During an animal disease emergency, efforts to contain and control the spread of disease will be essential. Responders need to have a basic understanding of the ways (or routes of transmission) pathogens can move from animal to animal, as well as location to location. This Just-In-Time training presentation will overview these routes of disease transmission as well as provide some basic preventive measures that can be used to prevent the spread of disease.

When considering the spread or transmission of microorganisms, we must look at the potential for transfer between animals, from the environment to animals, even from responders to animals (generally incidentally). For some diseases the spread can also occur from animals to humans. These zoonotic diseases can be of concern for responders and are addressed further in the Health and Safety: Zoonotic Disease Prevention Just-In-Time training presentation.

The spread of disease can occur by direct and indirect transmission methods. Direct spread of a disease may occur through contact with an infected individual, ingestion of the organism or through inhalation (or aerosol) exposure. Indirect methods involve fomites – or inanimate objects that can transfer pathogens – and vectors – living organisms able to transmit pathogens – most commonly insects.

Let's look first at direct contact transmission. It is one of the main methods of disease spread. It occurs when a susceptible animal comes in contact with an infected animal, its body fluids or tissues. Depending on the microorganism, it may be transferred directly by blood, saliva, urine, feces, or milk. It may also be spread through contact with infected animal lesions or tissues. Entry into the susceptible animal generally occurs through contact with the mucous membranes, such as the eyes, nose, or mouth but can also enter through open wounds or breaks in the skin. So, possible exposures can occur from nose-to-nose contact, biting or rubbing against each other. Some diseases of animals can also be spread during breeding as well as from mother-to-offspring, during gestation or through milk when nursing.
### Aerosol Transmission

Aerosol transmission is another means of disease spread. This involves the transfer of infectious diseases in droplets spread through the air, which are then inhaled by another animal. Most microorganisms are not able to survive for extended periods of time within the aerosol droplets, and as a result, close proximity of infected and susceptible animals is required for disease transmission. Aerosol transmission can also occur when infected droplets from urine, feces, or birthing material get stirred up from contaminated soil or dust and inhaled.

### Oral Transmission

Oral transmission of disease causing organisms involves ingestion through the consumption of contaminated feed or water, or by licking/chewing on contaminated environmental objects. Feed and water contaminated with feces, urine or saliva are frequently the cause of oral transmission of disease agents. Shared feed and water sources can contribute to the spread of the disease. [Top photo: Cattle sharing a water tank. Photo source: DB Weddle, CFSPH, Iowa State University; Bottom photo: Jersey calves eating out of rubber feed buckets on the ground which could be contaminated with feces or urine. Photo source: USDA]

### Fomite Transmission

Fomite transmission of diseases involves any inanimate object that can transfer microorganisms from an infected animal to another. Examples of fomites that may be present during a response include needles, balling guns (used to dispense medication to cattle), feed or water buckets, bedding and shovels. Even items such as clothing or vehicles may become contaminated and serve to spread pathogens. [Top photo: Syringe and balling gun. DB Weddle, CFSPH, Iowa State University; Bottom photo: Pickup and trailer. Source: Bryan Buss, CFSPH, Iowa State University].

### Vector Transmission

Lastly, some diseases are spread by vectors. This involves living organisms – most commonly insects - able to transfer microorganisms from an infected animal to another. Mosquitoes, ticks, midges and flies are common disease carrying vectors. [Top photo: Calf with numerous face flies. Photo source: USDA; Bottom left: Mosquito. Bottom right: Tick. Photo source: CDC]

### Points to Keep in Mind

It is important to remember that disease transmission can occur without animals exhibiting obvious clinical signs of disease. That is why awareness of the various routes of transmission becomes so essential when implementing a strategy to minimize disease spread during a response. Equally important is knowing that not all pathogens are spread by all of these routes of transmission. Knowing which disease causing organism you are up against, will help in determining which routes of transmission will be of concern during your activities. Finally, remain aware that many disease agents can survive for extended periods of time in soil or other organic material (e.g., bedding, manure,
old feed). Animals or humans can then acquire some pathogens from the environment through inhalation or aerosol, oral consumption, direct contact, or via fomites as discussed on previous slides. Therefore, environmental contamination should not be ignored. [Photo source: DB Weddle, CFSPH, Iowa State University]

While disease prevention measures are provided in the Biosecurity: Overview Just-In-Time training presentation, there are a few general prevention steps that can be taken regardless of the disease route of transmission. One of the first steps in preventing further spread of disease is minimize contact between susceptible and infected animals. This is often accomplished by isolating the infected animal. In the case of animal disease emergencies, often more than one animal is involved, therefore the entire farm may be quarantined, in efforts to prevent the further spread of the disease. Keeping feed and water clean by minimizing fecal and urine contamination is extremely important. Proper cleaning and disinfection procedures are also important for preventing the spread of pathogens by fomites, such as equipment, vehicles, or footwear. Keep the animal housing environment as clean and dry as possible to minimize risk of environmental exposure. [Top photo from Bryan Buss, Iowa State University; Bottom photo from Dr. Sandy Amass, Purdue University]

Maximize ventilation so that fresh air is provided to all animals and humidity and odors do not build up. Control the amount of dust generated in animal housing areas. This can damage the protective cells in the respiratory tract, as well as result in exposure to contaminated particles that can cause disease. [Top photo from USDA; Bottom photo from The Animal Photo Archive]

One of the best protections against a disease is washing your hands. This simple task can greatly reduce the chance of transferring a pathogen to other animals as well as to yourself – in the case of a zoonotic disease. Additionally, the use of personal protective equipment, such as gloves, coveralls, and boots can help reduce exposure and transfer. Gloves should be worn when working with sick animals or those that you are unaware of their health status (remember that infected animals do not always appear sick). This is especially important if hands have cuts, abrasions or are severely chapped because areas of broken skin provide an entrance for disease agents. Wearing gloves does not replace good hand washing habits- wash hands in warm water and soap after removing gloves. Coveralls will help keep your clothes clean and cover your arms to minimize disease exposure when handling tissues or animals. Boots will protect your
shoes from contamination and minimize spread to other areas of the farm. Wear masks in certain situations to prevent inhaling contaminated particles. [Top photo from Dr. Phil Prater, Morehead State University, KY; Bottom photo from Dan Thomson, Kansas State University]

Vector control begins with an understanding of the insect’s life cycle. Insect life stages vary and so do the specific, effective control measures. For instance, the egg laying grounds for flies are different than that of mosquitoes and midges, and one approach will not necessarily work for all. Source reduction consists of eliminating potential insect breeding areas and larval habitats. Generally this involves removing standing water sources, such as tree holes or old tires or agitating any water sources, such as stock tanks or water troughs. Some insects require manure or organic material for development, so cleaning animal feeding areas, yards and barns can minimize these vectors. Sometimes, parasitic or predatory insects may be used to control the larval stages of other insects. Controlling adult insects, often involves the use of insecticides, either as a knockdown or residual treatment. These methods are often less effective compared to habitat reduction methods. Baits and fly traps may aid efforts, but should not be used as the sole method of control. Sheltering animals indoors, can minimize the opportunities for insects to interact with animals.

This table reviews some of the possible biosecurity measures that may be used to limit transmission of pathogenic agents based on their routes of transmission. For pathogens spread by direct contact and aerosols, the isolation of infected animals and use of personal protective equipment, such as gloves, can limit and prevent transmission by these routes. For pathogens spread by fomites, such as equipment or vehicles, cleaning and disinfection measures can be effective in reducing contamination. For pathogens spread by oral routes, cleaning and disinfection measures can also be effective. Control of vector-borne diseases will involve the use of pest management procedures to limit transmission.

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