Encephalitis, Arboviral
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Encephalitis or Meningitis, Arboviral

Overview [1, 2, 3, 4]

For a more complete description of arboviral encephalitis or meningitis, refer to the following texts:

- Control of Communicable Diseases Manual (CCDM).
- Red Book, Report of the Committee on Infectious Diseases.
- Epidemic/Epizootic West Nile Virus in the United States: Revised Guidelines for Surveillance, Prevention, and Control, Centers for Disease Control and Prevention, April 2001
- West Nile Virus: A Primer for the Clinician, Annals of Internal Medicine, August 2002.

Case Definition [5]

Clinical description

Arboviral infections may be asymptomatic or may result in illnesses of variable severity sometimes associated with central nervous system (CNS) involvement. When the CNS is affected, clinical syndromes ranging from febrile headache to aseptic meningitis to encephalitis may occur, and these are usually indistinguishable from similar syndromes caused by other viruses. Arboviral meningitis is characterized by fever, headache, stiff neck, and pleocytosis. Arboviral encephalitis is characterized by fever, headache, and altered mental status ranging from confusion to coma with or without additional signs of brain dysfunction (e.g., paresis or paralysis, cranial nerve palsies, sensory deficits, abnormal reflexes, generalized convulsions, and abnormal movements).

Laboratory criteria for diagnosis

- Fourfold or greater change in virus-specific serum antibody titer, or
- Isolation of virus from or demonstration of specific viral antigen or genomic sequences in tissue, blood, cerebrospinal fluid (CSF), or other body fluid, or
- Virus-specific immunoglobulin M (IgM) antibodies demonstrated in CSF by antibody-capture enzyme immunoassay (EIA), or
- Virus-specific IgM antibodies demonstrated in serum by antibody-capture EIA and confirmed by demonstration of virus-specific serum immunoglobulin G (IgG) antibodies in the same or a later specimen by another serologic assay (e.g., neutralization or hemagglutination inhibition).

Case classification

Eastern Equine, Western Equine, and California Group Encephalitis or Meningitis

Confirmed: An encephalitis or meningitis case that is laboratory confirmed.
Probable: An encephalitis or meningitis case occurring during a period when arboviral transmission is likely, and with the following supportive serology:

- A single or stable (less than or equal to twofold change) but elevated titer of virus-specific serum antibodies; or
- Serum IgM antibodies detected by antibody-capture EIA but with no available results of a confirmatory test for virus-specific serum IgG antibodies in the same or a later specimen.

West Nile and St. Louis Encephalitis or Meningitis

Confirmed: A confirmed case of WNV or SLE encephalitis/meningitis is defined as a febrile illness associated with neurological manifestations ranging from headache to aseptic meningitis or encephalitis, plus at least one of the following:

- Demonstration of IgM antibody to WNV or SLE in CSF by IgM-capture EIA;
- A greater than or equal to four-fold serial change in plaque-reduction neutralizing (PRNT) antibody titer to WNV or SLE in paired, appropriately timed serum or CSF samples;
- Demonstration of either WNV- or SLE-specific IgM (by EIA) and IgG (screened by EIA or HI and confirmed by PRNT) antibody in a single serum specimen.
- Isolation of WNV or SLE from, or demonstration of WNV or SLE viral antigen or genomic sequences in, tissue, blood, CSF, or other body fluid. (Tests of tissues or fluids by PCR, antigen detection, or virus isolation cannot be used to rule-out cases because the negative predictive values of these test methods in this disease are unknown.)

Probable: A probable case is defined as a compatible illness (as above) that does not meet any of the above laboratory criteria, plus at least one of the following:

- Demonstration of serum IgM antibody against WNV or SLE (by EIA);
- Demonstration of an elevated titer of WNV- or SLE-specific IgG antibody in convalescent phase serum (screened by EIA or HI and confirmed by PRNT).

Not A Case: Defined as an illness that does not meet any of the above laboratory criteria, plus:

- A negative test for IgM antibody to WNV or SLE (by EIA) in serum or CSF collected 8-21 days after onset of illness; and/or
- A negative test for IgG antibody to WNV or SLE (by EIA, HI, or PRNT) in serum collected greater than or equal to 22 days after onset of illness.

Comments

- In some persons, WNV-specific serum IgM antibody can wane slowly and be detectable for more than one year following infection. Therefore, in areas where WNV has circulated in the recent past, the co-existence of WNV-specific IgM antibody and illness in a given case may be coincidental and not necessarily diagnostic of an *acute WNV infection*. Since WNV is known to have circulated in Missouri in 2002, suspected cases of acute WNV disease in subsequent years must be confirmed by one or more of the laboratory procedures noted above.

- Identification of an active human infection with WNV or SLE is an important event that usually triggers public health alerts, mosquito control measures, and media attention. The surveillance case definition above for WNV and SLE encephalitis/meningitis is a public health tool intended only for the surveillance of health events in populations. It is not intended for use in clinical diagnosis or management decisions in individual cases. Proper interpretation of laboratory results includes considering clinical context (encephalitis or meningitis), travel history, flaviviral vaccination history, and evidence of previous and current WNV activity in the region.

- Because closely related arboviruses exhibit serologic cross-reactivity, positive results of serologic tests using antigens from a single arbovirus can be misleading. In some circumstances (e.g., in areas where two or more closely related arboviruses occur, or in imported arboviral disease cases), it may be epidemiologically important to attempt to pinpoint the infecting virus by conducting cross-neutralization tests using an appropriate battery of closely related viruses. This is essential, for example, in determining that antibodies detected against St. Louis encephalitis virus are not the result of an infection with West Nile (or dengue) virus, or vice versa, in areas where both of these viruses occur.

- The seasonality of arboviral transmission is variable and depends on the geographic location of exposure, the specific cycles of viral transmission, and local climatic conditions. Reporting should be etiology-specific (see below; the six encephalitides/meningitides printed in bold are nationally reportable to CDC):
  St. Louis encephalitis/meningitis
  West Nile encephalitis/meningitis
  Powassan encephalitis/meningitis
  Eastern equine encephalitis/meningitis
  Western equine encephalitis/meningitis
  California serogroup viral encephalitis/meningitis (includes infections with the following viruses: La Crosse, Jamestown Canyon, snowshoe hare, trivittatus, Keystone,

and California encephalitis viruses)

Note: Venezuelan equine encephalitis/meningitis is reportable as a potential bioterrorism agent in Missouri.

Information Needed for Investigation

Verify the diagnosis. What laboratory tests were conducted? What were the results? What are the patient's clinical symptoms?
Establish the extent of illness. Determine if household or other members in the community are, or have been ill with compatible symptoms, by contacting the health care provider, patient, and family members.
Contact the Regional Communicable Disease Coordinator if an outbreak is suspected or if laboratory specimens will be submitted.

Case/Contact Follow Up And Control Measures

- Symptoms of arboviral encephalitis may be mild and mimic those of aseptic meningitis, Guillain Barré syndrome, flaccid paralysis, or Parkinsonism. Clusters of these syndromes should be investigated.
- Area clinicians and hospitals should be notified if cases are occurring in the geographical area so that surveillance can be increased.
- Obtain the patient's travel history for the two weeks prior to onset of illness.
- Determine whether the patient has received blood or blood products or an organ transplant in the preceding four weeks. Also determine whether patient has donated blood, blood products or an organ in the preceding two weeks.

Control Measures

- See the Control of Communicable Diseases Manual, Mosquito-borne Viral Encephalitides, "Methods of control."
- See the Red Book, Arboviruses, "Control Measures."
- See the Prevention and Control section of the Epidemic/Epizootic West Nile Virus in the United States: Revised Guidelines for Surveillance, Prevention, and Control, Centers for Disease Control and Prevention, April 2001; in particular, the subsection "Vector Management in Public Health Emergencies."
- See the Prevention section of West Nile Virus: A Primer for the Clinician, Annals of Internal Medicine, August 2002.

NOTE:

- When sporadic cases occur, large-scale mosquito control measures are not economically feasible. Municipalities and urban areas may implement local control measures to reduce mosquito populations.

- Some mosquitoes are weak flyers and tend to live close to their hatching sites. Birdbaths, wading pools, dog bowls, and other artificial containers of water should be emptied weekly to eliminate mosquito-breeding areas. Road ditches should be properly graded to allow water to drain. Rain gutters should be cleaned annually (every spring). Tires are notorious breeding places for mosquitoes.
- Private wastewater treatment facilities such as sewage treatment lagoons should be maintained to reduce mosquito breeding.

Laboratory Procedures

Specimens received at the Missouri Department of Health and Senior Services State Public Health Laboratory for arbovirus serology will be tested against antigens of:

- Flavivirus group – this includes West Nile virus and St. Louis encephalitis virus
- Eastern equine encephalitis (EEE) virus
- Western equine encephalitis (WEE) virus
- LaCrosse/California encephalitis group viruses

Two procedures are available:

- IgM antibody detection on acute serum and acute CSF
- IgG antibody detection on paired sera.

Specimen collection:

- For IgM arbovirus antibody panel collect acute serum 0 to 10 days after onset of symptoms; collect CSF as soon as possible after onset of symptoms.
- IgG antibody testing will only be performed on acute and convalescent serum samples when a positive IgM result has been obtained. The IgG results will be used to determine recent versus past infection.
- Collect convalescent serum 2 to 3 weeks after acute serum was collected.
- Collect serum in a red top vacutainer tube. It is best to send serum and not whole blood; however, whole blood may be sent if no method is available for removing serum.
- At least 0.5 ml of serum and 1.0 ml of CSF is required for serological testing.
- All acute serum specimens will be tested for IgM antibody against the appropriate arbovirus panel. Because of the possibility of a false negative IgM, it is recommended that a convalescent specimen also be tested.

Submission form:

- Complete Missouri Department of Health and Senior Services, "Viral Serology Test Request" (MO 580-0762).
- Under "Test Requested" section, write "Arbovirus Serology."

Laboratory test results:

- Testing results will normally be available 3 to 10 days after specimen receipt.
- See http://www.dhss.state.mo.us/Lab/west_nile_virus.htm (30 May 2003) for guidance on interpreting arboviral panel IgM and/or IgG test results and for additional information on submitting specimens.
- Comprehensive antibody testing (to detect a fourfold or greater rise in antibody titer) is available through CDC. This may include California Group (LaCrosse), eastern equine encephalitis, St. Louis encephalitis, western equine encephalitis, or Venezuelan equine encephalitis. An acute serum specimen should be collected within 1-7 days after the onset of illness. The convalescent serum specimen should be collected between 15 and 28 days after the onset of illness.
- Specimens for serological testing should be kept cool (refrigerator temperature) but not frozen until ready to be shipped. Send serum and CSF specimens at room temperature. Shipping containers are available upon request from the State Public Health Laboratory. Ensure specimens are packed securely to prevent breakage.
- Specimens for virus isolation, such as tissue, blood, and CSF, need to be frozen with dry ice. Viruses are usually found in the blood or CSF during the incubation period of the infection, but not in the acute phase of the illness. Brain specimens from patients may be acceptable for immunofluorescence testing.

Reporting Requirements

Arboviral encephalitis/meningitis is a Category II disease and shall be reported to the local health authority or to the Missouri Department of Health and Senior Services (DHSS) within three days of first knowledge or suspicion. **The exception to this is Venezuelan equine encephalitis/meningitis. Because of its possible use as a weapon of bioterrorism, it is classified as a Category IB condition and suspected or confirmed cases must be reported within 24 hours.**

1. For all cases, complete a "Disease Case Report" (CD-1).
2. For all cases, complete an "Arboviral Case Report" form (MO 580-2601). This form is found in this Section.
3. Entry of the completed CD-1 into MOHSIS negates the need for the paper CD-1 to be forwarded to the Regional Health Office.
4. Send the completed secondary investigation form to the Regional Health Office.
5. All outbreaks or "suspected" outbreaks must be reported as soon as possible (by phone, fax, or e-mail) to the Regional Communicable Disease Coordinator. This can be accomplished by completing the Missouri Outbreak Surveillance Report (CD-51).
6. Within 90 days of the conclusion of an outbreak, submit the final outbreak report to the Regional Communicable Disease Coordinator.

References

1. Chin, James, ed. "Mosquito-borne Viral Encephalitides." Control of Communicable Diseases Manual. 17th ed. Washington, DC: American Public Health Association, 2000: 39-43.
2. American Academy of Pediatrics. "Arboviruses." In: Peter, G., eds. 2000 Red Book: Report of the Committee on Infectious Diseases. 25th ed. Elk Grove Village, IL. 1997: 170-175.
3. Epidemic/Epizootic West Nile Virus in the United States: Revised Guidelines for Surveillance, Prevention, and Control, Centers for Disease Control and Prevention, April 2001, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Infectious Diseases, Division of Vector-Borne Infectious Diseases, Fort Collins, Colorado, http://www.cdc.gov/ncidod/dvbid/westnile/resources/wnv-guidelines-apr-2001.pdf (30 May 2003)
4. Petersen, Lyle R., and Marfin, Anthony A. West Nile Virus: A Primer for the Clinician, Annals of Internal Medicine, 2002; 137:173–179.
5. Missouri Department of Health and Senior Services - Section for Communicable Disease Prevention, surveillance case definition. Modified from Encephalitis or Meningitis, Arboviral (includes California serogroup, Eastern equine, St. Louis, Western equine, West Nile, Powassan) 2001 Case Definition, U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Epidemiology Program Office, Division of Public Health Surveillance and Informatics http://www.cdc.gov/epo/dphsi/casedef/encephalitiscurrent.htm (30 May 2003).)

Other Sources of Information

1. Shope, Robert E. and James M. Meegan. "Arboviruses." Viral Infections of Humans Epidemiology and Control; 4th ed. Eds. Alfred S. Evans and Richard A. Kaslow. New York: Plenum, 1997: 151 – 179.
2. Aiello, Susan E., ed. "Equine Encephalomyelitis." The Merck Veterinary Manual. 8th ed. Whitehouse Station, NJ: Merck & Company, Inc. 1998: 931-934.
3. Special West Nile Virus Edition of Emerging Infectious Diseases Journal. Aug 2001; 7(4). http://www.cdc.gov/ncidod/eid/vol7no4/contents.htm (30 May 2003)

Web Resources and Information

1. Centers for Disease Control and Prevention, West Nile Virus Web Page, http://www.cdc.gov/ncidod/dvbid/westnile/index.htm (30 May 2003).
2. Centers for Disease Control and Prevention, CDC Arbovirus Home Page, http://www.cdc.gov/ncidod/dvbid/arbor/index.htm (02 June 03).

Arboviral Encephalitis
FACT SHEET

What is encephalitis?
Encephalitis is inflammation of the brain. Arboviral encephalitis refers to those viruses transmitted to people by arthropods, usually mosquitoes. The annual disease incidence in the United States varies from 150 to over 4,000 cases a year.

How many types of arboviruses may cause encephalitis?
There are over 100 different viruses found in wild animals that may cause this disease in humans. In the United States, eastern equine encephalitis, western equine encephalitis, California/LaCrosse encephalitis, St. Louis encephalitis, and West Nile viruses account for the overwhelming majority of cases

What animals may carry arboviruses?
Many arboviruses that cause encephalitis have a variety of different vertebrate hosts. Wild birds carry eastern equine encephalitis, St. Louis encephalitis, and western equine encephalitis. West Nile virus also infects wild birds, which appear to serve as its primary reservoir. In addition, West Nile virus has been isolated in over 20 different species of mammals and reptiles, including, horses, cats, bats, chipmunks, skunks, squirrels, and domestic rabbits. However, humans and domestic animals can develop clinical illness but usually are "dead-end" hosts because they do not produce significant viremia, and do not contribute to the transmission cycle. Small mammals such as chipmunks or squirrels carry LaCrosse encephalitis. Horses (equines) are susceptible to infection by the virus but do not serve as the source of the virus.

What are the symptoms of arthropod-borne encephalitis?
The majority of human infections are asymptomatic or result in a nonspecific flu-like syndrome. Onset may be sudden with fever, headache, myalgias, malaise and occasionally prostration. Infection may, however, lead to encephalitis, with a fatal outcome or permanent neurologic impairment. Fortunately, only a small proportion of infected persons progress to encephalitis.

How long is the incubation period?
The incubation period is usually 2 to 6 days, but ranges from 2 to 14 days, and may be up to 21 days in immunocompromised people.

How is arboviral encephalitis diagnosed?
Since the disease cannot be distinguished from other causes of encephalitis based on symptoms, the diagnosis requires laboratory tests. Several different laboratory tests may need to be performed to rule out bacterial meningitis as cause of the illness.

What is the treatment for encephalitis?
Because the arboviral encephalitides are viral diseases, antibiotics are not effective for treatment and no effective antiviral drugs have yet been discovered. Treatment is supportive, attempting to deal with problems such as swelling of the brain, loss of the

automatic breathing activity of the brain and other treatable complications like bacterial pneumonia.

Can you get encephalitis from another person?
The principle route of infection for arboviral encephalitis is through the bite of an infected mosquito. However, additional routes of infection became apparent during the 2002 West Nile epidemic. It is important to note that these other methods of transmission represent a very small proportion of cases:

- A recent investigation has confirmed WNV transmission through transplanted organs.
- In addition, there is one documented case of transplacental (mother-to-child) transmission of WNV in humans. Although the newborn in this case was infected with WNV at birth and had severe medical problems, it is unknown whether the WNV infection itself caused these problems or whether they were coincidental. More research will be needed to improve our understanding of the relationship - if any - between WNV infection and adverse birth outcomes.
- Finally, although transmission of WNV and similar viruses to laboratory workers is not a new phenomenon, two recent cases of WNV infection of laboratory workers have been reported.

How can outbreaks of arboviral encephalitis be prevented?
The most important measure to control the disease is to eliminate mosquitoes. Since it is not practical to try to kill all mosquitoes, barrier methods such as window screens can be used. Additionally, homeowners can control the environment around their homes by eliminating any artificial or natural breeding pools for mosquitoes such as birdbaths, old tires, and standing water. Personal measures include reducing time outdoors particularly in early evening hours, wearing long pants and long sleeved shirts and applying a mosquito repellent that contains DEET to exposed skin areas. Vaccines are not available for use on humans to prevent the disease in the United States. Vaccines are available for horse owners to protect their animals from the equine infecting viruses.

Missouri Department of Health and Senior Services
Section for Communicable Disease Prevention
Phone: (866) 628-9891 or (573) 751-6113

West Nile Virus

FACT SHEET

What is West Nile virus?

The West Nile virus is transmitted by mosquitoes to birds, various animals, and humans. Most persons infected with this virus show no symptoms, although occasional infections can result in serious illness and even death.

Where did West Nile virus come from?

West Nile virus has been commonly found in humans, birds, and other animals in Africa, Eastern Europe, Western Asia, and the Middle East, but until 1999 had not previously been documented in the Western Hemisphere. The U.S. viral strain is most closely related genetically to strains found in the Middle East.

What are the symptoms of West Nile virus infection?

Most people infected with this virus do not have any symptoms. Some people experience a mild illness characterized by slight fever, headache, body aches, skin rash, and swollen lymph nodes. More severe illness can include encephalitis (inflammation of the brain) or meningitis (inflammation of the tissues that cover the brain and spinal cord). Severe manifestation of West Nile virus is marked by a rapid onset of a high fever, head and body aches, neck stiffness, muscle weakness, disorientation, coma, tremors, convulsions, and in the most severe cases, death.

How soon after exposure do symptoms appear?

Symptoms usually appear 3 to 15 days after exposure.

What if I am pregnant?

There is one documented case of transplacental (mother-to-child) transmission of WNV in humans. Although the newborn in this case was infected with WNV at birth and had severe medical problems, it is unknown whether the WNV infection itself caused these problems or whether they were coincidental. More research will be needed to improve our understanding of the relationship - if any - between WNV infection and adverse birth outcomes. The U.S. Centers for Disease Control and Prevention recommends that pregnant women use an insect repellant that contains DEET to prevent infection with mosquito-borne diseases.

How do people get West Nile virus?

The West Nile virus, like most mosquitoborne viruses, is found in wild and domestic birds. When a mosquito feeds on an infected bird, it can pick up the virus and transmit it to other, noninfected birds. Occasionally, infective mosquitoes will feed on mammals such as horses, dogs, cats, and humans, and transmit the virus to them.

If I live in an area where birds or mosquitoes with West Nile virus have been reported and a mosquito bites me, am I likely to get sick?

No, even in areas where mosquitoes do carry the virus, very few mosquitoes—much less than 1%—are infected. If the mosquito is infected, less than 1% of people who get bitten and become infected will get severely ill. The chances you will become severely ill from any one-mosquito bite are extremely small.

Can I get West Nile virus directly from birds?

Although transmission of WNV and similar viruses to laboratory workers is not a new phenomenon, two recent cases of WNV infection of laboratory workers have been reported. There is no evidence that a person can get the virus from simply handling live or dead infected birds. However, persons should avoid barehanded contact when handling any dead animals and use gloves or double plastic bags to place the carcass in a garbage can.

How can I report a sighting of dead bird(s) in my area?

Contact your local or state health department if you observe dead birds, particularly crows and blue jays. Health officials will determine whether the event should be investigated and whether bird specimens should be submitted to a laboratory for testing.

Can West Nile virus be spread from person-to-person?

A recent investigation has confirmed WNV transmission through transplanted organs and/or blood products. However, beyond this particular unique transmission pathway, West Nile virus infection is <u>not</u> transmitted from person to person. For example, you cannot get West Nile virus from touching or kissing a person who has the disease, or from a health care worker who has treated someone with the disease.

How can I protect myself from West Nile virus?

It is not necessary to limit any outdoor activities. However, you can and should try to reduce your risk of being bitten by mosquitoes. Mosquitoes are most active at dawn and dusk. Reducing the mosquito population around your home and property can be accomplished by eliminating standing water:

- Dispose of tin cans, plastic containers, ceramic pots or similar water-holding containers.
- Remove all discarded tires on your property. Used tires are very significant mosquito breeding sites.
- Drill holes in the bottoms of recycling containers that are kept outdoors.
- Make sure roof gutters drain properly, and clean clogged gutters in the spring and fall.
- Turn over plastic wading pools and wheelbarrows when not in use.
- Change the water in birdbaths at least weekly.
- Clean vegetation and debris from edges of ponds.
- Clean and chlorinate swimming pools, outdoor saunas, and hot tubs.

- Drain water from pool covers.
- Use landscaping to eliminate standing water that collects on your property.

In addition to reducing standing water in your yard, make sure all windows and doors have screens, and that all screens are in good repair. If West Nile virus is found in your area:

- Wear long-sleeved shirts and long pants whenever you are outdoors.
- Spray clothing with repellents containing permethrin or DEET since mosquitoes may bite through thin clothing. Apply insect repellent sparingly to exposed skin. An effective repellent will contain 35% DEET (N, N-diethyl-meta-toluamide). DEET in high concentrations (greater than 50%) provides no additional protection. Repellents may irritate the eyes and mouth, so avoid applying repellent to the hands of children. Whenever you use an insecticide or insect repellent, be sure to read and follow the manufacturer's DIRECTIONS FOR USE, as printed on the product.

What should hunters do to protect themselves against West Nile virus?

The West Nile virus has been isolated in white tail deer, rabbits, and squirrels. Hunters should follow the usual precautions when handling wild animals. They should wear gloves when handling and cleaning animals to prevent blood exposure to bare hands and meat should be cooked thoroughly. If hunters anticipate being exposed to mosquitoes, they should apply insect repellents to clothing and skin according to label instructions.

How is West Nile virus diagnosed?

If you or your family members develop symptoms such as high fever, confusion, muscle weakness, and severe headache, you should see your health care provider immediately. Your health care provider will assess your risk for West Nile virus infection. If you are determined to be at high risk, your provider will draw a blood sample and send it to a laboratory for confirmation.

What is the treatment?

There is no specific treatment for viral infections, other than to treat the symptoms and provide supportive care. In more severe cases, intensive supportive therapy is indicated, often involving hospitalization, intravenous fluids and nutrition, respiratory support, prevention of secondary infections, and good nursing care. Elderly persons are at highest risk for developing severe illness due to West Nile viral infection, so these individuals should promptly seek medical care if infection is suspected.

Is there a West Nile virus vaccine for humans?

No, but several companies are working towards developing a vaccine.

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MOSQUITOES AND DISEASE

Help keep mosquitoes out of our communities!

Disease Transmitted by Mosquitoes

Mosquitoes carry many diseases transmitted to humans and animals. Mosquito-borne diseases known to occur in Missouri include several encephalitis viruses in horses and humans and heartworms in dogs. Arthropods (mosquitoes, ticks, etc.) are vectors that transmit disease organisms to humans and animals. Animals (birds, raccoons, rodents, etc.) that may harbor disease organisms naturally are reservoirs.

St Louis Encephalitis (SLE) and West Nile Virus (WNV)

The Northern House Mosquito (*Culex pipiens*), the principle vector of both SLE and WNV, is found throughout Missouri. Birds such as house sparrows, blue jays, and finches may serve as reservoirs for these two closely related viruses. *Culex pipiens* can acquire SLE or West Nile virus while feeding on birds and is capable of transmitting the virus to people after 8 to 12 days. The Northern House Mosquito readily enters homes and bites people after dark. This small brownish mosquito is a weak flyer, seldom flying more than 200-300 yards from its breeding site. It breeds in dark or shaded, stagnant, organic matter-enriched water sources such as street-side catch basins, unkept polluted ditches, standing sewage effluent, and clogged rain gutters. Breeding areas such as birdbaths, flowerpot saucers, and stock tanks should have their water changed at least once a week, and discarded tires, boats, and canoes, should be covered or turned upside down to prevent rain from accumulating in them.

Western Equine Encephalitis (WEE)

Culex tarsalis, the vector of WEE, has a virus transmission cycle similar to SLE. Although it is widely distributed, it is most common in rural habitats in the western part of Missouri. *Culex tarsalis* feeds primarily on birds in the spring and early summer months and has a preference for mammals during the later summer months, including humans and horses. This mosquito, a twilight biter, is a strong flier, capable of flying many miles from its breeding site. It breeds in pastures and ditches with aquatic vegetation and irrigation wastewater, preferring sunlit areas.

La Crosse Encephalitis (LAC)

Aedes triseriatis, the vector of LAC, is distributed in forested areas throughout Missouri. *A. triseriatis* seldom flies far from its breeding sources and disease is restricted to localized mosquito populations. *A. triseriatis* breeds in tree holes of deciduous trees and will spread to adjacent areas where artificial containers such as cans, buckets, vases, tire casings, etc., may hold water. The Asian tiger mosquito, *Aedes albopictus*, recently introduced into the U.S., has requirements similar to *A. triseriatus* and has spread to many areas in Missouri. Although the Asian tiger mosquito is not yet involved as a vector of

LAC virus in nature, it has significant potential to proliferate disease in Missouri communities. *A. triseriatis* and *A. albopictus* will bite readily during the daylight hours, increasing at twilight hours.

Canine Heart Worm

There are numerous mosquito species that transmit heartworms to dogs. Mosquitoes feeding on infected dogs ingest the immature heartworm parasites. The parasite undergoes maturation in the mosquito, crawls out through the mouthparts at subsequent feedings, and penetrates the skin through the site of the bite. The tiny heartworms migrate through the tissues and establish in the chambers of the heart where they grow to maturity interfering with heart functions.

What Can You Do?

You can help rid your property and community of mosquitoes by the following simple practices:

1. Eliminate containers such as tin cans, bottles, buckets, and old tires that may hold water.
2. Ensure gutter down spouts are cleared of debris.
3. Cover or store boats and wheelbarrows upside down.
4. Stock rock garden pools and lily ponds with mosquito-feeding minnows or goldfish.
5. Empty wading pools weekly and maintain backyard swimming pools properly.
6. Fill or drain low areas that may hold water for longer than a week.
7. Cover rain barrels, cisterns, or fire barrels with 16-mesh screen.
8. Drain livestock water tanks weekly, or stock with mosquito-feeding minnows or goldfish.
9. Install splash blocks to carry water away from foundations to eliminate water in crawl spaces.

Where Do Mosquitoes Come From?

All mosquitoes require water to complete their life cycle. Only female mosquitoes bite. A blood meal usually is required before eggs will develop. Completion of the life cycle from egg to adult may require as little as 8-10 days.

All Mosquitoes Are Not The Same

There are more than 50 species of mosquitoes in Missouri. Although most are not involved in transmitting disease to humans and animals, many are serious biting pests. Preferential feeding times are unique to each species. While one species might only feed at night, others may feed at dusk/dawn, or even during the day.

Personal Protection

- Screen openings of your home.

- Avoid mosquito-infested areas when possible.
- Wear clothing that will provide protection (long sleeved shirts and long pants).
- Wear repellents that contain DEET.
- Avoid exposure during peak biting periods (twilight hours).

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SEROLOGICAL TESTING FOR WEST NILE VIRUS AND OTHER ARTHROPOD-BORNE VIRUSES (ARBOVIRUSES)
May 1, 2003

AVAILABILITY OF VIRAL SEROLOGY TESTS

Rapid identification and reporting of *active* human West Nile virus (WNV) infections provides state and local public health agencies with timely information on the location and prevalence of the virus. For this reason, the State Public Health Laboratory does not screen specimens and treats all specimens with the same priority.

Serologic testing is not necessary for asymptomatic persons or those with mild illness – these individuals should seek medical attention if they develop more severe symptoms. Because most infected persons are asymptomatic and because IgM antibody may persist for six months or longer, Missouri residents may have persistent IgM antibody from a previous infection that is unrelated to their current clinical illness. The U. S. Centers for Disease Control and Prevention's publication *West Nile Virus (WNV) Infection: Information for Clinicians* (August, 2002), which outlines clinical features, diagnosis, reporting, laboratory testing, and treatment of West Nile virus infection, is available at: http://www.cdc.gov/ncidod/dvbid/westnile/resources/fact_sheet_clinician_082102_0802.pdf.

There is no charge for arboviral serological testing through the Missouri Department of Health and Senior Services.

STATE PUBLIC HEALTH LABORATORY ARBOVIRAL SEROLOGY TESTS

- IgM antibody detection on single serum or acute CSF
- IgG antibody detection on paired sera

Specimens received for arbovirus serology will be tested for antigens of:

- Flavivirus Group
  - West Nile virus (WNV)
  - St. Louis Encephalitis (SLE) virus
- Western Equine Encephalitis (WEE) virus
- LaCrosse/California Encephalitis Group virus
- Eastern Equine Encephalitis (EEE) virus

SPECIMEN COLLECTION

- For IgM arbovirus antibody panel, collect acute serum 0 to 10 days after onset of symptoms.
- Collect CSF as soon as possible after onset of symptoms.
- For IgG arbovirus antibody panel, collect acute serum 0 to 10 days after onset of symptoms and collect convalescent serum 2-3 weeks after acute serum was collected.
- Collect serum in a red-top vacutainer tube. It is best to send only serum and not whole blood.
- Whole blood may be sent if no method is available for removing the serum.
- At least 0.5 ml of serum and 1.0 ml of CSF is required for serological testing.

SPECIMEN SUBMISSION

A completed Missouri Department of Health and Senior Services Lab Form MO580-0762 (12-99) (Viral Serology Test Request) (http://www.dhss.state.mo.us/Lab/arbovirus_fax_form.pdf) must accompany all specimens.

IMPORTANT: Testing will not be initiated without the inclusion of the following:

- Patient's name on submission form and specimen.
- Date of onset of symptoms.
- Specimen collection date.
- Pertinent travel history (3 months prior to onset of symptoms).

Additional details on specimen collection, shipping, test result interpretation are posted at: http://www.dhss.state.mo.us/Lab/west_nile_virus.htm.

VIRAL SEROLOGY TEST REQUEST

1. **Please provide the patient information requested.**
2. **Type or print with pressure.**
3. **Send all copies of this form with specimen to STATE PUBLIC HEALTH LABORATORY.**

PATIENT NAME (LAST, FIRST)

ADDRESS (CITY, STATE, ZIP CODE)

BIRTHDATE

SEX ☐ Female ☐ Male

RACE W | B | A/PI | AI/AN | O/U

MEDICAID NUMBER

The following information MUST BE PROVIDED before testing can be performed:

PERSON'S NAME AUTHORIZED TO RECEIVE PHONE RESULTS

FACILITY/LAB PHONE NO.

FACILITY/LABORATORY NAME

FACILITY/LABORATORY STREET/MAILING ADDRESS

FACILITY/LABORATORY CITY, STATE & ZIP CODE

DATE SPECIMEN COLLECTED

ACUTE

CONV

ONSET

RUBEOLA/RUBELLA VACCINATION HISTORY

TEST REQUESTED:

Please indicate below, see back of form for test description.

☐ Measles (Rubeola) IgM EIA

☐ Rubella IgM EIA

☐ Arbovirus

☐ Rickettsial Panel

☐ Other: CDC Referrals

DATE RECEIVED

ACUTE

CONV

DATE CONV. REQ'D

STATE LAB SERIAL NO.

FOR STATE HEALTH LAB USE ONLY

DATE REPORTED

LABORATORY REPORT

RUBEOLA EIA (IgM): ☐ Positive ☐ Negative ☐ Equivocal

RUBELLA EIA (IgM): ☐ Positive ☐ Negative ☐ Equivocal

MISSOURI DEPARTMENT OF HEALTH
STATE PUBLIC HEALTH LABORATORY
307 W McCARTY, PO BOX 570
JEFFERSON CITY MO 65101

EOAA EMPLOYER
Services Provided on a non-Discriminatory Basis

STATE OF MISSOURI
DEPARTMENT OF HEALTH AND SENIOR SERVICES

ARBOVIRAL CASE REPORT

MOHSIS ID NO.

NAME (LAST, FIRST, MI)	REPORT DATE ___ / ___ / ___

PARENT'S NAME (IF NOT ADULT)	TELEPHONE NUMBER	ONSET DATE ___ / ___ / ___	DATE OF FIRST NEUROLOGIC SYMPTOM ___ / ___ / ___

ADDRESS (INCLUDE CITY AND STATE)	COUNTY	DATE OF BIRTH ___ / ___ / ___	AGE

PHYSICIAN NAME	PHYSICIAN'S ADDRESS	PHYSICIAN'S TELEPHONE NUMBER

COUNTRY OF BIRTH	IF BORN OUTSIDE US, YEAR ARRIVED IN US	**TENTATIVE DIAGNOSIS**

PLACE OF WORK	OCCUPATION	ADDRESS	TELEPHONE NUMBER

HOSPITALIZED ☐ Yes ☐ No	HOSPITAL NAME	DATE OF ADMISSION ___ / ___ / ___	DATE OF DISCHARGE ___ / ___ / ___

PREGNANT? ☐ Yes, number of weeks _____ ☐ No ☐ Unknown	SEX ☐ Male ☐ Female

RACE (CHECK ALL THAT APPLY)
☐ Black ☐ White ☐ Hispanic ☐ Asian ☐ American Indian ☐ Pacific Islander ☐ Other (specify) _____

PERTINENT DIAGNOSTIC TESTS (ATTACH LAB RESULTS IF AVAILABLE), SYMPTOMS, AND TREATMENT

SPECIMEN	DATE	APPEARANCE	W.B.C	RBC	% LYMPS	% POLYS.	PROTEIN	SUGAR	SMEAR	CULTURE
SPINAL FLUID	__ / __ / __									

TYPE OF SPECIMEN Serum/CSF/Tissue	TYPE OF TEST PERFORMED ELISA, Virus Neut, PCR, FA, HI, Plaque Assay, Other	RESULT	DATE COLLECTED	NAME OF LABORATORY
			___ / ___ / ___	
			___ / ___ / ___	
			___ / ___ / ___	

(CHECK ALL THAT APPLY) ☐ MRI ☐ CT	DATE(S) ___ / ___ / ___ ___ / ___ / ___	RESULT(S)
☐ EMG	DATE ___ / ___ / ___	RESULT

HAS THE PATIENT EXPERIENCED ANY OF THE FOLLOWING SYMPTOMS DURING THE ILLNESS?
☐ Yes ☐ No If yes, check all that apply.

☐ Fever ≥ 100°	☐ Muscle pains	☐ Urinary symptoms	☐ Tremors
Duration in days _____	☐ Muscle weakness	☐ Chest pain	☐ Slurred speech
☐ Headache	☐ Rash	☐ Shortness of breath	☐ Unconscious
☐ Stiff Neck	☐ Nausea	☐ Cough	☐ Confusion
☐ Photophobia	☐ Diarrhea	☐ Sore throat	☐ Seizures
☐ Fatigue	☐ Vomiting	☐ Conjunctivitis (red eyes)	☐ Flaccid Paralysis
☐ Swollen glands (Lymph nodes)	☐ Abdominal pain	☐ Altered mental status	☐ Other, Specify: _____
☐ Joint pains	☐ Poor appetite	☐ Memory loss	

TREATMENT (TYPE, AMOUNT, DATES)
___ / ___ / ___ ___ / ___ / ___

EXPOSURE HISTORY

HAS PATIENT HAD CONTACT WITH SICK/DEAD
☐ Animals or ☐ Birds in the 3 weeks prior to illness? ☐ Yes ☐ No ☐ Unknown

IF YES, WHAT TYPE OF CONTACT OR ACTIVITY?

LOCATION	DATE ___ / ___ / ___

IN THE 3 WEEKS PRIOR TO ONSET OF ILLNESS, DID THE PATIENT RECALL BEING BITTEN BY MOSQUITOES?
☐ Yes ☐ No ☐ Unknown If yes, specify when ___ / ___ / ___ and geographic location

HAS THE PATIENT HAD CONTACT WITH TICKS (ATTACHED TO THE SKIN) IN THE 3 WEEKS PRIOR TO ONSET?
☐ Yes ☐ No ☐ Unknown If yes, specify when ___ / ___ / ___ and geographic location

DOES THE PATIENT USE INSECT REPELLENT WHILE OUTDOORS? ☐ Yes ☐ No ☐ Unknown If yes, what brand?	IS THE COMMUNITY WHERE PATIENT LIVES BEST CLASSIFIED AS ☐ Urban ☐ Suburban ☐ Rural

IN THE IMMEDIATE SURROUNDINGS OF THE PLACE OF RESIDENCE, ESTIMATE THE AMOUNT OF

Vegetation	☐ None	☐ Little	☐ Moderate	☐ Great
Surface Water	☐ None	☐ Little	☐ Moderate	☐ Great

PATIENT'S NAME (LAST, FIRST, MI)

DOES THE PATIENT'S RESIDENCE HAVE SCREENED WINDOWS AND DOORS?

☐ Yes ☐ No ☐ Unknown

WERE THERE ANY SOURCES OF STAGNANT WATER AROUND THE HOME IN WHICH MOSQUITOES COULD BREED (SUCH AS TIRES, FLOWERPOTS, BIRDBATHS, CANS, OR WADING POOLS) THE 3 WEEKS BEFORE SYMPTOM ONSET?

☐ Yes ☐ No ☐ Unknown If yes, please describe

APPROXIMATELY HOW MANY HOURS PER DAY DID THE PATIENT SPEND OUTDOORS (BOTH LEISURE AND WORK)?

TIME OUTSIDE IS DURING (CHECK ALL THAT APPLY)

☐ Dawn ☐ Morning ☐ Noon ☐ Afternoon ☐ Dusk ☐ Evening

IN GENERAL, 3 WEEKS PRIOR TO ONSET OF THE ILLNESS, DID THE PATIENT PARTICIPATE IN ANY OF THE FOLLOWING ACTIVITIES OR VISIT ANY OF THE FOLLOWING LOCATIONS?

a) Gardening	☐ Never	☐ Rarely	☐ Sometimes	☐ Often	Where? _____
b) Fresh water swimming	☐ Never	☐ Rarely	☐ Sometimes	☐ Often	Where? _____
c) Fishing	☐ Never	☐ Rarely	☐ Sometimes	☐ Often	Where? _____
d) Hunting	☐ Never	☐ Rarely	☐ Sometimes	☐ Often	Where? _____
e) Camping	☐ Never	☐ Rarely	☐ Sometimes	☐ Often	Where? _____
f) Outdoor sport field or stadium event	☐ Never	☐ Rarely	☐ Sometimes	☐ Often	Where? _____
g) Zoo	☐ Never	☐ Rarely	☐ Sometimes	☐ Often	Where? _____
h) Parks	☐ Never	☐ Rarely	☐ Sometimes	☐ Often	Where? _____
i) Other, specify	☐ Never	☐ Rarely	☐ Sometimes	☐ Often	Where? _____

HAS THE PATIENT TRAVELED

☐ Outside County ☐ Outside Missouri ☐ Outside USA in last 3 weeks? ☐ Yes ☐ No ☐ Unknown

IF YES, WHERE?	WHEN (DEPARTED)	RETURNED
	___ / ___ / ___	___ / ___ / ___

HEALTH HISTORY

RECENT VACCINATIONS	DATE	PRECEDING ILLNESS (IF YES, DIAGNOSIS AND DATE)
☐ Yes ☐ No If yes, type:	___ / ___ / ___	☐ Yes ☐ No ___ / ___ / ___

HAS PATIENT SERVED IN THE MILITARY?

☐ Yes ☐ No ☐ Unk If yes, dates of service ___ / ___ / ___ to ___ / ___ / ___

HAS PATIENT EVER RECEIVED A VACCINATION AGAINST

Yellow Fever	☐ Yes	☐ No	If yes, date of vaccination ___ / ___ / ___	Physician _____
Japanese Encephalitis virus	☐ Yes	☐ No	If yes, date of vaccination ___ / ___ / ___	Physician _____
Tick-borne Encephalitis (TBE)	☐ Yes	☐ No	If yes, date of vaccination ___ / ___ / ___	Physician _____

DID PATIENT EVER HAVE VIRAL ENCEPHALITIS?

☐ Yes ☐ No ☐ Unk If yes, when ___ / ___ / ___

DID PATIENT EVER HAVE DENGUE FEVER?

☐ Yes ☐ No ☐ Unk If yes, when ___ / ___ / ___

DOES THE PATIENT HAVE HISTORY OF ANY OF THE FOLLOWING CONDITIONS PRIOR TO THE ONSET OF THIS ILLNESS?

☐ Asthma ☐ Lung Disease ☐ Taking Steroids
☐ Diabetes ☐ HIV/AIDS ☐ Other immune-suppressing disease (lupus, rheumatoid arthritis, etc)
☐ Cancer ☐ Cardiac Disease ☐ Taking a blood thinner
☐ Hypertension ☐ Hepatitis ☐ Pancreatitis ☐ Alcohol abuse ☐ Seizures

HAS THE PATIENT RECEIVED A

☐ Blood transfusion ☐ Blood product ☐ Organ transplant or ☐ Tissue transplant within the last 4 weeks?

☐ Yes ☐ No ☐ Unknown If yes, type of blood product, organ or tissue

IF YES, WHERE?	TELEPHONE NUMBER	DATE OF PROCEDURE
		___ / ___ / ___

HAS THE PATIENT DONATED

☐ Blood ☐ Plasma ☐ Organ or ☐ Tissue within the last 2 weeks? ☐ Yes ☐ No ☐ Unknown

IF YES, TYPE	WHERE	TELEPHONE NUMBER	DATE OF DONATION
			___ / ___ / ___

OUTCOME OF PATIENT	IF PATIENT DIED, DATE OF DEATH
☐ Survived ☐ Died ☐ Unknown	___ / ___ / ___

WAS AN AUTOPSY PERFORMED?	RESULTS
☐ Yes ☐ No ☐ Unknown	

FINAL DIAGNOSIS

☐ West Nile Fever ☐ West Nile M/E ☐ St. Louis M/E ☐ Eastern Equine M/E
☐ Western Equine M/E ☐ La Crosse M/E ☐ California M/E ☐ Japanese M/E
☐ Venezuelan Equine M/E ☐ Dengue ☐ Yellow Fever
☐ Tick-borne M/E type if known: _____ ☐ Other: _____

NOTE:
M/E = meningitis and/or encephalitis

COMMENTS

DATE	INVESTIGATOR	AGENCY
___ / ___ / ___		