



Eastern Equine Encephalitis (EEE)

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Summary

Eastern Equine Encephalitis (EEE) is an arbovirus (arthropod-borne virus) of significance to the equine population. EEE, along with WEE, and VEE, are alphaviruses in the family Togaviridae.

In the United States, EEE has historically occurred in all states east of the Mississippi River with particular prevalence in the Southeastern United States. Recently, cases have been identified as far west as Texas and north into eastern Canada. Mosquito vectors for EEE include *Aedes* spp., *Coquilettidia perturbans*, and *Culiseta melanura*.

Note: EEE is a reportable disease; consult your State Animal Health Official when disease is suspected.

Clinical Signs

The clinical signs of EEE are highly variable, and none are pathognomonic.

- Moderate to high fever 102.5-104.5°F (39.17-40.28 °C)
- Depression
- Lethargy
- Inappetence
- Signs of encephalitis may include:
 - Dysphagia
 - Head pressing
 - Tremors
 - Weakness
 - Ataxia
 - Circling
 - Blindness
 - Dementia
 - Seizures
 - Rapid behavioral changes: somnolence, hyperexcitability, mania, self-mutilation
 - Cranial neuropathy: nystagmus, facial nerve paralysis, and weakness of the tongue and pharynx



- Coma
- Death

Mortality can exceed 90% in naive horses and is lower in horses with partial protection or previous vaccination. Death usually occurs within 2-3 days of onset of signs. Horses that survive may have permanent neurologic deficits including abnormal mentation and/or residual ataxia.

Transmission

Indirect transmission to horses occurs through bites from infected mosquitos. Mosquitoes become infected after feeding on viremic avian hosts, which serve as natural reservoirs for the virus. Multiple animal species may seroconvert to EEE with or without the appearance of clinical signs, however, only those that develop significant and prolonged viremia can be considered amplifying hosts. Infected horses do not develop viremia of sufficient magnitude for transmission and are therefore considered dead-end hosts. Horse-to-horse and horse-to-human transmission does not occur.

Incubation Period

5-14 days

Diagnostic Sampling, Testing, and Handling

Serology

- IgM-capture ELISA: This is the recommended test for suspected cases of acute EEE and is performed on single serum samples (red top tube) shipped refrigerated to laboratory by overnight courier. IgM titers $\geq 1:400$ are confirmatory in horses exhibiting clinical signs consistent with EEE. Detection of IgM in CSF (if available) is even more conclusive, but death may occur in EEE cases prior to an intrathecal antibody response. While IgM titers are generally considered specific to natural infection (as opposed to vaccination) false positives may occur in horses vaccinated for EEE within the previous 45 days.
- PRNT titers (Plaque Reduction Neutralization Test): Acute and convalescent samples (red top tubes) collected 10-14 days apart and shipped refrigerated to the laboratory by overnight courier. Four-fold increase in titers between samples is considered confirmatory in horses exhibiting clinical signs consistent with EEE and not having been recently vaccinated. A single high PRNT titer in an unvaccinated animal may be indicative of EEE in horses exhibiting clinical signs consistent with EEE.



	<ul style="list-style-type: none"> • Virus neutralizing (VN) antibody titers on paired serum samples may be performed in horses that survive, although this assay may have limited availability.
	<p>CSF analysis:</p> <ul style="list-style-type: none"> • CSF cytology on samples collected in EDTA, generally display moderate mononuclear, neutrophilic, or mixed pleocytosis and elevated microprotein concentrations (usually >70 mg/dl) • PCR and viral isolation may be attempted on CSF of clinically affected horses from an EDTA tube (or non-additive red top tube for PCR). <i>Contact laboratory for further instruction regarding test availability and sample handling.</i> • IgM Capture-ELISA may be performed on CSF.
	<p>PCR</p> <ul style="list-style-type: none"> • PCR assays are available for whole blood in EDTA, CSF samples, and brain. While PCR of CSF and brain have been validated, validation of this assay on whole blood is currently in progress.
Post-Mortem Findings	<p>HISTO FEATURES</p> <ul style="list-style-type: none"> • Fix at least one-half of the brain for histopathology. Fresh brain should be submitted for concomitant PCR, virus isolation, immunochemistry, and rabies testing. • <i>Note: A rabies prevention protocol should be followed for ALL horses demonstrating signs of encephalitis that undergo post-mortem examination. Rabies Testing Protocols</i> • For some neurologic cases, submission of the entire carcass to the diagnostic laboratory for post-mortem examination is recommended due to the time and labor required to collect samples from the equine CNS.
Shedding of Virus Following Resolution of Clinical Signs	<p>EEE-infected horses maintain very low levels of viremia and do not shed virus.</p>
Environmental Persistence	<p>Alphaviruses do not persist outside of the host, and are susceptible to drying, ultraviolet light and detergents.</p>
Specific Control Measures and Biosecurity Recommendations	<p>Vaccination</p> <p>EEE is considered a core vaccine. See AAEP Vaccination Guidelines</p>



	Vector Control <ul style="list-style-type: none"> • Reduce mosquito populations through removal of standing water in feed tubs, flowerpots, outdoor equipment, and other areas of potential water collection. • Implement mosquito mitigation measures for stock tanks. These can include <i>Bacillus thuringiensis</i> (Bti/mosquito dunks), mosquitofish/goldfish, a few tablespoons of mineral oil (enough to coat the surface), or a barley straw bundle. • Regular application of insect repellants to the horse • Avoid turning out horses at dusk and dawn • Use fans to promote air circulation in stables • Use physical mosquito barriers (fly sheets, face masks and fly bandages)
Zoonotic Potential	Horses are dead end hosts for EEE and are not considered a source of infection for other horses, animals, or humans. Nonetheless, precautions are indicated when performing necropsy examinations on neurologic horses of unknown etiology.
Resource Information	<p>Long MT, Gibbs EPJ. Equine alphaviruses. In Sellon D, Long M. Equine Infectious Diseases, 2nd ed. Philadelphia, PA: Saunders Elsevier 2014.</p> <p>Long MT. West Nile virus and equine encephalitis viruses: new perspectives. Vet Clin North Am Equine Pract. 2014. 30(3):523-42.</p>

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