

S  
l  
i  
d  
e

## Equine Viral Arteritis

*Equine Typhoid,  
Epizootic Cellulitis–Pinkeye,  
Epizootic Lymphangitis Pinkeye,  
Rotlaufseuche*

1

S  
l  
i  
d  
e

### Overview

- Organism
- History
- Epidemiology
- Transmission
- Disease in Humans
- Disease in Animals
- Prevention and Control



In today's presentation we will cover information regarding the organism that causes equine viral arteritis and its epidemiology. We will also talk about the history of the disease, how it is transmitted, species that it affects, and clinical and necropsy signs observed. Finally, we will address prevention and control measures, as well as actions to take if equine viral arteritis is suspected. [Photo: Horses. Source: USDA]

2

S  
l  
i  
d  
e

## THE ORGANISM

3

S  
l  
i  
d  
e

### The Organism

- Equine arteritis virus (EAV)
  - Order Nidovirales
  - Family Arteriviridae
  - Genus *Arterivirus*
- Isolates vary in virulence
- Only one recognized serotype
- Regional variations may occur





Equine viral arteritis is caused by equine arteritis virus (EAV), an RNA virus in the genus *Arterivirus*, family Arteriviridae and order Nidovirales. Isolates vary in their virulence and potential to induce abortions. Only one serotype has been recognized. Limited genetic analysis suggests that EAV strains found among donkeys in South Africa may differ significantly from isolates in North America and Europe. [Photo: Electron micrograph of an Arterivirus. Source: International committee on Taxonomy of Viruses]


4



S  
l  
i  
d  
e

## HISTORY

5


<p>S I d e 6</p>	<p style="text-align: center;"><b>History</b></p> <ul style="list-style-type: none"> <li>• First U.S outbreak             <ul style="list-style-type: none"> <li>- 1953, Ohio</li> <li>- Standardbred breeding farm</li> </ul> </li> <li>• Next epidemic             <ul style="list-style-type: none"> <li>- 1984, Kentucky</li> <li>- Thoroughbred breeding farm</li> </ul> </li> <li>• Periodic outbreaks still occur</li> </ul> 	<p>The first virologically confirmed outbreak of EVA in the world occurred on a Standardbred breeding farm near Bucyrus, OH, in 1953. Little concern was expressed at the time. However, the disease was again thrust into the limelight following a 1984 epidemic on a large number of Thoroughbred breeding farms in Kentucky. Periodic outbreaks still occur. Source: <a href="http://www.aphis.usda.gov/vs/nahss/equine/eva/eva_brochure_2001.pdf">http://www.aphis.usda.gov/vs/nahss/equine/eva/eva_brochure_2001.pdf</a>. [Photo: Mare and foal. Source: Megan Smith/CFSPH]</p>
<p>S I d e 7</p>	<p style="text-align: center;"><b>EPIDEMIOLOGY</b></p>	
<p>S I d e 8</p>	<p style="text-align: center;"><b>Geographic Distribution</b></p> <ul style="list-style-type: none"> <li>• EAV found in most countries             <ul style="list-style-type: none"> <li>- North and South America</li> <li>- Europe</li> <li>- Asia</li> <li>- Africa</li> <li>- Australia</li> </ul> </li> <li>• May be absent from Iceland and Japan</li> </ul>	<p>Antibodies to EAV have been found in most countries where testing has been done. Seropositive horses have been reported in North and South America, Europe, Asia, Africa and Australia. Infections are common among horses in continental Europe, but rare in the United Kingdom. This virus appears to be absent from Iceland and Japan.</p>
<p>S I d e 9</p>	<p style="text-align: center;"><b>Morbidity and Mortality</b></p> <ul style="list-style-type: none"> <li>• Prevalence             <ul style="list-style-type: none"> <li>- Varies by breed                 <ul style="list-style-type: none"> <li>• Standardbreds (24%)</li> <li>• Thoroughbreds (4.5%)</li> <li>• Warmbloods (3.6%)</li> <li>• Quarter horses (0.6%)</li> </ul> </li> <li>- Likely due to management practices</li> </ul> </li> <li>• Infected stallions             <ul style="list-style-type: none"> <li>- 10-70% become EAV carriers</li> </ul> </li> </ul> 	<p>The prevalence of equine arteritis virus varies significantly among horse breeds. In the U.S., this infection is particularly common among Standardbreds. In a survey done in 1998, 24% of unvaccinated Standardbreds, 4.5% of Thoroughbreds, 0.6% of Quarter horses, and 3.6% of Warmblood horses had antibodies to this virus. In Europe, the seroprevalence is particularly high among Warmbloods. Breed-related differences in seroprevalence might be due to genetic differences, but they are more likely to be caused by different management practices. Overall, approximately 10-70% of infected stallions become carriers of EAV. [Photo: Standardbred horse. Source: Wikimedia Commons]</p>
<p>S I d e 10</p>	<p style="text-align: center;"><b>Morbidity and Mortality</b></p> <ul style="list-style-type: none"> <li>• Outbreaks uncommon             <ul style="list-style-type: none"> <li>- Often linked to horse movement or shipped semen</li> </ul> </li> <li>• Severity of disease varies             <ul style="list-style-type: none"> <li>- Young and old most affected</li> </ul> </li> <li>• Asymptomatic infections common</li> <li>• Abortion rate             <ul style="list-style-type: none"> <li>- &lt;10% to 50-60%</li> </ul> </li> </ul>	<p>Outbreaks are much less common than infections, and tend to occur when horses have been moved or semen shipped. The clinical signs are generally more severe in old or very young animals, and in horses that are immunocompromised or in poor condition. They also vary with the route of exposure, and the strain and dose of the virus. Asymptomatic infections are common, and deaths are very rare in healthy adults; young foals are more likely to die. The abortion rate varies from less than 10% to as high as 50-60%.</p>

<p>S l i d e  1 1</p>	<p style="text-align: center;"><b>TRANSMISSION</b></p>	
<p>S l i d e  1 2</p>	<p style="text-align: center;"><b>Transmission</b></p> <ul style="list-style-type: none"> <li>• Respiratory             <ul style="list-style-type: none"> <li>- Common where horses gather                 <ul style="list-style-type: none"> <li>• Racetracks, sales, shows</li> </ul> </li> </ul> </li> <li>• Venereal             <ul style="list-style-type: none"> <li>- Acutely infected mares</li> <li>- Acutely and chronically infected stallions</li> <li>• Natural service and artificial insemination</li> </ul> </li> <li>• <i>In utero</i></li> </ul> 	<p>Equine arteritis virus can be transmitted by the respiratory and the venereal routes. Acutely affected horses excrete the virus in respiratory secretions; aerosol transmission is common when horses are gathered at racetracks, sales, shows and other events. This virus has also been found in urine and feces during the acute stage. It occurs in the reproductive tract of acutely infected mares, and both acutely and chronically infected stallions. In mares, EAV can be found in vaginal and uterine secretions, as well as in the ovary and oviduct, for a short period after infection. Mares infected late in pregnancy may give birth to infected foals. Stallions shed EAV in semen, and can carry the virus for years. Transmission from stallions can occur by natural service or artificial insemination. Some carriers may eventually clear the infection. [Photo: Horses in stalls. Source: <a href="http://www.equinewellnessmagazine.com">www.equinewellnessmagazine.com</a>]</p>
<p>S l i d e  1 3</p>	<p style="text-align: center;"><b>Transmission</b></p> <ul style="list-style-type: none"> <li>• Fomites             <ul style="list-style-type: none"> <li>- Equipment</li> </ul> </li> <li>• Mechanical transmission             <ul style="list-style-type: none"> <li>- Humans, other animals</li> </ul> </li> <li>• Virus inactivation             <ul style="list-style-type: none"> <li>- 20-30 minutes at 56-58°C</li> <li>- 2 to 3 days at 37-38°C</li> <li>- Up to 75 days at 4-8°C</li> <li>- Semen remains infectious after freezing</li> </ul> </li> </ul>	<p>Equine arteritis virus can be transmitted on fomites including equipment, and may be spread mechanically by humans or animals. This virus is inactivated in 20–30 minutes at 56-58°C (133-136°F), but can remain viable for 2 to 3 days at 37-38°C (99-100°F) and for up to 75 days at 4-8°C (39-46°F). Semen remains infectious after freezing.</p>
<p>S l i d e  1 4</p>	<p style="text-align: center;"><b>DISEASE IN HUMANS</b></p> <p>Equine viral arteritis virus is not a risk for people</p>	
<p>S l i d e  1 5</p>	<p style="text-align: center;"><b>DISEASE IN ANIMALS</b></p>	

<p>S I d e 1 6</p>	<p style="text-align: center;"><b>Species Affected</b></p> <ul style="list-style-type: none"> <li>• Equidae             <ul style="list-style-type: none"> <li>- Horses</li> <li>- Ponies</li> <li>- Donkeys</li> <li>- Zebras</li> </ul> </li> <li>• South American camelids (possibly)</li> </ul> 	<p>Equine arteritis virus is found in the Equidae. Antibodies to this virus have been reported in horses, ponies, donkeys and zebras. Illness occurs mainly among horses and ponies, but clinical signs have also been reported in experimentally infected donkeys. EAV might also be able to cause disease in South American camelids: polymerase chain reaction assay (PCR) detected viral nucleic acids in an alpaca that had aborted. [Photo: Horse. Source: public-domain-image.com]</p>
<p>S I d e 1 7</p>	<p style="text-align: center;"><b>Disease in Horses</b></p> <ul style="list-style-type: none"> <li>• Many infections asymptomatic             <ul style="list-style-type: none"> <li>- Mares bred to long-term carriers</li> </ul> </li> <li>• Severe infections             <ul style="list-style-type: none"> <li>- Respiratory, enteritis</li> <li>- Most common in foals</li> </ul> </li> <li>• Disease in adults             <ul style="list-style-type: none"> <li>- Fever, depression, anorexia</li> <li>- Edema</li> </ul> </li> </ul> 	<p>The incubation period varies from 2 days to 2 weeks. Infections transmitted venereally tend to become apparent in approximately one week. Most EAV infections, especially those that occur in mares bred to long-term carriers, are asymptomatic. Fulminant infections with severe interstitial pneumonia and/ or enteritis can be seen in foals up to a few months of age. Systemic illness also occurs in some adults. In adult horses, the clinical signs may include fever, depression, anorexia, limb edema (particularly in the hindlimbs), and dependent edema of the prepuce, scrotum, mammary gland and/or ventral body wall. Conjunctivitis, photophobia, periorbital or supraorbital edema and rhinitis can also be seen. Some horses develop urticaria; the hives may be localized to the head or neck, but are sometimes generalized. [Photo: Scrotal edema occurring in equine viral arteritis. Source: Dr. R.C. Giles, University of Kentucky, Noah's Arkive/CFSPH]</p>
<p>S I d e 1 8</p>	<p style="text-align: center;"><b>Disease in Horses</b></p> <ul style="list-style-type: none"> <li>• Pregnant mares             <ul style="list-style-type: none"> <li>- Abortion</li> <li>- Stillbirth</li> </ul> </li> <li>• Stallions             <ul style="list-style-type: none"> <li>- Decreased fertility (acute stage)                 <ul style="list-style-type: none"> <li>• Reduced sperm quality                     <ul style="list-style-type: none"> <li>- Caused by increased scrotal temperature and edema</li> </ul> </li> <li>• Decreased libido</li> </ul> </li> </ul> </li> </ul>	<p>Abortions or stillbirths can occur in mares that are pregnant when they are exposed. Abortions are not necessarily preceded by systemic signs. Temporary decreases in fertility, including reduced quality sperm and decreased libido, may be seen in stallions during the acute stage of the disease. The decrease in sperm quality has been attributed to increased scrotal temperature and edema, and can persist for up to 4 months. The quality of the semen is not decreased in carrier stallions. Except in cases of severe disease in foals, deaths are rare.</p>
<p>S I d e 1 9</p>	<p style="text-align: center;"><b>Disease in Donkeys and Mules</b></p> <ul style="list-style-type: none"> <li>• Outbreaks not reported             <ul style="list-style-type: none"> <li>- Antibodies found</li> <li>- Little information on clinical signs</li> </ul> </li> <li>• Experimental infections             <ul style="list-style-type: none"> <li>- Fever, depression</li> <li>- Serous ocular and nasal discharge</li> <li>- Pregnant donkey mares did not abort</li> </ul> </li> </ul>	<p>Outbreaks have not been reported among donkeys or mules, and although antibodies have been found, there is little information on the clinical signs in these species. Experimentally infected donkeys have developed mild to more severe clinical signs including fever, depression, serous ocular and nasal discharge, and conjunctivitis. Pregnant donkey mares did not abort, and their foals were clinically normal when born. Horses inoculated with this donkey strain had very mild clinical signs.</p>

S I d e 2 0	<h3>Post Mortem Lesions</h3> <ul style="list-style-type: none"> <li>• Acute cases                     <ul style="list-style-type: none"> <li>- Edema, congestion, hemorrhages</li> <li>- Fluid accumulation in body cavities</li> </ul> </li> <li>• Foals                     <ul style="list-style-type: none"> <li>- Pulmonary edema, interstitial pneumonia, splenic infarcts, enteritis</li> </ul> </li> <li>• Aborting mares                     <ul style="list-style-type: none"> <li>- Endometrial hemorrhages</li> <li>- Fetuses may be partially autolyzed</li> </ul> </li> </ul>	<p>In acute cases, the lesions are characterized by edema, congestion and hemorrhages of the subcutaneous tissues, visceral organs and lymph nodes. These changes are often found in the subcutaneous tissues of the limbs and abdomen, the thoracic and abdominal lymph nodes, and the small and large intestines (especially the colon and cecum), but may occur throughout the body. Accumulations of clear, yellowish fluid may be found in the peritoneal cavity, pleura and pericardium. Foals may also have pulmonary edema, interstitial pneumonia, emphysema, splenic infarcts and enteritis. In mares that abort, the endometrium may be swollen and congested, and can contain hemorrhages. Aborted fetuses are often partially autolyzed, but may be well preserved. In some fetuses, the only gross lesions may be excess fluid in the body cavities and signs of interlobular interstitial pneumonia.</p>
----------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

S I d e 2 1	<h3>Differential Diagnosis</h3> <ul style="list-style-type: none"> <li>• Equine influenza</li> <li>• Equine infectious anemia</li> <li>• African horse sickness</li> <li>• Getah virus</li> <li>• Hendra virus</li> <li>• Equine rhinitis A and B viruses</li> <li>• Equine adenoviruses</li> <li>• Equine herpesviruses 1 and 4</li> <li>• Purpura hemorrhagica</li> <li>• <i>Berteroa incana</i> (hoary alyssum) poisoning</li> </ul>	<p>Equine viral arteritis should be considered when the clinical signs include fever, depression, edema, conjunctivitis, nasal discharges and abortions. This disease is difficult to differentiate from other systemic and respiratory illnesses of horses. The differential diagnosis includes equine influenza, equine infectious anemia and African horse sickness, as well as infections with Getah virus, Hendra virus, equine rhinitis A and B viruses, equine adenoviruses, and equine herpesviruses 1 and 4. Equine viral arteritis also resembles purpura hemorrhagica and other streptococcal infections, as well as poisoning from the toxic plant <i>Berteroa incana</i> (hoary alyssum).</p>
----------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------


S I d e 2 2	<h3>Laboratory Diagnosis</h3> <ul style="list-style-type: none"> <li>• Virus isolation                     <ul style="list-style-type: none"> <li>- Semen (carrier stallions)</li> <li>- Rabbit kidney cells</li> </ul> </li> <li>• Nucleic acid detection                     <ul style="list-style-type: none"> <li>- RT-PCR</li> </ul> </li> <li>• Antigen detection                     <ul style="list-style-type: none"> <li>- Immunohistochemistry</li> <li>- Histopathology</li> </ul> </li> </ul> 	<p>In recently infected animals, equine arteritis virus may be recovered from nasal secretions, blood and semen as well as from a number of tissues and fluids at necropsy. Carrier stallions can be identified by isolating the virus from semen; EAV is not found in the respiratory secretions, blood or urine of carriers. This virus can be isolated in rabbit, equine and monkey kidney cells or cell lines. RK-13 (rabbit kidney) cells are the system of choice. RT-PCR can also detect viral nucleic acids in clinical samples from live horses or tissues taken at necropsy. Immunohistochemistry can identify viral antigens in necropsy samples, as well as in skin biopsies from acutely infected horses; the latter technique is not completely reliable. Histopathology is helpful in clinical cases. [Photo: Blood sampling. Source: Andrew Kingsbury/CFSPH]</p>
----------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

S I d e 2 3	<h3>Laboratory Diagnosis</h3> <ul style="list-style-type: none"> <li>• Serology                     <ul style="list-style-type: none"> <li>- Virus neutralization</li> <li>- Complement fixation</li> <li>- Agar gel immunodiffusion</li> <li>- Indirect fluorescent antibody</li> <li>- Fluorescent microsphere immunoassay</li> <li>- ELISA</li> </ul> </li> <li>• Carrier stallions can be detected by breeding to two seronegative mares</li> </ul>	<p>Serological tests include virus neutralization, complement fixation, agar gel immunodiffusion, indirect fluorescent antibody, fluorescent microsphere immunoassay (MIA) and enzyme-linked immunosorbent assays (ELISA). A complement-enhanced micro-neutralization test is often used to detect antibodies to EAV. In acute cases, a fourfold increase in titer should be seen in serological tests. Carriers can also be detected by breeding the stallion to two seronegative mares, which are checked for seroconversion four weeks after breeding.</p>
----------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

S I d e  2 4	<b>PREVENTION AND CONTROL</b>
--------------------------------	-------------------------------

S I d e  2 5	<p style="text-align: center;"><b>Recommended Actions</b></p> <ul style="list-style-type: none"> <li>• IMMEDIATELY notify authorities</li> <li>• Federal             <ul style="list-style-type: none"> <li>- Area Veterinarian in Charge (AVIC)</li> <li><a href="http://www.aphis.usda.gov/animal_health/area_offices/">http://www.aphis.usda.gov/animal_health/area_offices/</a></li> </ul> </li> <li>• State             <ul style="list-style-type: none"> <li>- State veterinarian</li> <li><a href="http://www.usaha.org/stateanimal_healthofficials.aspx">http://www.usaha.org/stateanimal_healthofficials.aspx</a></li> </ul> </li> </ul>	<p>If you suspect a case of equine viral arteritis, state or federal authorities should be notified immediately.</p>
--------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------

S I d e  2 6	<p style="text-align: center;"><b>Prevention and Control</b></p> <ul style="list-style-type: none"> <li>• Venereal transmission             <ul style="list-style-type: none"> <li>- Management                 <ul style="list-style-type: none"> <li>• Separate pregnant mares from other horses</li> <li>• Isolate new arrivals</li> <li>• Breed carrier stallions only to well-vaccinated or seropositive mares</li> </ul> </li> <li>- Vaccination                 <ul style="list-style-type: none"> <li>• Protects uninfected stallions</li> <li>• Vaccinate before breeding season</li> </ul> </li> </ul> </li> </ul>	<p>Venereal transmission can be controlled by good management and vaccination. To protect pregnant mares from abortion, they should be separated from other horses and maintained in small groups according to their predicted foaling dates. Newly acquired horses should be isolated for 3 to 4 weeks. Vaccination appears to prevent uninfected stallions from becoming long term carriers. Stallions that are not carriers should be vaccinated before the start of the breeding season. Prepubertal colts are given the vaccine when they are 6-12 months old. Carrier stallions are identified and bred only to well vaccinated or naturally seropositive mares. Similarly, semen that contains EAV should be used only in these mares. Because first-time vaccinates may shed field viruses for a short time after exposure, these mares should be isolated from seronegative horses, particularly pregnant mares, for three weeks after breeding. Naturally infected mares and those that are not first-time vaccinates are isolated for 24-48 hours, to protect other horses from the viruses present in semen.</p>
--------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

S I d e  2 7	<p style="text-align: center;"><b>Prevention and Control</b></p> <ul style="list-style-type: none"> <li>• Carrier stallions             <ul style="list-style-type: none"> <li>- Physically isolate from uninfected horses</li> <li>- Clean and disinfect fomites</li> <li>- No proven method to eliminate chronic infection</li> <li>- Some areas may require testing and identification</li> </ul> </li> </ul> 	<p>Carrier stallions should be housed where they can be physically separated from uninfected horses; in one case, stallions apparently became infected by indirect exposure to semen. However, this appears to be rare. EAV is sensitive to sunlight and low humidity, and uninfected stallions have been kept near carriers for years without infection. Excellent hygiene and decontamination of fomites should be practiced when breeding infected horses or collecting semen. Although some experimental methods may be promising, there is no proven method to eliminate carriage in stallions. Mandatory notification, annual testing, the identification of carrier stallions and control of transmission from these animals, and selective vaccination are being used in New Zealand to eradicate equine viral arteritis. [Photo: Horse in stall. Source: Danelle Bickett-Weddle/CFSPH]</p>
--------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

S  
I  
j  
d  
e  
  
2  
8

### Additional Resources

- Center for Food Security and Public Health  
– [www.cfsph.iastate.edu](http://www.cfsph.iastate.edu)
- USDA: Equine Viral Arteritis  
– [www.aphis.usda.gov/animal\\_health/animal\\_diseases/eva/](http://www.aphis.usda.gov/animal_health/animal_diseases/eva/)

Center for Food Security and Public Health, Iowa State University, 2013

S  
I  
j  
d  
e  
  
2  
9

### Acknowledgments

Development of this presentation was made possible through grants provided to the Center for Food Security and Public Health at Iowa State University, College of Veterinary Medicine from the Centers for Disease Control and Prevention, the U.S. Department of Agriculture, the Iowa Homeland Security and Emergency Management Division, and the Multi-State Partnership for Security in Agriculture.

**Authors:** Kerry Leedom Larson, DVM, MPH, PhD, DACVPM; Anna Rovid Spickler, DVM, PhD  
**Reviewer:** Glenda Dvorak, DVM, MPH, DACVPM

Last reviewed: June 2013