

WESTERN EQUINE ENCEPHALITIS VIRUS DISEASE

(Western equine encephalitis, WEE)

REPORTING INFORMATION

- **Class B:** Report by the end of the next business day after the case or suspected case presents and/or a positive laboratory result to the local public health department where the patient resides. If patient residence is unknown, report to the local public health department in which the reporting health care provider or laboratory is located.
- Reporting Form(s) and/or Mechanism:
 - The Ohio Disease Reporting System (ODRS) should be used to report lab findings to the Ohio Department of Health (ODH). For healthcare providers without access to ODRS, you may use the [Ohio Confidential Reportable Disease form](#) (HEA 3334).
 - The ODH [Mosquito-borne Illness Case Investigation worksheet](#) is available for use to assist in local disease investigation. Information collected from the form should be entered into ODRS and not sent to ODH, unless otherwise requested. If requested, the form can be faxed to ODH at (614) 564-2456 or uploaded to the ODRS record.
- Key fields for ODRS reporting include: import status (whether the infection was travel-associated or Ohio-acquired), date of illness onset, symptoms, all fields in the Epidemiology module and travel details in the Travel History module (with accurate departure and return dates along with city, province/county, state and country).

AGENT

Western equine encephalitis (WEE) virus is an RNA virus belonging to the genus *Alphavirus* (formerly group A of the arboviruses) of the family Togaviridae. It is closely related to Eastern equine encephalitis and Venezuelan equine encephalitis viruses.

Infectious dose: A single bite from an infectious mosquito.

CASE DEFINITION

Clinical Description

Most arboviral infections are asymptomatic. Clinical disease ranges from mild febrile illness to severe encephalitis. For the purpose of surveillance and reporting, based on their clinical presentation, arboviral disease cases are often categorized into two primary groups: neuroinvasive disease and non-neuroinvasive disease.

Neuroinvasive disease

Many arboviruses cause neuroinvasive disease such as aseptic meningitis, encephalitis or acute flaccid paralysis (AFP). These illnesses are usually characterized by the acute onset of fever with headache, myalgia, stiff neck, altered mental status, seizures, limb weakness or cerebrospinal fluid (CSF) pleocytosis. AFP may result from anterior ("polio") myelitis, peripheral neuritis or post-infectious peripheral demyelinating neuropathy (i.e., Guillain-Barré syndrome). Less common neurological manifestations, such as cranial nerve palsies, also occur.

Non-neuroinvasive disease

Most arboviruses are capable of causing an acute systemic febrile illness (e.g., West Nile fever) that may include headache, myalgia, arthralgia, rash or gastrointestinal symptoms. Some viruses can also cause more characteristic clinical manifestations, such as severe polyarthralgia or arthritis due to chikungunya virus or other alphaviruses (e.g., Mayaro, Ross River, O'nyong-nyong).

Clinical Criteria

A clinically compatible case of arboviral disease is defined as follows:

Neuroinvasive disease:

- Meningitis, encephalitis, acute flaccid paralysis or other acute signs of central or peripheral neurologic dysfunction, as documented by a physician and
- Absence of a more likely clinical explanation. Other clinically compatible symptoms of arbovirus disease include: headache, myalgia, rash, arthralgia, vertigo, vomiting, paresis and/or nuchal rigidity.

Non-neuroinvasive disease:

- Fever (chills) as reported by the patient or a healthcare provider and
- Absence of neuroinvasive disease and
- Absence of a more likely clinical explanation. Other clinically compatible symptoms of arbovirus disease include: headache, myalgia, rash, arthralgia, vertigo, vomiting, paresis and/or nuchal rigidity.

Laboratory Criteria for Diagnosis

- Isolation of virus from, or demonstration of specific viral antigen or nucleic acid in, tissue, blood, cerebrospinal fluid (CSF) or other body fluid or
- Four-fold or greater change in virus-specific quantitative antibody titers in paired sera or
- Virus-specific immunoglobulin M (IgM) antibodies in serum with confirmatory virus-specific neutralizing antibodies in the same or a later specimen or
- Virus-specific IgM antibodies in CSF or serum.

Case Classification

Probable:

- Neuroinvasive disease: A case that meets the above clinical criteria for neuroinvasive disease and with virus-specific IgM antibodies in CSF or serum but with no other testing.
- Non-neuroinvasive disease: A case that meets the above clinical criteria for non-neuroinvasive disease and with virus-specific IgM antibodies in serum but with no other testing.

Confirmed:

- Neuroinvasive disease: A case that meets the above clinical criteria for neuroinvasive disease and one or more the following laboratory criteria:
 - Isolation of virus from, or demonstration of specific viral antigen or nucleic acid in, tissue, blood, CSF or other body fluid or
 - Four-fold or greater change in virus-specific quantitative antibody titers in paired sera or
 - Virus-specific IgM antibodies in serum with confirmatory virus-specific neutralizing antibodies in the same or a later specimen or
 - Virus-specific IgM antibodies in CSF, with or without a reported pleocytosis, and a negative result for other IgM antibodies in CSF for arboviruses endemic to the region where exposure occurred.
- Non-neuroinvasive disease: A case that meets the above clinical criteria for non-neuroinvasive disease and one or more of the following laboratory criteria:
 - Isolation of virus from, or demonstration of specific viral antigen or nucleic acid in, tissue, blood or other body fluid excluding CSF or
 - Four-fold or greater change in virus-specific quantitative antibody titers in paired sera or

- Virus-specific IgM antibodies in serum with confirmatory virus-specific neutralizing antibodies in the same or a later specimen.

Comments

Imported Arboviral Diseases

Human disease cases due to dengue or yellow fever viruses are nationally notifiable to CDC using specific case definitions. However, many other exotic arboviruses (e.g., Japanese encephalitis, tick-borne encephalitis, Venezuelan equine encephalitis and Rift Valley fever viruses) are imported public health risks for the United States as competent vectors exist that could allow for sustained transmission upon establishment of imported arboviral pathogens. Healthcare providers and public health officials should maintain a high index of clinical suspicion for cases of potentially exotic or unusual arboviral etiology, particularly in international travelers. If a suspected case occurs, it should be reported to the appropriate local/state agencies and CDC.

Interpreting Arboviral Laboratory Results

- Serologic cross-reactivity: In some instances, arboviruses from the same genus produce cross-reactive antibodies. In geographic areas where two or more closely-related arboviruses occur, serologic testing for more than one virus may be needed and results compared to determine the specific causative virus. For example, such testing might be needed to distinguish antibodies resulting from infections within genera (e.g., flaviviruses such as West Nile, St. Louis encephalitis, Powassan, dengue or Japanese encephalitis viruses).
- Rise and fall of IgM antibodies: For most arboviral infections, IgM antibodies are generally first detectable at 3 to 8 days after onset of illness and persist for 30 to 90 days, but longer persistence has been documented (e.g., up to 500 days for West Nile virus). Serum collected within 8 days of illness onset may not have detectable IgM and testing should be repeated on a convalescent-phase sample to rule out arboviral infection in those with a compatible clinical syndrome.
- Persistence of IgM antibodies: Arboviral IgM antibodies may be detected in some patients months or years after their acute infection. Therefore, the presence of these virus-specific IgM antibodies may signify a past infection and be unrelated to the current acute illness. Finding virus-specific IgM antibodies in CSF or a fourfold or greater change in virus-specific antibody titers between acute- and convalescent-phase serum specimens provides additional laboratory evidence that the arbovirus was the likely cause of the patient's recent illness. Clinical and epidemiologic history also should be carefully considered.
- Persistence of IgG and neutralizing antibodies: Arboviral IgG and neutralizing antibodies can persist for many years following a symptomatic or asymptomatic infection. Therefore, the presence of these antibodies alone is only evidence of previous infection and clinically compatible cases with the presence of IgG, but not IgM, should be evaluated for other etiologic agents.
- Arboviral serologic assays: Assays for the detection of IgM and IgG antibodies commonly include enzyme-linked immunosorbent assay (ELISA), microsphere immunoassay (MIA) or immunofluorescence assay (IFA). These assays provide a presumptive diagnosis and should have confirmatory testing performed. Confirmatory testing involves the detection of arboviral-specific neutralizing antibodies utilizing assays such as plaque reduction neutralization test (PRNT).
- Other information to consider: Vaccination history, detailed travel history, date of onset of symptoms and knowledge of potentially cross-reactive arboviruses known to circulate in the geographic area should be considered when interpreting results.

SIGNS AND SYMPTOMS

Western equine encephalitis can produce a febrile illness of variable severity associated with neurologic symptoms ranging from headache to aseptic meningitis or encephalitis. Arboviral encephalitis cannot be distinguished clinically from other central nervous system (CNS) infections. Symptoms can include headache, confusion or other alteration in sensorium, nausea, and vomiting. Signs may include fever, meningismus, cranial nerve palsies, paresis or paralysis, sensory deficits, altered reflexes, convulsions, abnormal movements and coma of varying degree. Neurologic sequelae tend to be most severe in infants. The illness is fatal in about 3% of cases. [See also the [Aseptic Meningitis](#) chapter.]

DIAGNOSIS

Preliminary diagnosis is often based on a patient's clinical features, places and dates of travel (if patient is from a non-endemic country or area), activities and epidemiologic history of the location where infection likely occurred. In addition to the other more common causes of encephalitis and aseptic meningitis (e.g., herpes simplex virus and enteroviruses) and febrile illnesses, arboviruses such as chikungunya, dengue, Eastern equine encephalitis, Jamestown Canyon, LaCrosse, Powassan, St. Louis encephalitis, West Nile and Zika viruses should also be considered in the differential etiology.

Laboratory diagnosis of arboviral infections is generally accomplished by testing of serum or CSF to detect virus-specific IgM and neutralizing antibodies. During an acute infection, certain viruses can be isolated through culture or detected by nucleic acid amplification.

In fatal cases, nucleic acid amplification, histopathology with immunohistochemistry and virus culture of autopsy tissues can also be useful. Only a few state laboratories or other specialized laboratories, including those at CDC, are capable of doing this specialized testing.

For clinical samples being sent to CDC's Arbovirus Diagnostic Laboratory for testing, the [CDC Specimen Submission Form](#) must accompany the samples. Be sure the date of illness onset and travel history fields are completed. Use test order code CDC-10282 for arbovirus serology. Please contact ODH's Bureau of Infectious Diseases at (614) 995-5599 to arrange for testing at CDC.

EPIDEMIOLOGY

Source

Western equine encephalitis virus is circulated between birds and the *Culex tarsalis* mosquito species, common in farming areas and around irrigated fields. Horses, humans and other mammals are accidental dead-end hosts and are not usually a source of infection to humans.

Susceptibility

All individuals not previously infected with Western equine encephalitis virus (naïve individuals) are at risk for infection and developing disease. People who engage in outdoor work and recreational activities in endemic areas are at increased risk of infection.

Occurrence

From 1964 to 1999, 640 human cases have been confirmed in the United States. Historically, fewer than 5 cases were reported each year, and no cases have been reported since 1999. In the U.S., human cases are generally first seen in June or July. Western equine encephalitis virus is found in North, Central and South America, but

most cases have been reported from the plains regions of the western and central United States. There are no records of human cases acquired in Ohio.

Mode of Transmission

The reservoir of Western equine encephalitis virus is wild birds, and the virus is transmitted by the *Culex tarsalis* mosquito. While *Cx. tarsalis* can be found in Ohio, it is rather uncommon.

Period of Communicability

Humans and horses are dead-end hosts for the virus (i.e., they do not circulate sufficient numbers of the Western equine encephalitis virus in the blood stream to infect a mosquito). The disease cannot be spread person to person.

Incubation Period

The incubation period is 5 to 10 days.

PUBLIC HEALTH MANAGEMENT

Case

Investigation

With serologic identification of Western equine encephalitis virus infection, a complete travel history for the two weeks prior to onset should be obtained. The patient should also be questioned about donating or receiving blood, blood products and organs in the 4 weeks prior to onset of symptoms. Female patients should be asked whether they were pregnant at the time of infection, and infants should be checked whether they were breastfed before illness onset. Sites of outdoor exposure and activities can be evaluated for the presence of *Culex* mosquitoes by standard collection techniques (BG sentinel traps, light traps, larval samples, bait traps and oviposition [gravid] traps).

Treatment

There is no specific treatment for Western equine encephalitis virus disease. Supportive care is indicated.

Isolation and Follow-up Specimens

Since the diagnosis of Western equine encephalitis virus disease is often not known until after patient discharge, enteroviral precautions (i.e., fecal, respiratory) are usually indicated for encephalitis. A convalescent sample 2-4 weeks after the acute may be required to confirm a case.

Public Health Significance

High. Because an endemic case of Western equine encephalitis virus disease has never been found in Ohio, report of a single case may signify an outbreak is developing. A patient infected in Ohio would likely be newsworthy.

Contacts

No treatment or prophylaxis of contacts is indicated.

Prevention and Control

Vaccination

There is no vaccine for humans. There is a vaccine available for horses.

Vector Investigation

With the report of a human or equine case of Western equine encephalitis virus disease, a vector assessment should be done in the vicinity of home and travel sites to determine if an outbreak is developing. Mosquito samples should be collected to determine the prevalence of *C. tarsalis*. For advice on vector assessment, contact the ODH ZDP at (614) 752-1029 or via e-mail at zoonoses@odh.ohio.gov.

Mosquito Bite Avoidance

The best way to prevent Western equine encephalitis virus infection is to avoid mosquito bites. Prevention tips are similar to those for other viral diseases transmitted by mosquitoes, such as dengue or West Nile virus:

- Use insect repellent [registered by the U.S. Environmental Protection Agency \(EPA\)](#) on exposed skin. Always follow the directions on the package. When using both sunscreen and insect repellent, apply the sunscreen first then the repellent.
- Wear long sleeves, pants and socks if feasible.
- Wear permethrin-treated clothing to repel and kill mosquitoes.
- Use screens on windows and doors to exclude mosquitoes. And, when available, A/C can make households less hospitable to mosquitoes.
- Participation in community and homeowner based vector-control strategies:
 - Ensure that water does not collect in containers around the home and community by emptying water from containers such as flowerpots, buckets, barrels and tires. Change the water in pet dishes, and replace the water in bird baths weekly. Drill holes in tire swings so water drains out. Empty children's wading pools and store on their sides after use.
 - Use chemical or biological control of larvae and adult mosquitoes when necessary.

What is Western equine encephalitis?

Western equine encephalitis is a rare but serious disease that is caused by a virus spread by infected mosquitoes. Western equine encephalitis virus is one of a group of mosquito-transmitted viruses that can cause inflammation of the brain (encephalitis). Historically, fewer than 5 human cases are reported each year in the United States, but no cases have been reported since 1999. No cases have been acquired in Ohio.

How do people get infected with Western equine encephalitis virus?

Western equine encephalitis virus is transmitted through the bite of an infected mosquito. Disease transmission does not occur directly from person to person.

When and where have most cases of Western equine encephalitis virus occurred?

Most cases of western equine encephalitis virus have been reported from the plains regions of the western and central United States. Most human cases are first seen in June in July in the United States.

Who is at risk for infection with Western equine encephalitis virus?

Anyone in an area where the virus is circulating can get infected with Western equine encephalitis virus. The risk is highest who work outside or participate in outdoor recreational activities because of the greater exposure to potentially infected mosquitoes.

How soon do people get sick after getting bitten by an infected mosquito?

It takes 5 to 10 days after the bite of an infected mosquito to develop symptoms of Western equine encephalitis virus disease.

What are the symptoms of Western equine encephalitis virus disease?

Many people infected with Western equine encephalitis virus have no signs of illness. Those who do get sick generally have mild flu-like symptoms including high fever, stiff neck, muscle pain, headache and a lack of energy. In some cases, inflammation of the brain, called encephalitis, can develop. Affected infants often suffer seizures. Approximately 3% of Western equine encephalitis virus disease cases are fatal. Survivors may have mild to severe neurologic deficits.

How is Western equine encephalitis virus disease diagnosed?

Diagnosis is based on tests of blood or spinal fluid. These tests typically look for antibodies that the body makes against the viral infection.

What is the treatment for Western equine encephalitis virus disease?

There is no specific treatment for Western equine encephalitis virus disease. Antibiotics are not effective against viruses, and no effective antiviral drugs have been discovered. Severe illnesses are treated by supportive therapy which may include hospitalization, respiratory support, IV fluid and prevention of other infections.

Is there a vaccine for Western equine encephalitis virus disease?

There are no human vaccines available. A vaccine for horses is available through veterinarians.

How can people reduce the chance of getting infected with Western equine encephalitis virus?

Prevent mosquito bites. It only takes one bite from an infected mosquito to transmit disease.

- Use insect repellent registered with the U.S. Environmental Protection Agency (EPA) on exposed skin and/or clothing. The repellent/insecticide permethrin can be used on clothing to protect through several washes. Always follow directions on the package.
- Wear long sleeves and pants when weather permits.
- Have secure, intact screens on windows and doors to keep mosquitoes out.
- Eliminate mosquito breeding sites by emptying standing water from flower pots, buckets, barrels and other containers. Drill holes in tire swings so water drains out. Keep children's wading pools empty and on their sides when they aren't being used.

For more information, please visit these websites:

- U.S. Environmental Protection Agency (EPA) Registered Insect Repellents:
<https://www.epa.gov/insect-repellents>
- CDC Insect Repellent Use and Safety:
<http://www.cdc.gov/westnile/faq/repellent.html>
- U.S. Geologic Survey Western Equine Encephalitis Human Case Maps:
<http://diseasemaps.usgs.gov/mapviewer/>