

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

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.

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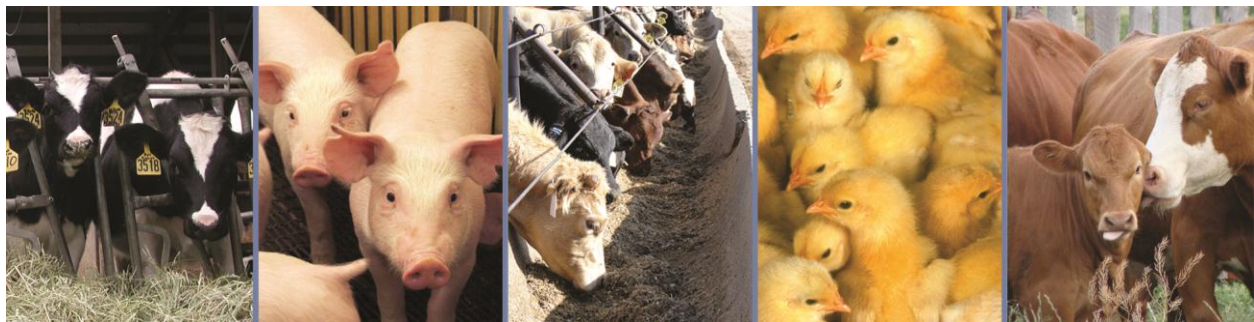
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THE IMPERATIVE FOR FOREIGN ANIMAL DISEASE PREPAREDNESS AND RESPONSE

Why Foreign Animal Diseases Matter

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

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



Challenges of Responding to an FAD Event

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

Lessons Learned from Past FAD Outbreaks

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

- Provide a unified State-Federal-Tribal-industry planning process that respects local knowledge
- Ensure the unified command sets clearly defined and obtainable goals
- Have a unified command that acts with speed and certainty to achieve united goals
- Employ science-based and risk-management approaches that protect public health and animal health, stabilize animal agriculture, the food supply, and the economy
- Ensure guidelines, strategies, and procedures are communicated and understood by responders and stakeholders

- Acknowledge that high expectations for timely and successful outcomes require the:
 - Rapid scale-up of resources and trained personnel for veterinary activities and countermeasures
 - Capability to quickly address competing interests before or during an outbreak
- Execute FAD tracing, which is essential for the efficient and timely control of FAD outbreaks

FAD PReP Mission and Goals

The significant threat and potential consequences of FADs and the challenges and lessons-learned of effective and rapid FAD response have led to the development of the Foreign Animal Disease Preparedness and Response Plan, also known as “FAD PReP.” The mission of FAD PReP is to raise awareness, expectations, and develop capabilities surrounding FAD preparedness and response. The goal of FAD PReP is to integrate, synchronize, and de-conflict preparedness and response capabilities as much as possible before an outbreak, by providing goals, guidelines, strategies, and procedures that are clear, comprehensive, easily readable, easily updated, and that comply with the National Incident Management System.

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

FAD PReP Documents and Materials

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

FAD PReP Suite of Documents and Materials



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

- Strategic Plans—Concept of Operations
 - *APHIS Framework for Foreign Animal Disease Preparedness and Response*: This document provides an overall concept of operations for FAD preparedness and response for APHIS, explaining the framework of existing approaches, systems, and relationships.
 - *National Center for Animal Health Emergency Management (NCAHEM) Stakeholder Coordination and Collaboration Plan*: This plan describes NCAHEM strategy for enhancing stakeholder collaboration and identifies key stakeholders.
 - *NCAHEM Incident Coordination Group Plan*: This document explains how APHIS headquarters will organize in the event of an animal health emergency.
- NAHEMS Guidelines
 - These documents describe many of the critical preparedness and response activities, and can be considered as a competent veterinary authority for responders, planners, and policy-makers.
- Industry Manuals
 - These manuals describe the complexity of industry to emergency planners and responders and provide industry a window into emergency response.
- Disease Response Plans
 - Response plans are intended to provide disease-specific information about response strategies. These documents offer guidance to all stakeholders on capabilities and critical activities that would be required to respond to an FAD outbreak.
- Critical Activity Standard Operating Procedures (SOPs)
 - For planners and responders, these SOPs provide details for conducting 23 critical activities such as disposal, depopulation, cleaning and disinfection, and biosecurity that are essential to effective preparedness and response to an FAD outbreak. These SOPs provide operational details that are not discussed in depth in strategic documents or disease-specific response plans.
- Continuity of Business Plans (Developed by public-private-academic partnerships)
 - *Secure Egg Supply (SES) Plan*: The SES Plan uses proactive risk assessments, surveillance, biosecurity, and other requirements to facilitate the market continuity and movement of eggs and egg products during an HPAI outbreak.
 - *Secure Milk Supply (SMS) Plan*: Currently under development, the SMS plan will help facilitate market continuity for milk and milk products during an FMD outbreak.
- Outbreak Response Tools
 - Case definitions, appraisal and compensation guidelines and formulas, and specific surveillance guidance are examples of important outbreak response tools.
- State/Tribal Planning
 - State and Tribal planning is essential for an effective FAD response. These plans are tailored to the particular requirements and environments of the State or Tribal area, taking into account animal populations, industry, and population needs.
- Industry, Academic, and Extension Planning
 - Industry, academia, and extension stakeholder planning is critical and essential: emergency management is not just a Federal or State activity.
- APHIS Emergency Management
 - APHIS directives and Veterinary Services Memorandums provide critical emergency management policy. APHIS Emergency Management documents provide guidance on topics ranging from emergency mobilization, to the steps in investigating a potential FAD, to protecting personnel from highly pathogenic avian influenza.

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

PREFACE

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

The Vaccination for Contagious Diseases Guidelines are a component of APHIS' FAD PReP/NAHEMS Guideline Series, and are designed for use by APHIS Veterinary Services (VS), and other official response personnel in the event of an animal health emergency, 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. This Guideline provides information for Vaccination Group Supervisors and other personnel associated with vaccination activities. 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. For more detailed response information, consult the FAD PReP Standard Operating Procedures (SOP): 16. Vaccination for Contagious Diseases (2010) and plans developed specifically for the incident.

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 (2011)
- Appendix B: Vaccination for Classical Swine Fever (2011)
- Appendix C: Vaccination for Highly Pathogenic Avian Influenza (2011)

Appendices A, B, and C are available as separate documents on the FAD PReP web site. 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” has a corresponding disease-specific FAD PReP Standard Operating Procedures (SOP): 16. Vaccination.

Several key APHIS documents complement this “FAD PReP/NAHEMS Guidelines: Vaccination for Contagious Diseases” and provide further details when necessary. This document references the following APHIS documents:

- FAD PReP/NAHEMS Guidelines:
 - Biosecurity (2011)
 - Cleaning and Disinfection (2011)
 - Personal Protective Equipment (2011)
- FAD PReP Industry Manuals:
 - Beef Feedlot (2011)
 - Dairy (2011)
 - Swine (2011)

Many of these documents are available on the FAD PReP collaboration website at: <https://fadprep.lmi.org>
Username and password can be requested.

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Guidelines: Vaccination for Contagious Diseases

1. INTRODUCTION

In the event of an incursion of a foreign animal disease in the United States, the Department of Agriculture in its role as an emergency response agency is authorized to deploy personnel to assist with response and recovery efforts. Animal and Plant Health Inspection Service (APHIS) employees as well as members of the National Animal Health Emergency Response Corps (NAHERC) may be deployed to assist during the emergency.

The control of a foreign animal disease outbreak may require large-scale vaccination of food animals to minimize the impact on animal and public health, ensure continuity of the U.S. food supply, and minimize the economic impact on food producers. This FAD PreP/NAHEMS Guideline: 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, and may change based on evolving information about the situation.

2. NATIONAL VETERINARY STOCKPILE

The National Veterinary Stockpile (NVS) is maintained by National Center for Animal Health Emergency Management (NCAHEM) through USDA-APHIS. The NVS is the nation's repository of veterinary countermeasures, including supplies, equipment, field tests, vaccines, and commercial support services. The NVS mission is to provide States the 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 against the 17 most damaging diseases and deploying the countermeasures in 24 hours.

The NVS program also provides logistical support for the North American Foot and Mouth Disease Vaccine Bank and delivers FMD vaccine to incident command. The NVS can also arrange service contracts for mass depopulation, disposal, and disinfection of animal production facilities if required. NVS will be deployed as needed through coordination efforts with State Animal Health Officials, the VS area veterinarian in charge, the VS regional office, and the NVS director. For more information about the NVS, visit <http://nvs.aphis.usda.gov>.

2.1 Vaccines in the National Veterinary Stockpile

The NVS intends to stockpile vaccines for animal diseases that would be most damaging to animal agriculture, human health, and the U.S. economy. By the year 2016, the NVS plans to acquire supplies to respond to the top 17 animal disease threats. Table 1 lists these diseases in order of importance.

Table 1. Top 17 Animal Disease Threats in the United States	
1.	High Pathogenic Avian Influenza
2.	Foot and Mouth Disease
3.	Rift Valley Fever
4.	Exotic Newcastle Disease
5.	Nipah and Hendra Virus
6.	Classical Swine Fever
7.	African Swine Fever
8.	Bovine Spongiform Encephalopathy
9.	Rinderpest
10.	Japanese Encephalitis
11.	African Horse Sickness
12.	Venezuelan Equine Encephalitis
13.	Contagious Bovine Pleuropneumonia
14.	Heartwater (<i>Ehrlichia ruminantium</i>)
15.	Eastern Equine Encephalitis
16.	Q Fever (<i>Coxiella burnetii</i>)
17.	Akabane Virus

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. 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, and 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. Therefore, these vaccines have to be handled carefully to maintain viability. Because they contain live organisms, these vaccines are sensitive to damage by improper handling or storage. 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. For instance, live *Bordetella bronchiseptica* intranasal vaccine for dogs can cause complications if given subcutaneously.

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). A syringe and needle size should be selected appropriate for the dose, species, and number of animals to be vaccinated. To prevent cross-contamination and disease spread, a new needle should be 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 bodily fluid contamination of the vaccine delivery device. Therefore, the risk of spreading disease from one animal to another by vaccination equipment is low, and there is no need to change needles 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 their safety and 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. 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) available at <http://www2a.cdc.gov/vaccines/ed/shtoolkit/>.

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 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, since 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 daily. 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 are available for download from the CDC in Fahrenheit (<http://www.immunize.org/catg.d/p3039.pdf>) and in Celsius (<http://www.immunize.org/news.d/celsius.pdf>).

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. Ensure that the doors are properly closed and sealed at the end of each day.

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 CDC in English (<http://www.cdc.gov/vaccines/pubs/pinkbook/downloads/appendices/C/warning-signs.pdf>) and in Spanish (<http://www.cdc.gov/spanish/prevencion/no-desconectar.pdf>)

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.

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. For more detailed information, refer to the Vaccine Storage and Handling Toolkit (<http://www2a.cdc.gov/vaccines/ed/shtoolkit/>).



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 ‘Vaccine Storage and Handling Toolkit’, National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention (<http://www2a.cdc.gov/vaccines/ed/shtoolkit/>).

Single-dose lyophilized vaccines should not be reconstituted until immediately prior to use. Multi-use vaccine vials should be marked with the date they were reconstituted and discarded before the time interval indicated by the manufacturer.

Multi-use vaccines should be used or discarded on the premises on which they are reconstituted. In order to reduce disease spread or mishandling, multi-use vaccines should not be moved from one animal facility to another.

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.

Make sure that neither the diluent nor the vaccine has passed the expiration date.

Check the diluent label and lot number to be sure it is for use with the vaccine selected.

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).

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

For multi-use 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.

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 it 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 storage 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 ‘Vaccine Storage and Handling Toolkit’, National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention (<http://www2a.cdc.gov/vaccines/ed/shtoolkit>).

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**, as vaccine supplies may be short in the event of an outbreak. Contact your supervisor, an APHIS VS official within incident command, or the Center for Veterinary Biologics program official for 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 tool 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. These syringes must be maintained and cleaned between uses. Any detergents or disinfectants must be thoroughly rinsed 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 users initials and date of first use; discard after approximately of month of use. Automatic multi-use syringes are appropriate for vaccinating large numbers of livestock, such as cattle being run through a chute. The syringe must be reloaded after 10-25 animals, 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 between each animal if there is concern about transmission of diseases between animals and before puncturing the seal of the vaccine vial.



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 must also be carefully cleaned and maintained between uses, and any detergents or disinfectants must 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 (See section on vaccine administration to fowl below).



6. ANIMAL TRACEABILITY

Regardless of the nature of the emergency requiring mass vaccination, identifying individual animals or herds of animals with nationally unique numbers and associating them with a standardized location identifier at a point in time is critical for traceability purposes. It is essential to have accurate information on which animals have been vaccinated in order to manage a disease outbreak. Keeping accurate records for information such as date, location, 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, or herds of animals is necessary to track vaccination records, testing results, or other information for the emergency response. In the case of companion animal sheltering due to a natural disaster, the animal must be uniquely, individually identified so that it can later be returned to its owner.

There are multiple animal identification technologies available for livestock traceability (described below), and the USDA has approved three official numbering systems for uniquely identifying all U.S. livestock. Many, but not all, locations where livestock are housed are uniquely identified with their State or Tribal Nation. If emergency vaccination is going to be used as part of a response to an animal disease event, identification of locations and animals for traceability purposes will be imperative. For more information about the USDA's cooperative approach with States and Tribal Nations on animal disease traceability, visit the USDA Animal Disease Traceability website: <http://www.aphis.usda.gov/traceability/>.

In the United States, identification devices marked with the U.S.'s three-digit country code, 840, can be purchased to individually identify animals. These devices may be read visually, by an electronic scanner, or both. A variety of devices for different species are available, including ear tags and ear buttons, which may incorporate radio frequency devices, and microchips. Microchips are for use in horses, llamas, and alpacas. 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. Visual 840 devices (ear tags and ear buttons) will include the U.S. shield, a 15-digit animal identification number, the words "Unlawful to Remove," and the manufacturer's logo or trademark (printed or stamped).

6.1 Horses

Some horses may arrive at an emergency shelter with permanent identification such as microchips, brands, or tattoos, which should be recorded on entry. In emergency situations, temporary visual identification systems should be employed to track each animal. Duplicate systems, such as temporary collars, stall cards, and photos, may be used in a given shelter to ensure animals are properly and uniquely identified.

6.1.1 Permanent Identification

6.1.1.1 Radio Frequency Identification (RFID)

Radio Frequency Identification (RFID) can be used in horses as a long-term method of identification. These injectable transponders should be implanted in the nuchal ligament from the left side, in the middle third of the neck, halfway between the ears and withers. Reading these requires a special scanner (see the table below on microchip frequencies).

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 tattoos. Other registries may track tattoo numbers for other breeds.

6.1.1.3 Brands

Brands in 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 (i.e. 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 Bureau of Land Management are freeze-branded on the left side of the crest of the neck with a brand that can identify the individual horse (see photo). The BLM brands are coded with the alpha angle symbol system. See illustration for decoding BLM brands.



6.1.2 Temporary Identification

Horses can be identified with temporary identification methods such as a collar, stall cards, USDA backtags 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 markings, such as leg and face markings, 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. 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. 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.).

For interstate commerce and market pigs, as well as sows and boars moving to harvest, animal identification has been mandatory since 1988. 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).

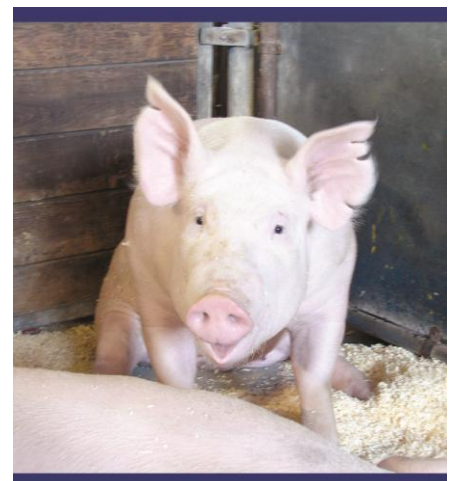
6.2.1 Permanent Identification

6.2.1.1 Ear Tattoos

Most nursery and grow-finish pigs can be identified as a group or lot, thus negating the need for individual traceability. This is usually done through a unique tattoo that has been registered and assigned to a particular farm by the State of origin. 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.

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*.



6.2.2 Semi Permanent Identification

6.2.2.1 Ear Tags

Ear tags for swine can be small plastic dangle tags and may be marked with homemade numbers, or USDA premises identification number, 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 read them. 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 a radio frequency identification (RFID) button tag, plastic dangle tag, and/or in some states, a metal brucellosis vaccination tag, or silver metal tag in the right ear, or some combination thereof. The methods of identification vary between operations. Young animals on 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. This is an official form of identification if registered with the breed association. Some non-registered cattle may be identified with a numbering system that is specific to a facility rather than a national registry and thus 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. At present, this is an official form of identification when the brand is registered with an official brand inspection agency and accompanied by an official 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.



6.3.2 Semi Permanent Identification

6.3.2.1 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 through a commercial source, or 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 be affixed to the animal.



6.3.3 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 the animal may have arrived with.

6.3.3.1 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 has the tag number programmed on it and is read with a reader device and the data transferred to a computer. Producers in the U.S. 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, making the tail web tattoo 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.

6.4.2 Semi Permanent Identification

6.4.2.1 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

Scrapie tags are now required by law for all sheep and goats entering into interstate commerce. They are part of the United States' effort to eradicate scrapie, and they allow each and every animal to 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 so 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

For the purposes of this document, dogs and cats will be discussed in the context of identification in the event of a natural disaster requiring mass sheltering and subsequent vaccinations for contagious diseases. While not a direct responsibility of USDA-APHIS-VS National Center for Animal Health Emergency Management, sheltering companion animals is an activity responders may assist with in specific situations. However, in a foreign animal disease outbreak, dogs and cats on livestock operations may serve as mechanical vectors, posing a risk of disease spread. Identification of animals is especially important in this situation 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 track each animal.

6.5.1 Permanent Identification

6.5.1.1 Microchips

The most reliable method of identifying companion animals is with a microchip, a device 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 can be read with a handheld scanning device. This code can then be linked to a database containing information about the animal's owner, vaccination history, and any other pertinent information.

Most microchip brands used in the United States for small animals emit at 125 kHz. Nonetheless, many scanners are brand-specific, and are not capable of reading the codes from other brands of microchips, even if they emit at the same frequency. Universal scanners capable of reading any brand of microchip are ideal for an emergency companion animal shelter situation, since animals may have different brands of microchips on intake. Table 2 lists small animal microchip frequencies by manufacturer.

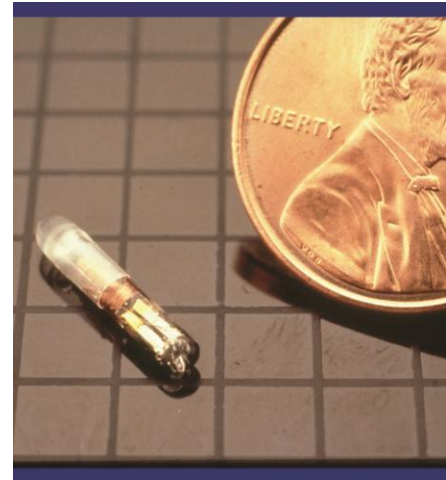


Table 2. Microchip Frequencies with Corresponding Manufacturers

125 kHz	128 kHz	134.2 kHz
Allflex	Bayer ResQ Chip	AKC Trovan
Avid Euro	Datamars (Swiss)	
Avid Secure Encrypted		
Destron Fearing		
HomeAgain		
Microchip ID Products		
TravelChip		

Reproduced from Veterinary Disaster Response,
Wingfield, W.E., and Palmer S.B.. Wiley-Blackwell, Hong Kong, 2009.

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.



6.5.3 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 foreign animal disease outbreak. Appendix A provides a Sample Herd/Flock Vaccination Form that can be modified as needed for the event.

7.1 Minimum Information that Should Appear 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)

8. VACCINE ADMINISTRATION & ANIMAL HANDLING

General recommendations for animal vaccination vary depending on species, living conditions, and the disease agents to which they are likely to be exposed. 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). The following section is meant to be a general guide to familiarize the responder with common vaccines that might be used in an emergency for each species, and to provide a general guideline on how to safely handle and restrain different domestic animal species for vaccination.

8.1 Horses

8.1.1 Vaccines for Foreign Diseases of Horses

There are a number of diseases of horses which are foreign to the United States with the potential to cause significant losses if introduced. USDA licensed vaccines are not available for most of these diseases. A compendium listing vaccines produced in other countries for diseases which are either rare or foreign to the U.S. can be found at: <http://apps.cfsph.iastate.edu/Vaccines/index.php>. Table 3 lists foreign and rare diseases to U.S. horses.

Table 3. Foreign and Rare Diseases of Horses	
Disease	Pathogen Responsible
African Horse Sickness	African Horse Sickness Virus (AHSV)
Brucellosis**	<i>Brucella abortus</i>
Contagious Equine Metritis*	<i>Taylorella equigenitalis</i>
Dourine	<i>Trypanosoma equiperdum</i>
Epizootic Lymphangitis	<i>Histoplasma capsulatum</i> var. <i>farciminosum</i>
Equine Babesiosis	<i>Babesia caballi</i> or <i>Theileria equi</i>
Hendra	Henipavirus
Glanders	<i>Burkholderia mallei</i>
Surra	<i>Trypanosoma evansi</i>
Venezuelan equine encephalomyelitis	Venezuelan equine encephalomyelitis virus (VEEV)
Vesicular Stomatitis***	Vesicular Stomatitis Virus (VSV)
* Present in the US	
** Present in the US, control or eradication program exists	
*** Present in US, sporadic disease	

8.1.2 Vaccine Administration

Always refer to the vaccine manufacturer's instructions for specific information on the appropriate dose and route of administration for individual vaccines. Always use a new needle on each horse when vaccinating due to the possibility of spreading infectious diseases (e.g., equine infectious anemia) between horses with contaminated needles. Properly dispose of all used needles in a puncture-proof container.

8.1.2.1 Subcutaneous Injection

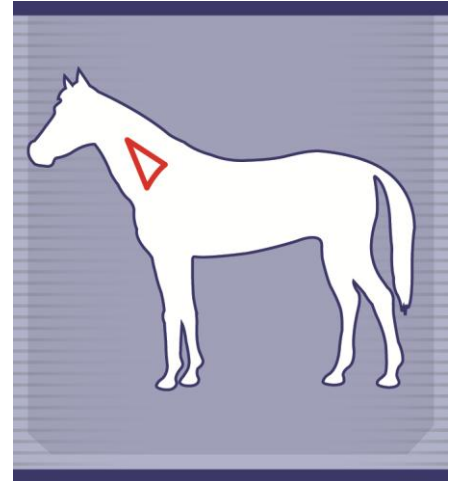
The neck is the preferred injection site for subcutaneous injection in horses because of the relatively loose skin in this area. Use a new 18 to 20 gauge, 1 to 1.5 inch needle for each animal. If giving multiple vaccinations to one animal, do not give them in the same site. For therapeutic treatments,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

With the horse adequately restrained, 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 horse has not gotten a full dose of vaccine, revaccinate the animal.

8.1.2.2 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.



8.1.2.3 Intranasal (Influenza)

Intranasal vaccines are administered with 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.

8.1.3 Equine Handling

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.

8.1.3.1 Halters

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

8.1.3.2 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.

8.1.3.3 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.

8.1.3.4 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.



8.1.3.5 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.

8.1.3.6 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.

8.1.3.7 Eyelid Press

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

8.1.3.8 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.

8.2 Swine

Commercial swine are kept at separate facilities, sometimes at great distances, for different life stages. The main types of operations are: breeding/gestation, farrowing, nursery, finishing, and boar studs. Boar studs consist exclusively of breeding boars, from which semen is collected for shipment to breeding/gestation facilities. Breeding/gestation and farrowing usually occur on the same premises, and these facilities consist of adult sows; replacement gilts; and young, unweaned piglets.

Nursery operations may be combined with finishing operations, or they may be separate facilities. These types of operations contain a range of ages from weaned piglets to market-weight pigs.

Pigs may be continuously brought in and shipped out, or they may operate as “all-in, all-out” facilities, where a group of pigs of the same age is brought in and fed until they are at market weight, then shipped out as a group. All-in, all-out systems break the disease cycle by allowing thorough cleaning and disinfection between groups, and by preventing the mixing of pigs of different ages and different immunological and disease statuses. Diseases of concern will vary by geographic area, season, type of operation, and management practices. Therefore, the commonly used vaccines are also variable. Mandatory meat withdrawal times must be observed following vaccination and will vary by vaccine. Follow the manufacturer’s guidelines for 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). For further information, refer to the *FAD PRoP Swine Industry Manual (2011)*.

8.2.1 Vaccines for Foreign Diseases of Swine

There are a number of swine diseases foreign to the United States with the potential to cause significant losses if introduced to domestic swine. USDA licensed vaccines are not available for most of these diseases. A compendium listing vaccines produced in other countries for diseases which are either rare or foreign to the U.S. can be found at: <http://apps.cfsph.iastate.edu/Vaccines/index.php> Table 4 lists diseases foreign and rare to U.S. swine.

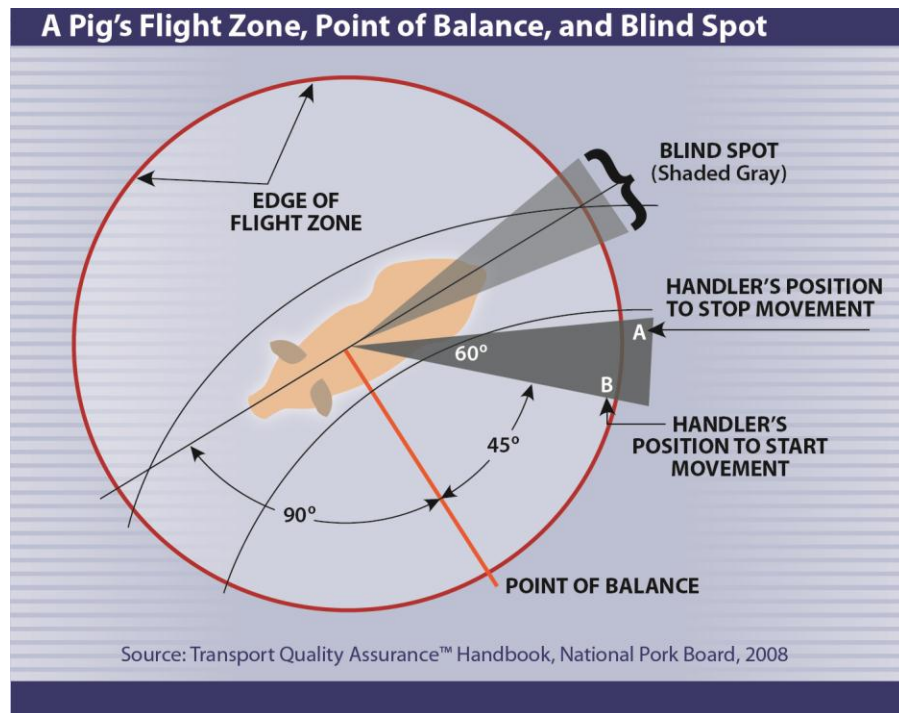
Table 4. Foreign and Rare Diseases of Swine	
Disease	Pathogen Responsible
Aujeszky's Disease (Pseudorabies)	Aujeszky's disease virus, Pseudorabies virus
Brucellosis	<i>Brucella suis</i>
Japanese Encephalitis	Japanese encephalitis virus
African Swine Fever	African swine fever virus
Classical Swine Fever, Hog cholera	Classical swine fever virus
Nipah Virus Encephalitis	Nipah virus
Swine Vesicular Disease	Swine vesicular disease virus
Highly Pathogenic Avian Influenza	Influenza virus

8.2.2 Swine Handling

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 (2011)*.



8.2.3 Vaccine Administration in Swine

Proper techniques and injection sites must be used when administering vaccines. Ensure the animal is properly restrained to allow successful administration and to reduce the potential for breaking needles. Ensure all needles are accounted for before and after administration. Follow the recommended guidelines for needle size and length in Table 5. Properly dispose of all used needles in a puncture-proof container. A new or disinfected needle should be used for each animal when there is concern about spreading diseases between animals. It is common practice to not change needles between swine within the same group. Maintaining careful records aids in ensuring each animal is vaccinated. See Appendix A, Sample Herd Vaccination Form.

Table 5. 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		

8.2.3.1 Intramuscular Injection

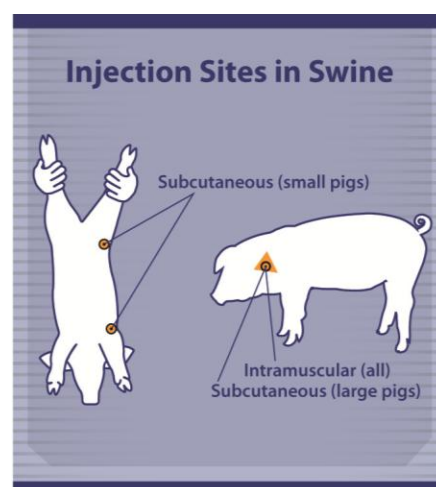
Intramuscular injections should be given in the neck just behind and below the ear, but in front of the shoulder.

8.2.3.2 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.

8.2.3.3 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.



8.3 Cattle

Domestic cattle can generally be divided into two categories: those raised for beef production and those raised for milk production. The diseases of concern will vary by geographic area, season, type of operation, and management practices. Therefore, vaccines and vaccination schedules are also variable. Mandatory meat withdrawal times must be observed between vaccination and slaughter for human consumption, and will vary by vaccine. Dairy operations must observe any required milk withdrawal times for modified live vaccines.

8.3.1 Vaccines for Foreign Diseases of Cattle

There are a number of cattle diseases foreign to the United States with the potential to cause significant losses if introduced to domestic cattle. USDA licensed vaccines are not available for most of these diseases. A compendium listing vaccines produced in other countries for diseases which are either rare or foreign to the U.S. can be found at: <http://apps.cfsph.iastate.edu/Vaccines/index.php>. Table 6 lists diseases foreign and rare to U.S. cattle.

Table 6. Foreign and Rare Diseases of Cattle	
Disease	Pathogen Responsible
Anthrax***	<i>Bacillus anthracis</i>
Bluetongue	Bluetongue virus
Bovine Anaplasmosis*	<i>Anaplasma marginale</i>
Bovine Babesiosis	<i>Babesia bovis</i> , <i>B. bigemina</i>
Bovine Genital Campylobacteriosis	<i>Campylobacter fetus venerealis</i> or <i>C. fetus fetus</i>
Brucellosis**	<i>Brucella abortus</i>
Contagious Bovine Pleuropneumonia	<i>Mycoplasma mycoides</i> small-colony type (SC)
Foot and Mouth Disease	Foot and Mouth Disease Virus (FMDV)
Heartwater	<i>Ehrlichia ruminantium</i>
Hemorrhagic Septicemia***	<i>Pasteurella multocida</i> serotypes B:2 or E:2
Lumpy Skin Disease	Lumpy Skin Disease Virus (LSDV)
Malignant Catarrhal Fever	several viruses in Herpesviridae family, <i>Rhadinovirus</i> genus
Rift Valley Fever	Rift Valley Fever Virus
Rinderpest	Rinderpest virus
Theileriosis (East Coast Fever)	<i>Theileria parva</i> , <i>T. annulata</i>
Trichomoniasis*	<i>Trichomonas fetus</i>
Vesicular Stomatitis	<i>Vesicular Stomatitis Virus (VSV)</i>
* Present in the US	
** Present in the US, control or eradication program exists	
*** Present in US, sporadic disease	

8.3.2 Vaccine Administration in Cattle

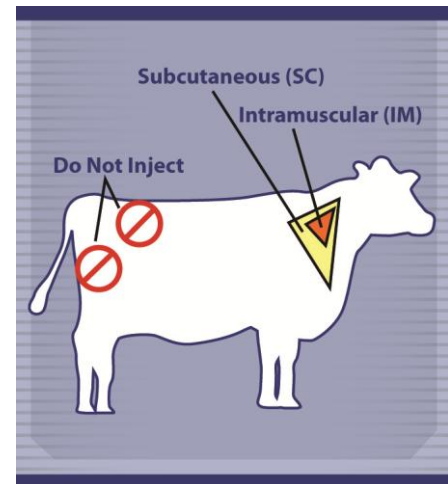
Injections into the muscle of cattle cause blemishing of the muscle, adversely affecting carcass value. Thus, whenever permitted by the vaccine label, it is best to give injections subcutaneously rather than intramuscularly. When giving more than one vaccine, it is preferable to administer them on opposite sides of the neck. Table 7 lists the types of needles recommended for different injection sites.

A new needle should be used for each animal when there is concern about spreading diseases between animals. New needles should always be used when vaccinating cattle intended for breeding or in a breeding herd, due to the potential to transmit bovine leukemia virus or bovine immunodeficiency virus between animals. It is common practice to not change needles between animals for cattle within the same group destined for slaughter. Ensure all needles are accounted for before and after administration. Properly dispose of all used needles in an approved biomedical sharps container.

8.3.2.1 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 (see figure below). 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.

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. 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 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 cow has not gotten a full dose of vaccine, revaccinate the animal.

8.3.2.1 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 (see figure above). 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, use an 18 gauge, 1 inch needle 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 animal may enter the breeding herd, a new needle should be used for each animal.

Table 7 lists the recommended needle sizes for various injection sites in cattle.

Table 7. Recommended Needle Sizes for Cattle		
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		

8.3.3 Beef Cattle

Beef cattle spend the first few months of life on smaller, less intensive cow-calf operations. Unless kept for breeding purposes, they are typically sold to finishing or feedlot facilities where they are commingled with many other cattle and exposed to new pathogens. Industry standards recommend that calves be vaccinated before weaning and receive another set of vaccines on arrival at a finishing facility or feedlot. The vaccines in routine use will vary by region, disease challenges, and handling equipment on the facility. Mandatory meat withdrawal times must be observed for all vaccines and will vary by the type of 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).

8.3.3.1 Beef Cattle Handling

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, and 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 the 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 such as the one pictured here 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.

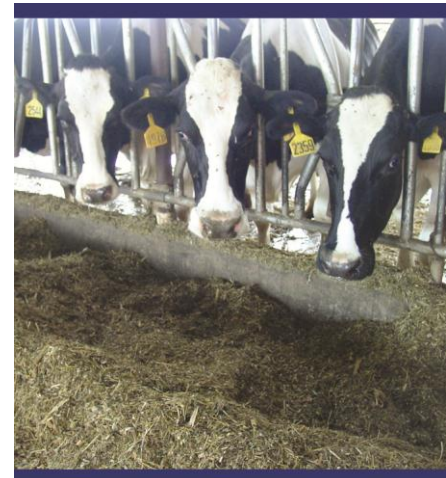
Maintaining careful records aids in ensuring each animal is vaccinated. See Appendix A, Sample Herd Vaccination Form. In some instances, marking the cattle temporarily with a wax marker can ensure that all animals receive the appropriate vaccination. For further handling guidelines, refer to the *FAD PRoP Beef Feedlot Industry Manual (2011)*.

8.3.4 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. Routine vaccination programs will vary by facility. Vaccination programs for dairy cattle are dependent on age, stage of lactation and/or gestation, and disease challenges. Mandatory meat and milk withdrawal times following vaccination must be observed and will vary by vaccine. Follow the manufacturer's guidelines for withdrawal time. 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).

8.3.4.1 Dairy Cattle Handling

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.



They 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. 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. It is difficult to get in between cattle while in the pen.

Maintaining careful records aids in ensuring each animal is vaccinated. See Appendix A, Sample Herd Vaccination Form. In some instances, marking the cattle temporarily with a wax marker is appropriate to ensure that all animals receive the appropriate vaccination. For further handling guidelines, refer to the *FAD PRoP Dairy Industry Manual (2011)*.

8.4 Sheep & Goats

Domestic sheep and goats can be raised for meat, milk, or wool/mohair production. The diseases of concern vary by geographic area, season, type of operation, and management practices—which makes vaccine type and vaccination schedules variable. Mandatory meat and milk withdrawal times must be observed following vaccination and will vary by vaccine. 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).

8.4.1 Vaccines for Foreign Diseases of Sheep & Goats

There are a number of diseases of small ruminants (sheep and goats) foreign to the United States with the potential to cause significant losses if introduced. USDA licensed vaccines are not available for most of these diseases. A compendium listing vaccines produced in other countries for diseases which are either rare or foreign to the U.S. can be found at: <http://apps.cfsph.iastate.edu/Vaccines/index.php>. Table 8 lists diseases foreign and rare to U.S. sheep and goats. Maintaining careful records aids in ensuring each animal is vaccinated. See Appendix A, Sample Herd Vaccination Form. In some instances, marking the sheep temporarily with a wax marker is appropriate to ensure that all animals receive the appropriate vaccination.

Table 8. Foreign and Rare Diseases of Sheep & Goats	
Disease	Pathogen Responsible
Foot and Mouth Disease	Foot and Mouth Disease virus
Rift Valley Fever	Foot and Mouth Disease virus
Rinderpest	Rinderpest virus
Heartwater	<i>Ehrlichia ruminantium</i>
Akabane	Akabane virus
Peste des petits ruminants (PPR)	Peste des petits ruminants (PPRV)
Sheep pox/Goat pox	Sheep pox/Goat pox (genus <i>Capripoxvirus</i>)
Contagious caprine pleuropneumonia	<i>Mycoplasma capricolum</i> , subspecies <i>capripneumoniae</i>
Nairobi sheep disease	Nairobi sheep disease virus (NSDV)
Vesicular stomatitis	Vesicular stomatitis virus (VSV)

8.4.2 Vaccine Administration in Sheep and Goats

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).

8.4.2.1 Subcutaneous Injection (SC)

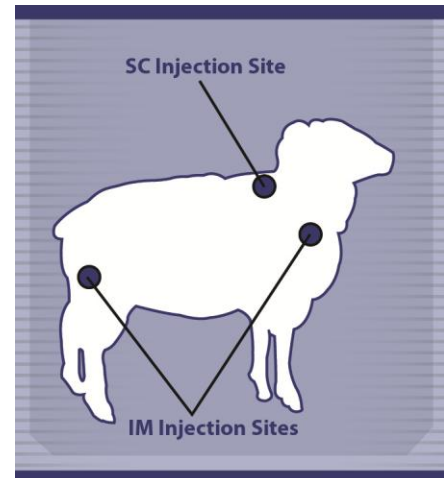
Subcutaneous injections in sheep and goats are usually given in the loose skin where the neck and shoulder join. They are given by making a tent of skin on the neck or shoulder and injecting the vaccine. A 0.5 inch needle is helpful for ensuring the needle is not accidentally pushed through both sides of the tented skin.

8.4.2.2 Intramuscular Injection (IM)

Intramuscular injections may be given in the thigh muscle or the large muscles along the side of the neck. IM injections are usually given in the lower hip or shoulder. A 0.5 inch needle is also a good size to use for intramuscular injections. Pull the plunger back and look for blood in the syringe. If you see blood, simply pull the needle out and inject in a different site.

8.4.3 Sheep & Goat Handling

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 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.



8.4.3.1 Sheep Handling

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 sheep handling much easier on both handler and animal.

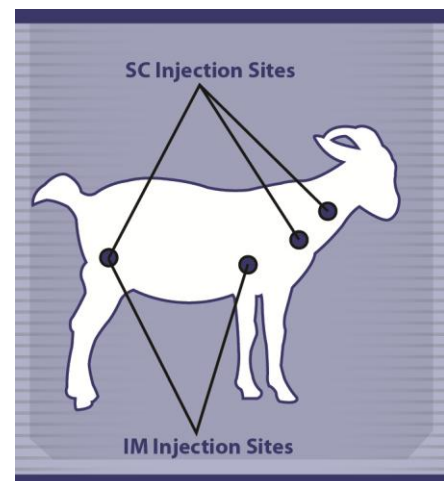
As with cattle, an understanding of a sheep's flight zone will make moving and handling them much easier and less stressful for both handler and animal. When the handler is standing outside the flight zone, the animal will turn towards the handler. Once the flight zone is invaded, the animal will turn 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. 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.

8.4.3.2 Goat Handling

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 can become aggressive towards each other, and they move in family groups with the oldest females moving first. When handling goats, higher gates may be needed than those suitable for sheep, and goats will find the escape spots in the handling system if they exist.

8.5 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. Not knowing which diseases are endemic in a particular location, as well as the cost of the vaccine, may deter some hobbyists. Also, many poultry vaccines come in large multi-dose vials of 500 or more, making them impractical for the owners of small flocks of fowl.

Mandatory meat withdrawal times following vaccination must be observed for vaccines 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).

8.5.1 Vaccines for Foreign Diseases of Poultry

There are a number of diseases of poultry foreign to the United States with the potential to cause significant losses if introduced. USDA licensed vaccines are not available for most of these diseases. A compendium listing vaccines produced in other countries for diseases which are either rare or foreign to the U.S. can be found at: <http://apps.cfsph.iastate.edu/Vaccines/index.php>. Table 9 lists diseases foreign and rare to U.S. poultry.

Table 9. Foreign and Rare Diseases of Poultry	
Disease	Pathogen Responsible
Highly Pathogenic Avian Influenza	<i>Highly Pathogenic Avian Influenza Virus</i>
Exotic Newcastle Disease	Avian Paramyxovirus
Venezuelan Equine Encephalitis	<i>Equine Encephalitis Virus</i>

8.5.2 Vaccine Administration in Poultry

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. Chicks may be individually vaccinated during processing before they are boxed and shipped, or after arrival. Boxed chicks can also be vaccinated by spraying each box or 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.

8.5.2.1 Oral

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.

8.5.2.2 Spray or Nebulization

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 in the eye by spray, 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 vaccine 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 conveyor, 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 that volume covers the entire inside of the box. 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.

8.5.2.3 Eye Drop

Eye drop vaccination is a highly effective means of delivering respiratory virus vaccines to birds, but it requires that each bird be handled individually. However, unlike mass vaccination methods, handling birds for eye drop vaccination ensures that every bird can be 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.

8.5.2.4 Scarification (Cutaneous)

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.



8.5.2.5 Intramuscular Injection

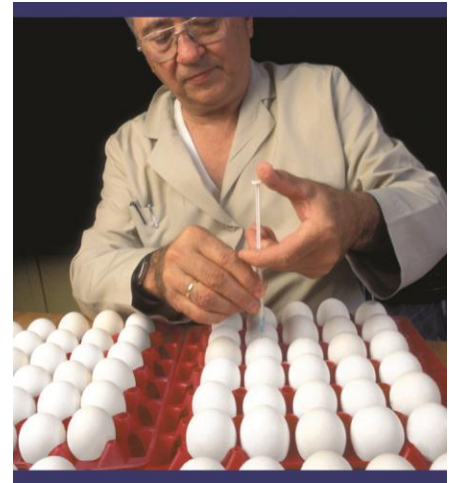
Intramuscular injection requires individual handling of birds. Vaccines usually come in multi-dose vials of 500 or more, where the use of an automatic syringe that delivers a pre-determined volume of vaccine improves efficiency. Injections may be made in the lower neck, breast, or leg. Improper needle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

8.5.2.6 Subcutaneous Injection

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

8.5.2.7 In Ovo Injection

In ovo vaccination is a highly efficient way of delivering vaccine to an entire flock of birds. Automated in ovo vaccination equipment is required, and 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 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.



8.6 Dogs and Cats

Of the 17 terrestrial foreign animal disease threats, dogs and cats are susceptible to a number of them, such as some strains of highly pathogenic avian influenza, Rift Valley fever, Hendra, Nipah, African horse sickness, and Q fever. However, USDA licensed vaccines are not available for any of these diseases in dogs and cats. In an outbreak situation, dogs and cats located on livestock premises would be susceptible to the same movement controls as livestock to minimize the risk of disease spread. Should a dog or cat ever need to be handled or administered a vaccine, proper technique will be required. This section of the document provides that essential information.

8.6.1 Dog Handling

The following are general guidelines for safe canine handling. The ability to effectively handle and restrain animals for vaccination is critical to the success of any vaccination program. Dog bites can cause serious injury and infection. Fearful, aggressive, and unsocialized dogs should be handled by experienced individuals. Dogs vary widely in their response to handling, depending on their temperament, training, and breed. In general, start with the least amount of restraint necessary to perform the procedure. Unnecessarily frightening a dog with firm restraint can increase the dog's desire to flee or defend itself, and make subsequent procedures more difficult. To minimize the amount of time the dog must be restrained, do not begin restraining the animal until all the supplies and personnel are ready.

Feral dogs are not accustomed to human handling. These dogs should only be handled by personnel familiar with their general temperament using appropriate equipment, such as a rabies catch pole.

Several methods of restraint and restraining equipment are listed below.

8.6.1.1 General Restraint

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

8.6.1.2 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. For very aggressive animals, a leash can be pulled through the angle of a door to restrain the dog's head in the corner. The door can then be opened towards the wall, squeezing the dog between the door and the wall.

8.6.1.3 Muzzle

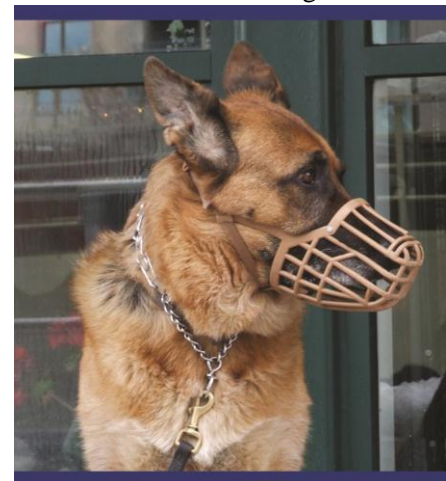
A number of commercially produced muzzles are available for dogs in a wide variety of sizes. Ensure that the muzzle is of an appropriate size for the dog, both for the safety of the dog and the handlers. Standard muzzles may not be useful for brachycephalic breeds, such as bulldogs and pugs, due to their short snouts, but specialized ball-shaped devices are available that fit over the entire head of the animal. Reusable muzzles should be disinfected between dogs to prevent the spread of communicable diseases. When applying a muzzle, bringing the muzzle from behind and above the dog is usually most effective. Approaching a dog from the front with a muzzle can result in serious bites. Some dogs are simply too aggressive to safely muzzle.

Soft Muzzle

For brief procedures, a nylon, cloth, or leather muzzle that prevents the dog from opening its mouth is acceptable. Be aware that even if the muzzle fits well, the dog may still be able to nip with its front teeth. Care must be taken to ensure the dog does not overheat as a result of being unable to pant. Soft muzzles should never be used on dogs in respiratory distress and should never be left on unattended dogs.

Cage/Basket Muzzle

A properly fitting cage muzzle allows the dog to open its mouth, breathe and pant freely, and drink through the muzzle. However, if a dog struggles while wearing a cage muzzle, it may be able to protrude its teeth through and injure handlers or itself. These muzzles are better suited to dogs that must be muzzled for long periods of time than for use in short procedures. Some dogs, particularly racing greyhounds and whippets, are accustomed to wearing basket muzzles.



Gauze Muzzle

A makeshift muzzle can be made from the inexpensive, non-stretch gauze available in many veterinary facilities. To apply the muzzle, first make a large loop with an overhand knot (half-hitch) in the top center (see photos). Holding the ends of the gauze, slip the loop over the dog's muzzle (A) and tighten the first loop (B). Bring the ends of the gauze under the dog's chin and make a second overhand knot (C). Lastly, bring the ends of the gauze behind the dog's ears (D) and tie a snug bow behind its head (E).

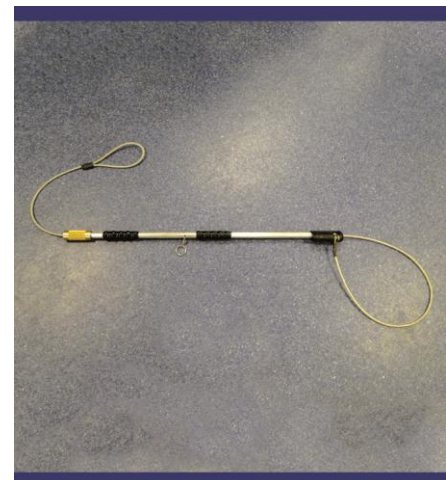


8.6.1.4 Towel

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.

8.6.1.5 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.



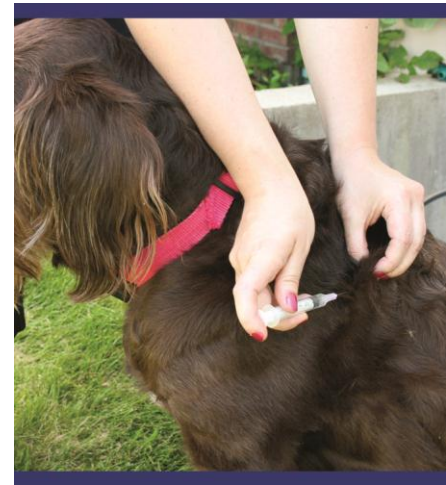
8.6.2 Dogs – Vaccine Administration

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.

8.6.2.1 Subcutaneous

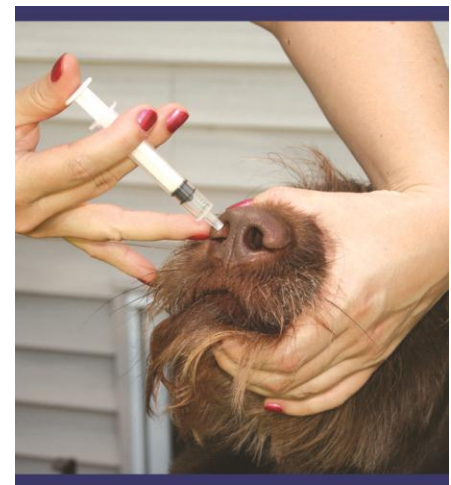
Vaccines labeled for parenteral injection should be given in the loose skin above the shoulder blades in dogs. This area is relatively insensitive, and the abundance of loose skin and relative lack of blood vessels makes subcutaneous injection in this area relatively straightforward. With the dog adequately restrained, lift up a tent of skin and insert the needle of the vaccine syringe parallel to the topline of the dog. 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 fur, 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 fur, wipe it off with an alcohol swab to prevent the dog from licking and accidentally ingesting the spilled vaccine. If you suspect that the dog has not gotten a full dose of vaccine, revaccinate the animal.



8.6.2.2 Intranasal

The only vaccine for intranasal use 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 this is also acceptable and common in practice.



8.6.3 Cat Handling

The following are general guidelines for safe feline handling. The ability to effectively handle and restrain animals for vaccination is critical to the success of any vaccination program. Despite their small size, cats are extremely agile, and their claws and teeth can inflict wounds and cause serious infection. Fearful, aggressive, and unsocialized cats should be handled by experienced individuals. Whenever possible, handle and examine cats in a fully enclosed room or structure so the cat can be recaptured if it escapes. Domestic cats vary widely in their response to handling. In general, start with the least amount of restraint necessary to perform the procedure. Escalating quickly to firmer restraint can anger the cat and make subsequent procedures more difficult. To minimize the amount of time the cat must be restrained, do not begin restraining the animal until all the supplies and personnel are ready.

Feral cats are notoriously unpredictable and have been known to climb furniture, walls, and people. They should be handled as little as possible and only by personnel familiar with their general temperament. Feral cats presented in a live cat trap can be vaccinated without removal from the trap. If it must be removed, restraint with a large net or a squeeze trap is recommended. The animal can be vaccinated directly through the net or squeeze trap and returned to an appropriate cage or trap. If an animal must be handled outside of its cage, use appropriate personal protective equipment, such as heavy leather gloves or gauntlets in a fully enclosed room.

Several methods of restraint and restraining equipment are listed below.

8.6.3.1 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.

8.6.3.2 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 either place a towel over the top of the cat and scoop the edges of the towel under the cat's legs, or set the cat on top of the towel and wrap the cat in the towel. 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.

8.6.3.3 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.

8.6.3.4 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.

8.6.3.5 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.

8.6.3.6 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 not to harm the cat while wearing gloves.

8.6.3.7 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.

8.6.3.8 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.

8.6.3.9 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.

8.6.3.10 Rabies/Catch Pole

See above under Dogs.

8.6.4 Cats – Vaccine Administration

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. Vaccines labeled for parenteral injection can be given under the skin (subcutaneously) or in the muscle (intramuscularly). To facilitate tracing of adverse vaccine reactions, each feline vaccine should be given in a specific location. If modified live vaccine intended for intramuscular or subcutaneous administration ends up on the hair coat, wipe it off with an alcohol swab. Some injectable modified live vaccines can cause disease if licked off during grooming.



8.6.4.1 Subcutaneous

With the cat adequately restrained, 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 fur, 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 fur and the cat has not gotten a full dose of vaccine, revaccinate the animal.

8.6.4.2 Intramuscular

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, which requires training and testing for blood flash in the syringe/needle hub as described under subcutaneous injection.

8.6.4.3 Intranasal

Several feline vaccines for intranasal use are available, including feline herpes virus and coronavirus. Vaccines labeled for topical or 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.

9. 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. 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 PReP/NAHEMS Guidelines: Biosecurity (2011)*, *Cleaning and Disinfection (2011)*, and *Personal Protective Equipment (2011)*.

9.1 Disease Transmission

Disease can be spread by one of 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 to reducing disease transmission.



9.2 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 vaccination 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 be administered to more animals than a smaller bottle.
- 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 (i.e., coveralls or scrubs,) over personal clothing and change outer clothing when contaminated, or 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 Biological Risk Management for Mobile Veterinarians, CFSPH 2005 available at: <http://www.cfsph.iastate.edu/BRM/mobileresources.htm> and the *FAD PRP/NAHEMS Guidelines: Biosecurity (2011), Cleaning and Disinfection (2011) and Personal Protective Equipment (2011)*.

10. VACCINATION STRATEGIES IN A DISEASE OUTBREAK

In the event of a disease outbreak affecting livestock, various strategies may be employed, depending on the scope of the outbreak and the nature of the disease. In some cases, depopulating livestock without vaccinating animals may be the fastest way for a disease-free country to resume trade without restrictions. Vaccination may 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. In the most recent foot-and-mouth disease outbreaks in the United Kingdom, vaccination was not used as a part of containment strategies due to a variety of complications associated with vaccination.

This section will focus on strategies to contain an outbreak that include widespread vaccination. Strategies will depend on the scope of the outbreak, the nature of the disease, the efficacy and availability of vaccine, and trade restrictions pertaining to a disease or vaccine. All vaccine strategies strive to effectively confine the outbreak while conserving vaccine, supplies, personnel hours, livestock, and expenditure related to containment efforts.

10.1 Suppressive or Dampening Down Vaccination

Vaccination can slow or stop pathogen transmission by decreasing the probability that an animal will become infected and/or reducing the shedding of pathogens from infected animals. Emergency vaccination conducted both within and around infected zones is called suppressive or “dampening down” vaccination. Suppressive vaccination can take place throughout a country or compartment; however, this strategy may require large quantities of vaccine and sufficient human resources.

10.2 Targeted Vaccination

Targeted vaccination may be directed at uninfected animals of high value, which can include livestock with valuable or unusual genetic backgrounds, long-lived production animals, zoo animals, or endangered species. Targeted vaccination can also be directed at uninfected areas where there is a high density of susceptible animals.

10.2.1 Ring Vaccination

Ring vaccination, a form of targeted vaccination, refers to a strategy of immunizing animals within a defined area around infected premises or infected zones. Its purpose is to prevent virus transmission from a focal outbreak to surrounding uninfected areas. Ring vaccination depends on the ability to rapidly detect disease cases and identify animals or premises at the greatest risk of disease from confirmed cases. Ring

vaccination may not be appropriate in cases where disease is widespread or contained in widely scattered foci, if it is difficult to identify; where there is a significant delay between infectivity and case confirmation; or where there is a significant delay between vaccine administration and onset of protection. The size and shape of the vaccination zone will depend on a disease's route(s) of transmission, the history of travel between zones, the geography and weather, and the number and species of susceptible animals. Defining the size and shape of a vaccination zone in ring vaccination can be complex. Modeling software may be able to estimate likely transmission zones for some pathogens and situations.

10.2.2 Barrier Vaccination

Barrier vaccination is very similar to ring vaccination in that its goal is to prevent transmission across the vaccination zone. Barrier vaccination can be appropriate when there is a risk that the infection will spread into an uninfected area from a neighboring country or region.

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- USDA APHIS VS: Feedlot Health Management Report Part II. 1995
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12. FOR MORE INFORMATION

Centers for Disease Control and Prevention

“Do Not Unplug” Signs

English: <http://www.cdc.gov/vaccines/pubs/pinkbook/downloads/appendices/C/warning-signs.pdf>

Spanish: <http://www.cdc.gov/spanish/prevencion/no-desconectar.pdf>

Temperature Logs – Vaccine Storage

Fahrenheit: <http://www.immunize.org/catg.d/p3039.pdf>

Celsius: <http://www.immunize.org/news.d/celsius.pdf>

Vaccine Storage and Handling Toolkit

<http://www2a.cdc.gov/vaccines/ed/shtoolkit/>

Center for Food Security and Public Health

Foreign Animal Disease Vaccines

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

Stationary Veterinary Clinic Biological Risk Management

<http://www.cfsph.iastate.edu/BRM/resources/stationary/StatVetBRMDocumentMarch2005b.pdf>

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

Animal Disease Traceability

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

Information about the National Veterinary Stockpile

http://www.aphis.usda.gov/animal_health/emergency_management/nvs.shtml

13. ACKNOWLEDGEMENTS

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Page 40	A photo of a man putting on new disposable coveralls by a truck showing a footbath. Photo source: Jane Galyon, Iowa State University

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.

Adjuvant

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

All-in, all-out

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

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

AVMA

American Veterinary Medical Association

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

IC

Inspection & Compliance; a division of CVB

IM

Intramuscular

IN

Intranasal

MLV

Modified Live Vaccine

NAHERC

National Animal Health Emergency Response Corps

NCAHEM

National Center for Animal Health Emergency Management

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 FAD PReP website at: <https://fadprep.lmi.org>. Username and password can be requested for access on the homepage.

APPENDIX B: VACCINATION FOR CLASSICAL SWINE FEVER

Content coming soon.

APPENDIX C: VACCINATION FOR HIGHLY PATHOGENIC AVIAN INFLUENZA

Content coming soon.

[illegible]

APPENDIX E: CARE OF VETERINARY VACCINE SYRINGES

Care of Veterinary Vaccine Syringes

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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 though 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.