal's temperament and the extent of past handling. For further handling guidelines, refer to the *FAD PReP Swine Industry Manual*.



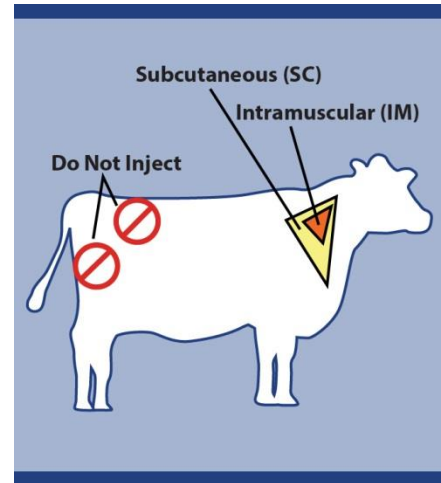
10.3 Cattle

10.3.1 Vaccine Administration in Cattle

10.3.1.1 Subcutaneous Injection

The preferable route of injection in cattle is subcutaneous because it is least likely to affect carcass quality. The neck is the preferred injection site. If multiple vaccinations are given to one animal, they should not be given in the same site. For therapeutic treatments, no more than 10mL should be administered in any one site, and it is recommended to separate injection sites by at least four inches.

Subcutaneous injections are relatively simple to administer. To reduce the possibility of accidentally sticking oneself with the needle (which can have adverse consequences for certain vaccines), use an 18 gauge needle 0.5 to 0.75 inches in length and inject at an acute angle to the skin so that there is no need to tent the skin. The skin and subcutaneous fat in an adult cow in the region indicated is thick enough that it is unlikely a 0.75 inches needle will penetrate the underlying muscle. With the cow adequately restrained, inject directly into the skin in the region indicated by the diagram. Alternatively, lift up a tent of skin and insert the needle of the vaccine syringe to administer.



10.3.1.2 Intramuscular Injection

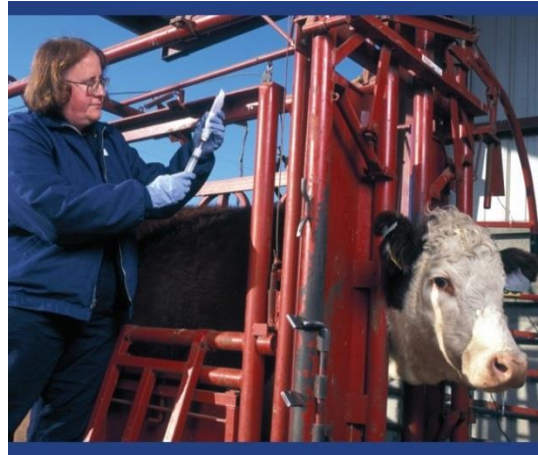
If a vaccine injection must be given intramuscularly, it should be given in the neck in a triangle outlined by the shoulder, the vertebrae, and the nuchal ligament. Avoid giving any injections into the upper rump or upper butt, as these yield the more valuable cuts of meat. When giving more than one vaccine, it is preferable to administer them on opposite sides of the neck. For adult breeding cattle, use a new 16 to 18 gauge, 1 to 1.5 inch needle for each animal. For younger calves, an 18 gauge, 1 inch needle should be used for each animal. Insert the needle at a 90 degree angle into the area indicated in the diagram and inject the vaccine dose. If the young animals may enter the breeding herd, a new needle should be used for each animal.

The following table lists the recommended needle sizes for various types of injections in cattle.

Recommended Needle Sizes for Cattle Injections		
Intramuscular Injection	Gauge	Length
Calves (<300#)	18 or 20	1" or 1 1/2"
Yearlings (300-700#)	16 or 18	1" or 1 1/2"
Adult cattle (>700#)	16 or 18	1" or 1 1/2"
Subcutaneous Injection	Gauge	Length
Calves (<300#)	16 or 18	1/2" or 3/4"
Yearlings (300-700#)	16 or 18	1/2" or 3/4"
Adult cattle (>700#)	16	1/2" or 3/4"
Source: Radostitis, Otto M, DVM, MSc. Herd Health Food Animal Production Medicine. W.B. Saunders Company. 2001. 3rd Ed. p. 620		

10.3.2 Handling Beef Cattle

Aside from hobby or project cattle, beef cattle are generally unaccustomed to being handled, and may be fearful of humans and protective of their calves. Quiet handling by people trained to use behavioral principles, such as flight zone and point of balance, is recommended. An understanding of an animal's flight zone is essential to making handling easier, safer, and much less stressful. When the handler is standing outside the flight zone, the animal will turn towards the handler; once the flight zone is invaded, the animal will turn away. It is best to work on the outside of an animal's flight zone. Invading it too deeply can threaten the animal, resulting in unpredictable behavior and possible injury to either the handler or the animal. The size of an animal's flight zone varies depending on the animal's temperament and degree of past handling. Flags and plastic paddles should be used as the primary movement aids. See the section on Swine for a diagram of an animal's flight zone.



Care should be taken to adequately restrain beef cattle before attempting vaccination. Most operations will have a system of lanes to move cattle into a chute one at a time and to return all of the vaccinated cattle to a separate pen. Restraint devices available will vary by premises, but a chute with a head gate, is generally adequate. Unfortunately, head gates restrain the neck in the optimal region for vaccination. Some gates have an arm to push the cow's head to one side so the neck is more accessible, or operators may have to do this manually. For further handling guidelines, refer to the *FAD PReP Beef Feedlot Industry Manual*.

10.3.3 Handling Dairy Cattle

Dairy operations typically consist of mature lactating dairy cows (many of which are pregnant), replacement heifers (which may or may not be pregnant), and young calves. Some dairy operations will keep a small number of young bulls on the premises, but many dairies rely on artificial insemination and do not keep bulls. Dairies may raise their own calves and replacement heifers, or they may send calves to another facility and purchase replacement heifers.



Dairy cattle are generally accustomed to being handled regularly for milking and reproductive examinations and are usually more docile than beef cattle. Quiet handling by people trained to use behavioral principles, such as flight zone and point of balance, is recommended. Compared to beef cattle, dairy cattle will likely have a much smaller flight zone due to being handled on a daily basis. However, the same principles apply. Dairy animals will move away from an intrusion into their flight zone, and towards a handler standing outside the flight zone. Flags and plastic paddles should be used as the primary movement aids. See the section on Swine for a diagram of an animal's flight zone.

Dairy cattle should be adequately restrained before attempting vaccination. Restraint devices available will vary by premises. Some operations will have a separate chute with a head catch to restrain individual animals, while others will have 'lock ups' at the feed bunk that can restrain multiple animals at a time (as pictured). A few cattle may be loose in the pen and will need to be handled separately. Administering

vaccines to animals in the lock ups at the feed bunk is done from the front of the animal, as it is difficult to get in between cattle while in the pen.

For further handling guidelines, refer to the *FAD PReP Dairy Industry Manual*.

10.4 Sheep & Goats

10.4.1 Vaccine Administration in Sheep and Goats

10.4.1.1 Subcutaneous Injection

Subcutaneous injections in sheep and goats are usually given by making a tent of the loose skin where the neck and shoulder join and injecting the vaccine. A 0.5 inch needle should be used to help ensure the needle is not accidentally pushed through both sides of the tented skin.

10.4.1.2 Intramuscular Injection

Intramuscular injections may be given in the thigh muscle or the large muscles along the side of the neck,. A 0.5 inch needle is also a good size to use for intramuscular injections.

10.4.2 Handling Sheep and Goats

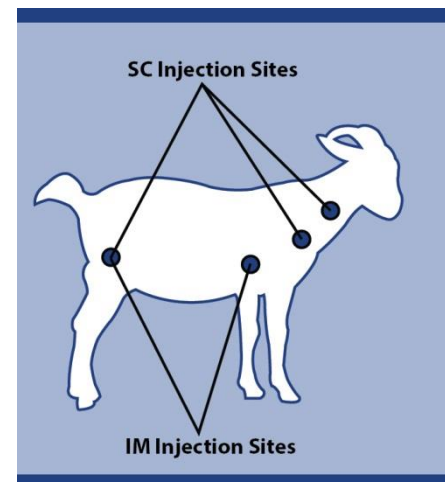
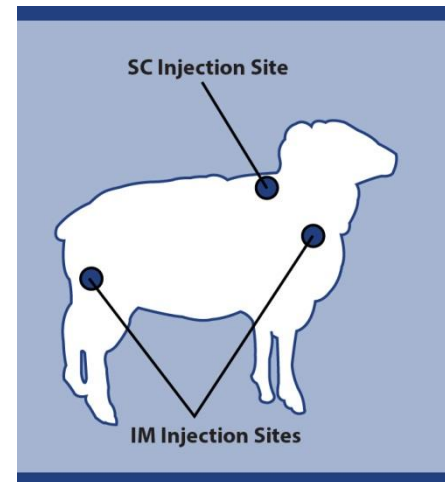
Sheep and goats are both classified as herd animals and behave similarly to their larger counterparts, cattle. They are easily frightened by sudden noises, movements, or shadows, and are uncomfortable alone, therefore isolating individuals from the herd should be avoided. When handling sheep and goats, their herd instincts and flight zone must be taken into account. Both species also have blind spots directly behind their shoulders. Refer to the flight zone and point of balance figure in the Swine section for more information.

10.4.2.1 Sheep

When handling sheep, always work slowly and easily, and never rush them or pull their wool. It is best to start training sheep as lambs; they are usually one of the easiest animals to train. If they refuse to follow, they can be encouraged by placing your left hand under their chin and your right hand on the dock, or tail. The use of alleys and gates makes the job of handling and restraining sheep much easier on both handler and animal.

As with cattle, an understanding of a sheep's flight zone will make moving and handling them much easier and less stressful for both handler and animal. When the handler is standing outside the flight zone, the animal will turn towards the handler. Once the flight zone is invaded, the animal will turn away. It is best to work on the outside of an animal's flight zone. Invading it too deeply can result in unpredictable behavior and possible injury to either the handler or the animal. The size of the flight zone varies depending on the animal's temperament.

When trying to single out and catch an individual animal, maneuver the herd into a corner of the pen and approach the sheep slowly and calmly. Cup your hand under the jaw of the sheep you are trying to catch, grab the bony part of the jaw, not the throat, and point the nose upwards. This will stop its forward motion and decrease its power, allowing you to maintain control.



The breed of sheep you are working with should also be taken into consideration. For example, Rambouillet sheep tend to flock together and remain as a group. Cheviots, on the other hand, are more independent than other sheep breeds.

10.4.2.2 Goats

Even though goats are herd animals, they have independent streaks and each animal has its own unique personality. Most goats are difficult to herd, drive, or scare into movement. The easiest way to train them is to teach them to come when called, to come to feed, or to lead them. Most goats can be easily handled and trained to lead with a collar or halter.

Though goats are small ruminants and behave similarly to sheep and cattle in most ways, there are some fundamental differences that affect handling practices. Goats are more difficult to handle than cattle or sheep when using handling equipment such as chutes and gates. They do not flow through the system as easily and become stressed easier than other species. When goats are frightened or stressed, they may lie down and sulk in a corner of the pen, risking injury from other goats. They may also become aggressive towards each other. Goats often move in family groups, with the oldest females moving first. When handling goats, higher gates may be needed than those suitable for sheep; goats will find the escape spots in the handling system if they exist.

10.5 Poultry

10.5.1 Vaccine Administration in Poultry

Commercial chicken operations are divided into broiler operations for meat and layer operations for eggs. Breeder operations provide replacement birds for either broiler or layer houses. Broiler and breeding chickens generally live on the floor of a barn bedded with litter. Layers are usually kept in cages with a small number of birds per cage and several levels of cages stacked into a single barn. Other species of fowl (e.g., turkeys, ducks) are usually housed on a litter-covered floor, similar to the housing of broiler chickens.

Because of the sheer numbers of birds that may occupy a single barn, identifying and vaccinating individual birds is usually impractical. Unlike other animals, commercial birds are not physically marked for identification purposes. Instead, birds can be identified by lot or group numbers. Small numbers of fowl kept by hobbyists are seldom vaccinated for several reasons. For example, many poultry vaccines come in large multi-dose vials of 500 or more, making them impractical for the owners of small flocks of fowl.

Vaccination of commercial adult birds is usually carried out with a mass delivery method, as it is impractical to handle all of the birds in a production barn. Mass vaccination methods include oral vaccination or spraying the entire barn. The goal of mass vaccination is to vaccinate a large enough percentage of birds in a barn to minimize or prevent the spread or effects of a disease; it is understood that not every bird will receive a therapeutic dose of vaccine.

Birds in breeding flocks may be individually handled and vaccinated, depending on the producer, disease prevalence, and vaccine. Methods of individual vaccine delivery include intramuscular and subcutaneous injection, eye drops, and scarification. Vaccinating chicks is somewhat easier than adult birds, because they arrive from breeding facilities in boxes or trays, and there are manageable numbers of birds per box. Boxed



chicks can be vaccinated individually, or sprayed by passing the boxes under a vaccine sprayer on a conveyer belt. Care must be taken not to chill the chicks with sprays. Depending on the vaccine, vaccination of chicks is not always effective because of their underdeveloped immune systems. Some vaccines may be given in ovo to birds before hatching. Automated systems are available for vaccinating trays of eggs.

Mandatory meat withdrawal times following vaccination must be observed for poultry vaccines, just as for other livestock, and will vary by vaccine. Follow the manufacturer's guidelines for meat withdrawal. In an emergency situation, instructions will be provided on which vaccines to administer, which route of administration is appropriate, and recommended withdrawal times (if applicable).

10.5.1.1 Oral Administration

Delivery of live oral vaccines is appropriate for some diseases affecting the gastrointestinal or respiratory system. Vaccines can be delivered orally either diluted in drinking water (most common) or sprayed on pelleted feed. For either method, care must be taken to ensure enough vaccine is consumed while it is viable. Feed and water intake are closely linked in chickens and may be influenced by lighting and/or short-term deprivation prior to vaccine administration. Birds do not generally eat or drink when it is dark. Turning off the barn lights for a specified period of time preceding vaccination may assist consumption when the lights are turned on again. Short-term deprivation of either feed or water before vaccine delivery may aid consumption, as long as the flock's health and welfare is not compromised.

Oral vaccines designed for delivery in water are only viable for a specific period of time after dilution—usually a few hours. This requires that the normal water supply be interrupted and drained of residual water. The vaccine should be diluted according to the manufacturer's directions and delivered directly to the trough of bell-style drinkers or run through the normal watering system, depending on the barn's watering setup. Care must be taken to ensure that no cleaning agents or disinfectants (chlorine in drinking water) contaminate the vaccine, as live vaccines may be inactivated by these agents. Rinse all equipment well, and be sure the water used for dilution does not contain chlorine or other disinfectants. Some facilities mix nonfat dry milk powder into the vaccine water, both to effectively inactivate any chlorine and to serve as a visual indicator that the vaccine has travelled from the source to the birds' waterers. Milk powder should be mixed at 2g/L or 10g/gal before the addition of concentrated vaccine.

10.5.1.2 Spray or Nebulization Administration

Delivering vaccines by spray allows mass vaccination of birds with minimal handling. Spray or nebulized vaccines can be delivered to day-old boxed chicks or to birds housed on a barn floor. Spray vaccines inoculate birds in one of two ways: 1) inhalation of small particles or 2) ingestion and mucous membrane contact. Small particles are inhaled by larger birds, but most delivery systems are unable to produce droplets consistently small enough for inhalation delivery to day-old chicks. Birds of all sizes will be inoculated directly by spray in the eye and will drink droplets from the feathers of other birds.

The effectiveness of inoculation by inhalation is highly dependent on droplet size. Droplets between 80 and 100µm are typically small enough to be inhaled and deposited in the upper respiratory tract. Droplets between 100 and 800µm are ideal for consistent vaccine delivery. Smaller droplets may drift away in air currents, but larger droplets do not travel far from the sprayer. Systems derived from herbicide applicators (known as controlled droplet application devices) and nebulizers are able to deliver a consistent droplet size between 80 and 100µm in size, ideal for inhalation delivery. These devices deliver vaccines in a band approximately one meter wide and three meters in front of the machine, allowing efficient coverage. As little as 900mL of diluted vaccine may vaccinate up to 30,000 birds. Pressurized sprayers rely on operating pressure and a nozzle to distribute droplets, and produce an inconsistent droplet size from 50 to 1000µm. Droplets of appropriate size may only travel 50cm from the spray nozzle. Pressurized sprayers therefore require the use of a larger volume of vaccine to ensure adequate coverage. Smaller droplets

delivered by these systems will be inhaled, the rest will be delivered by oral or ocular routes or will fall on the litter or floor. Fifteen to 30L of diluted vaccine may be needed to cover a barn. With all spray delivery, care must be taken not to chill the birds, particularly chicks. Cool, distilled water is ideal for diluting the vaccine, since it does not contain chlorine and prolongs the activity of the vaccine, but some producers may consider warm water to reduce the effects of chilling.

Day-old chicks arrive at production houses in boxes of 80 to 150 chicks. Provided the vaccine in question is effective in day-old chicks, vaccine delivery to boxed chicks may be the most efficient way to vaccinate a flock, since it is easier to ensure a given percentage of the birds are covered than it is in a large barn. The volume of spray delivered per box must be determined by the dilution of vaccine, the type of delivery device used, and the susceptibility of chicks to chilling. Between 7.5 and 40 ml per 100 birds is generally appropriate for pressure sprayers. Some spray delivery systems allow the user to adjust the volume delivered per unit time, while others must be calibrated and maintained. A flat curtain of spray which can be moved over each box, or which the boxes can be moved under on a conveyer, is superior to a sprayer that produces a ring of spray to vaccinate a rectangular box. With both types of sprayers, make sure that the appropriate volume is applied to each box and that the entire inside of the box is covered with the vaccine.

Spray vaccinating barns of birds may be more effective if ventilation is temporarily interrupted to prevent droplet drift. Also, dimming the lights will reduce bird movements. Since it is impossible to ensure each bird in a barn is sprayed, it may be helpful to develop an approach appropriate for the spray delivery device which considers birds as incidental to the delivery process and seeks to cover the entire floor surface of the barn.

10.5.1.3 Eye Drop Administration

Eye drop vaccination is a highly effective means of delivering respiratory virus vaccines to birds, but it requires that each bird be handled individually. Since all birds are handled, this method ensures that every bird is properly vaccinated. Eye drops in birds induce both local and humoral immunity. One droplet is applied to the eye of each bird, and the bird is held until it blinks to disperse the vaccine. Enough time must be allowed for handling to ensure the drop does not roll off the surface of the eye. Most eye drop vaccines come with a bottle designed for easy eye drop administration, and a dye mixed with the diluent to visually determine which birds have been vaccinated. Shortly after vaccination, the dye will visibly stain the nares.

10.5.1.4 Scarification (Cutaneous) Administration

Scarification is used exclusively for fowlpox vaccination, although the fowlpox vaccine may be combined with avian encephalomyelitis vaccine. This method of vaccine delivery involves damaging the skin with a short 19 gauge needle in the wing web, skin of the thigh, or foot and delivering a small amount of vaccine with a special two-pronged, grooved applicator. Fowlpox vaccine can cause lesions on the eyes and mouths of birds significant enough to inhibit food and water intake, so care must be taken to avoid getting any vaccine on the head.

10.5.1.5 Intramuscular Injection

Intramuscular injection requires individual handling of birds. Vaccines usually come in multi-dose vials of 500 or more, where the use of an automatic syringe that delivers a pre-determined volume of vaccine improves efficiency. Injections may be made in the lower neck, breast, or leg. Improper needle placement can result in granulomas, lameness, head swelling, or liver puncture.

10.5.1.6 Subcutaneous Injection

Subcutaneous injections are usually given in the skin fold of the leg or the skin of the neck.

10.5.1.7 In Ovo Injection

In ovo vaccination is a highly efficient way of delivering vaccine to an entire flock of birds. In most circumstances, automated in ovo vaccination equipment will vaccinate entire commercial trays of eggs. Chicken eggs are typically vaccinated between 17.5 and 19 days of incubation (18 days is usual). Some modified live vaccinations, such as those for Marek's disease virus, are highly effective when delivered in ovo. The vaccine is administered through a needle that punctures the bottom of the egg and the air cell, depositing vaccine into the egg membranes.



10.5.2 Handling Poultry

Handling large number of individual adults in commercial poultry operations is avoided. Birds tend to be flighty, and can injure wings, legs and bruise muscle intended for meat. Mass vaccination prevents unintended injuries to the birds, and provides an adequate immunity for the flock. Birds in breeding flocks may be individually handled and vaccinated, however, individual vaccine delivery is most efficient in eggs or day-old chicks. If necessary, chicks may be individually vaccinated during processing before they are boxed and shipped, or after arrival.

10.6 Dogs and Cats

Dogs and cats may be involved in an FAD event as susceptible species, or as biosecurity risks in mechanically spreading the disease. Dogs and cats have been infected with certain strains of highly pathogenic avian influenza, Rift Valley fever, Hendra, Nipah, African horse sickness, and Q fever. In an outbreak situation, dogs and cats located on livestock premises may need to be vaccinated, and may be included in the same movement controls as livestock to minimize the risk of disease spread.

10.6.1 Vaccine Administration in Dogs

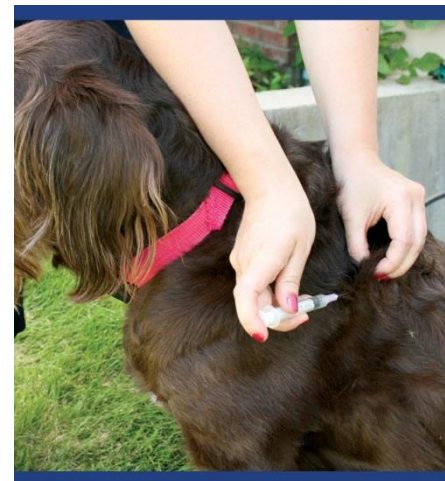
Always refer to the vaccine manufacturer's instructions for specific information on the appropriate dose and route of administration for individual vaccines. Typically, 22 gauge, 1 inch needles are used to administer vaccines in dogs.

10.6.1.1 Subcutaneous Injection

The most common site for subcutaneous injection of vaccines is in the loose skin above the shoulder blades in dogs. This area is relatively insensitive, and the abundance of loose skin and relative lack of blood vessels makes subcutaneous injection in this area relatively straightforward.

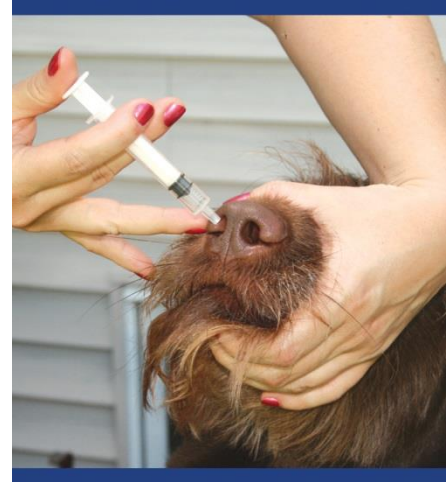
10.6.1.2 Intramuscular Injection

Intramuscular vaccinations may be administered in the large muscles of the thigh or in the muscles of the lumbar area of the back. If the muscles of the back are chosen, stay to the side of the midline to avoid the spine and any nerves that exit the spinal column.



10.6.1.3 Intranasal Administration

The only intranasal vaccine currently in use in dogs in the United States is a modified live *Bordetella bronchiseptica* vaccine, or *Bordetella bronchiseptica* combined with canine parainfluenza. These vaccines should ONLY be given intranasally, as they can cause local infection if given by injection. After the vaccine is reconstituted, it should be drawn up in the device provided by the vaccine manufacturer (often a small, single-use squeeze tube) and the entire contents applied at the entrance of the nostril. It is not necessary to apply vaccine to both nostrils, although it is also acceptable and common in practice.

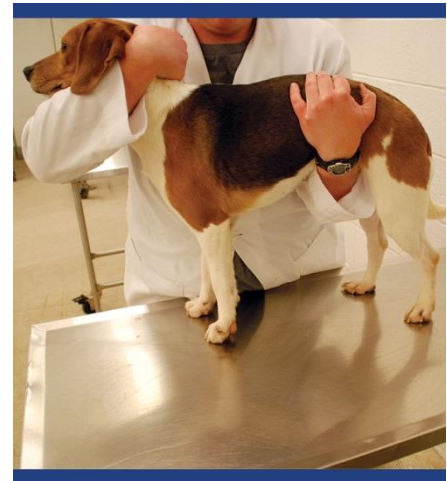


10.6.2 Handling Dogs

As with livestock, the ability to effectively handle and restrain dogs for vaccination is critical to the success of any vaccination program. Dog bites are serious injuries and fearful, aggressive, and unsocialized dogs should be handled carefully.

10.6.2.1 General Restraint

Restraining a dog's head and body as pictured is relatively effective for most non-objectionable procedures and vaccination.



10.6.2.2 Leash

Most dogs are accustomed to being walked on a leash. Slip leads are particularly useful because they adapt to any size of dog and do not require a collar. Leashes should never be used to restrain unattended dogs, as dogs may chew through them or strangle themselves. Additionally, one must be aware that a dog may charge towards the person holding the leash

10.6.2.3 Muzzle

Several types of muzzles are available to help prevent a dog from biting during a short procedure such as vaccination. In most cases the muzzle uncircles and guards the dog's mouth while snugly fastened behind the head. Muzzles in a variety of sizes may be made of nylon, leather, and firm plastic (basket muzzles). A makeshift muzzle can be made from the inexpensive, non-stretch fabric such as gauze, available in many veterinary facilities. When applying a muzzle, bringing the muzzle from behind and above the dog is usually most effective. Be cautious as stress or the inability to pant may cause overheating of the dog.



Standard muzzles may not be useful for brachycephalic breeds, such as bulldogs and pugs, due to their short snouts. Specialized ball-shaped devices are available that fit over the entire head of the animal.

10.6.2.4 Towel

Towels may be effective for blocking the dog's vision or for restraining small dogs. Wrapping a small fractious dog in a towel can effectively restrain it but also makes examination and vaccination difficult. One may either place a towel over the top of the dog and scoop the edges of the towel under the dog's legs, or set the dog on top of the towel and wrap the entire dog in the towel.

10.6.2.5 Rabies/Catch Pole

A rabies or catch pole consists of a coated wire loop run through a solid pole with plastic or rubber coating. The wire loop goes around the dog's neck, and can be loosened and tightened via a mechanism at the handler's end of the pole. The coating on the pole near the loop is made to withstand the bites of even the strongest dogs. The advantages of a catch pole over a leash are that the handler can use the pole to maintain a safe distance from the animal, and the animal cannot chew through it. Care must be taken not to harm the dog, particularly by strangulation. Anyone operating a catch pole should become familiar with the tightening and release mechanisms before ever using it on an animal. The functioning of these mechanisms should be checked before each use, since the wire loop can become kinked, making it difficult or impossible to release the neck loop.



10.6.3 Vaccine Administration in Cats

Always refer to the vaccine manufacturer's instructions for specific information on the appropriate dose and route of administration for individual vaccines. Typically, 22 gauge, 1 inch needles are used to administer vaccines in cats. Some cats have developed adverse reactions; especially noted have been a type of sarcoma due to components in feline vaccines. It is recommended to facilitate tracing of adverse vaccine reactions, each feline vaccine should be given in a specific location.

10.6.3.1 Subcutaneous Injection

The most common location for subcutaneous injection of vaccines has been the loose skin at the scruff of the neck.

10.6.3.2 Intramuscular Injection

Vaccines should be given in the right front leg, right hind leg, or left hind leg, in the muscular biceps or thigh. Be sure and avoid major nerves and blood vessels. This requires training as well as testing for blood flash in the syringe/needle hub as described earlier in this document.

10.6.3.3 Intranasal

Currently, several feline vaccines are available for intranasal use. Vaccines labeled for intranasal use should ONLY be given intranasally, as they can cause local infection if given by injection. After the vaccine is reconstituted, it should be drawn up in the device provided by the vaccine manufacturer (often a small, single-use squeeze tube) and the entire contents applied at the entrance of the nostril. It is not necessary to apply vaccine to both nostrils, although this is also acceptable and common in practice.

10.6.4 Handling of Cats

Cats can be agile and difficult to restrain, particularly if afraid or uncooperative. Cat bites and scratches have a propensity to become infected. Proper restraint will facilitate proper placement of the vaccination. Proper restraint will also prevent escape of the animal.

10.6.4.1 Scruffing

One of the simplest temporary restraint methods for cats is to grasp the loose skin behind the neck and over the shoulders. This has the effect of calming most cats, but the occasional cat will become fractious if scruffed. Obese cats may be difficult or impossible to scruff due to a lack of loose skin. Simultaneously restraining the front or rear legs can also prevent scratches or escape attempts.

10.6.4.2 Towel

Wrapping a fractious cat in a towel can be particularly effective at preventing it from striking but also makes examination and vaccination difficult. One may be able to expose a hind leg for vaccine administration, but the scruff area of the cat is generally inaccessible for vaccination when using a towel for restraint.



10.6.4.3 Cat Bag

Feline restraint bags generally consist of a sturdy nylon bag with a zippered top and a Velcro closure around the cat's neck, leaving the head free. Some cat bags have optional openings in each of the bottom corners to allow one or more limbs to be protruded from the bag.

10.6.4.4 Muzzle

A number of commercially produced muzzles are available for cats. They can be made of soft cloth, leather, or stiff plastic. Unlike dog muzzles, cat muzzles generally cover both the mouth and eyes of the cat, leaving a small opening near the nose. Muzzles should be disinfected between cats to prevent the spread of communicable diseases.

10.6.4.5 Distraction

During a momentary procedure such as vaccination, cats may be distracted from mildly aversive stimuli with such techniques as lightly tapping the cat on the top of the head, blowing on the cat's nose, or sliding the cat across the table on a towel or on its side as the vaccine is injected.

10.6.4.6 Gloves/Gauntlets

Leather gloves can be useful in handling particularly fractious cats. Lined, elbow-length leather welding gloves are a popular choice. While these gloves can effectively prevent scratches, they do not fully protect from cat bites. Further, because they reduce dexterity and sensation, it can be difficult to apply an appropriate amount of pressure, so care must be taken to not harm the cat while wearing gloves.

10.6.4.7 Cat Net

If a fractious cat escapes in an enclosed room, it may be particularly difficult to capture and restrain once it is caught. A large net can facilitate capture of the cat. It is important to quickly turn the handle of the net once the cat is inside to prevent it from escaping. Some nets have a purse-string closure at the top that can be operated at the handler's end of the pole, preventing the cat from escaping. If no further exam is warranted, the cat can be vaccinated directly through the net.

10.6.4.8 Squeeze Trap

A squeeze trap consists of two rectangular metal frames lined with mesh, and attached on one side in a clamshell configuration. The cat can be trapped between the frames in the mesh and vaccinated through the mesh.

10.6.4.9 Rope Leash

The use of a rope leash to catch or restrain a fractious cat has been suggested as an acceptable method. However, cats can escape a leash much more easily than a dog. Care must be taken not to harm the cat by strangulation. Additionally, a very fractious cat may charge towards the person holding the leash. Leashes are best used when pulled through a cage door or another barrier so that the cat cannot harm the handler.

11. PREVENTING DISEASE TRANSMISSION DURING VACCINATION

Due to the nature of handling many animals in a short period of time, any mass vaccination program has the potential to spread diseases from animal to animal or from premises to premises if appropriate precautions are not taken. Emergency vaccination programs will target unaffected animals on clean premises. However, transmission of both endemic disease and foreign highly contagious diseases must be considered. The set of precautions taken to prevent the introduction of a contagious disease to a population of animals is known as biosecurity. Biosecurity is equally important for vaccination crews brought in for that purpose and for vaccination crews made up of employees of the premises. Biosecurity practices will differ depending on whether they are general precautions or whether they are targeted at reducing the spread of a specific pathogen. This section highlights basic biosecurity principles for reducing the spread of disease by mobile vaccination crews between production animal facilities. For further information, see the *FAD PRoP/NAHEMS Guidelines: Biosecurity, Cleaning and Disinfection, and Personal Protective Equipment*.

11.1 Disease Transmission

Disease can be spread by five main methods: oral, aerosol, direct contact, fomite, and vector-borne. Vaccination efforts have the potential to alter risk of disease exposure, directly or indirectly, by all five methods. In particular, vaccination crews need to follow appropriate biosecurity measures to ensure they are not transmitting disease from one population of animals to another on vaccination equipment, restraining equipment, facilities, clothing, hands, or vehicles (fomites). Using disposable equipment where feasible, disposing of waste appropriately, and cleaning and disinfecting reusable equipment and clothing are all crucial activities to help reduce the chance of disease transmission.



11.2 Between Premises

Mobile vaccination crews moving from facility to facility must be especially careful to reduce disease transmission on fomites. A biological risk management plan can be tailored to each vaccination crew, depending on the accepted risk of disease transmission and acceptable expense. General biological risk management guidelines for mobile vaccination crews are listed below.

- Keep fingernails trimmed and cleaned.
- Pull back, tie up, or cover hair to minimize exposure and fomite transmission.
- Do not wear jewelry.
- Wash hands or change examination gloves between animals, barns, or pens.
- Use disposable equipment when possible.
- Use a new, sterile, disposable needle when concerned about spreading diseases between animals within a group.
- Contain and dispose of refuse on the site on which it was generated.
- Learn to properly clean and disinfect multi-dose syringes to prevent contamination and spread of disease.

- Use the smallest vaccine vial that is feasible. A large vial of vaccine will be punctured more times than a smaller vial, increasing the risk of contamination. A large vial of contaminated vaccine will then be administered to more animals than a smaller bottle would be.
- Disinfect reusable equipment between animals by submerging it in disinfectant, when appropriate, or wiping the surface with disinfectant. Do not expose the vaccine in the syringe or needle to disinfectant.
- Wear protective clothing or the appropriate level of personal protective equipment (PPE) (i.e., scrubs or coveralls) over personal clothing and change outer clothing when contaminated, between groups of animals with differing health or immune status, or between facilities as appropriate. Keep dirty, contaminated clothing in a plastic bag in a designated “dirty” area of the vehicle until it can be washed.
- Do not wear protective outer clothing home from a facility.
- Shower in and out of large production units when facilities allow.
- Wear disposable shoe covers or protective boots (i.e., rubber boots) that are easily cleaned and disinfected.
- Remove debris from boots on site.
- Step in a disinfectant bath before entering and after leaving barns and facilities.
- Follow all on farm decontamination procedures for vehicles, equipment, and personal protective equipment.

For step-by-step instructions on cleaning veterinary vaccine syringes, please see the University of Nebraska-Lincoln document in Appendix E.

For further information on methods to reduce disease transmission, see Infection Control resources at the Center for Food Security and Public Health web site. A link to the Infection Control resources as well as a Biological Risk Management tool can be found in the For More Information section at the end of this document. In addition, see the *FAD PReP/NAHEMS Guidelines: Biosecurity, Cleaning and Disinfection, and Personal Protective Equipment*.

12. VACCINATION STRATEGIES IN AN FAD OUTBREAK

Strategies for the response to, and management of, an FAD outbreak will change as the outbreak progresses and will depend upon the magnitude, location, other characteristics of the outbreak, and vaccine availability. At the beginning of an outbreak, and in a small outbreak, the highest priority is to take all measures possible to prevent disease spread, to stamp-out the disease as rapidly as possible, and to reestablish the nation as free of the disease. However, particularly as an outbreak grows, it is of the highest priority to ensure that the response to the disease outbreak does not cause more damage or disruption than the disease itself.

Initially or with a small outbreak, depopulating livestock without vaccinating animals may be the most effective approach to control, contain, and eradicate the disease. Vaccination may also be inappropriate or impractical in instances where vaccinated animals cannot be distinguished from naturally infected animals (where DIVA vaccines are not available) or where sufficient quantities of vaccine are not readily available.

To prevent spread of the disease and minimize the number of animals depopulated, a vaccination strategy may be considered, depending on epidemiological information, availability of effective and sufficient vaccine, and considering the economic impact (including disease-free status of the decision).

There are five strategies for the control and eradication of a highly contagious FAD in domestic livestock or poultry; these strategies are not mutually exclusive; 4 of the 5 include emergency vaccination. These strategies are described below. For more information, please see, *Foreign Animal Disease Framework: Response Strategies (FAD PRoP Manual 2-0)*. These include:

- Stamping-out;
- Stamping-out modified with emergency vaccination to kill;
- Stamping-out modified with emergency vaccination to slaughter;
- Stamping-out modified with emergency vaccination to live;
- Emergency vaccination to live without stamping-out.

12.1 Stamping-Out

Stamping-out is defined as the depopulation of clinically affected and in-contact susceptible animals. Stamping-out has been a common approach in a number of past FAD outbreaks. This strategy is most appropriate if the outbreak is contained to a jurisdictional area or a region in which the FAD can be readily contained and further dissemination of the agent is unlikely.

12.2 Stamping-Out Modified with Emergency Vaccination to Kill

This suppressive emergency vaccination strategy involves the depopulation of clinically affected and in-contact susceptible animals and vaccination of at-risk animals, with subsequent depopulation and disposal of vaccinated animals at a later date. Targeted populations may be susceptible animals in high-risk locations. Ring or regional vaccination around an Infected Premises or Infected Zone is a frequently cited example of this strategy.

12.3 Stamping-Out Modified with Emergency Vaccination to Slaughter

This is a second suppressive strategy that involves the depopulation of clinically affected and in-contact susceptible animals and vaccination of at-risk animals, with subsequent slaughter and processing of vaccinated animals at a later date, if animals are eligible for slaughter under USDA Food Safety and Inspection Service (FSIS) authority and rules and/or State and Tribal authority and rules. In comparison with vaccinate-to-kill, the targeted populations may be similar, however, the disposition of the vaccinated animals is different.

12.4 Stamping-Out Modified with Emergency Vaccination to Live

This protective emergency vaccination strategy involves the depopulation of clinically affected and in-contact susceptible animals and vaccination of at-risk animals, without subsequent depopulation or slaughter of vaccinated animals because of their vaccination status. Vaccinated animals intended for breeding, slaughter, milking, or other purpose live out their useful lives. If animals are intended for slaughter, animals must be eligible for slaughter under USDA FSIS authority and rules and/or State and Tribal authority and rules. The targeted population is non-infected animals including valuable genetic stock, long-lived production animals, or areas with a high-density population of susceptible animals at high risk of becoming infected.

12.5 Emergency Vaccination to Live Without Stamping-Out

This strategy is reserved for a disease outbreak in which the disease is widely disseminated across the United States, affecting many animal industries. Resources are not available for stamping-out, and a policy decision has been made not to stamp-out. This strategy is highly unlikely to be employed initially in an FAD outbreak response. However, if the scope of an outbreak expands to a point that the use of resources for the other strategies is no longer feasible, the decision might be made to implement vaccination to live without stamping out. The FAD may be managed as an endemic disease.

All response strategies involving vaccination may require vaccinated animal traceability and the diagnostic capability to differentiate infected from vaccinated animals (DIVA) for movement between

zones, interstate commerce, and international trade. Vaccinated animal identification, movement controls, traceability, and an effective, scalable permitting system may be necessary.

For certain diseases, additional planning has been conducted regarding the relationship between the magnitude of the outbreak and the likelihood of using vaccination strategies. For example, see the *FAD PreP Strategy Document, Classification of Phases and Types of a Foot-and-Mouth Disease Outbreak and Response*. A web link for *Classification of Phases and Types of a Foot-and-Mouth Disease Outbreak and Response* can be found in the For More Information section at the end of this document.

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14. FOR MORE INFORMATION

Centers for Disease Control and Prevention

Vaccine Storage and Handling Toolkit

<http://www.cdc.gov/vaccines/recs/storage/toolkit/>

Center for Food Security and Public Health

FAD PReP Strategy Document, Classification of Phases and Types of a Foot-and-Mouth Disease Outbreak and Response

<http://www.cfsph.iastate.edu/pdf/phases-and-types-of-an-fmd-outbreak>

Compendium of Veterinary Vaccines for Transboundary Diseases (Foreign Animal Diseases)

<http://apps.cfsph.iastate.edu/Vaccines/index.php>

Infection Control and Biological Risk Management

http://www.cfsph.iastate.edu/Infection_Control/index.php

Immunization Action Coalition (IAC)

“Do Not Unplug” Signs

<http://www.immunize.org/catg.d/p2090.pdf>

Vaccine Temperature Logs (See under Clinic Resources, Storage and Handling)

<http://www.immunize.org/clinic/storage-handling.asp>

U.S. Department of Agriculture, Animal and Plant Health Inspection Service

Animal Disease Traceability – For a listing of official identification devices and requirements

<https://www.aphis.usda.gov/traceability>

APHIS Foreign Animal Disease Framework: Response Strategies, Foreign Animal Disease (FAD) Preparedness and Response Plan (PReP) Manual 2-0

http://www.aphis.usda.gov/animal_health/emergency_management/downloads/documents_manuals/fadprep_manual_2.pdf

FAD PReP Materials and References

<http://www.aphis.usda.gov/fadprep>

High-Consequence Foreign Animal Diseases and Pests, APHIS VS Factsheet, July 2013

http://www.aphis.usda.gov/publications/animal_health/2013/fs_hc_diseases.pdf

National Veterinary Stockpile (NVS)

http://www.aphis.usda.gov/wps/portal/banner/help?1dmy&urile=wcm%3apath%3a%2Faphis_content_library%2Fsa_our_focus%2Fsa_animal_health%2Fsa_emergency_management%2Fsa_nvs%2Fct_nvs

NVS Factsheet

http://www.aphis.usda.gov/animal_health/emergency_management/downloads/nvs_factsheet.pdf

U.S. Department of the Interior, Bureau of Land Management

Alpha Angle Symbol System for Freeze Brands

http://www.blm.gov/wo/st/en/prog/wild_horse_and_burro/What_We_Do/wild_horse_and_burro0/freeze_marks.html

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Authors and contributors to this document and prior versions from the Center for Food Security and Public Health, College of Veterinary Medicine at Iowa State University include:

- Jim Roth, DVM, PhD, DACVM
Director, CFSPH
Distinguished Professor, Veterinary Microbiology and Preventive Medicine
- Amber Stumbaugh, MS
Third year veterinary student intern
- Anna Rovid-Spickler, DVM, PhD
Veterinary Specialist
- Danelle Bickett-Weddle, DVM, MPH, PhD, DACVPM
Associate Director, CFSPH
- Janice Mogan, DVM
Veterinary Specialist
- Heather Allen, Allen, PhD, MPA
Program Manager
- Shaine DeVoe
Senior Animal Science Student, Iowa State University

Illustrations designed by:

- Dani Ausen, BFA
- Andrew Kingsbury, BFA

Assistance provided by:

- Sarah Weiland
Student Intern

Section of this document or prior versions were reviewed within USDA APHIS by:

- Jonathan Zack, DVM,
Director, National Preparedness and Incident Coordination
Surveillance, Preparedness, and Response Services
- Patricia Foley, DVM, PhD
Risk Manager, Policy, Evaluation, and Licensing
Center for Veterinary Biologics
- R. Alex Thompson, DVM, PhD
Veterinary Medical Officer
Surveillance, Preparedness and Response Services
- John F. Wiemers, DVM, MS
Senior Staff Veterinarian, Animal Disease Traceability
National Preparedness and Incident Coordination

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Glossary

840 Device

A tag or chip with the code 840 on it that coincides with the international community denoting the animal has its origin in the United States. Has a unique animal or group identification number that can be read visually or with an appropriate radiofrequency scanner device.

Adjuvant

A substance added to vaccines to enhance the capacity to stimulate the production of antibodies or cell-mediated immune responses.

Biosecurity

A series of management practices designed to prevent the introduction of disease agents onto an animal production facility.

Cold Chain

The system used to ensure that vaccines stay within an appropriate temperature range from manufacturer to the point of administration.

Differentiating Infected from Vaccinated Animals (DIVA)

A type of vaccine that is marketed with a companion diagnostic kit to distinguish animals vaccinated against a disease from those infected with the natural pathogen.

Diluent

A liquid used to rehydrate a desiccated product, or a liquid used to dilute another substance.

DNA Vaccine

Vaccine produced by engineering genes for protective antigens into bacterial plasmids, purifying the plasmid DNA from that of the bacterial host, and administering it to the animal.

Efficacy

Specific ability or capacity of the biological product to effect the result for which it is offered when used under the conditions recommended by the manufacturer.

Fomite

An inanimate object or material on which disease-producing agents may be conveyed (e.g., feces, bedding, harness, clothes).

Freeze Indicator

A device often included in vaccine shipments that indicates that the contents of the shipment have dropped below 32°F. They do not indicate the length of time the contents were exposed to freezing temperatures.

Gene-Deleted Vaccine

Vaccines made from an organism that has had a specific gene or genes deleted or inactivated.

Killed Vaccine

Vaccines that contain all or part of an inactivated pathogen. They generally require an adjuvant to stimulate the host's immune response and provide protection from disease.

Live Vectored Vaccine

Vaccine produced by identifying a protective antigen or antigens for a particular pathogen and then engineering the genes coding for those antigens into another organism that may safely express the antigen in the target species.

Master Cell Stock

The supply of cells of a specific passage level from which cells for production of biologics originate.

Master Seed Organism

An organism at a specific passage level which has been selected and permanently stored by the producer from which all other seed passages are derived within permitted levels.

Modified Live Vaccines

Vaccines that replicate themselves in the host but should produce no or only very mild clinical signs. They induce the animal to mount an immune response that will provide protection from severe disease by the natural pathogen.

National Veterinary Stockpile (NVS)

Established by Homeland Security Presidential Directive 9 and operational in 2006. Able to deploy large quantities of veterinary resources anywhere in the continental U.S. within 24 hours.

Needle-Free (Transdermal) Injection

Mode of vaccine delivery that uses a specialized system to drive the vaccine into the skin with a burst of compressed air or gas.

Ocular

Mode of vaccine delivery in which the vaccine is applied to the surface of the eye. Mimics a natural route of infection for some pathogens.

Parenteral Injection

Mode of vaccine delivery using a syringe and needle. May be given in the muscle (intramuscularly) or under the skin (subcutaneously).

Personal Protective Equipment (PPE)

Equipment used as a barrier between an individual and a hazard that could result in injury or occupational illness.

Plant-Derived Vaccine

Vaccine produced by engineering genes from animal pathogens into plants or plant viruses so that the transgenic plants or plants infected with the transgenic plant virus, produce large amounts of antigen that can be used as vaccines.

Potency

Relative strength of a biological product as determined by test methods or procedures as established by APHIS in Standard Requirements or in the approved Outline of Production for such product.

Purity

Quality of a biological product prepared to a final form relatively free of extraneous microorganisms and extraneous material (organic or inorganic), as determined by test methods or procedures established by APHIS in Standard Requirements or in the approved Outline of Production for such product, but free of extraneous microorganisms or material which in the opinion of the Administrator adversely affects the safety, potency, or efficacy of such product.

Scarification

Method of vaccine delivery that involves damaging the skin with a short needle and applying a small amount of vaccine with a special two-pronged, grooved applicator. Used exclusively for fowlpox vaccinations.

Serial

The total quantity of completed product which has been thoroughly mixed in a single container and identified by a serial number, provided that, when all or part of a serial of liquid biological product is packaged as a diluent for all or part of a serial of desiccated product, the resulting combination packages shall be considered a serial of the multiple fraction product.

Slap Tattoos

Method of swine identification applied by tattoo hammer to the pig's shoulder. Most often used for market pigs at the slaughter plant.

Stability

The ability of a vaccine to remain potent for a period of time, or its "shelf life".

Sterility

Freedom from viable contaminating microorganisms as demonstrated by procedures prescribed in part 113 of Title 9 CFR, subchapter E, Standard Requirements, and approved Outlines of Production.

Time and Temperature Indicator

Device often included in vaccine shipments that indicates when temperatures have exceeded a specified temperature and how long the shipment was at that temperature. Also known as heat indicators.

Zoonotic Disease/Zoonoses

Diseases that are transmissible from animals to humans under natural conditions.

Acronyms

APHIS

Animal and Plant Health Inspection Service

BLM

Bureau of Land Management

BRM

Biological Risk Management

CDC

Centers for Disease Control and Prevention

CFSPH

Center for Food Security and Public Health

CVB

Center for Veterinary Biologics; a division of APHIS

DIVA

Differentiating Infected from Vaccinated Animals

FAD

Foreign Animal Disease

FMD

Foot-and-Mouth Disease

HPAI

High Pathogenicity Avian Influenza

IAC

Immunization Action Coalition

IC

Inspection & Compliance; a division of CVB

IM

Intramuscular

IN

Intranasal

MLV

Modified Live Vaccine

NAHERC

National Animal Health Emergency Response Corps

NPIC

National Preparedness and Incident Coordination

NVS

National Veterinary Stockpile

PEL

Policy, Evaluation, and Licensing; a division of CVB

PPE

Personal Protective Equipment

PRéP

Preparedness and Response Plan

RFID

Radio Frequency Identification

SC

Subcutaneous

TTI

Time and Temperature Indicators

USDA

United States Department of Agriculture

APPENDIX A: VACCINATION FOR FOOT-AND-MOUTH DISEASE

Available as a separate document on the USDA FAD PReP website at:

<http://www.aphis.usda.gov/fadprep>.

APPENDIX B: VACCINATION FOR CLASSICAL SWINE FEVER

Available as a separate document on the USDA FAD PReP website at:
<http://www.aphis.usda.gov/fadprep>.

APPENDIX C: VACCINATION FOR HIGHLY PATHOGENIC AVIAN INFLUENZA

Available as a separate document on the USDA FAD PReP website at:

<http://www.aphis.usda.gov/fadprep>.

APPENDIX D: SAMPLE HERD/FLOCK VACCINATION FORM

Animal/Herd Owner				
Last Name		First Name		
Street Address		City	State	Zip Code
Species				
<input type="checkbox"/> Cattle	<input type="checkbox"/> Swine	<input type="checkbox"/> Sheep		
<input type="checkbox"/> Beef	<input type="checkbox"/> Horse	<input type="checkbox"/> Goats		
<input type="checkbox"/> Dairy	<input type="checkbox"/> Poultry	<input type="checkbox"/> Other (specify): _____		
Vaccine				
Disease		Manufacturer	Product Name/Number	
Serial/Lot Number	Expiration Date	Withdrawal time (if applicable)		
Dose given (i.e. 5mL)	Route of administration (IM, SQ)	Location Given (i.e. Left Neck)		
Date	Animal or Group Identification Number	Breed	Sex	Processor

APPENDIX E: CARE OF VETERINARY VACCINE SYRINGES

Care of Veterinary Vaccine Syringes

Dee Griffin, DVM, MS
Beef Production Management Specialist
University of Nebraska, Great Plains Veterinary Educational Center

The following explains the basics of veterinary vaccine syringe cleaning and care.

Inadequate vaccine syringe cleaning is frequently responsible for localized infections associated with vaccination. Injection site swelling is common, especially when killed vaccines such as clostridial bacterins are given subcutaneously. Generally, these swellings can be considered good evidence the animal is developing a proper immune response. But if the vaccine injection site swelling is greater than a bantam hens egg, the swelling may be due to infection and should be examined. Injection site swellings that are the result of infection will be full of fluid. Normal injection site nodules should not contain fluid. If the infection is severe, it may become generalized and the animal may die from a condition known as phlegmonous cellulitis. If the swelling is hard it could be due to getting the subcutaneous injection too deep and penetrating part of the first layer of muscles. If this is the cause, consider using a “B-Bevel” 5/8-inch needle or a short (1/2 or 3/4 -inch) regular bevel needle. The injection point on the B-Bevel needle is shorter than a regular injection needle. Subcutaneous injections are less likely to accidentally get a portion of the medication or vaccine in the outer layer of the muscle underlying the skin. Using an injection needle cover placed over the needle and attached to the syringe will also shorten injection needle approximately 3/8-inch. This will effectively shorten a standard 1-inch injection needle to 5/8-inch length.

Sterile disposable syringes will virtually eliminate injection site infections. If you require multiple dose syringes, several brands of disposable sterile automatic vaccine syringes are available. In addition, there is at least one manufacturer of a pistol grip syringe that uses a sterile disposable barrel and plunger. This syringe also includes a needle guard to help protect the needle from bending and breaking off should the animal restraint be inadequate.

If multiple dose syringes are reused the following syringe cleaning and care points will help you avoid injection site infections:

1. Clean the external syringe surface with soap, water and a brush.
2. Rinse the inside components of the vaccine syringe, including tubes and connectors with distilled or de-ionized water that is near the boiling point (greater than 180° F). This is accomplished by repeatedly drawing water that is greater than 180° F into the syringe and squirting it out. Three to five rinses should be adequate. Remove as much water from inside the syringe as can be squirted out and let the syringe cool before using. Heat kills modified live

vaccine products. You should not use a soap or disinfectant on internal components. Soap or disinfectant residues may kill MLV vaccines.

3. Store the vaccine syringe in a dust free, dry (low humidity) environment. It is best if the newly cleaned vaccine syringe is stored in a new sealable plastic bag and placed in the freezer.
4. Vaccine transfer needles should be boiled in water and allowed to cool before using. Transfer needles should be stored in a new sealable plastic bag in the freezer.

Special care points for metal syringes:

Metal syringes can be taken apart and boiled in hot water.

- a. Clean work area ... don't try to work in an area subject to blowing dust,
- b. Wash external surface of syringes,
- c. Operator needs to wash his or her hands for 2 minutes,
- d. Cover clean work area with new clean paper towels,
- e. Disassemble syringes,
- f. Wash syringe parts with clean hot tap water (do not wash the internal parts with soap or disinfectant),
- g. Boil all internal syringe parts in boiling de-ionized or distilled water for five minutes,
- h. Reassemble while hot,
- i. Use a small amount of CLEAN vegetable oil spray to lubricate rubbers,
- j. After assembly is completed rinse the internal parts three to five times with water greater than 180° F,
- k. Allow the syringe to cool for 10 minutes before using.
- l. If storing the syringe, place the syringe in a new zip-lock bag
- m. Store the syringe in a freezer,
- n. Prior to using the syringe after storage, rinse the internal syringe with water greater than 180° F. Boil 2 cups of water in Microwave and pull boiled water into syringe three to five times,
- o. Let syringe cool for five to ten minutes before using.

Special care points for plastic automatic syringes:

Plastic syringes can be heat sterilized in a microwave oven. Note, this is another method of heat sterilization; there is nothing special about microwaves in this instance. The plastic automatic syringe must be covered in water while being heated in a microwave oven.

- a. Wash the external parts of the plastic automatic syringe in soap and water,
- b. Rinse the internal parts with hot tap water (do not use soap or disinfectant) by drawing water up through the intake tube while repeatedly depressing the syringe plunger,
- c. Completely fill the plastic automatic syringe with de-ionized or distilled water (draw off tube and syringe should be full of water),
- d. Wrap the plastic automatic syringe in five to ten layers of wet paper towels,
- e. Place the wet paper towel wrapped syringe in a zip-lock bag,
- f. Leave zip-lock bag open and place in a microwave oven,
- g. Set microwave oven on high setting and microwave each plastic automatic syringe individually for five minutes,

- h. Check moistness of paper towel wrapping half way through the process and remoisten if paper towels appear to be drying out, (don't let paper towels dry out – microwave ovens can start paper towels on fire if they are allowed to dry out while in the microwave),
- i. Remove the plastic automatic syringe from the zip-lock bag and unwrap. Most of the water that was filling the plastic automatic syringe will have boiled off, if not squirt out all remaining water.
- j. Allow syringe to cool for ten minutes before using the vaccine syringe.
- k. If storing, remove zip-lock bag containing the plastic automatic syringe from the microwave oven and place directly in the freezer.

Microwave oven sterilization of vaccine transfer needles:

Vaccine transfer needles can be heat sterilized in a microwave oven. The transfer needle must be covered in water while being heated in the microwave oven.

Two methods are available:

1. Clean the transfer needle in hot tap water (no soap or disinfectant) and place the cleaned transfer needle in clean cup. Completely cover with six to eight ounces of de-ionized or distilled water. Microwave using the high setting to bring the water to a boil and continue to boil for one additional minute. Never allow the water level to evaporate to the level of the transfer needle. It must be completely covered during the entire process.
2. Clean the transfer needle in hot tap water (no soap or disinfectant) and wrap in several layers of paper towels. Soak the towels and transfer needle in water and place in a zip-lock bag. Place the zip-lock bag in a microwave oven and leave the top of the bag open. Microwave, using the high setting for two minutes. Do not let the paper towels dry out while being heated in the microwave oven.

Quality Control:

Ask your veterinarian to review your vaccine syringe preparation technique. If you think you are having a problem with syringe sterility ask your veterinarian to test the sterility of your vaccine syringe. Note: heat without pressure will not kill spores, therefore autoclaving is required or using a pressurized canner is required to achieve sterilization at a level adequate to kill spores.