

Mosquito-Borne Viral Encephalitides

Summary

The mosquito-borne viruses, or arboviruses, are a group of illnesses that are primarily transmitted through the bite of an infected mosquito. The diseases of this group that have been transmitted in New Mexico are Western equine encephalitis (WEE), St. Louis encephalitis (SLE), and West Nile virus (WNV). Travelers to endemic areas can be exposed to other arboviral illnesses such as dengue (DEN), chikungunya (CHIK), or Zika (ZIK) viruses. The majority of arboviral infections are asymptomatic or mild. Fever is the most common symptom, with others including myalgia, arthralgia, and rash. When there is central nervous system involvement, aseptic meningitis or encephalitis may occur and can cause altered mental status, coma, or death. The elderly are at greatest risk of severe illness with SLE and WNV. Neurologic sequelae are most severe in children infected with WEE. Zika virus is the only arbovirus known to cause birth defects in fetuses whose mother was infected during pregnancy and is also the only arbovirus with documented sexual transmission. Control of these diseases is primarily through effective mosquito control and personal protective measures to prevent mosquito bites.

Agent

Each disease is caused by a specific virus: Western equine encephalitis and chikungunya viruses are in the family *Togaviridae* (*Alphavirus*); St. Louis encephalitis, dengue, Zika and West Nile viruses are in the family *Flaviviridae* (*Flavivirus*).

Transmission

Reservoir host:

Birds are the source of WNV, WEE, and SLE infection for feeding mosquitoes during active transmission (usually summer and early fall). Little is known about the overwintering mechanisms for these viruses. The virus may remain viable in infected hibernating adult female mosquitoes, birds or other animals.

Primates, including humans, are the reservoir for CHIK, DEN, and ZIK.

Vector:

In the United States mosquito species in the genus *Culex* are the principal vectors of WEE, WNV and SLE.

DEN, CHIK, and ZIK could potentially be vectored by invasive *Aedes aegypti* and *A. albopictus* mosquitoes, which are present in New Mexico and have been confirmed as far north as Bernalillo County.

Mode of transmission:

- Through the bite of infected mosquitoes that have acquired the virus by feeding on an infected reservoir host. Rarely, organ and tissue transplant or blood transfusion can also cause infection. The blood supply of the United States is screened for arboviruses.
- Zika virus can also be spread through unprotected sexual contact and from a pregnant person to a fetus.

Period of communicability:

- With the exception of ZIK, these viruses are not transmissible from human to human or from other animals to humans. Zika virus may be spread through unprotected sexual contact with an infected female partner for up to two months after exposure or onset, and with an infected male partner for up to three months after exposure or onset.

Clinical Disease

Incubation period:

Usually 2-14 days, up to 21 days for SLE or for WNV in immunocompromised people.

Illness:

Locally acquired disease in humans is most common in summer and early fall. Symptoms are variable depending on the virus and the age and general health of the individual. Mild cases often present as a febrile headache or aseptic meningitis. Severe infections are usually marked by acute onset of headache, high fever, meningeal signs, altered mental status, disorientation, coma, tremors, occasional convulsions (especially in infants), and spastic or flaccid paralysis. Case fatality rates range from 2% – 20%, and the ratio of asymptomatic infections to clinical cases can be quite high (about 80% of infections are asymptomatic). Signs and symptoms of SLE and WNV are most severe in persons >50 years of age. Adults usually recover completely from WEE, but about half of children affected with WEE suffer permanent neurological effects, including progressive mental retardation and varying degrees of physical and mental dysfunction. ZIK is usually a mild illness with very few hospitalizations or deaths; however, infection during pregnancy can cause microcephaly, eye/ear problems, and other congenital defects in the fetus. Severe DEN infection may cause plasma leakage, shock, severe bleeding, and multiorgan failure.

Horses suffer clinical disease with WEE or WNV infection. Some bird species infected with WNV can become sick and die, unlike infections with SLE or WEE.

Laboratory Diagnosis

Patients with consistent signs and symptoms and compatible travel or exposure history in which diagnosis of an arboviral infection is highly suspected should have blood and possibly cerebrospinal fluid (CSF, if signs or symptoms of neuroinvasive disease are present) collected for testing.

Commercial laboratories in New Mexico and other states are able to test serum and/or CSF specimens. Typical patients to test include:

- Any patient with encephalitis, or atypical Guillain-Barre type syndrome and evidence of pleocytosis in the CSF.
- Any patient with suspect viral meningitis if other etiologic agents have been ruled out.
- Pregnant women who resided in or traveled to a Zika virus endemic area and had symptoms of fever, rash, headache, or arthralgia within 2 weeks of exposure.

In cases with atypical laboratory results, New Mexico Department of Health Scientific Laboratory Division (SLD) may forward samples to CDC in Ft. Collins, Colorado for further testing. Call the Epidemiology and Response Division at 505-827-0006 prior to shipment of any specimens. A submission form with brief clinical information will need to be completed.

Treatment

No antiviral medication is available for any of these arboviruses. Supportive therapy is indicated, and patients should be monitored for cerebral edema. DEN patients should avoid medications containing ibuprofen, Naproxen, or aspirin.

Dengue hemorrhagic fever generally requires hospitalization and may be treated using fluid replacement therapy.

Surveillance

Case Definition:

Clinical case definition-

Patients must have a compatible exposure or travel history in addition to clinical signs.

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 health-care provider (with the exception of ZIK, which does not always present with fever and can be suspected in the presence of at least one clinical symptom), 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:

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 or serum.

Case Classification

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 serum but with no other testing.

Confirmed

Neuroinvasive disease

A case that meets the above clinical criteria for 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, 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 for a confirmed case:

- 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.

Reporting:

Report all suspected or confirmed cases of encephalitis to the Epidemiology and Response Division (ERD) at 505-827-0006. Information needed includes: patient's name, age, sex, race, ethnicity, home address, home phone number, occupation, and health care provider.

Case Investigation:

Use the Arbovirus Case Report Form to complete the investigation. Information should also be entered into NM-EDSS per established procedures.

Control Measures

1. Case management

1.1. Isolation: Isolation of patients with mosquito-borne encephalitis is not required.

Contact precautions are appropriate until bacterial meningitis is ruled out. Patients suspected of having DEN, CHIK, or ZIK should take measures to avoid mosquito bites during their viremic period (approximately 7 days after illness onset). Humans and horses are dead-end hosts for WNV, WEE, and SLE and therefore cannot pass the infection to mosquitoes that feed on them. ZIK patients should also use barrier protection with sex partners (8 weeks for females, 6 months for males) and avoid pregnancy during that time.

2. Contact management

2.1. Isolation: None required. DEN, CHIK, and ZIK patients should avoid exposure to mosquitoes.

2.2. Prophylaxis: Not applicable.

3. Prevention

3.1. Immunization: No vaccine is available for humans. Horses should be vaccinated annually against Western equine encephalitis, Eastern equine encephalitis, West Nile virus, and Venezuelan equine encephalitis.

3.2. Control mosquito vectors through elimination of breeding sites (i.e., standing water). Educate the public on potential backyard sources of mosquito breeding such as discarded tires, abandoned swimming pools, and other water-holding containers.

3.3. Conduct larval and adult mosquito control through community vector control programs.

3.4. Screen windows and doors of houses and buildings.

3.5. Avoid exposure to mosquitoes during hours of biting. If mosquitoes cannot be avoided, wear long sleeves and long pants and apply an effective repellent (such as DEET [chemical name, N, N-diethyl-meta-toluamide] or picaridin) to exposed skin or clothing. Do not apply repellents under clothing. Use the lowest concentration of DEET that is effective (usually 10 – 35%). Use products containing no more than

10% DEET on children and do not apply DEET-containing products to children less than two months of age. Permethrin is an effective repellent used on clothing. Do not apply Permethrin to skin. Products containing botanical essential oils (such as lemon eucalyptus oil) are also available as mosquito repellents but need to be applied more frequently than DEET-containing repellents.

3.6. Surveillance and testing of mosquito vector populations has value by identifying rates of infection and geographic areas involved.

References

Heymann, DL, ed. Control of Communicable Diseases Manual. 19th edition. Washington, DC: American Public Health Association; 2012.

Fraddin MS. Mosquitoes and Mosquito Repellents: A Clinician's Guide. *Annals of Internal Medicine* 1998; 128: 931-940.

Mandell GL, Bennett JE, Dolin R, eds. *Principles and practices of infectious diseases* 6th ed. NY, NY: Churchill Livingstone, 2005; 1913-20, 1926-50.

Surveillance Case Definitions for Current and Historical Conditions, <https://wwwn.cdc.gov/nndss/conditions/> accessed 10/04/2017.

See West Nile Virus Fact Sheets ([English](#)) ([Spanish](#)).

See Zika Fact Sheets ([English](#)) ([Spanish](#)).