
CASE DEFINITION FOR EASTERN EQUINE ENCEPHALITIS

- 1. General disease/pathogen information:** Eastern equine encephalomyelitis (EEE) is a mosquito-borne viral disease that primarily affects horses. EEE, also known as sleeping sickness, is characterized by central nervous system dysfunction and a moderate to high case fatality rate. The causal virus is maintained in nature in an alternating infection cycle between mosquitoes and birds. Humans and horses serve as dead-end hosts. Although horses and humans are most often affected by the virus, birds may exhibit clinical signs, and infection and disease occasionally occurs in other livestock, deer, dogs, and a variety of mammalian, reptile, and amphibian species.
 - 1.1. Etiologic agent:** EEE is caused by the Eastern equine encephalomyelitis virus (EEEV), an *Alphavirus* of the family *Togaviridae*. It is closely related to the Western and Venezuelan equine encephalomyelitis viruses and Highlands J virus, all of which cause similar neurological dysfunction disorders in horses. There are two distinct antigenic variants of EEEV. The North American variant is more pathogenic than the South and Central American variant.
 - 1.2. Distribution/frequency of agent or pathogen in U.S.:** EEEV is distributed throughout the Western Hemisphere. It has also been reported in the Caribbean Islands, Mexico, Central America, and South America. In North America, it is found in eastern Canada and all States in the United States east of the Mississippi River as well as Arkansas, Iowa, Minnesota, South Dakota, Oklahoma, Louisiana, and Texas. EEEV is endemic in the Gulf of Mexico region of the United States.
 - 1.3. Clinical signs:** Horses infected with EEEV will initially develop fever, lethargy, and anorexia. Neurological signs usually develop 5 days after infection and include cranial nerve abnormalities, altered mentation, impaired vision, circling, head pressing, wandering, and difficulties swallowing. In its more severe form, the disease will progress to hyperexcitability, ataxia, convulsions, and death. Case fatality rate usually exceeds 90 percent and most deaths occur 2-3 days after onset of neurologic signs.
 - 1.4. Incubation period:** 5-15 days
 - 1.5. Differential diagnosis:** Diagnosis of EEE cannot be based on clinical signs alone due to similarities to other arboviral diseases (Western, Highlands J, and Venezuelan equine encephalomyelitides, West Nile encephalitis) as well as other neurological disorders (rabies, botulism, hepatoencephalopathy, leukoencephalomalacia, equine herpesvirus myeloencephalopathy, bacterial meningitis, protozoal myeloencephalopathy, intoxications).
 - 1.6. Transmission and reservoir:** EEEV depends upon cyclic transmission between birds and mosquitoes for its survival in nature. Horses and other mammals serve as dead-end hosts. EEEV has been isolated from 27 different mosquito species in the United States. The primary vector of the enzootic cycle is the *Culiseta melanura*, while *Aedes vexans* and *Aedes canadensis* are thought to be the key mosquito species that act as bridge vectors for bird-to-mammal transmission of EEEV. Seasonal changes in climate heavily influence EEEV transmission. The enzootic transmission of EEEV occurs mainly in the



spring and early summer in swampy habitats where *C. melanura* breed. In the later summer months and into the fall, the mosquitoes will move to drier habitats. At this time, infection rates in birds soar and the interaction with and infection of horses, people, and other mammals occur. In regions with tropical or subtropical climates, EEEV infections occur year-round with a peak occurring in the summer. Transmission of EEEV is also influenced by movement of infected vectors by wind currents and migration of infected bird hosts.

- 1.7. *Epidemiology*: EEE is a highly fatal, yet preventable (by vaccination) neurological disease in horses. Horses are the most susceptible animal species to EEEV infection and have case fatality rates ranging from 50 percent to 90 percent in animals that exhibit clinical signs. Emus and ostriches are also highly susceptible to infection with EEEV, with case-fatality rates up to 85 percent. EEE is clinically similar to the disease caused by the related Western equine encephalomyelitis virus, yet EEE results in much higher case fatalities and is much more frequently observed in the United States. EEEV causes severe disease in humans, with a case fatality rate of 30-70 percent.
2. **Laboratory criteria**: OIE Manual of Standards for Diagnostic Tests and Vaccines for Terrestrial Animals, 2008. Chapter 2.5.5.
 - 2.1. *Agent identification*: Reverse transcriptase polymerase chain reaction (RT-PCR) may be performed on unfixed brain tissue. Virus isolation is performed on brain or other tissue, with virus identification by complement fixation (CF), direct immunofluorescent staining, plaque reduction neutralization (PRNT), or RT-PCR.
 - 2.2. *Serological tests*: Tests include CF, or IgM capture enzyme-linked immunosorbent assay (ELISA), or PRNT, or hemagglutination inhibition (HI). Vaccination for EEE can produce positive PRNT, HI, CF, and possibly IgM test results.
 3. **Case definition**:
 - 3.1. *Suspect case*: A susceptible equid with clinical signs consistent with Eastern equine encephalomyelitis and located in or has recently visited an area with appropriate climate and active hematophagous insects.
 - 3.2. *Presumptive positive case*: A suspect case that:
 - 3.2.1. Has antibody against EEE (and is not vaccinated)
 - 3.2.1.1 Positive plaque reduction neutralization (PRNT); *OR*
 - 3.2.1.2. ELISA detection of IgM antibody (acute infection).
 - 3.3. *Confirmed positive case*: Compatible clinical signs and may meet presumptive level of certainty **AND**
 - 3.3.1. Isolation of EEEV; **OR**
 - 3.3.2. RT-PCR detection of specific viral antigen or genomic sequences; **OR**
 - 3.3.3. Serological confirmation of EEE virus infection with a fourfold or greater change in antibody titer in paired serum samples collected 10–14 days apart (unvaccinated or known vaccination history); **OR**
 - 3.3.4. Positive immunohistochemistry for EEEV antigen in tissue.
 4. **Reporting criteria**:
 - 4.1. Suspect cases are reported according to individual State procedure, typically by notification of the State Arboviral Coordinator or State Animal Health Official.

- 4.2. Positive cases are to be reported to CDC's ArboNET by the State's chief animal health officer or appointed arboviral coordinators. Public distribution of this information is provided at:
 - 4.2.1. USDA's National Animal Health Surveillance System (NAHSS) Eastern Equine Encephalitis virus information page
<http://www.aphis.usda.gov/vs/nahss/equine/eee/index.htm>
 - 4.2.2. U.S. Department of the Interior's USGS Disease Maps information page
http://diseasemaps.usgs.gov/eee_us_veterinary.html
- 4.3. National Animal Health Reportable System (NAHRS) reportable disease reporting of confirmed case occurrence. If a case meets the presumptive level of diagnostics only, animal health officials must use their discretion to decide if the case is valid. If considered valid, the case should be reported to NAHRS.

5. Control and surveillance procedures:

- 5.1. Annual vaccination of horses is recommended with increased vaccination protocols in areas of year-long active vector survival. Detailed vaccination guidelines are available from the American Association of Equine Practitioners (AAEP) at:
http://www.aaep.org/vaccination_guidelines.htm
- 5.2. Insect vector control by elimination of breeding sites, frequent manure removal, weed control, mosquito protection of horses (insect repellants), and shelters (fans and screens).
- 5.3. Passive surveillance is done during routine activities by accredited veterinarians, State animal health officials, and others.

References

1. American Association of Equine Practitioners (AAEP) Vaccination Guidelines. Available online at http://www.aaep.org/vaccination_guidelines.htm
2. Iowa State University: The Center for Food Security and Public Health: Eastern Equine Encephalomyelitis, Western Equine Encephalomyelitis, and Venezuelan equine Encephalomyelitis Fact Sheet. 2008. Available online at http://www.cfsph.iastate.edu/Factsheets/pdfs/easter_wester_venezuelan_equine_encephalomyelitis.pdf
3. Merck Veterinary Manual. Eastern Equine Encephalitis. Available online at
 - a. <http://www.merckvetmanual.com/mvm/index.jsp?cfile=htm/bc/100900.htm&word=Eastern%2cEquine%2cEncephalitis>
4. Merck Veterinary Manual. Equine Encephalomyelitis. Available online at <http://www.merckvetmanual.com/mvm/index.jsp?cfile=htm/bc/100900.htm&word=equine%2cencephalitis>
5. OIE: Manual of Diagnostic Tests and Vaccines for Terrestrial Animals 2008: Chapter 2.5.5. *Equine Encephalomyelitis (Eastern and Western)*. Available online at
 - a. http://www.oie.int/eng/normes/mmanual/2008/pdf/2.05.05_EQUINE_ENCEPH.pdf
6. Promed Mail: search EEE. Available online at: <http://www.promedmail.org>
7. Schmitt, S.M. *An outbreak of Eastern equine encephalitis virus in free-ranging white-tailed deer in Michigan*. Journal of Wildlife Diseases. 2007. 43(4): 635-44.
8. United States Department of the Interior, U.S. Geologic Survey (USGS) Disease Map 2008. <http://diseasemaps.usgs.gov/index.html>. Accessed March 7, 2009.