This presentation will review some key points of biological risk management, general prevention steps that can be applied to every farm to decrease the risk of disease introduction and spread, and specific steps to reduce the chance of aerosol transmission on farm.

Biological risk management is the overall process of awareness education regarding the risk of infectious diseases entering or spreading through an animal facility. It also involves evaluating and managing those risks. BRM is designed to help livestock producers understand the need for infection or disease control, not only for foreign animal disease threats but domestic diseases as well. Biological risk management provides the tools to minimize the risk (photo courtesy of: DB Weddle).

BRM recognizes that diseases cannot be eliminated, but that the risk can be managed through effective control measures. As animal caretakers, it is our duty to be knowledgeable of the animal and its environment to minimize the risk of disease. For nearly all diseases there is a relationship between dose exposure and severity of disease. For disease that are always present (endemic), reducing the dose of infectious agent the animal is exposed to can positively affect the farm’s economic impact and help justify the cost of implementing BRM. Many different solutions exist and because all cattle facilities are different, there is not a one-size-fits-all answer. Photo depicts cattle in a pasture and the owner walking through them monitoring for illness (courtesy of USDA, taken by Bill Tarpenning).

Disease agents can be spread from animal to animal, or animal to human, through a variety of transmission routes. For the purposes of the biological risk management materials, 5 main routes were identified: aerosol, direct contact, fomite, oral and rector-borne. The sixth route, zoonotic, can be spread from animals to humans through one of the 5 previously listed routes. Many infectious agents can be transmitted by more than one route of infection. This photo shows cow-calf pairs being herded to another pasture in Oregon (courtesy of USDA, image # 95cs0779 CD0109-045, taken by Doug Wilson).

Vector transmission occurs when an insect acquires a pathogen from one animal and transmits it to another. Midges, ticks, and mosquitoes are common biological vectors of disease, meaning they take the disease agent into their body and have to inject into the next animal. Flies are a common mechanical vector as they carry the disease agent on their body rather than taking it into their body. The top photo shows a calf with two old insecticide ear tags and numerous face flies, while the bottom photo shows an adult deer tick, *Ixodes scapularis* (photos courtesy of USDA).
### Algunas enfermedades que se propagan por vectores

<table>
<thead>
<tr>
<th>Exóticas</th>
<th>Existentes en E.E.UU.</th>
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<td>Akabane</td>
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<td>Fiebre del Valle de Rift</td>
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### Vías de transmisión

- Atañen a todos los agentes infecciosos
- El animal tiene que estar expuesto para contraer la enfermedad
- Comprender las distintas vías de transmisión = obtener el control
- Es necesario identificar las áreas de riesgo
  - Diseñar protocolos para minimizar la exposición

### Transmisión de la enfermedad

- Es posible que los animales no muestren signos evidentes de la enfermedad
- El conocimiento de todas las vías de transmisión es esencial
  - Formular una estrategia que minimise el riesgo de enfermedad en la operación ganadera

### Pasos preventivos generales

- Panorama general
  - Perímetro de la explotación agropecuaria
  - Identificación de los animales
  - Salud animal
  - Animales enfermos/muertos
  - Aislamiento/cuarentena
  - Administración del abastecimiento
  - Manejo neonatal

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There are many diseases transmitted by the vector route, both diseases that are foreign animal diseases (FADs) and those that are present in the US (endemic). Some examples of foreign animal diseases include akabane, bluetongue, heartwater, lumpy skin disease, and Rift Valley fever. Examples of diseases that are already present in the US include anaplasmosis, anthrax, contagious mastitis, pink eye (*Moraxella bovis*) and vesicular stomatitis. The main point to drive home is that they are all transmitted by the same route and prevention practices aimed at one will protect against others. For a complete listing of all diseases transmitted by the vector route, please refer to the Bovine Routes of Transmission Handout- Vector.

Every disease has to enter into an animal by some route, so looking at disease prevention through the routes of transmission makes sense. One advantage to this approach is that it will also help protect against new or unexpected infectious diseases. This classification system is effective and easy to understand without requiring knowledge about a wide range of diseases, like all those listed at the beginning of this presentation. While disease agents and the infections they produce vary, they all have one thing in common: the animal must be exposed to them to develop disease. Once it is understood that different diseases can be acquired by various routes of transmission (i.e. aerosol, oral, fomite, direct contact, vector), it is easier to gain control over them. From a management standpoint, it may be easier to identify risk areas, such as fomites, and then design protocols to minimize exposure.

It is important to remember that disease transmission can occur without animals exhibiting obvious signs of disease. That is why awareness of the various routes of transmission becomes so essential when assessing and developing a strategy to minimize the risk of disease for a facility or operation. The photo shows a calf lying in a pasture (photo source USDA).

There are many general prevention steps that every farm could implement that would help prevent against a variety of diseases that are transmitted in various ways. Things such as knowing what is in the area of your farm perimeter- farms, neighboring livestock, wildlife; individual animal identification, animal health protocols, recognizing and dealing with sick and dead animals, isolation/quarantine, supply handling, and neonatal management. This next section will provide some general prevention recommendations for those areas.
### Pasos preventivos generales

- **Restrian el contacto con animales como**
  - El ganado vecino
  - Fauna silvestre, aves
  - Perros, gatos que deambulan
- **Den mantenimiento a las cercas**
- **Establezcan protocolos de bioseguridad para vehículos de reparto, del personal**
- **Cierren con llave las entradas**

Limit contact with animals that may present a disease risk by coordinating with your neighbors to avoid fence line contact between herds. Prevent cats and dogs from roaming between farms. By maintaining fences (repairing/replacing posts, tightening wires), you minimize the risk of animals escaping, or other animals entering, and mixing with other livestock or wildlife species, which increases their risk of disease exposure. You should establish biosecurity protocols for delivery vehicles and personnel to follow on your farm. Gates are installed as a barrier to human entry and should be locked to prevent animal contact and subsequent disease exposure. Photo courtesy of DB Weddle, ISU.

### Pasos preventivos generales

- **Identifiquen individualmente a los animales**
  - Comunicar su estado de salud
  - Las necesidades de tratamiento
  - La ubicación dentro de la explotación agropecuaria
  - Llevar registros

If more than one person works on an operation, individual animal identification is imperative for proper communication of health status, treatment needs, antibiotic withdrawal/residue prevention status, and location on farm. Individual animal identification is essential for proper treatment and vaccination records so alterations can be made to the animal health protocols on farm; this will also help ensure what you think is happening is actually happening. Producers should work with their veterinarian to investigate those animals that present with unusual symptoms or are unresponsive to treatment, especially neurologic cases, downers and those that die suddenly.

### Pasos preventivos generales

- **Lleven registros del estado de salud de cada uno de los animales**
- **Revisen los programas de vacunación y tratamientos**
  - Anualmente, semestralmente
  - Protocolo comparado con la realidad
  - Investigan síntomas poco usuales, casos que no responden al tratamiento
  - Neurologicos, animales caídos, muerte súbita

To monitor health status, it is imperative to keep health records on every animal. It is important to work with your veterinarian to review treatment and vaccination records so alterations can be made to the animal health protocols on farm; this will also help ensure what you think is happening is actually happening. Producers should work with their veterinarian to investigate those animals that present with unusual symptoms or are unresponsive to treatment, especially neurologic cases, downers and those that die suddenly.

### Pasos preventivos generales

- **Capaciten al personal de la explotación para que reporte a los animales enfermos**
  - Inspeccionen a los animales diariamente
  - Equipo, ropa, vestimenta limpios
  - De manera inmediata y adecuada, sacrifiquen a los animales terminalmente enfermos
  - Retrántelos del predio o beneficiándolos para extraer grasa
  - Realicen la necropsia a los animales que hayan muerto por causas desconocidas

By establishing and educating all employees on what to look for regarding sick animals and having a reporting system so that those in charge can make treatment decisions or the veterinarian can be contacted, serious diseases can be identified early on and minimize the risk of disease spread. It is important to clean any equipment, boots, clothing that is used between groups of animals with differing health status. Animals that are not going to recover can serve as a reservoir for many disease organisms and should be euthanized humanely and in a timely manner. Dead animals can also serve as a reservoir for many disease organisms and should be promptly removed from the operation. Dead animals need to be rendered, composted or buried in a timely manner so predators, wild birds, etc do not spread disease. By having a veterinarian necropsy animals that die of undetermined causes, a diagnosis may be obtained by sending samples into a diagnostic laboratory. Unusual diseases may not present in a manner you are used to, so involving a veterinarian may help identify a potentially infectious disease before it becomes widespread on your facility. Photo depicts a steer being necropsied by veterinary students at a feed yard (courtesy of Dan Thomson, KSU).
Pasos preventivos generales

- Aíslen de inmediato a los animales enfermos
  - Sin ventilación compartida, sin contacto directo con otros animales
- Pongan en cuarentena a los animales de reciente introducción
- El lapso de tiempo se determina junto con el médico veterinario
- Realicen pruebas para detectar enfermedades clave antes de colocarlos con el resto del hato

Cattle that are identified as ill should be removed from the rest of the herd immediately and placed in an isolation area where ventilation, feed/water, and other equipment and is not shared and direct contact with other animals does not occur in order to minimize the risk of disease spread. Newly introduced animals, including show cattle/calves that have been away from the farm as pictured here, may be carrying diseases that your home herd is not immune to, so quarantine them for a period of time. Time spent in isolation and quarantine varies depending on the risk so this should be determined together with your herd veterinarian. Before taking animals out of isolation or quarantine, it is a good risk management plan to test them for key diseases (determined together with your herd veterinarian) and make sure they are not carrying diseases that could be introduced into the home herd.

Pasos preventivos generales

- Almacenen las vacunas y antibióticos que no requieren refrigeración fuera de la luz de sol ya que ésta podría desactivarlos
- Monitoreen mensualmente la temperatura de refrigeración
  - Temperatura ideal 36-46°F
- Restrien el acceso a las medicinas para que solo lo tenga el personal debidamente capacitado

Sunlight can deactivate vaccines resulting in inadequate protection; it can also reduce effective treatment by rendering antibiotics ineffective. When using these in your animals, make sure you read the label and store them properly. Vaccines and medicines that need to be refrigerated are susceptible to changes in temperature and may not be effective if they get too warm (greater than 46 degrees Fahrenheit) or too cold/frozen (less than 36 degrees Fahrenheit); monitoring your refrigerator at least monthly can help ensure the products are adequately stored. Work with your veterinarian to teach proper handling procedures to all people who routinely deal with vaccines and medicine and restrict access to only trained personnel. The photo depicts a refrigerator on a dairy farm with a thermometer- purchased for less than $3 at a large retail store (photo courtesy of DB Weddle, ISU).

Pasos preventivos generales

- Garanticen la ingestión adecuada de calostro libre de enfermedades durante las 6 primeras horas de vida
- Eviten el contacto con animales mayores, ambientes contaminados

Adequate ingestion of colostrum is the most important consideration for calf’s resistance to disease and all calves should receive colostrum within 6 hours of birth. A calf’s immune system depends on the antibodies in colostrum. After 6 hours of life, the calf’s ability to absorb antibodies from colostrum diminishes. Once a calf is born, subsequent milk production in the cow will dilute colostrum and therefore require the calf to consume more for maximum antibody absorption and immune function. Another good practice is to prevent contact of the neonate with older animals and also contaminated environments. This will decrease the pathogen load to the newborn and give the colostrum the ability to provide protection. (Photo courtesy of Bryan Buss, ISU).

Control de la transmisión por vector

Now that we have discussed some general prevention steps, let us look specifically at vector transmission and control measures you can apply on your beef operation to minimize disease spread.
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 does not work for all. We will discuss options in future slides. Controlling adult insects, be it flies or mosquitoes, often involves the use of insecticides. This is often less effective, so more effort should be focused on controlling breeding areas. Finally, minimize the opportunities for insects to even interact with animals, such as ticks or midges. Treatment protocols for each of the areas will be discussed in the next slides.

Flies have a four stage life cycle. The adult female fly lays her eggs in organic matter, be it manure, feed or wet bedding. These eggs then develop into larva, which change to pupa and finally emerge as adult flies. This process can be as short as 10 days in warm weather. One way to decrease the prevalence of flies is to minimize areas where they can lay their eggs by disturbing the piles of organic matter weekly. Flies lay their eggs in organic matter, be it manure, feed or wet bedding. One way to decrease their prevalence is to minimize these areas by disturbing them weekly to prevent eggs from developing. Keep pastures rotated, drag dry lots to break up the fecal pats, clean up spilled feed, clean around feed bunks. The photo depicts an excellent area for flies to lay their eggs- old feed (courtesy of Bryan Buss, ISU).

Feed additives (larvicides) have some effectiveness but the key is to get it in the feed at least 3 weeks before fly season, feed it to ALL animals on farm and maintain it in the feed until the end of fly season. This should be in addition to some of the other hygiene procedures of cleaning yards, barns and feeding areas. Parasitic wasps, predatory mites and beetles feed on pupae/larvae living in manure, bedding, vegetation. Certain insects can only be used in certain areas because they may feed on other beneficial insects, so check with your local extension specialist for recommendations.

Adulticides such as knockdowns that kill a fly on contact should be applied in areas of high fly concentrations because they do not last long in the environment (1-2 hours). Residual sprays can be applied to shaded surfaces (barn walls, ceilings) where flies rest to kill them through contact. To avoid insecticide resistance, it is a good idea to alternate between area and residual sprays. Baits and fly traps work against house flies but should be part of an integrated pest management system for best efficacy.

Target key areas on farm with insecticides to minimize cost. Animals can have impregnated ear tags put in each ear, a pour-on applied to their back as the photo on the left shows, made to walk through dusters, oilers or backrubbers with insecticides on them or have an Insect Growth Regulator bolus placed in their rumens. Barns can be sprayed with products approved for food animals. This is a cost effective way to spend money on insecticides. The photo on the left depicts cattle receiving pour-on for insect control (courtesy of Bryan Buss, ISU) and the photo on the right depicts a cattle barn that was recently sprayed for flies (courtesy of DB Weddle, ISU).
Flies are capable of spreading contagious mastitis, *Dermatophilus* (rain rot), grubs, lumpy skin disease, pink eye (*Moraxella bovis*) pictured here, and screwworm. Photo courtesy of Addison Biological Laboratories.

Biting midges, or no-see-ums, lay their eggs in decaying vegetation or wet soil or mud, and larvae need moisture and organic matter to survive. Adults stay pretty close to their breeding sites, so manage those areas by agitating settling ponds and minimize stagnant water. It is more difficult to manage the larval sites due to their vastness and hard to treat regions. Photo is a biting midge, courtesy of Ed T. Schmidtmann, USDA/ARS http://creatures.ifas.ufl.edu/aquatic/Biting_midges_02.htm

The biting midge, *Culicoides variipennis* or *sonorensis* transmits bluetongue virus which causes erosions around the muzzle of cows, as pictured here. Photo courtesy of The Gray Book.

There are about 200 different species of mosquitoes in the United States, all of which live in specific habitats, exhibit unique behaviors and bite different species of animals. Some lay single eggs on damp soil that is later flooded by water; others lay an egg raft on the water’s surface. Eggs hatch to larvae then to pupae, both of which live in the water and come to the surface to breathe by utilizing a siphon tube or trumpet while hanging upside down from the surface of the water. The larva require large amounts of nutrients for maturation and feed on organic matter in the water.

Since there are over 200 species of mosquitoes, they are not all capable of spreading disease, only certain types can spread certain diseases. Some of the diseases they can spread include West Nile virus, Rift Valley fever, lumpy skin disease (as pictured here) and vesicular stomatitis. Photo courtesy of USDA APHIS.
Reducción de fuentes
- Eliminen el hábitat de larvas de mosquitos
- Retengan los huecos de los árboles
- Vacíen semanalmente los recipientes que contienen agua
- Hagan circular el agua de lagunas y tanques
- Hagan perforaciones en los neumáticos desecharlos o utilicen las mitades para pilas de material ensilado

Larvicidas de mosquitos
- Utilicen los cuando la reducción de fuentes y el control biológico no sean realizables
- Son más eficientes y dirigidos al objetivo
- Menos controvertidos que los adulticidas
- Se aplican en áreas geográficas más pequeñas
  - Las larvas se concentran en lugares específicos

Control de mosquitos adultos
- Insecticidas/adulticidas
- Son menos eficientes que la reducción de fuentes
- Requieren que se hagan aplicaciones múltiples
- Requieren contar con condiciones ambientales adecuadas
  - Viento ligero, sin lluvia
  - Pequeñas gotas que entren en contacto con los adultos

Minimizar la interacción con animales
- Garrapatas
  - Siguen los pastizales
  - Acaricidas
- Jejenes
  - No existe tratamiento animal eficaz
  - Incrementen la distancia desde la fuente
  - Confinen a los animales

Transmisión de enfermedades
- Las garrapatas pueden propagar
  - Anaplasmosis
  - Babesiosis
  - Dermatomiosis
  - Hidropericardio/ Cowdriosis
  - Fiebre Q

Source reduction consists of eliminating larval habitats or making them unsuitable for larval development. Tree holes can be good breeding grounds for some mosquitoes, so those should be filled. Containers that hold water, like stock tanks or water troughs, should be emptied weekly or agitated weekly to keep mosquitoes from laying eggs there. By minimizing standing water through circulating lagoons or water tanks, a lot can be done to minimize their breeding areas. Another problem on farms are old tires used for silage piles, as pictured on the bottom (courtesy of DB Weddle). Not only do mosquitoes transmit disease to animals, but to humans too and a farm walk through to identify and eliminate trash containers is good prevention.

Larvicides are used when immature mosquito populations become larger than source reduction can manage or biological control can handle. They are often more effective and target-specific than adulticides, making them less controversial. They can be applied to smaller geographic areas than adulticides because larvae are often concentrated in specific locations, such as standing water. Photo depicts a swampy area in the distance that is too big too drain but could be treated with larvicides to reduce the number of adult mosquitoes that emerge in this area (courtesy of USDA image # 96cs0506, taken by Bill Tarpenning).

Insecticides are often the least efficient control program and often require multiple applications. Effective adult mosquito control with adulticides requires small droplets that drift through mosquito areas and come in contact with adults to kill them as pictured here. Insecticides are applied in a concentrated form at very low volumes such as 1 oz (29.6 mL) per acre. Excessive wind and updrafts reduce control, but light wind is necessary for drifting spray droplets.

While source reduction will help decrease numbers of insects in the area, often times it is necessary to minimize the interaction with animals. This could involve environmental management such as mowing pastures, as the top picture depicts, to reduce tick habitats to chemical treatments with acaricidas (tick killing chemicals) every 2-4 weeks during tick season. Other ways to minimize interaction is to confine the animals to an insect proof structure. In the case of vesicular stomatitis outbreaks or bluetongue, it is necessary to confine the animals in a stall as the bottom photo illustrates, until the insect season has passed. This can be difficult to do depending on the farm or types of animals raised. But if it is the only way to prevent disease, temporary structures could be put up. Both photos were found at: http://www.equestrianservicesllc.com/gallery.cfm

There are many different species of ticks and some are capable of spreading diseases such as anaplasmosis, babesiosis, dermatophilus (rain rot- pictured here), heartwater and Q fever. Photo courtesy of DB Weddle, ISU.
Vector-borne transmission does occur on farms with everyday diseases like mastitis, pink eye, and anaplasmosis. Should a foreign animal disease occur in the US, such as akabane, Rift Valley Fever, or heartwater, they too can be spread through vector-borne transmission. Taking some of the basic prevention steps as described in this presentation can help you decrease your risk of disease introduction and spread on your farm.

Throughout this presentation, we have stressed that biological risk management is important. All diseases are transmitted by a few common routes and managing disease exposure will help decrease the level of disease. While disease risk cannot be completely eliminated, it can be managed. Awareness education is essential for effective disease control and each of YOU play a critical role!