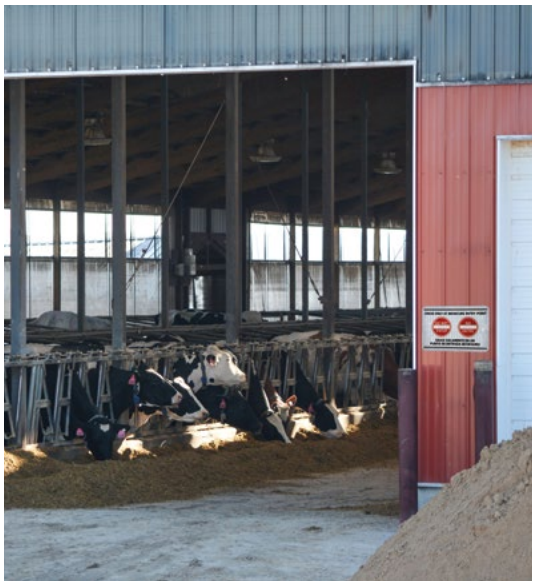
Everyday Biosecurity

Reference Manual Version 1



This manual is not a legal document and is intended for educational purposes only. Dairy farmers are individually responsible for determining and complying with all requirements of local, state and federal laws and regulations.

Foreword

For decades, the U.S. has worked to decrease disease spread among animals and prevent the introduction of a foreign animal disease (FAD). We are fortunate to live in a country where, through collaborative federal, state and industry partnerships, diseases like bovine tuberculosis, brucellosis and foot and mouth disease (FMD) that plague other countries are eradicated or at very low levels.

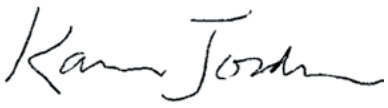
However, the threat of an FAD outbreak is always there, looming in the background until one day, it isn't. An FMD outbreak would stop the flow of milk and disrupt the entire supply chain leading to wasted milk and empty store shelves. A case of tuberculosis on a dairy farm can put a farm in a quarantined test and remove cycle lasting years, and an outbreak of Salmonella could kill dozens of calves. The cost of disease and disease spread can be high for dairy farms.

The FARM Biosecurity Program provides dairy farmers with the tools they need to protect their herds and employees. As an extension of the standards developed for the FARM Animal Care Program, the FARM Biosecurity Program is designed to be easily incorporated on your farm. As a first step to prepare for an FAD outbreak, farms should start incorporating protocols in this Everyday Biosecurity Manual today. Many everyday biosecurity best practices, including for example, vaccines and utilizing different equipment for manure and feed handling, are already being performed on your farm. Everyday biosecurity is the first step to being fully prepared for an FAD.

The companion manual to this, Enhanced Biosecurity for the Secure Milk Supply Plan, provides the tools and protocols necessary to develop an enhanced biosecurity plan to prepare for an FMD outbreak. Having an enhanced biosecurity plan may be needed to obtain a movement permit to keep your milk moving in the event of an FAD outbreak.

Day in and day out, dairy farmers provide the best animal husbandry care. As part of continuous improvement, we evaluate our best management practices and disease prevention protocols to keep our animals healthy and comfortable. Through the FARM Biosecurity Program, we are highlighting and incorporating the best practices needed to protect the health of our herds and employees.

Sincerely,



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Background

Acronym List

AABP:
American Association of Bovine Practitioners

ADT:
Animal Disease Traceability

AI:
Artificial Insemination

BVD:
Bovine Viral Diarrhea

FAD:
Foreign Animal Disease

FADD:
Foreign Animal Disease Diagnostician

FARM Program:
National Dairy Farmers Assuring Responsible Management Program

FMD:
Foot and Mouth Disease

GPS:
Global Positioning System

LOS:
Line of Separation

NAHMS:
National Animal Health Monitoring System

PIN:
Premises Identification Number

PMO:
Pasteurized Milk Ordinance

SMS:
Secure Milk Supply

USDA:
United States Department of Agriculture

VCPR:
Veterinarian-Client-Patient Relationship

VOR:
Veterinarian of Record

Target Audience

FARM Biosecurity Program participants include any cooperative, proprietary processor, milk handler or organization that has a signed, current FARM participation agreement on behalf of their membership, patrons or direct shippers. Participants manage the FARM Program on behalf of the farms and facilities belonging to the milk handling entity. FARM Biosecurity Program materials were designed to help dairy farmers develop and strengthen their biosecurity plans and protocols.

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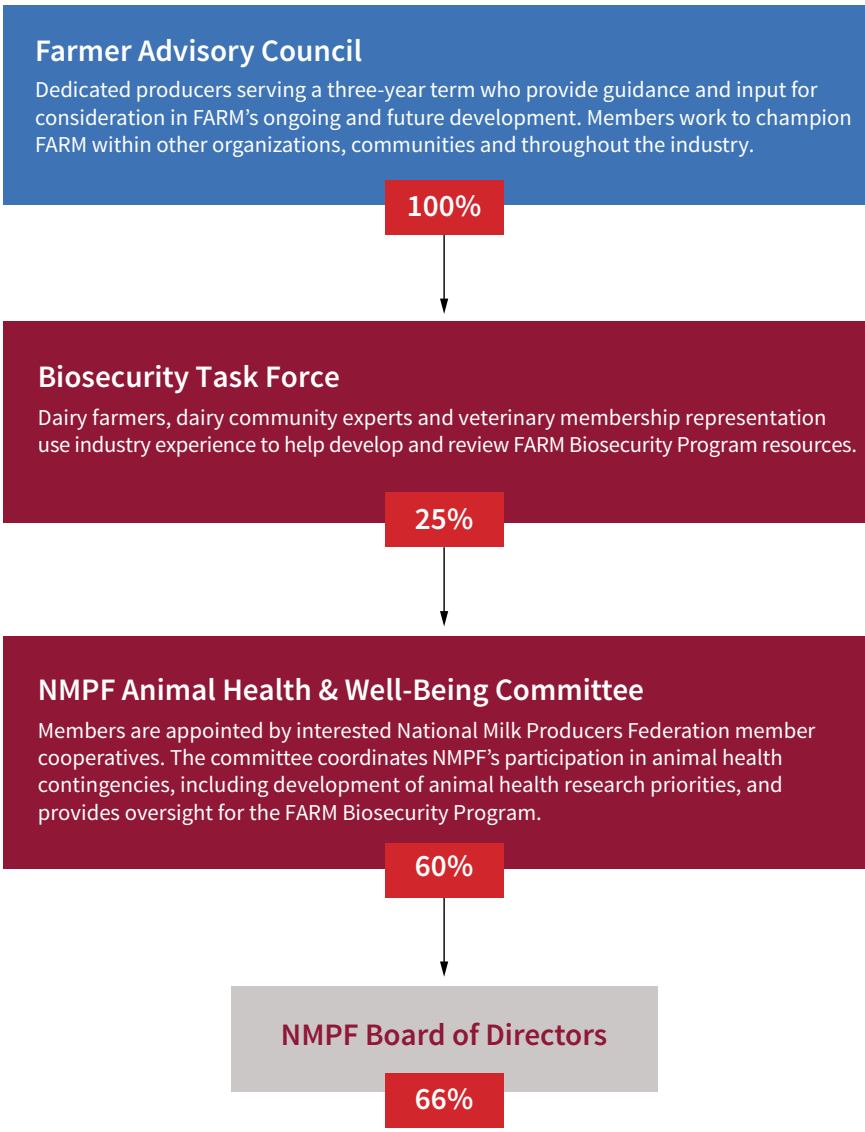
FARM Biosecurity Governance

The FARM Biosecurity Task Force, which includes representation from dairy farmers, the veterinary community, co-ops, processors, dairy organizations, state animal health officials and university biosecurity experts, guides the program — ensuring that it fosters a culture of continuous improvement and that the best biosecurity management practices, which are the cornerstone of the program, evolve with the latest biosecurity research.

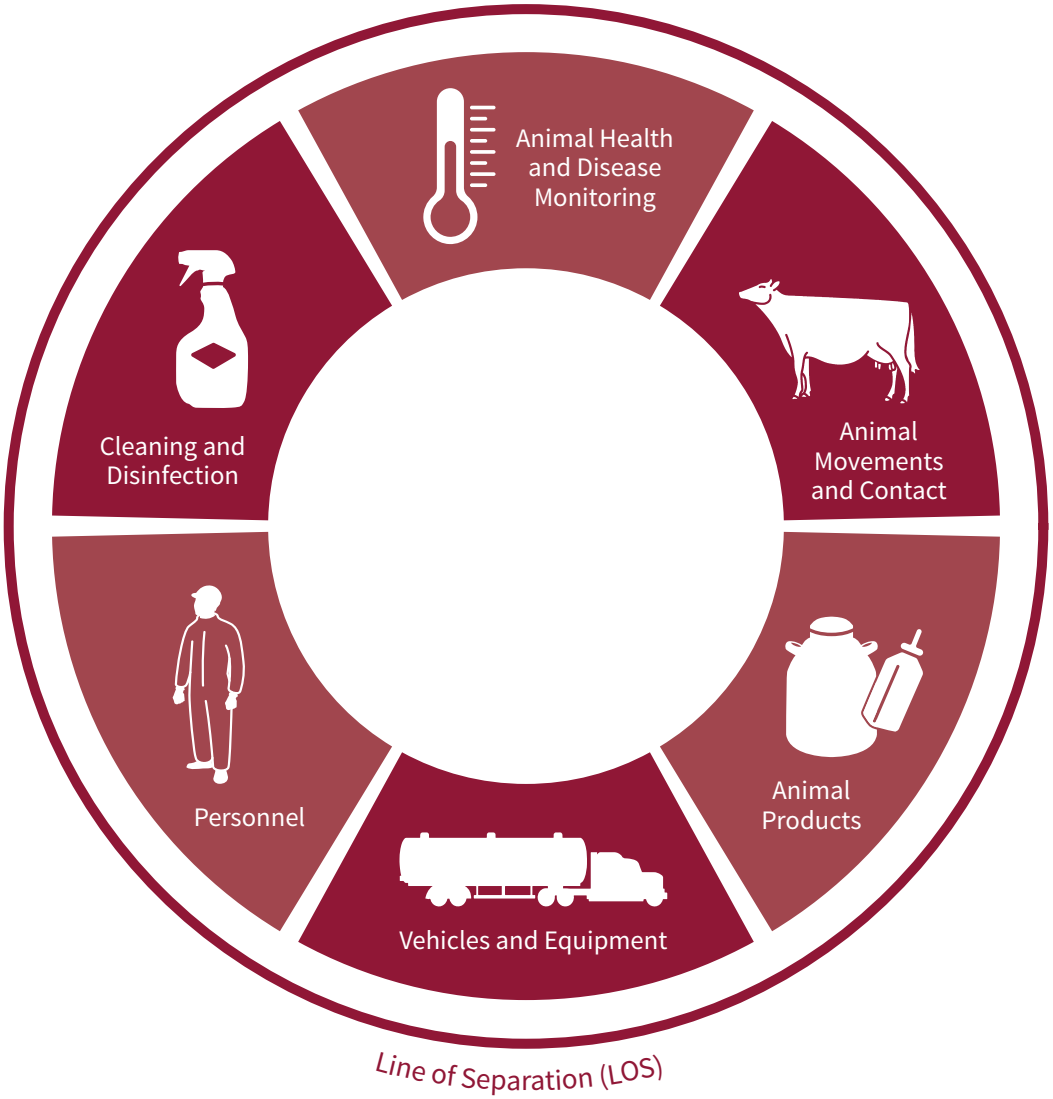


Executive Summary

Biosecurity includes management practices designed to protect cattle and people from disease exposure. Focus on preventing exposure whenever possible. The FARM Biosecurity Program provides dairy farmers with resources to demonstrate the steps they take every day to protect the health of their animals. This FARM Everyday Biosecurity Manual provides you with the steps to **get started** and **build additional protections** for your cattle. Biosecurity is viewed as a multi-step process. Everyday biosecurity is the first step to reaching the enhanced biosecurity that will be needed for a foreign animal disease (FAD) outbreak. Each of these steps are a building block. When put in place, over time you will have built a strong wall or fortress to further protect herds.

This manual includes seven biosecurity building blocks with best management practices, all of which contribute to improving animal health when put in place. This can take time. The FARM Biosecurity Task Force ranked the three most important blocks for dairy farmers to focus on first as they get started with everyday biosecurity. They are: first, **Animal Movements and Contact;** second, **Animal Health and Disease Monitoring;** and third **Personnel.**

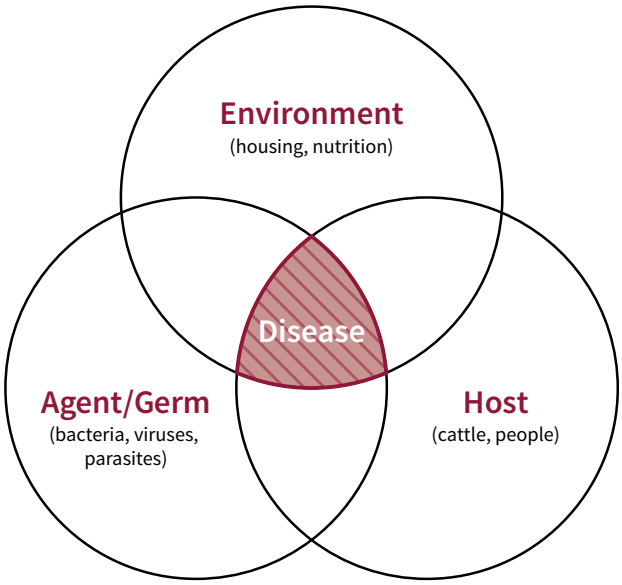
Once those are applied, focus efforts on the four remaining blocks. The concepts of cleanliness and separation are presented throughout the manual, including Cleaning Steps and Disinfection Steps from **Cleaning and Disinfection.**



01

FARM Biosecurity: Introduction

Biosecurity includes management practices designed to protect cattle and people (hosts) from disease exposure (agents/germs). Biosecurity built upon a strong foundation of excellent animal care and husbandry practices (environment) can help animals thrive. **The goal of effective biosecurity is to minimize disease spread.** This includes diseases entering the dairy from outside sources and controlling spread of diseases on the dairy. This happens when steps are put in place to limit exposure to disease agents through separation and cleanliness while strengthening the hosts immunity and creating an optimal environment for healthy living. Ensuring biosecurity practices are explained to guests prior to arriving and through employee training is key to a successful program. Everyone has a role in protecting cattle and human health on your farm.



Why Biosecurity?

While it can be difficult to eliminate all diseases, the disease risk can be managed through mitigation steps. Focus on preventing exposure whenever possible through good biosecurity practices. This leads to better animal health, animal well-being and productivity. It also reduces risks to human health when cattle and caretakers or the public are not sharing zoonotic diseases (those that spread between animals and people). Consumers expect and deserve wholesome dairy products. This begins with healthy, well-cared for animals. Healthy cattle produce more milk due to less treatment costs and losses from clinical and subclinical infections. This provides economic benefits for the producer, the industry and the nation. Investing in biosecurity can save money over time due to business continuity and ensuring quality milk and dairy beef are available to consumers in the U.S. and abroad.

Why Now?

U.S. dairy farmers provide their herds with the top level of care, as evident through the National Dairy FARM Program. The FARM Animal Care Manual Version 4 describes ways to create an optimal environment through proper housing and nutrition. It also has steps to strengthen the host's immunity through proper nutrition, vaccination and herd health plans developed with your Veterinarian of Record (VOR). Some of these prevention steps are highlighted throughout this manual to bring a holistic approach to biosecurity.

The FARM Biosecurity Program provides dairy farmers with **additional** resources to demonstrate the steps they take every day to protect the health of their animals. Common disease threats like contagious mastitis, respiratory infections and scours can be prevented, or their impact lessened, with effective biosecurity steps. There are many benefits to fewer disease challenges as described above.

Another reason FARM Biosecurity has been created is to build a stronger foundation and more resiliency against FADs. These require stronger, or enhanced, levels of biosecurity to protect cattle against highly contagious diseases. These enhanced biosecurity steps are outlined in the Secure Milk Supply (SMS) Plan (securemilksuppy.org).

SMS SECURE MILK SUPPLY

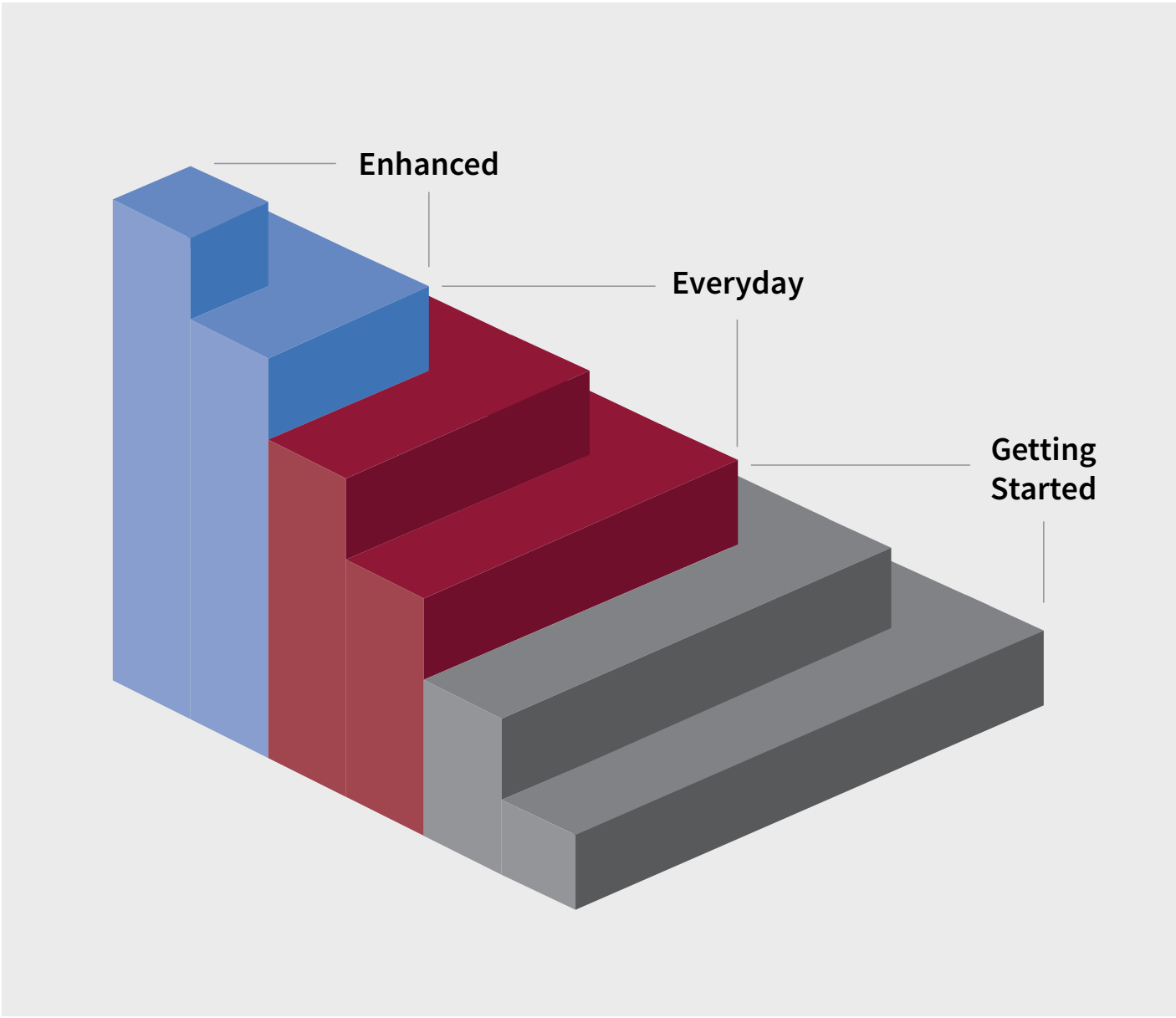
Secure Milk Supply (SMS) Plan

- Continuity of business plan for dairies during a foot and mouth disease (FMD) outbreak
- Voluntarily prepare before an outbreak
- Guidance to meet movement permit requirements

By putting everyday biosecurity practices in place to protect against the introduction of common diseases, dairy producers have laid the building blocks to protect against diseases with higher consequences. Good biosecurity takes time and practice to be effective. Building these practices into the routine can help protect animals from all kinds of disease threats.

Figure 1

GETTING STARTED IS THE FIRST STEP TOWARDS ENHANCED BIOSECURITY



02 Biosecurity Starts with General Farm Security

Keeping your farm secure is essential to maintaining biosecurity on your farm. Dairy farmers need to be vigilant in protecting their premises.

Below are simple steps which can be taken to protect your herd, employees and yourself.

- Have proper lighting, motion detectors and security cameras for offices and livestock housing.
- Post signs guiding people to where they can and cannot go on your farm.
- Create a map of your facilities to share with law enforcement in the event something happens (e.g., theft, vandalism, personal injury, etc.).
- Verify the identity of unexpected or unknown visitors to the farm. Do not be afraid to ask for second forms of identification or credentials. Make sure someone is always with the visitor.
- Evaluate any inquiries and information requests received by phone, mail or online. Gather as much information as possible before sharing pertinent information.
- Thoroughly screen all applicants applying to work on your farm, including checking all references.
- If you do encounter any suspicious activity, immediately contact local law enforcement.[1]

Securing your farm does not mean you have anything to hide – it means you want to protect the safety of your animals, people on your property and your livelihood.[1]

BIOSECURITY EVERYDAY

Everyday Biosecurity Plans

Biosecurity plans do not have to be complex to work. The best plans are ones that are practical and can be put in place on your dairy every day. They should be written to address your risks and disease management goals. By focusing on the unique factors and disease risks for your dairy, you can develop a plan that is relevant, practical and effective for protecting your cattle and the people that care for them.

This FARM Everyday Biosecurity Manual provides you with the steps to **get started** and **build additional protections** for your cattle. Biosecurity is viewed as a multi-step process. Everyday biosecurity is the first step to reaching the enhanced biosecurity that will be needed for an FAD outbreak. Each of these steps are a building block. When put in place, over time you will have built a strong wall or fortress to further protect herds.

BIOSECURITY
ENHANCED

Enhanced Biosecurity: Secure Milk Supply Plan

Why are we concerned with an FAD infecting our cattle? If introduced, our cattle have no immunity to it. Most FADs cause severe sickness and even death of infected animals. FADs also cause major economic consequences for dairy producers, the dairy industry and other livestock industries. For example, the introduction of a highly contagious animal disease like foot and mouth disease (FMD), would have devastating trade impacts. While FMD is not a public health or food safety concern, other countries would stop taking our animals and animal products to prevent disease spread to their animals. The supply chain issues experienced during the COVID-19 pandemic, a human disease outbreak, provide a glimpse at the impact FMD could have on the U.S. dairy industry.

If FMD gets into the U.S., you will have to implement *enhanced biosecurity* measures to protect your cattle. FMD is much more contagious than common diseases like bovine viral diarrhea (BVD), mastitis and calf scours. The health consequences are severe for infected animals (*see sidebar*). The economic consequences for infected farms can be devastating.

One strategy to control the spread of FMD involves stopping animal movement, which includes dairy cattle of all ages, semen and embryos. Stopping milk movement may also happen. This stop-movement event would impact continuity of business for many dairies.

Continuity of business in an FAD outbreak involves:

- Using a science- and risk-based approach
- Managing movement of non-infected animals and non-contaminated animal products
- Helping agriculture and food industries maintain or return to business

Source: USDA

FMD causes painful blisters in the mouth, on the feet and teats of cattle. Infected adult animals go off-feed, become lame and lose production. Young calves may die due to heart disease.

Links for English and Spanish **Foot and Mouth Disease in Cattle: Progression of Lesions** posters are available in chapter resources.

Helping producers protect their farm, to the extent possible, from the impacts of animal and milk movement restrictions led to the development of the Secure Milk Supply (SMS) Plan for Continuity of Business (securemilksupply.org). The SMS Plan provides guidance for producers to voluntarily prepare before an outbreak. Movement during an FMD outbreak will require a special permit. The SMS Plan also provides guidance for producers who have cattle with no evidence of FMD infection to meet movement permit requirements.

The best way to ensure continuity of business is to make sure cattle do not become infected with FMD. Preventing exposure is critical. Producers can work with their herd veterinarian to develop an operation-specific, written, enhanced biosecurity plan using the resources for FMD prevention available on the SMS website:

- Self-Assessment Checklist for Enhanced Biosecurity
- Information Manual (examples and detailed guidance)
- Biosecurity Performance Standards for Raw Milk Collection and Transport
- Enhanced Biosecurity Plan Template

The enhanced biosecurity steps are built on the foundation of daily biosecurity practices in the FARM Biosecurity Program. Putting enhanced biosecurity in place will be a smaller step for producers who have taken the initial steps to adopt everyday biosecurity practices outlined in this manual. For producers who are ready to build an Enhanced Biosecurity Plan, NMPF has added Biosecurity to their Dairy FARM Evaluator online resource. This aligns with the SMS guidance and guides producers through plan creation.

Secure Milk Supply Plan Components:

- ✔ Request a National Premises Identification Number
- ✔ Ensure milk truck and driver biosecurity performance standards are being met
- ✔ Implement your enhanced biosecurity plan
- ✔ Monitor for signs of FMD
- ✔ Keep movement records of animals, people, vehicles and equipment

Source: Secure Milk Supply Plan

Resources

Foot and Mouth Disease in Cattle Poster (CFSPH)

- English: cfsph.iastate.edu/pdf/foot-and-mouth-disease-progression-of-lesions-in-cattle
- Spanish: cfsph.iastate.edu/pdf/fiebre-aftosa-en-cerdos-progresion-de-las-lesiones-de%20bovinos

Self-Assessment Checklist for Enhanced Biosecurity (SMS)
securemilksupply.org/Assets/SMS_Enhanced-Biosecurity-Self-Assessment-Checklist.pdf

Information Manual (SMS)
securemilksupply.org/Assets/SMS_Enhanced-Biosecurity-Info-Manual.pdf

Biosecurity Performance Standards for Raw Milk Collection and Transport (SMS)
securemilksupply.org/Assets/SMS-BPS-Raw-Milk-Collection-Transport-Factors_FINAL.pdf

Enhanced Biosecurity Template (SMS)
securemilksupply.org/Assets/SMS_Enhanced-Biosecurity-Plan-Template.docx

References

[1] *Adopted from Animal Agriculture Alliance "Secure Your Farm." animalagalliance.org/resource/secure-your-farm/*

03

Protecting Your Animals from Disease

Understanding how diseases could enter or spread on your farm allows you to develop a plan to protect your cattle from these diseases. Dairy facilities differ in their size, layout, flow of cattle and traffic, as well as human and equipment resources. Thus, there is no “one size fits all” biosecurity plan. Plans need to be tailored to fit each individual operation. Basic concepts will be similar from farm to farm, but practices will vary.

How Diseases Enter a Farm

Disease causing agents, such as bacteria and viruses, can enter a farm through different means. They could be carried in or on:

Animals: new or returning from calf ranches/growers, livestock shows, breeding, embryo transfer services, or grazing lands with other livestock and wildlife. Also, rodents, wildlife and other animals contacting cattle or their areas.

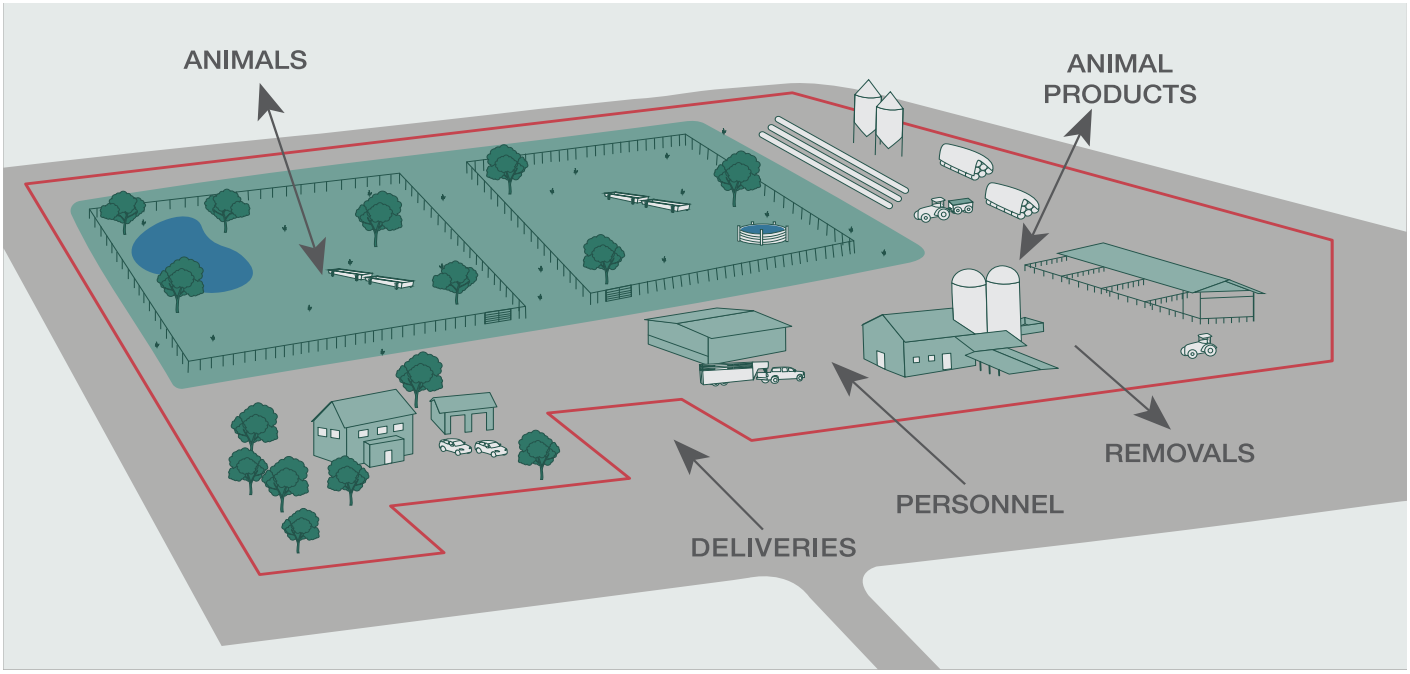
Vehicles and equipment: deliveries and removals of feed, milk, livestock, carcasses and manure or other vehicles/equipment that have been on other farms and are allowed to drive in animal areas or areas where animals travel.

Animal products: raw colostrum and raw milk that have not been treated to kill potential germs; also semen and embryos if the donors carry diseases.

People: workers, veterinarians, artificial insemination (AI) technicians, hoof trimmers, salespeople, truck drivers and others that that have direct contact with animals or workers on your operation.

Figure 1

MOVEMENTS THAT COULD BRING DISEASE TO A FARM



Source: Center for Food Security and Public Health (CFSPH), Iowa State University

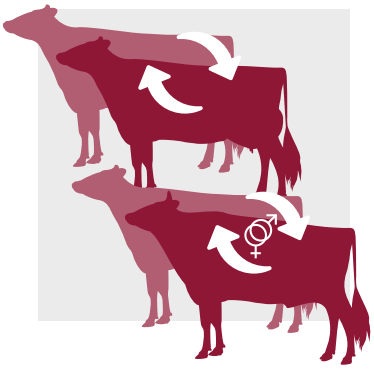
How Diseases Enter Animals or People

If we understand how diseases spread to animals or people, we can find ways to control and protect them from exposure. Even though there are hundreds of diseases, they all have one thing in common: the animal or human must be exposed to bacteria, viruses or parasites to get the disease. Once we understand how disease-causing germs enter a body, we can put biosecurity steps in place to prevent exposure.

Some diseases are spread between animals only. Some diseases are spread between animals and people and are called zoonotic diseases. Some diseases are spread by only one route; others are spread by several. For nearly all diseases, there is a relationship between exposure dose (how much) and severity of disease (how sick). For diseases that are always present (also referred to as endemic diseases), reduce the dose using separation and cleanliness biosecurity steps. These two concepts can be applied to most situations.

Below are descriptions of five different ways diseases can be spread to animals or people. Example biosecurity steps focus on preventing exposure.

Direct Contact

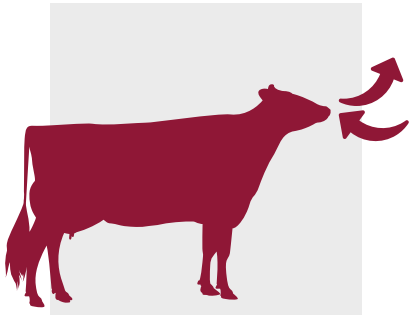


Prevention involves:
SEPARATION

A cow carrying a disease could spread it to another cow or between different species when the germ touches open wounds, mucus membranes (e.g., eyes, gums) or skin through blood, saliva, nose-to-nose contact, rubbing or biting. A cow can also spread diseases directly to her calf through the uterus or during birth. Bulls can spread diseases during mating. Prevention involves separation. Examples include:

- Separating sick and newly introduced animals from healthy ones.
- Avoiding fence line contact between animals of different health or vaccination status.
- Testing cows for diseases of concern and removing them from the herd before breeding.
- Ensuring bulls, semen or embryos come from high health status sources.
- Vaccinating for diseases spread by direct contact to make cattle more disease resistant.

Aerosol
(breath or inhalation)

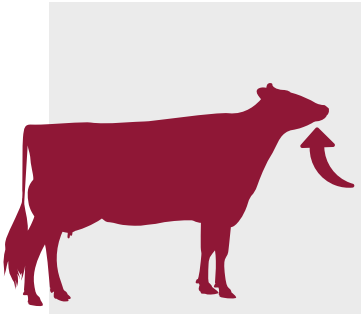


Prevention involves:
SEPARATION

When an infected cow exhales, respiratory droplets may spread those germs to another cow. Prevention involves separation. Examples include:

- Increasing the distance between sick and healthy animals, ensuring they do not share airspace or droplets.
- Providing appropriate ventilation and humidity levels between 50-75% for indoor housed animals to decrease the germ load in the air.
  - » Bacteria survive better at warmer temperatures. Viruses survive better at colder temperatures.
- Minimizing overstocking or crowding animals of different health or vaccination status.
- Vaccinating for diseases spread by aerosol to make cattle more disease resistant.

Oral
(ingestion)

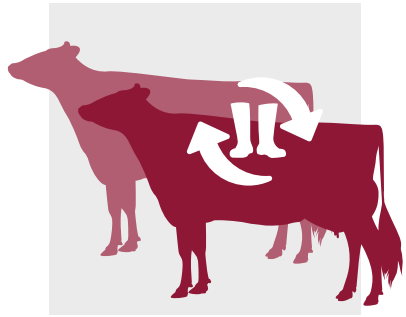


Prevention involves:
CLEANLINESS

A cow may become infected if she eats feed or drinks water that is contaminated with manure, saliva, urine or parasites from an infected animal. Prevention involves cleanliness. Examples include:

- Ensuring feed, water or anything that can be licked or swallowed is not contaminated.
- Pasteurizing milk and colostrum to kill disease agents.
- Sourcing quality feed and storing it to reduce spoilage and rodent or wildlife access.
- Offering feed and water in bunks or troughs that prevent manure or urine contamination.
- Vaccinating for diseases spread orally to make cattle more disease resistant.
- Using parasiticides labeled for use in food-producing animals and following withdrawal times for milk and meat.

Fomite

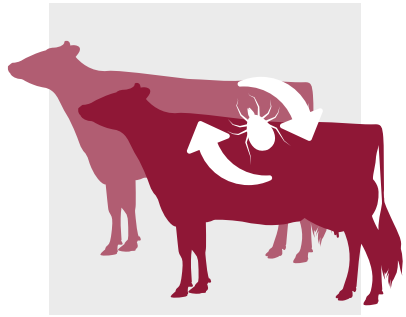


Prevention involves:
CLEANLINESS

When an infected animal contaminates an inanimate object like a needle, person's footwear, livestock trailer or milking unit, the germ can be spread to other animals it touches. Manure, blood and calving fluids are common contaminants. Prevention involves cleanliness. Examples include:

- Cleaning items used to treat, restrain or collect samples from sick animals.
- Using separate equipment for handling manure, dead animals or feed. Cleaning and disinfecting equipment between these different uses if separate equipment is not available.
- Wearing clean or dedicated clothing and footwear when handling calves or working with them before older, sick or quarantined animals.
- Milking sick or quarantined animals last if a separate hospital parlor is not available.
- Cleaning livestock trailers between hauling older, sick or new animals and calves or after hauling animals from another herd.

Vector



Prevention involves:
CLEANLINESS

Insects, wildlife, rodents, wild birds and other animals like dogs and cats can spread germs to cows. This can happen mechanically (on the footpads or feathers) or biologically (insect bite or shed in feces). Prevention involves cleanliness. Examples include:

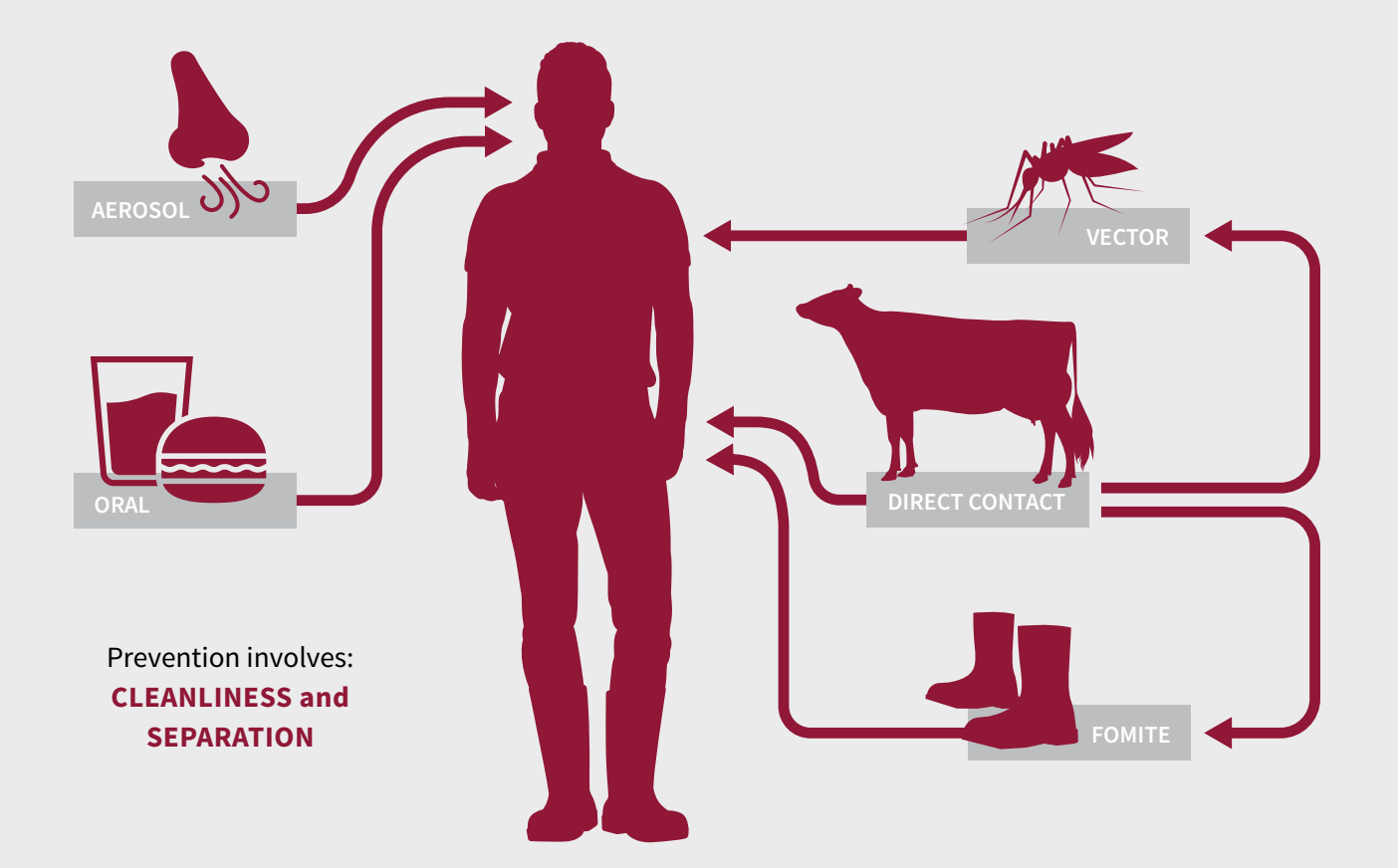
- Eliminating standing water where mosquitoes breed or decaying organic matter (e.g., manure, old feed) where flies breed.
- Using topical, oral or injectable pesticides labeled for use in food-producing animals and following withdrawal times for milk and meat.
- Storing feed in bulk bins and putting milk replacer and calf starter bags in sealable metal or heavy-duty plastic containers.
- Using rodent bait according to label directions can decrease the population.

Zoonotic Diseases

It is important to consider the health of your employees and family members in addition to keeping your animals healthy. **Zoonotic diseases** can spread between animals and people through the same ways described previously: direct contact, aerosol, oral, fomite and vectors.

Figure 2

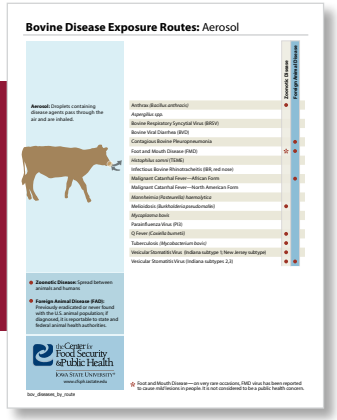
ZOONOTIC ROUTES



Prevention involves cleanliness and separation. Examples include:

- Washing hands after animal contact or handling items contaminated with bodily fluids (e.g., feces, blood, urine, saliva, calving fluids, etc.).
- Washing hands before handling food or any items that may enter the mouth.
- Wearing barriers to prevent direct contact, aerosol, oral or vector spread.
  - » Gloves to protect chapped or cracked hands
  - » Palpation sleeves to protect arms
  - » Goggles to protect the eyes from splashes
  - » Face shields to protect the eyes and mouth from splashes
  - » Masks to protect from aerosolized dust or droplets
  - » Long sleeves and pants can protect from insect bites

Link for **Bovine Disease Exposure Routes** is available in chapter resources.



Link for **Protect Your Dairy Cows** is available in chapter resources.

Example Cattle Diseases and Their Spread

In the 2014 National Animal Health Monitoring System (NAHMS) study conducted by the United States Department of Agriculture (USDA), the four diseases listed in Table 1 were the ones producers reported being fairly knowledgeable about. These four diseases are shed by cattle in a variety of ways. Some have the same exposure routes. Biosecurity steps that stop oral exposure would help protect cattle from several diseases.[1]

Table 1

CATTLE INFECTIOUS DISEASES, MODES OF SPREAD AND INCUBATION PERIOD

EXAMPLE DISEASE/GERM	SHED BY CATTLE	EXPOSURE ROUTES	INCUBATION PERIOD
Johne's Disease *(Mycobacterium avium* subspecies *paratuberculosis)*[2]	Feces, milk, colostrum	Direct contact, oral	2 years
Leptospirosis *(Leptospira hardjo bovis)*[3]	Urine, vaginal fluids, fetus	Direct contact, oral, zoonotic	Less than 7 days
Bovine viral diarrhea (BVD) virus[4]	Respiratory droplets, feces, urine, milk	Aerosol, oral, direct contact, fomite	6-12 days
Mycoplasma mastitis, pneumonia, arthritis *(Mycoplasma bovis)*[5,6]	Respiratory droplets, milk, vaginal fluids, semen, calf nasal discharge	Aerosol, oral, direct contact	Days to weeks

Biosecurity Steps for Common Diseases Can Protect from Foreign Animal Diseases

The biosecurity steps that you use to protect your cattle from common diseases can help protect them from other, and often more contagious, diseases that are spread the same way. Table 2 shows the similarities and economic differences in protecting cattle from exposure. Herds that use biosecurity practices to control or prevent BVD exposure will be better able to protect against FMD exposure.

Table 2

COMPARING EXPOSURE AND IMPACTS OF BVD AND FMD

DISEASE	EXPOSURE ROUTES	HEALTH IMPACT	ECONOMIC IMPACT
Bovine viral diarrhea (BVD)	Aerosol, oral, direct contact, fomite	Reproductive and production losses, calf deaths	~$200 per infected cow
Foot and mouth disease (FMD)	Aerosol, oral, direct contact, fomite	Reproductive and production losses, calf deaths	Total loss

Putting biosecurity steps in place now to protect cattle from BVD exposure may lead to your cattle surviving an FMD incursion, allowing you to provide wholesome, safe milk and meat to consumers. Neither BVD or FMD are public health or food safety concerns.

Resources

Movements That Could Bring Disease to a Farm (CFSPH)
cfsph.iastate.edu/thelivestockproject/movement-risks-checklist-for-organic-and-alternative-livestock/

Bovine Disease Exposure Routes (CFSPH)
cfsph.iastate.edu/Infection_Control/Routes/English/DiseaseBRMBovine.pdf

Protect Your Dairy Cows (CFSPH)
cfsph.iastate.edu/Assets/info-protect-dairy-cattle.pdf

Zoonotic Diseases of Cattle Disease and Prevention Table (CFSPH)
cfsph.iastate.edu/Assets/zoonotic-diseases-of-cattle-table.pdf

Zoonotic Diseases of Cattle Disease and Summary Chart (CFSPH)
cfsph.iastate.edu/Assets/zoonotic-diseases-of-cattle-summary-chart.pdf

Transmission Routes of Zoonotic Diseases (CFSPH)
cfsph.iastate.edu/Zoonoses/assets/English/zoonotic_dz_transmission.pdf

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[1] *USDA Dairy 2014 Health and Management Practices on U.S. Dairy Operations, February 2018, Available at: aphis.usda.gov/animal_health/nahms/dairy/downloads/dairy14/Dairy14_dr_PartIII.pdf*

[2] *USDA Johne's Disease, 2020: aphis.usda.gov/aphis/ourfocus/animalhealth/nvap/NVAP-Reference-Guide/Control-and-Eradication/Johnes-Disease*

[3] *Spickler, A.R. Leptospirosis, Oct. 2013: cfsph.iastate.edu/Factsheets/pdfs/leptospirosis.pdf*

[4] *Grungerg W. Bovine Viral Diarrhea and Mucosal Disease Complex, Merck Veterinary Manual, Feb. 2021: merckvetmanual.com/generalized-conditions/bovine-viral-diarrhea/bovine-viral-diarrhea-and-mucosal-disease-complex*

[5] *Dudek K., et al. Mycoplasma Bovis Infections-Occurrence, Diagnosis and Control, Pathogens, Aug. 2020: ncbi.nlm.nih.gov/pmc/articles/PMC7459460/*

[6] *Calcutt M.J., et al. Gap Analysis of Mycoplasma Bovis Disease, Diagnosis and Control: An Aid to Identify Future Development Requirements, Transboundary and Emerging Diseases, April 2017: onlinelibrary.wiley.com/doi/epdf/10.1111/tbed.12860*

04

Building Your Biosecurity Plan

Each farm will have different disease risks, and the plan should be customized to those risks. Identify an on-site person to be the Biosecurity Manager and write the plan. They should be familiar with the health status of the animals and the daily activities in the operation that could introduce or spread disease (the risks). This person may be an owner, herd manager, veterinarian or another employee. The Biosecurity Manager should also be responsible for:

- Ensuring biosecurity steps are followed daily
- Training others on biosecurity expectations
- Taking corrective action if biosecurity is not followed
- Updating and revising the plan
- Putting the enhanced biosecurity plan into action during an FAD disease outbreak

Scope of the Biosecurity Plan

Each unique location with cattle should have its own biosecurity plan. Begin by defining your premises, clearly describing the animals (all species) and animal housing (e.g., buildings, pastures and dry lots) associated with the dairy operation. Additionally, other businesses operated from the same premises should be accounted for in the biosecurity plan such as:

- Distribution or sales of milk or milk products, eggs, fruits, vegetables, feed mineral, fertilizer, compost, seed or equipment
- Petting zoo
- Hosting farm tours
- Repair shop, etc.

Animals owned by the operation but reared off-site should have a separate biosecurity plan. Biosecurity plans for premises owned/managed similarly may have significant overlap. However, the exposure risks may be different and thus prevented differently.

The Premises Identification Number (PIN) should be included on each unique biosecurity plan. A PIN is a unique alphanumeric number assigned to a physical location where animals are raised. The PIN is validated with a 911 address or a set of GPS coordinates (latitude and longitude) reflecting the actual location of the animals on the premises. GPS coordinates can be used for animals on pasture or barns without a postal address. A PIN is required to request movement permits during an FAD outbreak.

Producers can request a PIN from their State Animal Health Official. USDA provides links to state contact information. Visit **bit.ly/PremisesIdentificationNumber** or scan the QR code.

Records Management

In addition to treatment records, there are other important management items to keep track of with respect to biosecurity. For instance, keeping records of animal movement on and off the farm. Animals and their products are the primary ways disease can be introduced. Should a disease be introduced, records would allow you to find the source and make better informed management decisions.

As part of the USDA Animal Disease Traceability (ADT) program, accredited veterinarians are required to keep copies of Interstate Certificate of Veterinary Inspection (ICVI) documents for cattle movement for five years.[1] As a best practice, dairy farmers should also keep copies of their ICVI documents. If your herd was part of a disease outbreak investigation for brucellosis, tuberculosis or FAD, having records readily available for review can speed up tracing possible disease exposures. The faster records can be reviewed to demonstrate no contact with diseased animals or herds, the faster business can resume. Other key biosecurity records are discussed throughout the manual.

Herd Health Plan Development with Veterinarian of Record

Dairy farmers and veterinarians working alongside each other to develop herd health plans should consider including biosecurity components. As part of the Veterinarian-Client-Patient Relationship (VCPR), the Veterinarian of Record (VOR) is responsible for making recommendations with respect to animal health; biosecurity contributes to health through disease prevention. The VOR must sign a VCPR annually to document their involvement and formalize the relationship. Annual review of treatment protocols, records and training personnel could be expanded to include biosecurity steps to meet the goals of ensuring animal care. See the current FARM Animal Care Manual Version 4 for further information.

References

[1] *aphis.usda.gov/traceability/downloads/rule_movement_general.pdf*

05

Biosecurity Building Blocks

Building a biosecurity plan can be done by any dairy of any size. Once the scope of the plan is set, break up the plan into blocks with similar disease risks and prevention steps. Putting the various building blocks in place protects the herd from disease exposure. Best management practices will be described for the following:

- Animal Health and Disease Monitoring
- Animal Movements and Contact
- Animal Products
- Vehicles and Equipment
- Personnel
- Cleaning and Disinfection
- Line of Separation (LOS)


Animal Health and Disease Monitoring
Animal Movements and Contact
Animal Products
Vehicles and Equipment
Personnel
Cleaning and Disinfection
Line of Separation (LOS)

Animal Health and Disease Monitoring

Good husbandry combined with good biosecurity helps animals thrive. This includes proper housing, good nutrition, appropriate use of vaccinations and biologics, parasite control and preventing stress through proper handling. Despite best efforts, animals may still get sick. This makes having a disease monitoring plan so important. This includes watching animals for signs of illness or poor health so they can be separated from healthy animals and receive extra care, and so they do not suffer or spread disease to others. These are the foundational building blocks for cattle and calf health. Many of these are covered in the FARM Animal Care Manual Version 4 and the Calf Care and Quality Assurance (CCQA) Manual Version 1. Biosecurity practices should build on top of these best practices. The practices also align with the requirements in the Food and Drug Administration (FDA) Pasteurized Milk Ordinance (PMO).

Housing

Providing all age classes of animals with clean, dry, comfortable places to rest contributes to good health. Managing the cows' environment is one of the animal care components that benefits biosecurity. Manure and urine can carry disease organisms and should not be allowed to build up in areas where cattle lie. Cows are especially vulnerable after milking when the teat canal is still open, allowing for increased exposure of disease organisms to the mammary gland. Stalls, dry lots or bedded packs should be monitored at every milking and contamination removed to reduce the risk of exposure.

Good air quality and proper ventilation also contribute to cattle health. Ventilation options vary based on housing style. The goal is to reduce odors, dust and noxious gas like ammonia that can damage the respiratory tract.

More housing details are available in the **FARM Animal Care Manual Version 4** and the **Calf Care and Quality Assurance Manual Version 1**. Links are available in chapter resources.

Isolating Sick Animals

A hospital or sick pen that isolates the sick animal(s) from the herd is a best practice. The risk of infection from airborne pathogens may be minimized by segregating or isolating animals with highly contagious diseases from the air space occupied by the rest of the group/herd, and by ensuring adequate ventilation rates. As a best practice, ensure the ventilation system does not move air from infected animals to areas occupied by healthy animals.

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A dedicated hospital or sick pen will minimize disease spread on the farm while allowing sick cattle to recover. This is called isolation. The sick pen or isolation area should have separate air space to prevent the spread of aerosol diseases (e.g., bovine respiratory syncytial virus [BRSV], bovine tuberculosis).

The area should not share panels/fence lines, feeding or watering space with healthy animals to prevent direct contact and ingestion of contaminated feed or water (e.g., from diseases such as BVD, Johne's Disease, *Salmonella*). Contaminated equipment and instruments (fomites) can also carry disease from one animal to another. Cleaning and disinfection should occur after each procedure to control the spread of germs.

Healthy animals should be cared for before sick or diseased animals to decrease risk of disease transmission. If not possible, change clothing and clean or change footwear before working with healthy animals. This prevents the spread of diseases (e.g., *Escherichia coli*, rotavirus, coccidiosis) through contaminated outerwear (fomites). Some diseases that make cattle sick are zoonotic (e.g., cryptosporidiosis, *Salmonella*) so it is important to train personnel to protect themselves. Ensure they have access to gloves, handwashing and, if needed, a barrier (e.g., goggles/face shield) to protect their eyes/mouth from splashes.

Avoid putting lame or fresh animals in the same hospital/sick pen as clinically ill cows, heifers or calves. This will help prevent direct contact spread to a lame animal or an immunosuppressed fresh cow. Lactating cows in the hospital pen should be milked last unless there is a dedicated hospital parlor. This helps prevent spread of contagious mastitis organisms (e.g., *Staphylococcus aureus, Mycoplasma* spp.). Work with your VOR on prevention practices that work with your management style and resources.

When animals have unusual signs, do not respond to treatment or die suddenly, investigate further. This may involve a necropsy or additional testing of the animals or the environment. Work with your VOR to determine if there is a cattle health concern. Early recognition may help prevent disease spread.

Nutrition

Proper nutrition contributes to cattle's immunity against disease challenges.

Nutritional management is key to excellent animal health. All animals should have consistent, daily access to adequate feed and water, according to their specific requirements. Rations should provide the required nutrients for maintenance, growth, stage of lactation, health and pregnancy based on an animal's life stage.

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Fresh, clean feed and water are necessary to maintain animal health and to produce quality milk and meat. Animals can get exposed to germs or toxins if feed and water is contaminated. If antibiotics are used in feed or water sources, ensure that they are used under the supervision of a veterinarian and withdrawal periods are followed.

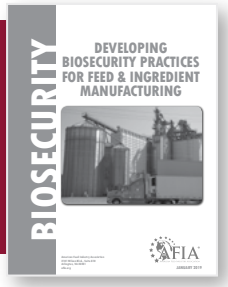
The FARM Drug Residue Prevention Manual and accompanying pocket guide are educational tools for dairy farm managers on the prudent and responsible use of antibiotics, including avoidance of drug residues in milk and meat. These tools review antibiotics approved for dairy animals. They can also be used to help inform on-farm best management practices necessary to avoid milk and meat residues.

FARM Drug Residue Prevention Manual, 2021

Feed[1]

It is important to buy feed only from reputable sources that have a quality control program. The American Feed Industry Association created the Guidance for Developing Biosecurity Practices for Feed and Ingredient Manufacturing to control the potential spread of animal diseases.

Link for **Guidance for Developing Biosecurity Practices for Feed and Ingredient Manufacturing** is available in chapter resources.



For all feed purchases, keep records of the date purchased and delivered, and the label/tag that came with the product. Feed quality control programs should include:

- Supplier verification so contamination of ingredients is controlled
- Preventive controls for ingredient receiving
- Controlling people access throughout the facility
- Steps to prevent feed contamination during manufacturing
- Transporting finished feed in clean, secure trailers
- Recording batch or lot numbers as required by the FDA

It is best to have dedicated equipment for storing, handling and preparing feed. If using feed equipment for dead animal or manure handling, thoroughly clean and disinfect before using for feeding. The goal is to remove *Salmonella, E. coli,* and Johne's Disease (*Mycobacterium paratuberculosis*) that could be found in manure or dead animals.

When storing feed, prevent exposure to weather and pests. Clean up spills to prevent attracting pests.

Safely storing bulk supplies of feed in appropriately designed areas will help avoid moisture, vermin and bacterial or fungal contamination. Proper storage will also help assure maintenance of feed quality and safety. As a best practice, ***medicated feeds are stored separately and properly labeled.***

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When mixing or offering feed to calves, heifers or adults, look for contaminants like mold, rodent droppings, unusual color or odor, or foreign material (e.g., plastic, wire, twine). If the growing season was abnormally dry or wet, test as needed for nitrates and mycotoxins. Do not feed if contaminants or toxins are found. Offer feed in elevated feeders, troughs or bunks that prevent animals from entering (e.g., neck rail, head locks) to decrease manure and urine contamination. To decrease the risk of spoilage or bacterial growth in the bunk, do not place new feed on top of old feed. Leftover or uneaten feed from adult cattle should not be fed to young stock less than 12 months old; the risk of disease transmission (e.g., Johne's Disease, *Salmonella*) is too high. Prevent overgrazing pastures to decrease exposure to feces and toxic plants.

Daily removal of non-consumed feeds ensures feed freshness, prevents mold and spoilage and aids in insect control.

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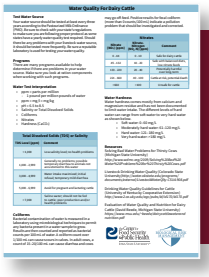
Water

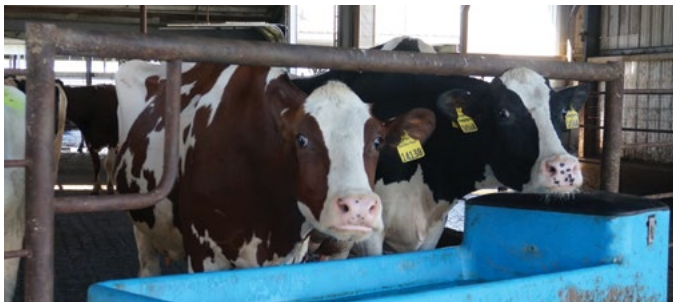
Milk is comprised of 85% water and lactating animals consume several gallons daily to meet production needs. Water quality is paramount to production, health and food safety. Water can contain bacteria, like coliforms, nitrates and salinity, or total dissolved solids (TDS). These can cause illness in calves and cows.



For more information, the link for **Water Quality for Dairy Cattle** is available in chapter resources.

The FDA PMO requires all Grade A dairies quality test their water every three years. Some states require more frequent testing. This requirement pertains to the water used in the milk house for milking operations, not livestock drinking water. However, any time a change is made to the water source, testing is recommended. Have a back-up plan for water sources in case they become unsafe for livestock to drink. Contact your milk inspector for other PMO specific details on protecting water sources.

Offer clean, good quality water to all animals. Elevating water troughs can help prevent animals from stepping into them. Installing railings around waterers about two feet above the top edge of the trough will prevent adult animals from entering and decrease the risk of defecation or urination. This minimizes the risk of fecal and urine contamination and disease exposure (e.g., leptospirosis, Johne's Disease, *E. coli*).



Check and regularly clean waterers to avoid build up. Water troughs accumulate feed and sediment over time. Water and organic matter are excellent environments for bacterial or fungal growth to occur. It is important to remove the sediment as that is where the organisms live. Disturbing the sediment without removing it and sanitizing afterwards can result in greater numbers of bacteria in the water and cow exposure.

Steps to properly clean water troughs:

1. Shut off the water to the trough
2. Use a brush to loosen the sediment along sides, bottom of trough
3. Remove the drain plug and scoop/push the sediment and water out
4. Flush with water to remove the remaining sediment
5. With the trough empty, scrub the sides/bottom to remove buildup
6. Flush with water to remove remaining organic matter
7. Bleach can be used to disinfect the trough
   - » 1 part household bleach (6% solution) to 32 parts water for 15 minutes of wet contact time. Drain the solution and refill with water.

To help control vectors, change or flush water sources at least weekly to decrease insect eggs and larvae. Fence off areas where wastewater or other contaminated water could be accessed by animals.

> Facilities should be free of standing water.
>
> ***FARM Animal Care Manual Version 4***

Parasite control is another important component to prevent disease. Parasites, internal or external, are vectors that can spread diseases. They can also reduce an animal's immune response to other diseases. High parasite numbers, internal or external, steal energy from the animal. This makes them more apt to get sick when exposed to germs. Efforts to reduce the source of parasites, either in the environment or in/on the animal, can benefit animal health. Based on your herd's needs, work with your herd VOR to include a parasite control program in your written herd health plan. This may include periodic fecal testing to see how well the deworming program is working.

Vaccinations and Biologics

Vaccines and biologics contribute to a biosecurity plan by improving cattle health. Products must be properly stored, handled and properly administered to animals to be most effective. Veterinary biologics include vaccines, bacterins, diagnostic kits, colostrum replacers with IgG and other products of biological origin. In the U.S., they are regulated by USDA Animal and Plant Health Inspection Service (APHIS).[2]

Vaccinations play a key role to support resistance to specific diseases. Identify diseases of concern for your herd and their risk of occurrence. Based on your herd's needs, work with your herd VOR to develop an effective and economical vaccination protocol to include in your written herd health plan. Review this at least annually and adjust based on disease risk, health status, management goals or as changes occur on the dairy (e.g., expansion, off-site calf-rearing/breeding, exhibitions, introducing bulls, etc.).

> Vaccinations can help prevent clinical disease and/or reduce disease effects, which ultimately can decrease the need for antimicrobial therapy The protocol should include the type of vaccine to use [by age group], timing [including boosters], vaccine storage and administration. In general, a basic vaccination program should be used on every farm to enhance immunity to disease. Further vaccination strategies can be implemented based on the veterinarian's knowledge of the herd's disease history and farm risk.
>
> ***FARM Animal Care Manual Version 4***

Proper storage temperatures are listed on product labels. Monitor refrigeration temperatures; it should be between 36 and 46 degrees Fahrenheit. Avoid storing products in the fridge door because the temperature changes each time the door is opened. Improper storage or handling may decrease efficacy of the vaccine. Cattle may not be protected. Products used for treatment may not work as expected if they get too warm or freeze. Cattle may not recover from illness.

Once products are taken out of the fridge for use, make sure they stay at the appropriate temperature and away from sun exposure until given to the animal. Pay close attention to weather – high temperatures will cause the product to warm up quickly. Use coolers with ice packs and padding to make sure the vaccines or biologics do not freeze or break. Coolers will also protect from sun exposure which can inactivate vaccines. Cold temperatures may cause the product to freeze. Coolers with warm packs and padding can be used to keep vaccines or biologics from freezing or breaking. Work with your VOR on a vaccine handling protocol.

Read and follow product label directions for each product. Take time to become familiar with the products. Record vaccinations and treatments given to cattle, including withdrawal times.

> **The FARM Drug Residue Prevention Manual** and accompanying pocket guide are educational tools for dairy farm managers on the prudent and responsible use of antibiotics, including avoidance of drug residues in milk and meat. These tools review antibiotics approved for dairy animals. They can also be used to help inform on-farm best management practices necessary to avoid milk and meat residues.
>
> Visit **FARM Antibiotic Stewardship standards webpage** to learn more.
>
> ***FARM Drug Residue Prevention Manual, 2021***

Needle and Syringe Use and Care

Make sure the items used to give vaccines or biologics to cattle are clean to prevent disease spread. Keep needles capped until they are used. Use a new needle when drawing up vaccines or biologics. Used needles can contaminate the product and impact efficacy or increase risk of adverse reactions. Properly dispose of used needles following local, state and U.S. Environmental Protection Agency (EPA) guidelines. Sharps containers should be used with personnel safety in mind.

> Disposable equipment is recommended and preferred to minimize contamination risk. Single-use needles are preferred to help prevent the spread of bloodborne diseases such as bovine leukosis and anaplasmosis.
>
> ***FARM Drug Residue Prevention Manual, 2021***

Ensure personnel are trained in safe needle handling. If an accidental needlestick happens, wash the injury immediately and notify the farm manager or supervisor. Products can cause allergic reactions, severe tissue damage or even death. Take the product and product insert with you when seeking medical care so health care providers know how best to treat an injury. As a best practice, contact the product manufacturer for specific human health care instructions. Additional resources are available through the Upper Midwest Agricultural Safety and Health Center at: umash.umn.edu/needlestick-prevention/ including a two-minute video in English and Spanish: *Preventing Needlestick Injuries, Proper Use on Dairy Farms:* youtu.be/KXrrqtrnmu0.

If using multidose syringes, label them for their use, either vaccines or biologics. Vaccines can be inactivated by biologics so syringes should be dedicated to one product type. Labeling can help prevent accidental mixing when vaccinating or treating multiple animals at once.

Multidose syringes, transfer needles and multiple use injection needles may become contaminated. Disinfectants should not be used on needles or multidose syringes as they may inactivate vaccines and impact efficacy. Vaccine transfer needles can be cleaned with boiling water.

> Consult your veterinarian before sterilizing equipment to ensure proper techniques. Improper sterilization of equipment can reduce effectiveness for future injections and lead to an infection at the injection site.
>
> ***FARM Drug Residue Prevention Manual, 2021***

Some general practices for cleaning multidose syringes include:

- The exterior can be cleaned with soap, water and a soft brush to remove organic matter.
- Avoid using soaps or disinfectants on the inside of syringes or needles. They can bind to the item and inactivate future products used.
- The interior should be repeatedly rinsed with hot (180 degrees Fahrenheit) distilled or deionized water. Tap water has minerals that may remain behind in the syringe and bind to products and inactivate them.
- Allow items to cool before using or storing. Storage should protect from contamination.
- Place cool, clean items in a sealed plastic bag and keep in the freezer until the next use.
- Plastic multidose syringes could be sterilized in a microwave.

More information can be found in the link for **Care of Veterinary Vaccine Syringes** available in chapter resources.

Disease Monitoring[3]

Maintaining dairy cattle health relies on having systems in place to prevent, diagnose, control and treat disease. Caretakers should be trained to know how to find sick animals quickly and report concerns to the herdsperson, manager or herd veterinarian. Your VOR is an excellent training resource. Work together to determine needs and set a schedule to meet the needs of personnel in their areas of responsibility. The sooner sick animals can be found, isolated from healthy animals and treated as needed, there is less suffering and disease spread to others.

Signs of illness may include lower feed intake, lower milk production, weight loss, decreased activity, lameness, difficulty breathing, deep coughing, eye or nasal discharge, bloody diarrhea, depression or abortion.

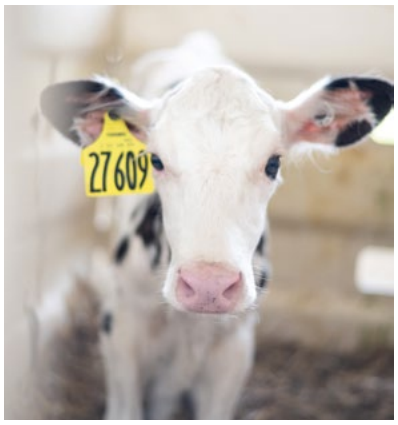
Finding blisters on feet, in the mouth, on the teats or cattle with nervous system signs (e.g., staggering, falling) may be signs of a contagious disease or one of high concern. Notify your herd, state or federal veterinarian immediately. They will work with you to learn more about the farm history (i.e., animal and animal product movement, people movement, deliveries), signs you are seeing in the herd and, if needed, send out a foreign animal disease diagnostician (FADD) to investigate. The FADD will collect samples, free of charge, to rule out an FAD. There will be a constant stream of communication between you, the FADD and the state and federal veterinarian throughout the investigation and testing period. They will provide guidance on how to dispose of the carcass, and other biosecurity steps to prevent potential disease spread while waiting for test results. The investigation is confidential.

Animal Movements and Contact

Introducing animals and animal products allows for expansion and genetic improvement of a dairy. Movement of animals on and off the dairy can introduce disease to the home herd unless prevention steps are put in place. Contact with wildlife, rodents, wild birds and other animals like cats and dogs can also introduce disease. Protecting the herd begins with determining risk tolerance around animal contact and movement and putting biosecurity practices in place that meet disease management goals.

Animal Identification

For biosecurity purposes, animal identification (ID) is essential for communicating among caretakers about health status, tracking treatments and withdrawal times, and location (e.g., pen/dry lot, pasture, grower, breeder, dry cow facility). Animal ID used in records allows monitoring for efficacy in disease management, vaccinations and parasite treatment. Reviewing this information with the VOR at least yearly can determine if health management steps are working to protect cattle health.



There are specific requirements for official animal ID for the interstate movement of livestock and record keeping.

Animal identification [ID] and record keeping are critical for making important management decisions about feeding, grouping, selecting, treating, breeding, and culling an animal from the herd. In addition, food safety, foreign animal disease threats and bio/agro-terrorism concerns make premises and individual animal identification a necessity. The FARM Program recommends using 840-RFID ear tags, which USDA recognizes as an official identification device for the lifetime of an animal.

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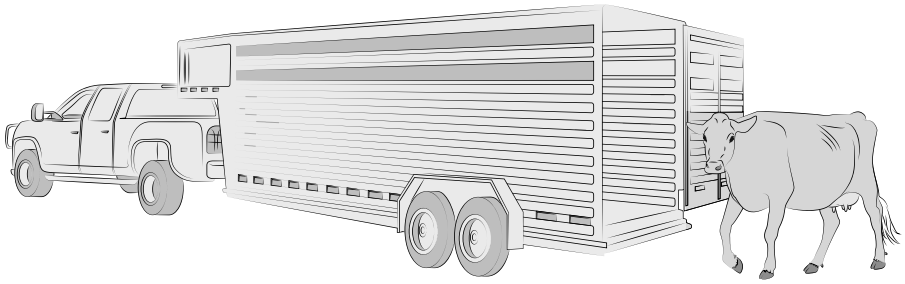
More details can be found in the link for the **USDA APHIS Animal Disease Traceability website** available in chapter resources and through the Office of the State Animal Health Official for the origin and destination herd.

Incoming, Returning Animals



New or returning animals can bring diseases to the farm. Examples include newly purchased bred heifers or bulls, show animals and calves or dry cows returning from off-site rearing. Animals brought in from outside sources are a greater risk to your herd than those born and raised on your dairy because they have been exposed to other farms and animals. The newly introduced animals may introduce new diseases or become sick themselves. Keep in mind, new animals may have little to no immunity to the diseases circulating in your herd.

Risks vary based on animal age and immune status. For example, young animals could introduce scours and respiratory diseases. Animals that have mated previously could introduce reproductive diseases (e.g., trichomoniasis, brucellosis, vibriosis). Older animals could be carriers of chronic or latent infections like contagious mastitis or viral diseases (e.g., BVD, bovine respiratory disease complex, leukosis).

Putting biosecurity and testing in place for incoming or returning animals can minimize the risk. Dairy farmers, in consultation with their herd veterinarian, need to determine the level of disease risk they are willing to accept based on their ability to invest in prevention or handle the consequences of disease spread.

By using good prevention practices, you can protect your herd from some diseases. Some practices may include:

- Knowing the health of the source herd
- Purchasing animals only from herds with a verified health status
- Testing for diseases of concern before bringing animals to your farm
- Separating, also called quarantining, new or returning animals for a minimum of 21 days for most diseases

These steps require a financial investment. When introducing animals, do so in groups that can be housed, fed, milked and treated together to help spread out the costs of the prevention practices.

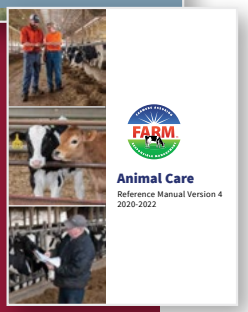
Animals taken off the operation for exhibitions, breeding, embryo transfer or treatment at a veterinary clinic should be handled as a new introduction when they return. While these animals are off-site, biosecurity practices should include:

- Limiting contact with other animals
- Avoiding sharing items with other animals unless cleaned and disinfected before using (e.g., halters, feed/water containers, reproductive equipment, etc.)
- Offering fresh feed from known sources

When moving animals, transport them in trailers that have been cleaned and disinfected. This can help prevent diseases spread through the oral and fomite routes (e.g., Johne's Disease, *Salmonella*, cryptosporidiosis).

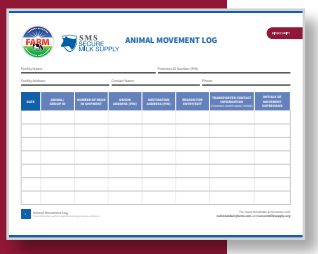
More guidelines and practices are described in the **Beef Quality Assurance (BQA) Transportation Manual.**

The **FARM Animal Care Manual Version 4** includes a chapter on fitness-to-transport, laying out best practices and considerations when moving dairy animals including unloading animals, transportation, in-transit care and when a cow should not be transitioned to dairy beef.



Visit **FARM Animal Care standards webpage** to learn more.

All animal movements should be recorded and this **Animal Movement Log** is a template for recording.



Links available in chapter resources.

Quarantine Incoming and Returning Animals [4,5]

Incoming or returning animals may not look sick but may be carrying disease. Separating these animals and watching them for sickness can prevent disease from entering your operation. This is called quarantine. If an animal in quarantine becomes sick, it only exposes the animals it already contacted. Continual introduction of new animals to an established group can also cause social stress and repeated exposure to new germs. When possible, keep groups of animals "closed" until they are ready to enter the main herd.

Ideally, quarantine animals for at least 21-30 days before letting them contact the rest of your herd. Diseases have different incubation periods – or the time between exposure and illness. A few examples are provided in Table 1. Work with your veterinarian to set animal quarantine periods based on diseases of concern, entry testing and herd health goals. While in quarantine, perform health and breeding soundness exams if not done prior to arrival.

Management of a quarantine area should use the same biosecurity goals as isolation areas for sick animals. Protecting your herd may require investing in extra equipment or extra labor. The return on investment happens when cattle remain healthy and productive.

Table 1

CATTLE INFECTIOUS DISEASES, EXPOSURE ROUTE AND INCUBATION PERIOD[6]

DISEASE	EXPOSURE ROUTES	INCUBATION PERIOD IN CATTLE
Bovine respiratory syncytial virus (BRSV)[7]	Aerosol (short distances), direct contact	3-5 days
Bovine tuberculosis (*Mycobacterium bovis*)[8]	Aerosol, direct contact, oral, zoonotic	Months to years
Brucellosis (*Brucella abortus*)[9]	Direct contact, oral, fomite, zoonotic	Variable; up to one year or more
Contagious mastitis (*Staphylococcus aureus*)[10]	Direct contact, fomite, vector (biting insects)	Days to weeks
Cryptosporidiosis (*Cryptosporidium parvum*)[11]	Aerosol, oral, zoonotic	3-5 days
Foot and mouth disease (FMD, FMD virus)[12]	Aerosol, oral, direct contact, fomite (foreign animal disease)	2-14 days
Leukosis (Bovine leukemia virus)[13]	Direct contact, fomite, vector (biting insects)	Years
Red nose/Infectious Bovine Rhinotracheitis (IBR, bovine herpesvirus-1)[14,15]	Aerosol, direct contact	4-6 days up to 3 weeks
Scours/*Salmonella species* (as an example)[16]	Oral, fomite, zoonotic, vector (rodents)	Days to weeks
Vesicular stomatitis virus[17]	Aerosol, direct contact, fomite, vector (mosquitos)	3-7 days

As with isolation areas, quarantine areas should be in separate buildings, pastures or dry lots away from the rest of your herd. The goal is to not share air space, fence lines, watering space or have nose-to-nose contact with resident cattle. People working with quarantined animals should do so after working with healthy cattle and before handling sick animals. Dedicate clothing and footwear to quarantined animal handling, and wash hands before and after working with these animals. Quarantined animals should be milked after healthy animals and before sick animals. This prevents the spread of diseases through equipment. Leftover feed from quarantined animals should not be fed to other animals on farm to prevent oral exposure to diseases (e.g., Johne's Disease, salmonellosis). Soiled bedding should be handled as contaminated. Keep it away from healthy animals.

Work with your VOR on a health plan for animals in quarantine. This may be when animals are tested for diseases of concern and further examined. For instance, perform breeding soundness examinations, feet examinations, trimming and any treatments needed. Giving vaccines and treating for parasites may improve animal health. In the 2014 NAHMS Dairy Study, 70.6% of large operations (500 head or more) required or gave vaccines to new additions.[18]

Health of Source Herd

Introducing animals from sources whose health status is known provides valuable information to manage disease risk. This is done through records of vaccinations, test results, milk quality and treatments. Work with your VOR to determine vaccination, entry testing, parasite treatment and breeding soundness exams to meet your herd health goals.

Cattle raised off-site and returned to the dairy fall into one of two categories:

Single source: meaning they are only raised with animals from the same dairy.

Commingled: meaning they are raised with animals from multiple sources and share equipment, caretakers and/or raw milk sources.

Single source cattle pose less of a risk for introducing a novel disease when they return to the dairy. If vaccinations and parasite control programs are aligned with the destination herd, this can increase disease resistance prior to returning.

Commingled cattle pose a higher risk of introducing a novel disease. In addition to aligning vaccination and parasite control programs, testing for key diseases prior

to entry and quarantining for 21-30 days before mixing with the home herd can minimize disease entry.

When purchasing bulls for natural breeding, a breeding soundness exam combined with testing provides important health information. When using AI, use semen from a reputable source that tests their bulls for venereal diseases and screens for genetic abnormalities.

Disease Testing

Animals coming from out of state may be required to be tested for diseases. Follow all state and federal testing rules. Producers may also want to test animals before introducing them to their herd. Pre-purchase examinations can also yield important information. Involve the VOR in the herd entry testing plan. They can advise on:

- The risk of disease introduction by the animal(s)
- Diagnostic tests available with costs
- Potential consequences associated with disease introduction (e.g., illness, lost production, death)
- How the disease is spread
- Whether there are other effective ways to manage or control the disease (e.g., vaccination or treatment)

Characteristics of the diagnostic tests should also be considered. These include sensitivity (i.e., finding true positive animals), specificity (i.e., finding true negative animals), cost (including state subsidized testing and sample pooling options) and convenience. Some tests are more meaningful when done on the source herd (e.g., pre-purchase testing) rather than the incoming animals (e.g., Johne's Disease, *Mycoplasma*, bovine tuberculosis). Also consider the potential risks associated with testing and how much time is required to obtain meaningful results. Some results are instant; others can take weeks. Lastly, if money is spent on testing, what decisions will be made based on the results? Would additional biosecurity steps be put in place if disease is found?

A positive test result could justify termination of the sale/move or additional testing for more definitive diagnosis. A negative test result does not guarantee freedom from disease and should not be accepted as the sole determinant of risk. The test sensitivity, clinical appearance of the animal, history and status of the herd of origin must all be used to provide meaning to a negative test result and limit the risk posed by a newly introduced animal. The VOR can advise on an appropriate testing program and assist with the interpretation of results.[19]

Other testing includes physical examination of the cattle, either pre-purchase or before commingling with the home herd. Trained dairy personnel, hoof trimmers and the herd veterinarian can all contribute to evaluating the animal's appearance, lack of signs of illness, sound legs and feet and udder health.

Wildlife, Rodent, Other Animals, Fly Control[20,21]

Wildlife, rodents, wild birds and other animals like cats and dogs can carry disease on their fur, feet, feathers or in their feces. Flies can carry germs on their feet and spread it between cattle. They are considered vectors for disease spread. It is not possible to keep all wildlife, rodents, birds and flies out of a dairy given the feedstuffs that attract them. Steps should be taken to decrease their activity. One overarching prevention step is to clean up spills and excess feed daily. Before taking any other action, make sure that the wildlife, birds or other animals you want to control are not endangered, threatened or protected in your area.

Keep buildings and fences in good repair. Good fences can help keep out some wildlife species, such as feral swine, coyotes and deer. If possible, keep cattle away from the edges of wooded areas or wildlife habitats. Guard animals such as dogs or donkeys can also help keep wildlife away. Make sure these animals are up to date on vaccines and parasite control. Keep animal feeders and waterers where they can be monitored for wildlife activity (e.g., signs of urine, feces, animal tracks).

Cats (83.8%) and dogs (70.5%) are very prevalent on dairy operations.[18] While cats may be used for rodent control, they, along with dogs, can be biosecurity risks. To prevent disease spread, be mindful of where cats

and dogs have access to on the property. All dogs and cats on the operation should be up to date on vaccines and parasite control. This will help keep them healthy and decrease risks for spreading diseases such as leptospirosis, rabies and neosporosis to cattle. Spaying and neutering dogs and cats will decrease roaming off your property. This will also reduce the attraction of strays and neighbor animals onto your property, which could be sources of disease and parasites. Discourage dogs and cats from accessing cattle feed and water to prevent disease spread through saliva, urine or feces.

Birds can spread germs such as *Salmonella* to cattle by contaminating animal feed and water through droppings, feathers and dander. Identify areas where birds perch, nest and bathe. Especially look for areas where they roost above livestock areas. Take steps to minimize bird contact and bird nesting. Options include installing netting or screens to prevent birds from entering through curtain sides. Install bird spikes on beams and rafters to discourage roosting or nesting. Also, repair holes in buildings or barns to prevent entry. Consider contacting a pest control company to assist with wild bird problems. Most wild birds are federally protected. Contact your area U.S. Fish and Wildlife Service regional office, or your state agriculture or natural resources department before moving forward with plans to deter wild birds. They can help you determine your best options based on the species of bird(s).

Rodents can spread diseases like leptospirosis and salmonellosis. Pest control companies can regularly monitor for and remove rodents. Flies can spread the bacteria that cause pinkeye and contagious mastitis. Flies can lay eggs in many places on a dairy, making it nearly impossible to completely get rid of them.

Integrated Pest Management (IPM) for rodents and flies combines several different methods to control pests to decrease disease risk. This starts with identifying what pests exist. Next, use a combination of control strategies that work together, beginning with sanitation or cleanliness.

Cleanliness

Keep trash in rodent-proof containers. Store animal feed in bulk bins and put milk replacer and calf starter bags in sealable metal or heavy-duty plastic containers. Do not allow manure or other waste to build up in or around animal areas. Keep grass mowed and remove weeds or shrubs within 3 feet around buildings. This will discourage rodent breeding and hiding areas and help eliminate food sources. Prevent access to buildings and feed storage areas by repairing or blocking off small holes where rodents can enter. Eliminate areas where rodents hide.

Controlling fly populations begins with disturbing the areas where they lay eggs. Preventing buildup of wet organic matter like manure, bedding and feedstuffs can contribute to fly control. Drag dry lots to break up manure piles. This can prevent insect eggs from hatching. If manure is stored, unless a hard crust forms, eggs can still be laid and hatch. Clean pens to remove wet bedding and feed mangers to remove uneaten feed. Mow tall grass and weeds around animal housing to decrease fly resting areas. Dead stock and afterbirth should be removed from animal areas to avoid attracting flies. Remember, there is no one chemical treatment for flies that will make up for poor sanitation.

Biological Control

Rodent predators, such as cats, carry their own disease risks for cattle including toxoplasmosis and cryptosporidiosis, both of which are also zoonotic. Prioritize disease management goals when planning rodent control programs.

Fly predators and parasites have been used with success on some facilities. They prey on fly larvae or pupa, preventing hatching.

Physical Control

Several rodent trap options exist depending on the pest. Rats and mice can carry salmonellosis which can infect people. Wearing gloves when removing dead carcasses and washing hands after can decrease the risk of zoonotic disease.

Fly traps, tape and lights may be helpful in specific cattle housing areas to decrease adult fly numbers. These can be used in places where chemicals are ineffective or prohibited (e.g., feed rooms). Follow the PMO guidelines for fly control in milk rooms or parlors.

Chemical Control

Rodenticides (poison) need to be used with caution. Rodents can move bait to other locations, exposing non-rodent animals to poison. Monitor these areas carefully.

Exercise caution to avoid contaminating feedstuffs when implementing pest control, as contaminants may pass into the animals' bodies and milk. A certified pesticide applicator or a pesticide service may be used. Read and follow label directions for all pesticide products.

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Insecticides (e.g., area or residual sprays) kill adult flies on contact. If using bait, keep cattle from accessing it and do not allow it to contaminate feed, water or milk. Animal treatments for flies are numerous. Discuss options with your VOR as cost effectiveness varies based on management needs. Pastured cattle may benefit from pour-ons, sprays, dusters, oilers or ear tags that contain insecticide. Oral options include feed with larvicides or boluses with insect growth regulators.

It is a violation of state and federal law to use a pesticide in any manner that differs from the product label. Use only according to label directions to avoid meat or milk residue hazards, environmental damage and animal or human injury.

Find more information in the link for **Ruminations: Dairy Fly Control and Your Bottom Line** available in chapter resources.

Animal Products

Semen/Embryos

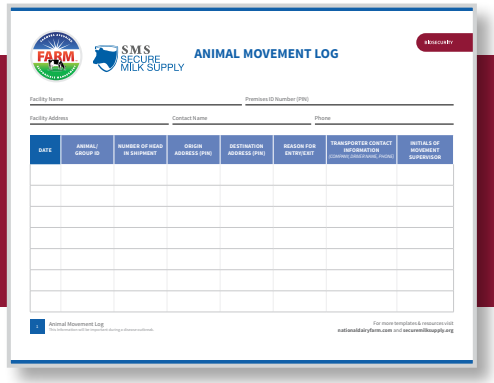
All semen and embryos should come from reputable sources that test their bulls for reproductive diseases and screen for genetic abnormalities. If the source herd has biosecurity practices like or better than your own, disease risk can be lowered. Semen and embryos should be transported in containers whose exteriors can be easily cleaned. This is a fomite prevention practice.

AI or embryo transfer personnel entering your facility should follow all biosecure entry protocols. Coveralls or clothing and footwear should be clean and free of organic matter (e.g., feces, urine, saliva, milk) from other animals. All barriers (e.g., gloves, rectal sleeves) should be disposed of after use. Provide facilities and encourage hand washing after animal handling. Similar precautions should be taken when collecting and transplanting embryos.

Feeding Dairy Products (e.g., colostrum, raw milk, waste milk)

Raw colostrum provides essential immune-building proteins, but it can also be a source of disease transmission to newborn calves. Raw and unpasteurized waste milk may also pose a risk of disease spread by oral exposure. Design a biosecurity plan that minimizes these risks and meets your herd health goals. This may include testing cows for diseases of concern (e.g., Johne's Disease, tuberculosis, BVD, *Salmonella*) before feeding calves their colostrum or milk. This may also include pasteurization and/or the use of commercial colostrum and milk replacers. Single source, dam to calf colostrum poses the least novel disease risk to the calf. When this is not possible, feed colostrum that originated on the same operation where the calf was born.

All semen/embryo movements and animal product movements (e.g., raw milk, colostrum) should be recorded and the link for this **Animal Movement Log** template is available in the chapter resources.


FARM
SMS SECURE MILK SUPPLY
ANIMAL MOVEMENT LOG
Facility Name
Premises ID Number (PIN)
Facility Address
Contact Name
Phone
DATE
ANIMAL/ GROUP ID
NUMBER OF HEAD IN SHIPMENT
ORIGIN ADDRESS (PIN)
DESTINATION ADDRESS (PIN)
REASON FOR ENTRY/EXIT
TRANSPORTER CONTACT INFORMATION (COMPANY, DRIVER NAME, PHONE)
INITIALS OF MOVEMENT SUPERVISOR
Animal Movement Log
For more templates & resources visit nationaldairyfarm.com and securemilksupply.org

Pasteurization of colostrum and raw milk is another prevention practice to break the cycle of disease spread. This can benefit calves raised on their birth farm or at off-site rearing (e.g., calf ranch, growers). With batch pasteurization, monitor the temperature (140 degrees Fahrenheit) and time (60-120 minutes) frequently to ensure proper destruction of germs. Proper storage and handling afterwards are also essential to ensure contamination does not occur.


United States Department of Agriculture

Colostrum Feeding and Management on U.S. Dairy Operations, 1991-2014

Information Brief September 2021

INTRODUCTION

NAHMS DAIRY 2014 STUDY

Figure 1. States/regions that participated in the NAHMS Dairy 2014 study

Additional information can be found in the link for **Colostrum Feeding and Management on U.S. Dairy Operations** in the chapter resources.

Commercial colostrum and milk replacers are also options to prevent disease introduction and spread to calves. Proper handling and storage are needed to ensure feed quality and keep out germs and contaminants that could spread disease via the oral route. Use air-tight, rodent proof containers for storage.

Calf care and feeding should be based on the counsel of a qualified nutritionist and the herd veterinarian.

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Whatever the source of milk for calves, ensure the feeding utensils (e.g., bottles, nipples, buckets, gang feeders, automatic feeders) are clean. Milk is a perfect media for bacteria growth. Any item contacting milk or milk replacers should be rinsed thoroughly and cleaned using soap, rinsed and allowed to dry in a clean area. Once dried, nipples can be stored in a sealable plastic bag in the freezer to prevent bacteria growth. These steps will help prevent fomite and oral disease spread.

Vehicles and Equipment

Vehicles and equipment that go from farm-to-farm may introduce or spread animal diseases if dirty or shared between farms. Examples include feed delivery, milk trucks, livestock trucks and trailers, rendering trucks, manure hauling, delivery services, veterinary vehicles, and garbage and recycling trucks. Diseases like Johne's and salmonellosis can be spread on tires if they enter animal areas or share a drive path with on-farm vehicles. These diseases can also spread in soiled livestock trailers if not cleaned between animal groups.

Making changes to traffic flow or limiting access may decrease the overall disease exposure to cattle. Separation practices can be used to keep dirty or hard-to-clean vehicles away from animal areas or shared drive paths. Prevention should also focus on cleanliness when off-farm vehicles or equipment contact animals.

Traffic Flow

Consider ways to redirect traffic flow, for both on-farm and off-farm vehicles. Keep off-farm vehicles out of animal areas or limit access to only the perimeter of the property. This may be where equipment can be left for servicing and pallets of bagged feed or supplies can be left in protected structures. Also, where dead stock could be held for pick-up, preferably out of sight from main roadways and away from all other farm traffic. Dead stock handling needs to comply with local and state laws.

Limiting Access

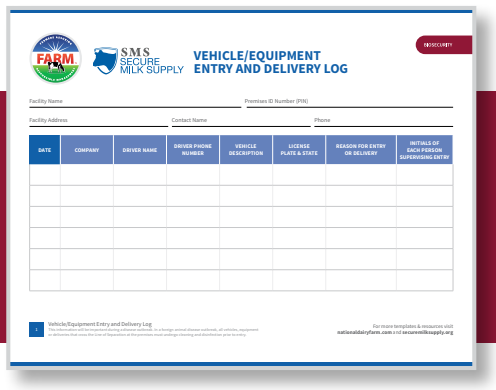
Limiting entry of dirty and high-risk vehicles, machinery and equipment is one way to prevent disease introduction. Higher risk vehicles include the rendering truck, contracted manure hauling equipment, livestock trucks and milk trucks that go from farm-to-farm. Entry points should not be adjacent to animal holding or housing areas. This can help prevent tire contamination from getting into animal areas.

Based on USDA studies of dairy operations, fewer operations restricted vehicle entry to animal areas in 2014 (35.8%) compared to 2007 (51.3%) and 2002 (41.8%). However, 81.5% of the producers surveyed in 2014 said they could move all traffic to a controlled single access point in the event of an FAD outbreak. This would allow for a single area to clean and disinfect the vehicles entering so they do not introduce contagious diseases on truck tires or undercarriage.[22]

Designated Parking Area[19,23]

A simple and effective vehicle control measure is to have a designated parking area on the perimeter, away from animal areas. Personnel either walk into the facility or use on-farm vehicles to haul equipment, supplies or treatment materials. This is not always possible for milk truck drivers, feed deliveries, veterinarians, breeders, hoof trimmers and equipment repair personnel. At a minimum, their vehicles should not drive in areas with direct animal contact. If animals will directly contact the vehicle or equipment, it should be cleaned prior to entry to remove manure, urine, blood or other visible contamination from previous livestock.

All vehicle and equipment entry should be recorded and the link for this **Vehicle/Equipment Entry and Delivery Log** template is available in the chapter resources.


SMS SECURE MILK SUPPLY

VEHICLE/EQUIPMENT ENTRY AND DELIVERY LOG

BIOSECURITY

Facility Name | Premises ID Number (PIN)

Facility Address | Contact Name | Phone

DATE	COMPANY	DRIVER NAME	DRIVER PHONE NUMBER	VEHICLE DESCRIPTION	LICENSE PLATE & STATE	REASON FOR ENTRY OR DELIVERY	INITIALS OF EACH PERSON SUPERVISING ENTRY

1 Vehicle/Equipment Entry and Delivery Log

For more templates & resources visit nationaldairyfarm.com and securemilksupply.org

Cleanliness

Cleaning tires, wheel wells and undercarriages is another prevention practice. It is labor and resource intensive to do well. In an FAD outbreak, a vehicle cleaning and disinfection station may be necessary to protect cattle health. It is not without challenges. Planning and practicing changes to traffic flow prior to an outbreak may lessen the number of vehicles and equipment that need to enter and undergo cleaning and disinfection.

Carcass Disposal

Dead animals, either euthanized or expired from natural causes, are potential sources of infection. Carcass disposal is conducted using the appropriate method in accordance with applicable local ordinances.

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Carcasses can be a hazard to the environment unless properly handled. Carcasses must be promptly disposed of using appropriate methods compliant with local and state laws. Disposal methods may include rendering, burial, composting, landfills or incineration. Work with your local or state environmental agency or office of the state veterinarian on a proper disposal plan. For carcasses disposed of on farm, prevent access by scavengers or rodents. Insect control is also important as they can be vectors for contagious disease spread.

Carcasses that are rendered should be moved to a designated location away from healthy animals and away from public view. Animals that died of infectious diseases on other operations are a risk to your operation. Limiting access is critical. Place carcasses near the perimeter or in a place that prevents the truck from entering the operation or sharing drive paths is an important disease spread mitigation step.

If you suspect the animal died of an infectious disease, work with your VOR to determine the cause of death. Where warranted and feasible, waste and bedding of an animal that has died should be removed from the facility to an area inaccessible to other animals.

Manure Management[24]

Manure can be good for the soil and, when properly dried, a good bedding option. It can also contain bacteria and parasites (e.g., Johne's Disease, salmonellosis, coccidiosis, helminths, cryptosporidiosis). Proper handling can prevent animal and human disease. Most dairy farms are required to have a Nutrient Management

Plan which includes manure storage and utilization requirements. These vary by state, so follow the governing agency rules for proper manure disposal in your area.

The survival of germs within manure depends on a variety of factors. First is the type of pathogen. Other factors include sunlight, drying, freezing/thawing cycles, high temperature, pH, exposure to oxygen, ammonia concentration numbers and the adsorption of the pathogen to soil. Exposing manure to environmental conditions can decrease the exposure risk. Separating manure solids from the liquid, anaerobic digestion and proper manure composting can also kill germs.

Manure handling equipment that is shared between operations poses a biosecurity risk. Consider options that limit access because cleaning and disinfecting equipment is impractical unless controlling spread of a highly contagious disease. Using on-farm equipment to haul manure to a location that can be accessed without entering the animal areas is ideal. Changing traffic flow during manure hauling times is another option if manure storage is centrally located. Areas traveled by off-farm hauling equipment should not be traveled until steps to decrease manure build-up can be done. Scraping drive paths, water flushing the area and using sunlight to dry the area are all ways to decrease contamination. Climate, resources and disease management goals will impact the options.

If spreading manure, apply it in thin layers onto pasture. Prevent young animals from grazing pastures fertilized with fresh manure. Some germs (e.g., Johne's Disease) can survive up to a year in manure. If trying to prevent Johne's Disease spread, do not graze replacement heifers on pastures with manure from adult cattle. Do not spread or transport manure or soiled bedding after a contagious disease outbreak. Work with your VOR on handling and disposal options.

Air quality can be improved through manure management.

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Biosecurity practices focusing on **cleanliness** can decrease the risk of fecal disease spread through oral exposure. Cleanliness applies to animal housing, walking, holding, milking and maternity areas. Keeping these areas clean and dry will reduce disease spread by hooves, people's footwear and equipment (i.e., fomites).

Separation is another important biosecurity approach to halting disease spread by manure.

Keep young animals away from the manure and soiled bedding of older animals. Separate equipment should be used for manure and feed or fresh bedding handling for any age animal. This includes tractors, skid loaders, truck beds, shovels, scrapers and pitch forks. If the same equipment is used for "dirty" items before handling feed or fresh bedding, fully clean and disinfect it between uses.

Manure management can contribute to insect control as described under **Integrated Pest Management** in this manual. Drag dry lots to break up manure piles. This can prevent insect eggs from hatching. If manure is stored, unless a hard crust forms, eggs can still be laid and hatch. Ensure runoff from stored manure does not enter animal areas or contaminate water sources.

Additional information can be found in **Composting Animal Manures: A Guide to the Process and Management of Animal Manure Compost** in the chapter resources.

Personnel

Personnel that have been around other livestock may carry disease agents on their clothing, footwear, personal belongings or hands. Disease spread could occur if biosecurity steps are not followed. Personnel includes employees, family and visitors that come to the dairy. Prevention should focus on cleanliness when possible. Limiting who has access to animals is another step to limiting exposure. For those with animal contact, ensure they are aware of the biosecurity steps to take to protect cattle health and their own health. When working with different groups of animals, start with the youngest, healthiest animals first. Work with older animals next, then sick animals, and quarantined animals last.

Biosecure Entry for Personnel[23,25]

Personnel entering the facility fall into one of two categories:

- Contacting animals on the premises
- No contact with animals on the premises

Contacting Animals

The 2014 NAHMS Dairy Study listed contract haulers (29.2%), veterinarians (26.6%) and neighbors (21.8%) as having the highest average number of animal contact visits per year across all operations.[22] Others may be infrequent, such as visitors/tour groups, nutritionists, milk truck drivers, artificial insemination technicians, hoof trimmers, Dairy Herd Improvement Association (DHIA) personnel, inspectors, rendering truck driver, drug suppliers, feed delivery personnel or university/extension personnel. Biosecurity entry steps will be similar because of the risk of contamination entering on clothing, footwear or hands.

In general, people contacting animals should:

- Have showered since last contacting livestock off-site
- Wear clean clothing and footwear
- Stay home if ill, for their health, their coworkers' health and the animals' health

Clothing

Clothing for employees or frequent visitors should be dedicated to the dairy, or groups of animals on the dairy (e.g., calves, maternity pen, milking, etc.). It remains on-site and is worn by the same person. Coveralls or other protective covering worn over street clothes also provides a protective barrier while on the dairy. Offer these items to anyone with animal contact.

If possible, make laundry facilities available for washing work clothes and coveralls on-site. This can help prevent germ spread on clothing brought home to launder. If soiled clothing or footwear is going to be taken off the property, store in a plastic bag or container until it can be laundered/cleaned and disinfected. If non-dairy workers are handling soiled laundry, they should wash their hands to prevent fomite exposure to zoonotic diseases (e.g., *Salmonella*, cryptosporidiosis, Q fever and others).

Footwear

Clean footwear is another important biosecurity step to prevent disease introduction. For those frequently on the farm, dedicate a pair of boots or footwear to remain on-site to be worn by the same person. To prevent disease spread between groups, dedicating boots or footwear to certain groups of animals on the dairy (e.g., calves, maternity pen, milking, etc.) is another level of protection. Rubber boots with treads that are easy to clean and disinfect are best. Rubber boots should not have buckles/clasps or creases and cracks that could hide germs.

Cleaning footwear when moving between animal groups can help prevent germ spread. Disposable boot coverings can also be used. Take care when wearing plastic boot covers as they may be slippery on some surfaces. They also get holes in them when walking on pavement or gravel surfaces. The number of dairy operations reported using disposable or clean boots for visitors contacting animals increased over time (31.5% in 2014 compared to 28.3% in 2007 and 18.9% in 2002, across all operations).

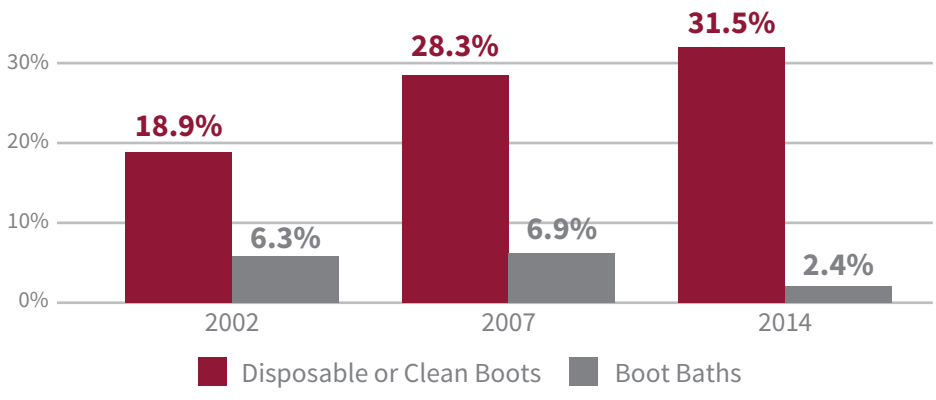
More information and photos demonstrating the steps are in **Cleaning and Disinfection on the Farm: Footwear**. Link available in chapter resources.

Meanwhile, the use of boot baths (aka footbaths) was used by fewer dairy operations as a biosecurity practice for visitors contacting animals over this same time frame (2.4% in 2014 compared to 6.9% in 2007 and 6.3% in 2002, across all operation sizes). *See Figure 1.*[22,26]

Boot baths must be properly used and maintained to be effective. Otherwise, they provide a false sense of biosecurity. A **footwear cleaning station** can play an important role with certain groups of animals. Hosing off and scrubbing boots prior to stepping into a boot bath should be step one. If really soiled, use soap and scrub. Then, rinse before stepping into the disinfectant solution or applying it to boot surfaces. Disinfectants need to have wet contact time to work well. Some disinfectant solutions do not work well or are inactivated with a buildup of organic matter. Boot baths may need to be prepared fresh at least daily, depending on use. Read and follow all product labels. Changing footwear may be more practical than standing in a boot bath for the full contact time. Another option is to have two pairs of boots so that one pair can soak in the disinfectant solution.

Figure 1

NUMBER OF DAIRY OPERATIONS USING DISPOSABLE OR CLEAN BOOTS VERSUS BOOT BATHS[22,26]



Hands

Wear disposable gloves and/or plastic sleeves during direct contact with animal tissues or fluids, and ill or isolated animals. Provide trash cans to collect used disposable footwear, outerwear and gloves.

All animal handlers should wash their hands before and after animal handling and/or wearing gloves. Provide a sink with running water and soap, a scrub brush and towels. Post signs in animal areas that promote handwashing before and after animal contact. All personnel should wash their hands using soap and warm water for at least 20 seconds. Hand wipes are another option when there is no sink nearby. These can mechanically remove organic matter. Hand sanitizer, containing at least 60% alcohol, can be used on clean hands. Hand sanitizer does not work on cryptosporidiosis.

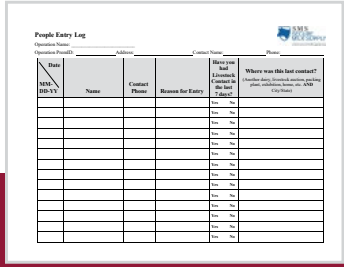
Without Animal Contact

Personnel that visit the facility and have no animal contact are a minor risk to introducing germs to the cattle. Ensure they do not drive or walk in livestock areas or contact feed, milk or manure to prevent fomite spread. If they must share walking paths, clean footwear or disposable boots should be worn. Create barriers around animal areas to limit unplanned visitor contact with your animals. Clearly mark areas that are off limits or where protective clothing is required.

Links for **Protecting the Dairy Herd: Visitors Contacting Cattle** in English and Spanish and for **Protecting the Dairy Herd: Visitors Without Cattle Contact** in English and Spanish are available in chapter resources.

Keeping Track of Entry[25]

Know who comes on your facility and what other animal contact they have had. Have a sign-in sheet with questions about animal contact. Visitors who have their own livestock or contact livestock on other farms may carry disease-causing germs onto your dairy. Make people aware of the biosecurity steps to follow before they enter your operation.



People Entry Log

Operation Name: _____

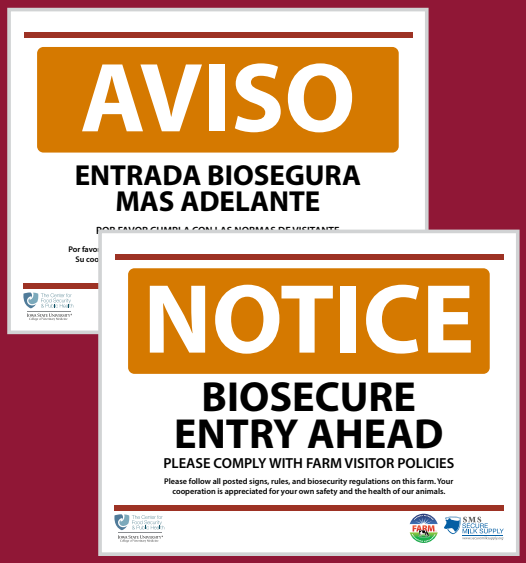
Operation Phone#: _____ Address: _____ Contact Name: _____ Phone: _____

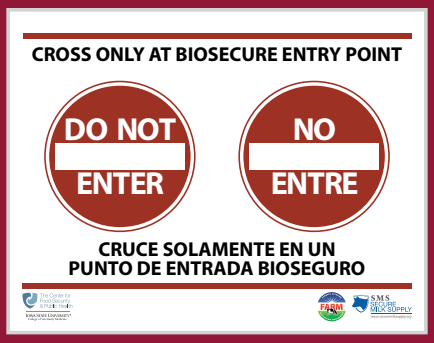
Date MM\DD-YY	Name	Contact Phone	Reason for Entry	Have you had Livestock in contact in the last 7 days?	Where was this last contact? (Another dairy, livestock auction, packing plant, exhibition, home, etc. AND City/State)
				Yes No	
				Yes No	
				Yes No	
				Yes No	
				Yes No	
				Yes No	
				Yes No	
				Yes No	
				Yes No	
				Yes No	
				Yes No	
				Yes No	
				Yes No	
				Yes No	

All people entering should be recorded and the link for this **People Entry Log** template is available in chapter resources.

Some non-U.S. countries have serious animal diseases that the U.S. is trying to keep out. Visitors to your farm/ranch may include people who have travelled internationally. Post a sign or use a sign-in sheet asking any visitor to inform you of recent (i.e., within the last 5 days) international travel. Ask if they were on a farm or near farm animals during their travels. At a minimum, restrict animal contact and require coveralls, boot covers or on-site boots to be worn.

Links for a variety of on-farm biosecurity signs are available in chapter resources.

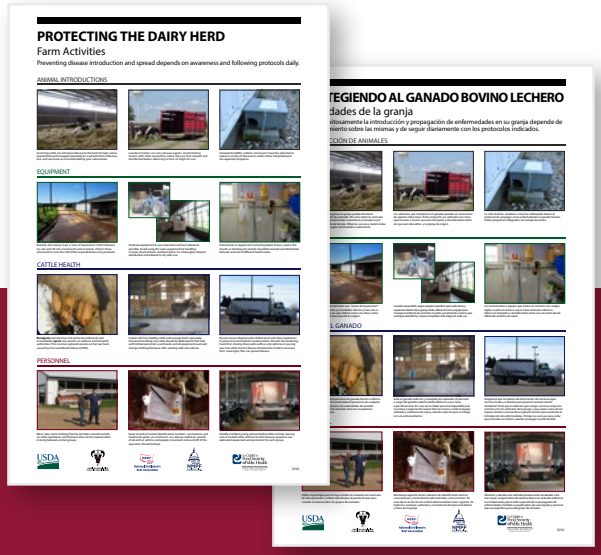




Training[23]

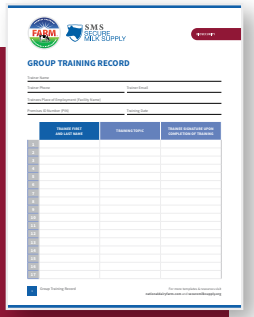
An effective biosecurity plan needs to be understood and followed by everyone on the facility. This involves communicating expectations with people who work on or enter the dairy. This also involves training animal caretakers, feeders and team members about the biosecurity steps that apply to their areas of responsibility. Ideally, compliance with the biosecurity practices should become part of the culture of the facility.

The Biosecurity Manager(s), owners and essential personnel should be trained at least annually or whenever there are changes impacting animals, the facility or herd health goals. New employees should be trained upon hiring to ensure they understand the biosecurity measures necessary to keep cattle healthy. The Biosecurity Manager(s) should inform personnel about the biosecurity measures they are to follow in a language they understand. Individuals should be made aware of the biosecurity concepts and procedures that apply to their specific areas of responsibility.



Key concepts are presented in the **Protecting the Dairy Herd: Farm Activities** poster. Links for English and Spanish versions are available in the chapter resources.

Training sessions should be documented or logged and the link for this **Group Training Record** template is available in chapter resources.



All individuals, including visitors, entering the dairy should understand how to:

- Contact the Biosecurity Manager(s)
- Follow biosecure entry requirements
- Perform biosecurity measures for their specific job duties

In addition to the above, employees and family members should:

- Understand the importance of biosecurity
- Review the entire biosecurity plan
- Review the labeled premises map
- Know who to report to if they see someone not complying or something preventing compliance
- Recognize the consequences for not complying with biosecurity protocols

Effective training can be done through one-on-one or group sessions, depending on the responsibilities of the individuals and their learning style.

Cleaning and Disinfection (C&D)

Throughout this manual, cleanliness has been noted as an important disease prevention practice. Just like the steps needed to properly sanitize the milking system, certain steps need to be followed for different items found on a dairy farm. In some cases, cleaning is all that will be needed to decrease disease risk. In other cases, the extra step of disinfection is needed to kill germs. General guidance provided here can be used to write protocols to address the risks and disease management goals on your dairy. Your veterinarian is another resource for recommendations on cleaning and disinfecting items used on animals.

Item Surface Affects C&D

The material the item is made from affects how it can be cleaned. If the item also needs to be disinfected, read the product label carefully to make sure it can be used on the surface type.

A list of some common dairy farm items and the materials they are made from are listed below.

Table 2

ITEMS USED WITH CATTLE AND THEIR MATERIAL/SURFACE TYPE

ITEM	MATERIAL	SURFACE
Balling gun	Metal or plastic	Smooth to cracked
Boots	Rubber	Smooth to cracked
Bottles	Plastic	Smooth to cracked
Calf hutch	Plastic or wood	Smooth or porous
Calving/obstetric chains and calf jack	Metal	Smooth
Chute	Metal	Smooth to porous (if rusted)
Clippers	Metal and plastic	Smooth to porous
Clothing/coveralls/towels	Cloth	Porous
Dehorner	Metal	Smooth
Esophageal feeder*/stomach tube	Plastic	Smooth to cracked
Halter/lead rope/straps	Braided cotton, nylon	Porous
Hoof knife	Metal, wood, plastic	Smooth and porous
Milking unit liners	Silicone, rubber	Smooth to cracked
Needles*	Metal	Smooth
Nipples	Rubber	Smooth to porous
Syringes*	Plastic, glass, metal	Smooth to cracked

Items used for antibiotics or electrolytes cannot be disinfected. Refer to **Needle and Syringe Use and Care section for specific guidance.*

Porous Surfaces

Porous surfaces (e.g., braided cotton, nylon, cement, wood) will need more soaking using soaps or detergents and scrubbing to remove visible contamination. Extra rinsing with water may be needed to remove the soap.

Smooth Surfaces

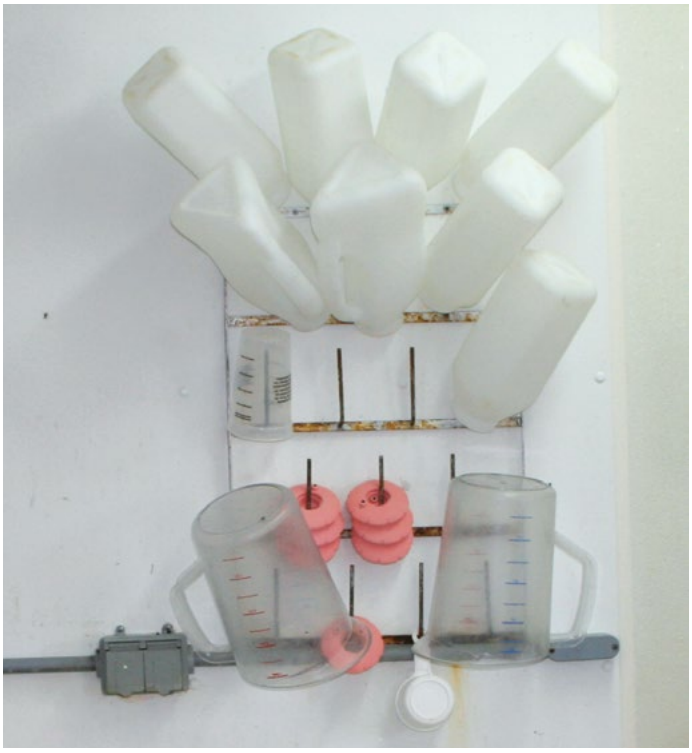
Smooth surfaces (e.g., metal, glass, plastic) can withstand a variety of cleaning and disinfecting steps. If the metal rusts or cracks appear, the item is now more porous and may require more soaking and scrubbing. Some disinfectants will react with rust or certain metals.

Some items start out smooth (e.g., rubber, silicone, vinyl) and over time, become cracked. One example is milking unit liners. Over time, the cracks can harbor germs and they need to be replaced as the sanitizing step is no longer effective. Other items that fall into this category are calf nipples and plastic esophageal feeders that get chewed on. They become more difficult to clean and sanitize. When used with young animals who are more susceptible to diseases, do not use if it cannot be cleaned and sanitized.

Water Characteristics Impact Cleaning and Disinfecting

Water quality, temperature and pressure can impact the cleaning and disinfection process. Read the product label for specific guidance. Hard water can interfere with how well soaps and disinfectants work. Soaps, detergents and degreasers break up the membrane around the organic material or germ. This allows it to loosen from the item and be removed. If there is a lack of lather or suds created, test the water for calcium or magnesium levels. Hard water can also bind to certain disinfectants and prevent them from killing the bacteria or removing the virus.

Water temperature is important when sanitizing items (e.g., calf milk pasteurizers) or food contact surfaces (e.g., milking equipment). Some disinfectants work better in cold temperatures, others in warm to hot temperatures. Monitoring water temperature is important to ensure the process is working to protect cattle health. If people are responsible for cleaning items, they may do a more thorough job if the water temperature is comfortable (i.e., not too hot, not too cold).



Water pressure can aid in organic matter removal on solid and porous surfaces. Combining heat with water pressure can be an effective way to remove manure and other organic material. Not all surfaces can withstand high pressure; it may cause damage. Some high-pressure washers (200-1,000 psi) can aerosolize disease organisms and spread them to other areas or expose the person cleaning. Use pressure washers in well-ventilated areas where healthy animals are housed, transported, moved or treated (e.g., calf hutches, parlors, chutes, tilt-tables, head-catch). Pressure washers may not remove all the contamination from cracks, crevices or corners.

Cleaning Steps

Cleaning must be done first to remove organic matter (e.g., manure, dirt, blood, urine, feed and bedding).

Dry clean: Remove organic matter (i.e., shovel, sweep, scrape, scrub) so you can see the surface.

Wash: Soap and warm water is best for lightly soiled areas. Presoaking with a degreaser may be needed on heavily soiled items. Scrub surfaces and any hiding places for germs (e.g., cracks, crevices, corners).

Rinse: Water can remove soap/detergent/degreaser residue that may inactivate some disinfectants. Work from top to bottom or cleanest to dirtiest.

Dry: Water puddles can dilute disinfectants; allow equipment to drip dry.

Best practices for cleaning items include:

- After use on sick or newly introduced animals
- Before use with young animals
- Between animals of different health or vaccination status
- After use when handling manure or dead animals if used for feed
- When organic matter builds up
- If organic matter will cause the item to rust or corrode

Cleanliness can be monitored through bacteria cultures or using a luminometer. This is especially important when illness rates increase.

Disinfection Steps

Disinfectants must directly contact the germ to kill it. Choose a product that is labeled to work against the common germs on your dairy. Some disinfectants are combined with soaps. These products still require dry cleaning as the first step. Disinfectant steps include:

Apply as directed on the label: Spray, wipe, soak, fog.

Contact time: Make sure the surface stays wet for the full time. In hot, dry areas, disinfectants may have to be applied more than once.

Rinse as directed on the label: Some products are toxic to animals or leave residues on food contact surfaces.

Dry as directed.

Best practices for disinfecting items include:

- Read the product label first and follow the steps.
- Wear proper protective gear when using disinfectants. This may include rubber gloves, goggles and masks/respirators depending on the chemicals in the product.
- Ensure disinfectant runoff does not enter animal areas or water supplies. Disinfectants can be toxic to cattle and aquatic animals.

Disinfectants are considered pesticides. It is a violation of state and federal law to use a pesticide in any manner that differs from the product label. Use only according to label directions to avoid meat or milk residue hazards, environmental damage and animal or human injury.

Line of Separation (LOS)[27]

As described under **Vehicles and Equipment** and **Personnel**, separation is one way to keep diseases off your dairy or out of certain animal groups. The goal is to make it harder for germs to get to your cattle. Having a line of separation (LOS) in place to separate off-farm from on-farm movements can decrease the risk of exposure. This works for common diseases that can be carried by vehicle tires or people's footwear like *Salmonella, E. coli,* or Johne's Disease. Having an LOS in place is a recommendation in the enhanced biosecurity plan for FMD prevention.

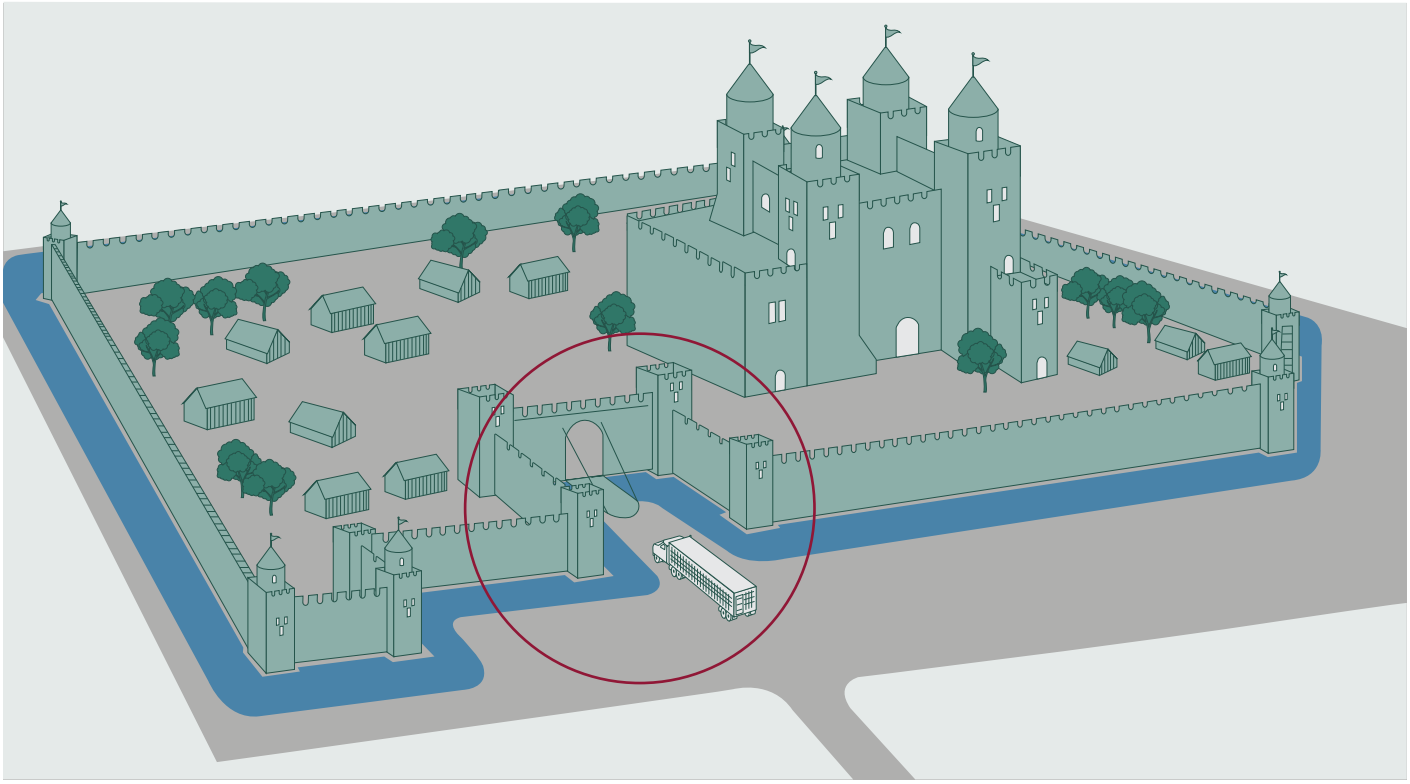
Start by picturing your operation or each animal building as a "castle" with a "moat" around it. The "moat" is an LOS between off-farm movements and on-farm animals. Entry to the facility or animal areas is only through "drawbridges" or access points. Making sure vehicles and people follow biosecurity steps before crossing the LOS can stop disease entry.

The on-farm area (i.e., inside the LOS) should include the animals and any supplies, feed, vehicles or equipment that must be taken into animal areas. The LOS might be around the entire operation, just the animal areas or something in between. Many options exist based on the layout of your farm and the need to control access. Using fences or gates is one way to mark a LOS.

Making small changes to traffic or people flow before an outbreak can benefit cattle now through less disease exposure. Start by exploring what is practical in different seasons. Try it and adjust before the stakes are high as they would be in an FMD outbreak.

Figure 2

LINE OF SEPARATION (LOS) "MOAT" WITH DRAWBRIDGE OPEN



Source: CFSPH

Points of Entry[19,23]

Limiting access is another way to keep germs off the farm or animal areas. This can be done through a limited number of "drawbridges" or access points. Each point of entry to the facility or animal area should be clearly marked with signs written in languages understood by all who need to enter. Signs should include biosecurity protocols and who to contact prior to entry. Limiting points of entry requires fewer signs and places to monitor. This is one step in preventing disease entry from dirty vehicles, equipment or people with contaminated clothing and footwear (e.g., fomites).

Labeled Premises Map

Biosecurity plans with a labeled premises map provide a visual look at layout, entrances, traffic flow and critical areas. An aerial view of the farm with labels can also be used in emergency planning and response should a disaster like a fire, tornado, hurricane or wildfire impact your farm. Knowing where shut offs are located for water, gas, fuel and power supplies may be critical to first responders. Labeling where first aid kits and fire extinguishers are stored is important for farm safety and worker health. As discussed under "General Farm Security," having a map is helpful to share with law enforcement in the event something happens (e.g., theft, vandalism, personal injury, etc.). The enhanced biosecurity plan for FMD prevention recommends a labeled premises map. Creating one now gets you one step closer to protecting your cattle from highly contagious diseases spread on vehicles and footwear.

Start with an aerial view of your premises. Several options exist. Some internet programs may not show all current buildings, depending on when the satellite images are updated. Options include:

- Google maps
- Bing maps
- Zoom Earth
- Google Earth
- Aerial photographs (e.g., drone images, farm photographers, etc.)
- Drawn images (e.g., computer aided or handwritten)

Create a legend with the following information and mark each on the aerial view:

- Public road
- Private/shared roads
- Chain link fence (existing)
- Entrances/access points
- Line of Separation (LOS)
- Designated parking area
- Milk house
- Milk truck route to milk house
- Animal loading/unloading area(s)
- Carcass disposal location and removal pathways
- Manure storage location
- Deliveries
- Buildings that house animals
- Shut off locations for water, gas, fuel, power
- First aid kit
- Fire extinguisher(s)
- Compass indicating north

Resources

Animal Health and Disease Monitoring

Housing
Animal Care Manual Version 4 (FARM)
nationaldairyfarm.com/farm-animal-care-version-4-0/

Calf Care and Quality Assurance Manual Version 1 (CCQA)
calfcareqa.org/Media/CalfCare/Docs/ccqa-manual_digital.pdf

Buy printed copy: nationaldairyfarm.com/product/calf-care-quality-assurance-manual/

Feed
Guidance for Developing Biosecurity Practices for Feed and Ingredient Manufacturing (AFIA)
afia.org/pub/?id=E348BF9F-98ED-09DB-A45D-504737FE7AE2

Water
Water Quality for Dairy Cattle (CFSPH)
cfsph.iastate.edu/Infection_Control/Routes/Water_Quality_Dairy_Cattle.pdf

Needle and Syringe Use and Care
Care of Veterinary Vaccine Syringes (UNL)
digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1221&context=extensionhist

Animal Movements and Contact

Animal Identification
Animal Disease Traceability Website (USDA)
aphis.usda.gov/aphis/ourfocus/animalhealth/SA_Traceability

Incoming, Returning Animals
Transportation Manual (BQA)
bqa.org/programs/transportation-program

Animal Care Manual Version 4 (FARM)
nationaldairyfarm.com/farm-animal-care-version-4-0/

Animal Movement Log (SMS)
securemilksupply.org/Assets/SMS_AnimalMovementLog.pdf

Chemical Control
Ruminations: Dairy Fly Control and Your Bottom Line (CDQAP)
cdqap.org/ruminations/dairy-fly-control-and-your-bottom-line/

Animal Products

Semen/Embryos - Feeding Dairy Products (e.g., colostrum, raw milk, waste milk)
Animal Movement Log (SMS)
securemilksupply.org/Assets/SMS_AnimalMovementLog.pdf

Colostrum Feeding and Management on U.S. Dairy Operations (USDA)
aphis.usda.gov/animal_health/nahms/dairy/downloads/dairy17/colostrum-feeding-mgmt-us-dairy-ops-1991-2014.pdf

Vehicles and Equipment

Vehicle/Equipment Entry and Delivery Log (SMS)
securemilksupply.org/Assets/SMS_VehicleMovementLog.pdf

Composting Animal Manures: A Guide to the Process and Management of Animal Manure Compost (NDSU)
ndsu.edu/agriculture/sites/default/files/2022-03/nm1478.pdf

Personnel

Contacting Animals
Footwear
Cleaning and Disinfection on the Farm: Footwear (CFSPH)
cfsph.iastate.edu/Assets/tipsheet-cd-footwear.pdf

Hands

Visitors with Animal Contact Poster (SMS)

- English: securemilksupply.org/Assets/DAIRY_Visitors-With-Contact.pdf
- Spanish: securemilksupply.org/Assets/DAIRY_Visitors-With-Contact_SPANISH.pdf

Without Animal Contact Poster (SMS)

- English: securemilksupply.org/Assets/DAIRY_Visitors-No-Contact.pdf
- Spanish: securemilksupply.org/Assets/DAIRY_Visitors-No-Contact_SPANISH.pdf

Keeping Track of Entry

People Entry Log (SMS)

securemilksupply.org/Assets/SMS_PeopleEntryLog.pdf

Signs for Visitor Entry:

Do Not Enter - English and Spanish (SMS)

securemilksupply.org/Assets/DO_NOT_ENTER_CrossBiosecurePoint.pdf

Biosecure Entry Ahead (SMS)

- English: securemilksupply.org/Assets/Biosecure_Entry_Ahead.pdf
- Spanish: securemilksupply.org/Assets/Biosecure_Entry_Ahead_Spanish.pdf

Stop – Biosecure Entry Point (SMS)

- English: securemilksupply.org/Assets/STOP_Biosecure_Entry_Point.pdf
- Spanish: securemilksupply.org/Assets/STOP_Biosecure_Entry_Point_Spanish.pdf

Training

Protecting the Dairy Herd: Farm Activities Poster (SMS)

- English: securemilksupply.org/Assets/DAIRY_Employees_FarmActivities.pdf
- Spanish: securemilksupply.org/Assets/DAIRY_Employees_FarmActivities_SPANISH.pdf

Group Training Document Form (SMS)

securemilksupply.org/Assets/SMS_GroupTrainingForm.pdf

Cleaning & Disinfection (C&D)

Reading Disinfectant Product Labels (CFSPH)

- English: cfsph.iastate.edu/Disinfection/Assets/disinfectant_product_label.pdf
- Spanish: cfsph.iastate.edu/Disinfection/Assets/S_disinfectant__product_label.pdf

Characteristics of Selected Disinfectants (CFSPH)

cfsph.iastate.edu/Disinfection/Assets/CharacteristicsSelectedDisinfectants.pdf

Characteristics of Selected Disinfectants (CCQA - modified from CFSPH)

calfcareqa.org/Media/CalfCare/Docs/characteristics-of-selected-disinfectants-checkoff.pdf

Fomites: Managing them to Minimize Disease Spread (CFSPH)

- English: cfsph.iastate.edu/Disinfection/Assets/disinfectant_product_label.pdf
- Spanish: cfsph.iastate.edu/Infection_Control/Routes/Spanish/S_fomite_management.pdf

Line of Separation (LOS)

Step-By-Step Guidance for Creating a Premises Map (SMS)

securemilksupply.org/Assets/SMS_CreatingPremisesMap.pdf

Map Module (Western Institute for Food Safety and Security)

bioplan.wifsslearning.com/map-module/

Making a Property Map Using Google Maps video (Oregon State University Extension)

youtu.be/7XIw3fqOxWM

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[2] *USDA APHIS Veterinary Biologicals, Updated June 2021 at: aphis.usda.gov/aphis/ourfocus/animalhealth/veterinary-biologics*

[3] *Animal Health and Disease Monitoring Tip Sheet: cfsph.iastate.edu/Assets/tip-sheet-animal-health-dz-monitoring.pdf*

[4] *Animal Movement Tip Sheet: cfsph.iastate.edu/Assets/tip-sheet-animal-movement.pdf*

[5] *Livestock Isolation and Quarantine Areas Tip Sheet: cfsph.iastate.edu/Assets/tip-sheet-isolation-quarantine.pdf*

[6] *Center for Food Security and Public Health, Iowa State University. Bovine Routes of Transmission, N.D.: cfsph.iastate.edu/Infection_Control/Routes/English/DiseaseBRMBovine.pdf*

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[8] *Spickler, A.R. Zoonotic Tuberculosis in Mammals, Including Bovine and Caprine Tuberculosis, Oct. 2019: cfsph.iastate.edu/Factsheets/pdfs/leptospirosis.pdf*

[9] *Spickler, A.R. Brucellosis; Brucella Abortus, May 2018: cfsph.iastate.edu/Factsheets/pdfs/brucellosis_abortus.pdf*

[10] *Rainard P. et al. Knowledge Gaps and Research Priorities in Staphylococcus Aureaus Mastitis Control. Transbounary and Emerging Diseases, 2018;(65)1,149-165: onlinelibrary.wiley.com/doi/epdf/10.1111/tbed.12698*

[11] *Spickler, A.R. Cryptosporidiosis, August 2018: cfsph.iastate.edu/Factsheets/pdfs/cryptosporidiosis.pdf*

[12] *Spickler, A.R. Foot and Mouth Disease, March 2021: cfsph.iastate.edu/Factsheets/pdfs/foot_and_mouth_disease.pdf*

[13] *Nagy D.W. Overview of Bovine Leukosis. Merck Veterinary Manual, July 2014: merckvetmanual.com/generalized-conditions/bovine-leukosis/overview-of-bovine-leukosis*

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[15] *National Animal Disease Information Service. Infectious Bovine Rhinotracheitis. nadis.org.uk/disease-a-z/cattle/ibr-infectious-bovine-rhinotracheitis/*

[16] *Holschbach C.L., Peek S.F. Salmonella in Dairy Cattle. Vet Clinics of North America Food Animal Practitioner, 2018,(34)1:133-154 at: ncbi.nlm.nih.gov/pmc/articles/PMC7135009/*

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[19] *Bickett-Weddle D., Ramirez A. Dairy Biological Risk Management, 2005 at: lib.dr.iastate.edu/cgi/viewcontent.cgi?article=1001&context=vdpam_pubs*

[20] *All Rodent Info from CFSPH Wildlife and Rodent Control Tip Sheet at: cfsph.iastate.edu/Assets/tip-sheet-wildlife-rodent.pdf*

[21] *Fly Control Measures at: cfsph.iastate.edu/Infection_Control/Routes/English/fly_control.pdf*

[22] *USDA Dairy 2014 Health and Management Practices on U.S. Dairy Operations, February 2018, Available at: aphis.usda.gov/animal_health/nahms/dairy/downloads/dairy14/Dairy14_dr_PartIII.pdf*

[23] *Information Manual for Enhanced Biosecurity for FMD Prevention: Dairy at: securemilksupply.org/Assets/SMS_Enhanced-Biosecurity-Info-Manual.pdf*

[24] *Manure, Litter, and Bedding Management Tip sheet at: cfsph.iastate.edu/Assets/tip-sheet-manure-litter-bedding-management.pdf*

[25] *Personnel (Employees, Family, Visitors) Biosecurity Tip Sheet at: cfsph.iastate.edu/Assets/tip-sheet-personnel.pdf*

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Acknowledgments

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