

Arboviral Infection

Surveillance Protocol

Arboviruses endemic to the U.S. include mosquito-borne Eastern equine encephalitis virus (EEE), LaCrosse encephalitis virus (LAC), Saint Louis Encephalitis virus (SLE), West Nile virus (WNV), Western equine encephalitis virus (WEE), and tick-borne Powassan encephalitis virus (POW). See other material for guidance on non-endemic arboviruses (e.g., dengue fever and yellow fever).

Provider Responsibilities

1. Report suspect and confirmed cases of arbovirus infection by completing the provider section of the WVEDSS Arbovirus form. Forward the completed form to the local health department within one week of diagnosis. Include a copy of the laboratory report.
2. Assure that a serological or CSF specimen from the patient is referred to the Office of Laboratory Services (OLS) within one week of diagnosis. OLS can be reached at 304-558-3530.
3. Note: In West Virginia, appropriate arbovirus testing should include: EEE, LAC, SLE, and WNV. Testing for all four may be performed free-of-charge at the OLS. During June to November, testing is strongly recommended for hospitalized patients with encephalitis.

Laboratory Responsibilities

1. Report positive test results for arbovirus to the local health department within 1 week.
2. Submit a serological or CSF specimen to the Office of Laboratory Services for confirmation within 1 week.
3. Note: In West Virginia, appropriate arbovirus testing should include: EEE, LAC, SLE and WNV. Laboratories that cannot offer complete and appropriate testing can refer specimens directly to the Office of Laboratory Services (OLS) free-of-charge. Call 304-558-3530

Public Health Action

1. When a case is reported:
 - a. Enter the case into WVEDSS
 - b. Contact the healthcare provider to document/determine the following:
 - i. Record symptom onset date

Division of Infectious Disease Epidemiology

350 Capitol Street, Room 125, Charleston, WV 25301-3715
Phone: 304.558.5358 Fax: 304.558.6335 www.wvidep.org

Arboviral Infection

Surveillance Protocol

- ii. Clinical symptoms of fever, meningitis, encephalitis, or other symptoms.
 - iii. Document underlying immunosuppressive condition(s)
 - iv. Examine the laboratory testing that was done to ensure all testing that was performed on the case has been reported to DIDE including CBC, metabolic panels and/or CSF studies.
 - v. Collect case's demographic data and contact information (birth date, county, sex, race/ethnicity, occupation, address, phone number(s))
 - vi. Record hospitalizations: location, admission and discharge dates
 - vii. Record outcomes: recovered or date of death
 - c. Interview the case or proxy to determine source and risk factors; focus on the 2-week incubation period prior to illness onset.
 - i. Document recent travel to endemic areas. Consider:
 1. Outdoor activities
 2. Occupational risks (e.g., laboratory worker, landscape worker, etc.)
 - d. Investigate cases of human arboviral disease and perform a visit to the homes of all confirmed and probable arbovirus case-patients to:
 - i. Visualize the outdoor environment.
 - ii. Educate the family about removal of containers, mosquito habitat abatement, and use of personal protective measures, including use of mosquito repellent.
 - iii. Obtain latitude and longitude of the home of the case-patient.
 - iv. Interview the case-patient (or family members) to obtain information on the location of other potential exposures, including time spent out of doors during the incubation period. Include a travel history during the incubation period.
 - v. Document using the Arbovirus WVEDSS Investigation Form. Forward the completed WVEDSS Arbovirus form and paper copies of laboratory reports to DIDE
2. Educate the public about mosquito-borne diseases, especially regarding elimination of mosquito breeding sites and use of personal protective measures. Especially in La Crosse endemic areas, target resources to areas that have experienced cases in the past.

Division of Infectious Disease Epidemiology

350 Capitol Street, Room 125, Charleston, WV 25301-3715
Phone: 304.558.5358 Fax: 304.558.6335 www.wvidep.org

Arboviral Infection

Surveillance Protocol

3. Educate physicians and hospital infection control practitioners to:
 - a. Recognize clinical syndromes that warrant arbovirus testing (especially hospitalized encephalitis cases during summer and early fall), and
 - b. Order appropriate testing for West Nile virus (WNV), La Crosse encephalitis (LAC), Eastern equine encephalitis (EEE), and St. Louis encephalitis (SLE).
 - i. This action should be accomplished by generating a physician alert from the county health department and/or by asking infection control practitioners to assist in alerting physicians.
4. Educate veterinarians to consider WNV and EEE as a possible etiology of summertime encephalitis in horses.
5. Educate government officials at all levels regarding mosquito surveillance and integrated pest management as a means of preventing cases of arboviral diseases.
6. Maintain a line listing of dead bird reports at the local health department.
 - a. Contact the Division of Infectious Disease Epidemiology (DIDE) at 1-800-423-1271 to obtain an ID number to use for sending oral swab samples from recently dead (i.e., ≤ 24 hours) birds to OLS for WNV, SLE and EEE virus testing.
 - b. Contact the nearest West Virginia Division of Natural Resources district office immediately any time of year to report suspicious clusters of dead birds (see <http://www.wvdnr.gov/contact.shtm> to find the contact information for the nearest district office)
 - c. Should a highly pathogenic avian influenza virus (e.g., H5N1) be isolated from wild birds or poultry in the Western hemisphere, recommendations may change regarding bird mortality surveillance.
7. Report confirmed/probable/suspected human, equine, or avian arbovirus cases urgently to DIDE.
8. Given existing resources if bird, human, or equine cases of arboviral disease are identified:
 - a. increase public education to encourage use of personal protective measures
 - b. increase public education to encourage elimination of mosquito breeding sites
 - c. increase education of government officials at all levels regarding mosquito surveillance and integrated pest management as a means of preventing additional cases

Division of Infectious Disease Epidemiology

350 Capitol Street, Room 125, Charleston, WV 25301-3715
Phone: 304.558.5358 Fax: 304.558.6335 www.wvidep.org

Arboviral Infection

Surveillance Protocol

- d. generate an alert to physicians to intensify surveillance for human cases
 - e. For cases of EEE and WNV, generate an alert to veterinarians to intensify surveillance for equine cases.
9. If additional resources become available:
- a. establish local or regional mosquito surveillance and control capacity, and
 - b. enhance viral surveillance of mosquito populations

Disease Prevention and Control Objectives

1. Prevent the development of human cases through:
 - a. Appropriate mosquito surveillance and control
 - b. Education of the public to use personal protective measures and eradicate mosquito breeding sites
2. If a positive mosquito pool or a case of avian, equine or human arboviral infection is identified, consider issuing a press release to notify the public and provide information regarding prevention of arboviral infection (See Disease Prevention and Control Objectives 1.a and 1.b above)
3. If the resources and/capacity exists, consider the use of targeted local or regional mosquito control activities.

Disease Surveillance Objectives

1. To monitor arbovirus incidence in West Virginia and document trends by demographics, place and time.
2. To detect West Nile virus activity, if present (to be accomplished through dead bird testing).
3. Detect equine cases of arbovirus, and characterize by place and time.
4. To detect early season human cases of arboviral disease.
5. To characterize arbovirus-infected mosquitoes in West Virginia by species, location and type of habitat.
6. To identify breeding sites and geographic distribution of mosquitoes that may potentially vector novel or travel-associated arboviruses such as dengue or chikungunya.

Division of Infectious Disease Epidemiology

350 Capitol Street, Room 125, Charleston, WV 25301-3715
Phone: 304.558.5358 Fax: 304.558.6335 www.wvidep.org

Arboviral Infection

Surveillance Protocol

Public Health Significance

After its introduction in 1999, West Nile virus expanded its territory across the United States. West Nile called attention to the weakened public health infrastructure for arbovirus surveillance in the United States. Due to this concern, Federal money was allocated to improve public health infrastructure, including laboratory diagnostic and medical entomology capacity. Travel associated outbreaks of chikungunya and dengue virus have further called attention to the possibility of introduction of new arboviruses into the United States.

The occurrence of arboviral disease outbreaks is unpredictable; thus public health officials should remain vigilant for increased activity during the summer months, which coincides with increased vector activity. SLE and EEE can occur in sometimes dramatic outbreaks at lengthy intervals with little or no apparent transmission in intervening years. Here are the types of surveillance that should be performed and the purpose of each type of surveillance:

1. **Dead Bird Surveillance:** The purpose of dead bird surveillance is to monitor the presence of WNV, EEE or SLE within the jurisdiction under surveillance. This is accomplished by testing freshly dead birds for WNV, SLE and EEE.
2. **Mosquito Surveillance:** Mosquito surveillance is conducted to identify mosquito breeding sites and prioritize sites for abatement, and determine if disease-carrying adult mosquitoes are present.
3. **Equine Surveillance:** Horses may serve as an important indicator of WNV and EEE activity in the jurisdiction.
4. **Human Surveillance:** The purpose of human surveillance is to detect human arbovirus infection within the jurisdiction. Enhanced passive surveillance (via a HAN message) is employed annually by the Bureau for Public Health to remind providers of the importance of recognizing, testing, and prompt reporting of arboviral infections to the local health department.

Regardless of the type of surveillance performed, the information collected should be used to prevent further human cases of disease. The ecology and public health aspects of arboviruses are complex. West Virginia public health officials are encouraged to take the necessary time to educate themselves about these diseases.

In West Virginia, the major arbovirus of concern is LAC; although WNV has occurred in West Virginia in the recent past. Birds positive for EEE were identified in 2002 in West

Division of Infectious Disease Epidemiology

350 Capitol Street, Room 125, Charleston, WV 25301-3715
Phone: 304.558.5358 Fax: 304.558.6335 www.wvdep.org

Arboviral Infection

Surveillance Protocol

Virginia. Twelve human cases of SLE were reported from West Virginia between 1964 and 2008, with the majority of cases occurring in 1975 during a national SLE epidemic. No human cases of Powassan have been identified in West Virginia; however, the virus was isolated from the brain of a sick fox in West Virginia in 1977 and the primary tick vector, *Ixodes cookei* has been documented in several West Virginia counties.

Clinical Description

Arboviral diseases are clinically indistinguishable from one another. They vary in terms of severity, long-term sequelae and the age groups most heavily affected. The most common manifestation is asymptomatic infection for WNV, LAC and SLE; while EEE is noteworthy for its low case-infection ratio and its high case-fatality rate. Other common clinical syndromes include 1) undifferentiated febrile illness, also referred to as ‘febrile headache;’ and 2) CNS infection, including aseptic meningitis, encephalitis or myelitis. Clinical presentations with nervous system involvement can be particularly variable and may involve the brain, spinal cord or nerves. The patient may present with syndromes mimicking a stroke or Parkinsonism, as well as tremors, movement disorders, neuritis, acute flaccid paralysis and/or SIADH.

First, some definitions:

Acute flaccid paralysis: sudden onset of muscle weakness with hyporeflexia (decreased muscle reflexes) due to peripheral nerve or spinal cord involvement.

Aseptic meningitis: Symptoms of meningitis include fever, headache, photophobia, stiff neck and vomiting. Persons with aseptic meningitis have greater than 5 white blood cells in the spinal fluid and negative bacterial cultures. Meningitis means ‘inflammation of the meninges.’ Meninges are the membranous lining around the brain. ‘Aseptic’ means that there are no bacteria found (in the spinal fluid).

Encephalitis: literally means ‘inflammation of the brain.’ These persons have fever and signs of central nervous system involvement, including: seizures, altered mental status, muscle weakness, sensory loss, or even movement disorders. On CT or MRI, focal or generalized swelling of the brain may be identified.

Febrile headache: is a self-limited illness characterized by fever and headache. Other signs and symptoms associated with this syndrome may include: rash, arthritis, weakness, vomiting and lymphadenopathy.

Division of Infectious Disease Epidemiology

350 Capitol Street, Room 125, Charleston, WV 25301-3715
Phone: 304.558.5358 Fax: 304.558.6335 www.wvidep.org

Arboviral Infection

Surveillance Protocol

Myelitis: literally inflammation of the spinal cord. The spinal cord contains nerve fibers that support motor and sensory function. Myelitis results in weakness or paralysis, sensory changes and impaired bowel or bladder function.

Neuritis: literally inflammation of a nerve. Peripheral nerves are those outside of the brain or spinal cord. Neuritis prevents the nerve from functioning normally, so the person with neuritis may lose sensory (feeling, seeing, etc.) or motor (moving) function.

Parkinson's Disease: is a neurological disorder characterized by tremor, difficulty walking, movement and coordination. Parkinsonism refers to any condition that causes a movement disorder similar to Parkinson's Disease.

SIADH: Syndrome of inappropriate antidiuretic hormone results in hyponatremia (low blood sodium) due to excessive secretion of antidiuretic hormone.

While there is no way to clinically distinguish one arboviral infection from another, the arboviruses result in illness of varying clinical severity by age group and several occur in distinct regions of the country (Table 1).

Arboviral Infection

Surveillance Protocol

Table 1. Clinical spectrum, high risk groups and geographic distribution of endemic North American arboviruses.

Virus	Case-Fatality Rate	Prevalence of Neurological sequelae	Age Groups Most Affected	Geographic Distribution in United States
Eastern equine encephalitis	36–70% of symptomatic cases	35% of surviving symptomatic cases	Children and the elderly	Atlantic and Gulf coastal areas, Great Lakes
LaCrosse encephalitis	< 1% of all infections; ≈ 1% of hospitalized cases	3–12% of hospitalized cases	Children (primarily 15 years or younger)	Upper Midwestern, mid-Atlantic and southeastern states
St. Louis encephalitis	< 1% of all infections; 3–30% among symptomatic cases (higher in the elderly)	Unknown	Infants and elderly	Reported throughout U.S.; outbreaks in Mississippi Valley and Gulf Coast
West Nile encephalitis	< 1% of all infections; 12–14% among hospitalized cases (higher in the elderly)	Up to 50% of hospitalized patients at one year follow up	Elderly	Widespread; current incidence is greatest in Western U.S.
Western equine encephalitis	3–7% among symptomatic cases	15–30% (primarily among children <1 year)	Young children and the elderly	West of Mississippi River
Powassan	10–15% among symptomatic cases	Up to 50% of surviving symptomatic cases	Adults	New England, North Central states

Division of Infectious Disease Epidemiology
 350 Capitol Street, Room 125, Charleston, WV 25301-3715
 Phone: 304.558.5358 Fax: 304.558.6335 www.wvidep.org

Arboviral Infection

Surveillance Protocol

Etiologic Agent

The viruses responsible for the endemic North American arboviruses belong to three distinct families: Togaviridae, Bunyaviridae, and Flaviviridae (Table 2).

Table 2. Family and genera of endemic North American arboviruses.

Virus	Etiologic Agent
Eastern equine encephalitis	family Togaviridae, genus <i>Alphavirus</i>
LaCrosse encephalitis (California serogroup)	family Bunyaviridae, genus <i>Bunyavirus</i>
Saint Louis encephalitis	family Flaviviridae, genus <i>Flavivirus</i>
West Nile virus	family Flaviviridae, genus <i>Flavivirus</i>
Western equine encephalitis	family Togaviridae, genus <i>Alphavirus</i>
Powassan encephalitis	family Flaviviridae, genus <i>Flavivirus</i>

Reservoir

Reservoir species develop sufficiently high viremia such that a mosquito or tick can pick up virus from a blood meal and subsequently transmit the virus to other hosts. Horses and humans develop only low-level viremia and are referred to as ‘dead-end’ hosts, meaning they are not important in transmission to other species.

The natural reservoirs for the endemic North American arboviruses vary depending on the specific virus and its transmission cycle but generally include birds or small rodents (Table 3).

Division of Infectious Disease Epidemiology

350 Capitol Street, Room 125, Charleston, WV 25301-3715
Phone: 304.558.5358 Fax: 304.558.6335 www.wvdep.org

Arboviral Infection

Surveillance Protocol

Table 3. Endemic North American arboviruses and their reservoirs.

Virus	Reservoir
Eastern equine encephalitis	Wild birds (e.g., songbirds)
LaCrosse encephalitis	Small wild rodents (e.g., chipmunks and squirrels)
Saint Louis encephalitis	Wild birds (e.g., house sparrow, pigeon, blue jay, and robin)
West Nile virus	Wild birds (e.g., crows, blue jays)
Western equine encephalitis	Wild birds (e.g., house finches and sparrows)
Powassan encephalitis	Small rodents, small wild carnivores (e.g., opossums, rabbits, groundhogs, squirrels, skunks, and foxes)

Mode of Transmission

The primary mode of transmission is through the bite of an infected mosquito (for EEE, LAC, SLE, WNV, and WEE) or infected tick (for POW only). This is known as vectorborne transmission. See Table 4 for the primary vectors involved in human transmission.

Five additional routes of infection for West Nile include transplantation, transfusion, breastfeeding, transplacental and occupational (laboratory workers). These modes of transmission represent a very small proportion of cases.

There is no documented evidence of direct person-to-person or animal-to-person transmission of arboviruses. There is a theoretical concern that a person may get WNV from handling live or dead infected birds, so people should avoid bare-handed contact when handling dead animals, and use gloves or double plastic bags to place carcasses in garbage cans. People should ALWAYS wash hands after handling a sick or dead animal.

Division of Infectious Disease Epidemiology

350 Capitol Street, Room 125, Charleston, WV 25301-3715
Phone: 304.558.5358 Fax: 304.558.6335 www.wvwidep.org

Arboviral Infection

Surveillance Protocol

Table 4. Primary vectors for the endemic North American arboviruses.

Virus	Primary Arthropod Vector	Primary Species Important for Transmission to Humans, Horses
Eastern equine encephalitis	Mosquito	<i>Culex</i> species (<i>Cx. pipiens</i> and <i>Cx. quinquefasciatus</i> in the east, <i>Cx. nigripalpus</i> in Florida, and <i>Cx. tarsalis</i> and members of the <i>Cx pipiens</i> complex in western states)
LaCrosse encephalitis	Mosquito	<i>Ochlerotatus triseriatus</i> , <i>Oc. Japonicas</i> , <i>Aedes albopictus</i>
Saint Louis encephalitis	Mosquito	<i>Culex</i> species (<i>Cx. pipiens</i> and <i>Cx. quinquefasciatus</i> in the east, <i>Cx. nigripalpus</i> in Florida, and <i>Cx. tarsalis</i> and members of the <i>Cx pipiens</i> complex in western states)
West Nile virus	Mosquito	<i>Culex</i> species
Western equine encephalitis	Mosquito	<i>Culex tarsalis</i>
Powassan encephalitis	Tick	<i>Ixodes cookei</i>

Incubation Period

The incubation periods for the endemic North American arboviruses are similar and range from 2 to 18 days, depending on the specific virus. Table 5 outlines the incubation period for each virus.

Division of Infectious Disease Epidemiology

350 Capitol Street, Room 125, Charleston, WV 25301-3715
 Phone: 304.558.5358 Fax: 304.558.6335 www.wvidep.org

Arboviral Infection

Surveillance Protocol

Table 5. Incubation period ranges for the endemic North American arboviruses.

Virus	Incubation Period (days)
Eastern equine encephalitis	3–10
La Crosse encephalitis (California serogroup)	5–15
St. Louis encephalitis	4–14
West Nile encephalitis	5–15
Western equine encephalitis	2–10
Powassan encephalitis	4–18

Period of Communicability

There is no direct person-to-person transmission of these viruses. See section on Modes of Transmission above.

Outbreak Recognition

Any case of human or equine WNV, SLE, EEE, WEE or POW is defined as an outbreak, because of low baseline incidence. La Crosse is endemic in parts of West Virginia, so an outbreak of LAC is defined as cases over and above the expected or encroachment into an area of the state not previously known to have cases. DIDE should be notified immediately about outbreaks.

Case Definition

2011 Case Definition

CSTE Position Statement Numbers: 10-ID-18, 10-ID-20, 10-ID-21, 10-ID-22, 10-ID-23, 10-ID-24

California Serogroup Viruses, (i.e., California encephalitis, Jamestown Canyon, Keystone, La Crosse, Snowshoe hare, and Trivittatus viruses) Eastern Equine encephalitis Virus, Powassan Virus, St. Louis Encephalitis Virus, West Nile Virus, Western Equine Encephalitis Virus

Division of Infectious Disease Epidemiology

350 Capitol Street, Room 125, Charleston, WV 25301-3715
Phone: 304.558.5358 Fax: 304.558.6335 www.wvdep.org

Arboviral Infection

Surveillance Protocol

Background

Arthropod-borne viruses (arboviruses) are transmitted to humans primarily through the bites of infected mosquitoes, ticks, sand flies, or midges. Other modes of transmission for some arboviruses include blood transfusion, organ transplantation, perinatal transmission, consumption of unpasteurized dairy products, breast feeding, and laboratory exposures.

More than 130 arboviruses are known to cause human disease. Most arboviruses of public health importance belong to one of three virus genera: Flavivirus, Alphavirus, and Bunyavirus.

Clinical description

Most arboviral infections are asymptomatic. Clinical disease ranges from mild febrile illness to severe encephalitis. For the purposes 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 stiff neck, altered mental status, seizures, limb weakness, cerebrospinal fluid (CSF) pleocytosis, or abnormal neuroimaging. 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, myalgias, arthralgias, rash, or gastrointestinal symptoms. Rarely, myocarditis, pancreatitis, hepatitis, or ocular manifestations such as chorioretinitis and iridocyclitis can occur.

Clinical criteria for diagnosis

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

Neuroinvasive disease

- Fever ($\geq 100.4^{\circ}\text{F}$ or 38°C) as reported by the patient or a health-care provider, **AND**
- Meningitis, encephalitis, acute flaccid paralysis, or other acute signs of central or peripheral neurologic dysfunction, as documented by a physician, **AND**

Division of Infectious Disease Epidemiology

350 Capitol Street, Room 125, Charleston, WV 25301-3715
Phone: 304.558.5358 Fax: 304.558.6335 www.wvdep.org

Arboviral Infection

Surveillance Protocol

- Absence of a more likely clinical explanation.

Non-neuroinvasive disease

- Fever ($\geq 100.4^{\circ}\text{F}$ or 38°C) as reported by the patient or a health-care provider, **AND**
- Absence of neuroinvasive disease, **AND**
- Absence of a more likely clinical explanation.

Laboratory criteria for diagnosis

- 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 and a negative result for other IgM antibodies in CSF for arboviruses endemic to the region where exposure occurred, **OR**
- Virus-specific IgM antibodies in CSF or serum.

Case classification

Confirmed:

Neuroinvasive disease

A case that meets the above clinical criteria for neuroinvasive disease and one or more the following laboratory criteria for a confirmed case:

- 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 and a negative result for other IgM antibodies in CSF for arboviruses endemic to the region where exposure occurred.

Division of Infectious Disease Epidemiology

350 Capitol Street, Room 125, Charleston, WV 25301-3715

Phone: 304.558.5358 Fax: 304.558.6335 www.wvdep.org

Arboviral Infection

Surveillance Protocol

Non-neuroinvasive disease

A case that meets the above clinical criteria for non-neuroinvasive disease and one or more of the following laboratory criteria for a confirmed case:

- 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 and a negative result for other IgM antibodies in CSF for arboviruses endemic to the region where exposure occurred.

Probable:

Neuroinvasive disease

A case that meets the above clinical criteria for neuroinvasive disease and the following laboratory criteria:

- 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 the laboratory criteria for a probable case:

- Virus-specific IgM antibodies in CSF or serum but with no other testing.

Comment

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

Division of Infectious Disease Epidemiology

350 Capitol Street, Room 125, Charleston, WV 25301-3715
Phone: 304.558.5358 Fax: 304.558.6335 www.wvdep.org

Arboviral Infection

Surveillance Protocol

- 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.

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., Chikungunya, Japanese encephalitis, Tick-borne encephalitis, Venezuelan equine encephalitis, and Rift Valley fever viruses) are important public health risks for the United States as competent vectors exist that could allow for sustained transmission upon establishment of imported arboviral pathogens. Health-care 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 health agencies and CDC.

Division of Infectious Disease Epidemiology

350 Capitol Street, Room 125, Charleston, WV 25301-3715
Phone: 304.558.5358 Fax: 304.558.6335 www.wvdep.org

Arboviral Infection

Surveillance Protocol

Preventive Interventions

There is currently no vaccine against human arboviruses, and treatment is supportive.

Repellants such as DEET, oil of lemon eucalyptus, IR3535 and picaridin have demonstrated efficacy against mosquitoes.

Share these prevention messages with the public:

1. Empty standing water in old tires, cemetery urns, buckets, plastic covers, toys, or any other container where mosquitoes may breed.
2. Empty and change the water in bird baths, fountains, wading pools, rain barrels, and potted plant trays at least once a week if not more often.
3. Drain or fill temporary pools with dirt.
4. Keep swimming pools treated and circulating, and rain gutters unclogged.
5. Use mosquito repellents according to the label directions. Apply sparingly to children before they play out of doors, and rinse children off with soap and water when they come back in. Do not apply repellent to the face and hands of young children because they may rub it in their eyes. Follow label directions and precautions closely.
6. Use head nets, long sleeves, and long pants if you venture into areas with high mosquito populations.
7. Make sure window and door screens are “bug tight.”

Treatment

Supportive; no specific treatment exists for arboviral infections.

Surveillance Indicators

1. Number of dead birds submitted for testing for arboviruses.
 - a. Percentage of dead birds testing positive for arboviral infection
2. Number of mosquito pools collected and tested for arboviruses
 - a. Percentage of pools testing positive for arboviral infection
3. Number of equine specimens submitted for testing for arboviruses.
 - a. Percentage of equine specimens testing positive for arboviral infection
4. Percentage of human arboviral infection case specimens forwarded by OLS to CDC for laboratory confirmation (e.g., PRNT).
5. Proportion of cases with complete clinical investigation: Patient demographics, involvement in outdoor activities, travel history and clinical symptoms.
6. Proportion of cases with home visit completed for environmental evaluation, including GIS coordinates of location, patient and family education.

Division of Infectious Disease Epidemiology

350 Capitol Street, Room 125, Charleston, WV 25301-3715
Phone: 304.558.5358 Fax: 304.558.6335 www.wvdep.org

Arboviral Infection

Surveillance Protocol

References

(WNV)

1. Armstrong WS, Bashour CA, Smedira NG, et.al. "A case of fatal West Nile virus meningoencephalitis associated with receipt of blood transfusions after open heart surgery." *Ann Thorac Surg*, 2003; 76:605-7.
2. CDC. "Possible West Nile virus transmission to an infant through breast-feeding – Michigan, 2002." *MMWR*, 2002; 51:877-878.
3. CDC. "Update: investigations of West Nile virus infections in recipients of organ transplantation and blood transfusion – Michigan, 2002." *MMWR*, 2002; 51:879.
4. CDC. "Laboratory-acquired West Nile virus infections – United States, 2002." *MMWR*, 2002; 51:1133-1135.
5. CDC. "Intrauterine West Nile virus infection – New York, 2002." *MMWR*, 2002; 51:1135-1136.
6. CDC. "Update: detection of West Nile virus in blood donations – United States, 2003." *MMWR*, 2003; 52(Dispatch):1-3.
7. CDC. "Surveillance for Human West Nile Virus Disease — United States, 1999–2008." *MMWR*, 2010; 59(No. SS-2).
8. Chowers MY, Lang R, Nassar F, et.al. "Clinical characteristics of the West Nile fever outbreak, Israel, 2000." *Emerg Infect Dis*, 2001; 7:675-678.
9. Peterson, LR, Marfin AA. "West Nile virus: a primer for the clinician." *Ann Intern Med*, 2002; 137:173-179.
10. Sejvar JJ, Haddad MB, Tierney BC, et.al. "Neurologic manifestations and outcome of West Nile virus infection." *JAMA*, 2003; 290:511-515.

(SLE)

11. Jones SC, Morris J, Hill G, Alderman M, Ratard RC. "St Louis encephalitis outbreak in Louisiana in 2001." *J La State Med Soc*, 2002; 154:303-306.
12. Meehan PJ, Wells DL, Paul W, et.al. "Epidemiological features of and public health response to a St. Louis encephalitis epidemic in Florida, 1990-1." *Epidemiol Infect*, 2000; 125:181-188.
13. Paulson GW, Brinker KR. "St. Louis encephalitis epidemic in Ohio in 1975." *Ohio State Med Assoc J*, 1978; 74:491-493.
14. Tsai TF, Cobb WB, Bolin RA, et.al. "Epidemiologic aspects of a St. Louis encephalitis outbreak in Mesa County, Colorado." *Am J Epidemiol*. 1987; 126:460-473.
15. Wasay M, Diaz-Arrastia R, Suss RA, et.al. "St Louis encephalitis: a review of 11 cases in a 1995 Dallas, Tex, epidemic." *Arch Neurol*, 2000; 57:114-118.

Division of Infectious Disease Epidemiology

350 Capitol Street, Room 125, Charleston, WV 25301-3715
Phone: 304.558.5358 Fax: 304.558.6335 www.wvdep.org

Arboviral Infection

Surveillance Protocol

16. CDC. Saint Louis encephalitis – epidemiology and geographic distribution.
Available at <http://www.cdc.gov/sle/technical/epi.html> Accessed 2011 April 7.

(LAC)

17. Balkhy HH, Schreibner JR. “Severe LaCrosse encephalitis with significant neurologic sequelae.” *Pediatr Infect Dis J*, 2000; 19:77-80.
18. Erwin PC, Jones TF, Gerhardt RR, et.al. “LaCrosse encephalitis in Eastern Tennessee: clinical, environmental, and entomological characteristics from a blinded cohort study.”: *Am J Epidemiol*, 2002; 155:1060-1065
19. Hedberg CW, Washburn JW, Sjogren RD. “The association of artificial containers and LaCrosse encephalitis cases in Minnesota, 1979.” *J Am Mosq Control Assoc*, 1985;1:89-90.
20. McJunkin JE, Khan RR, Tsai TF. ”California-LaCrosse encephalitis.” *Infect Dis Clin North Am*, 1998; 12:83-93.
21. McJunkin JE, de los Reyes EC, Irazuzta JE, et.al. ”LaCrosse encephalitis in children.” *N Engl J Med*, 2001; 344:801-807.
22. Rust RS, Thompson WH, Matthews CG, Beaty BJ, Chun RWM. “LaCrosse and other forms of California encephalitis.” *J Child Neurol*, 1999; 14:1-14.
23. Woodruff BA, Baron RC, Tsai TF. “Symptomatic LaCrosse infections o the central nervous system: a study of risk factors in an endemic area.” *Am J Epidemiol*, 1992; 136:320-7.

(EEE)

24. Deresiewicz RL, Thaler SJ, Hsu L, Zamani AA. “Clinical and neuroradiographic manifestations of Eastern equine encephalitis.” *N Engl J Med*, 1997; 336:1867-74.

(WEE)

25. Iverseen, JO. “Western equine encephalomyelitis.” *Handbook of zoonoses*, 2nd ed. Section B: viral. Ed GW Beran. Boca Raton, FL: CRC Press Inc, 1994.
26. Zacks MA and S. Paessler. Encephalitic alphaviruses. *Vet Microbiol*. 2010 January 27; 140(3-4): 281.

(POW)

27. Hardy, JL. “Arboviral zoonoses of North America.” *Handbook of zoonoses*, 2nd ed. Section B: viral. Ed GW Beran. Boca Raton, FL: CRC Press Inc, 1994.

Division of Infectious Disease Epidemiology

350 Capitol Street, Room 125, Charleston, WV 25301-3715
Phone: 304.558.5358 Fax: 304.558.6335 www.wvidep.org

Arboviral Infection

Surveillance Protocol

28. Artsob, H. "Powassan encephalitis" The arboviruses: epidemiology and ecology, Vol 1. 2nd ed. Ed TP Monath. Boca Raton, FL: CRC Press Inc, 1988.

(General)

29. American Academy of Pediatrics. "Arboviruses." In: Pickering LK, ed. Red Book: 2009 Report of the Committee on Infectious Diseases. 28th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2009:214-221.
30. American Public Health Association. "Arthropod-Borne Viral Encephalitides." In: Heyman DL, ed. Control of Communicable Diseases Manual. 18th ed. Washington, D.C.: United Book Press, Inc, 2004: 37-41.
31. Markoff L. "Alphaviruses" In: Mandell GL, Bennett JE, Dolin R., ed. Principles and Practice of Infectious Diseases. 7th Ed. Philadelphia, PA: Churchill Livingstone, 2010:2117-2125.
32. Reimann CA, Hayes EB, DiGiuseppi C, Hoffman R, et.al. "Epidemiology of neuroinvasive arboviral disease in the United States, 1999-2001." Am J Trop Med Hyg, 2008; 79:974-979.
33. Vaughn DW, Barrett A, Solomon T. "Flaviviruses (Yellow Fever, Dengue, Dengue Hemorrhagic Fever, Japanese Encephalitis, West Nile Encephalitis, St. Louis Encephalitis, Tick-Borne Encephalitis). In: Mandell GL, Bennett JE, Dolin R., ed. Principles and Practice of Infectious Diseases. 7th Ed. Philadelphia, PA: Churchill Livingstone, 2010:2133-2156.

Division of Infectious Disease Epidemiology

350 Capitol Street, Room 125, Charleston, WV 25301-3715
Phone: 304.558.5358 Fax: 304.558.6335 www.wvidep.org