

LA CROSSE VIRUS NEUROINVASIVE DISEASE

A.M. Tucker, Learning and Training Specialist: Vectors and Vector Borne Diseases

C.A. Day, Post doctoral Researcher

R.T. Trout Fryxell, Professor of Medical and Veterinary Entomology

Department of Entomology and Plant Pathology

La Crosse virus (LACV) is one of the California serogroup viruses which may be transmitted to humans by infected mosquitoes. It was first isolated in 1964 from preserved brain tissue from a child who died in 1960 from encephalitis (inflammation of active brain tissues) in La Crosse, Wisconsin. LACV may be identified in cases where aseptic meningitis (inflammation in tissues surrounding the brain or spinal cord) or encephalitis of unknown origin are identified. LACV affects ~80 people in the Eastern United States every year, primarily children aged 16 and younger living in the Appalachian region. It may cause severe neuroinvasive (enters the nervous system) diseases that regularly result in long-term cognitive disorders that impede neurological development.

TRANSMISSION OF DISEASE PATHOGENS

The complex transmission cycles of LACV are presented in Figure 1. Uninfected female mosquitoes can obtain LACV from the blood of infected animals such as chipmunks (called virus amplification hosts in which the virus can grow) and transmit the pathogen to humans when feeding on them. Female eastern treehole mosquitoes, *Aedes triseriatus*, directly transmit LACV to their eggs (called transovarial transmission). When infected eggs hatch, they remain infected through each developmental stage (egg, larva, and pupa). Infected adults can immediately transmit LACV after emergence from the pupa. Adult males that are infected by their mother by transovarial transmission can transmit LACV to uninfected females during mating (called venereal transmission). Adult males that are infected by their mother by transovarial transmission can transmit LACV to uninfected females during mating (called venereal transmission).

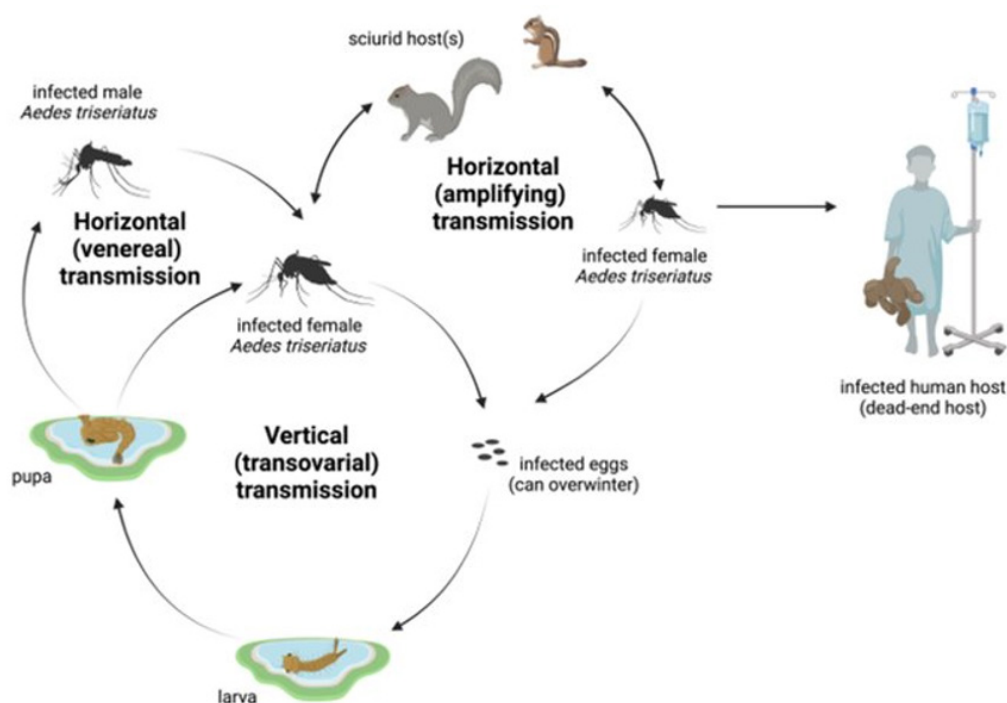


Figure 1. Eastern treehole mosquito transmission cycle for LACV (graphic by Mary Nordgulen and published in Day et al 2023^o)

MOSQUITO LIFE CYCLE

The eastern treehole mosquito is the primary vector, the main transmitter of the disease pathogens, of LACV. The Asian tiger mosquito, *Ae. albopictus*, and Asian bush or rock pool mosquito, *Ae. japonicus*, are secondary vectors. Secondary vectors are capable of transmitting disease pathogens and are less effective than the primary vector. All three mosquito species are found in the same areas and are considered container mosquitoes.

Eggs are laid by the adult female in artificial containers such as tires and planter bottoms or in natural containers such as tree holes in areas close to a hardwood forest. If there is sufficient water and organic matter in the containers, the larvae will develop into adults.

These adult mosquito species are active during the day and into the early evening hours. Both sexes will feed on sugar sources to gain the carbohydrates for flight. Females, however, require a blood meal to gain the protein for successful egg production. Blood meal sources for the female include deer, chipmunks, squirrels, humans and dogs. The eastern treehole mosquito is known to also feed on amphibians and reptiles.

HIGH RISK AREAS FOR LACV INFECTIONS

LACV cases are reported to the CDC by state and local health departments since it is a reportable condition. While there are ~30-90 LACV neuroinvasive cases reported each year, CDC hypothesizes that this condition is under-reported and/or under-diagnosed because some cases resemble summertime illness and others are asymptomatic. Historically, the upper Midwestern states (Iowa, Illinois, Indiana, Wisconsin, Michigan and Ohio) had reported LACV cases. In recent years, Northeastern (Rhode Island, travel case), mid-Atlantic (Virginia and West Virginia), and Southeastern (North Carolina, Kentucky, Tennessee and Georgia) states also have reported cases. Figure 2 shows the counties within Appalachia where the more severe neurological cases occur.

SIGNS AND SYMPTOMS OF LACV

Children are more commonly diagnosed with LACV infections than adults. Most infections are asymptomatic and go unnoticed. When symptoms do occur, they are likely to occur in late spring to early fall. In less severe cases, initial symptoms are like influenza or the common cold, and individuals are expected to recover without complications. In more severe cases, LACV is neuroinvasive and enters the central nervous system. This results in severe diseases including meningitis and encephalitis. Typical symptoms of neuroinvasive LACV infections include:

- Fever
- Headache
- Vomiting
- Seizures
- Disorientation

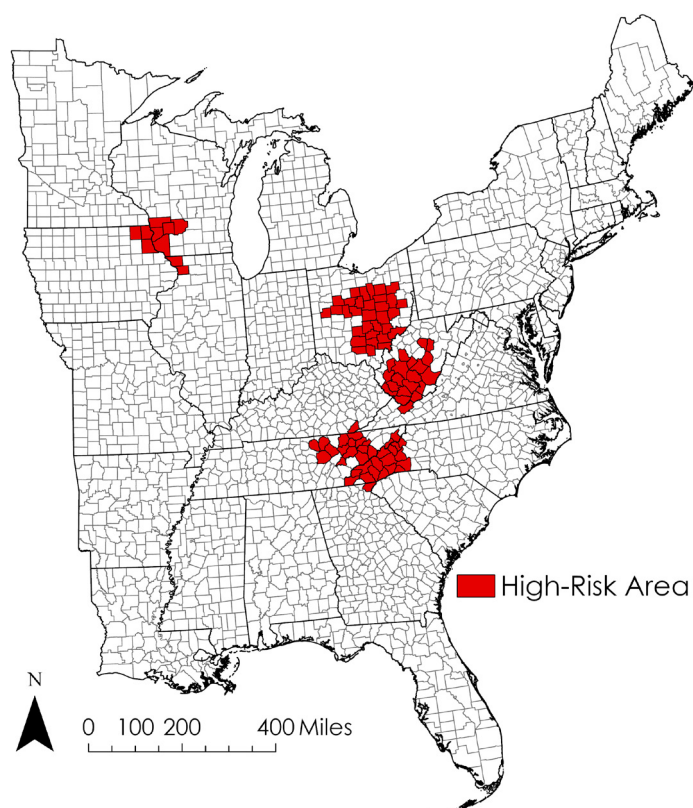


Figure 2. The LACV high-risk counties in the Eastern US (data obtained from ArboNET, figure adapted from Day et al, 2023^b)

MEDICAL TESTING AND TREATMENT OF NEUROINVASIVE LACV INFECTIONS

People living in high-risk areas are at the greatest risk for LACV infections. Travel-related cases are common in people who visit high-risk areas. If a person develops LACV infection symptoms after spending time in a region with known LACV transmission, then it is important to inform healthcare providers of recent travel history to a LACV-endemic area.

Individuals who present with encephalitis, hyponatremia (low sodium in serum) and/or meningitis in areas where LACV is known should be tested to rule out LACV, particularly if they play, work or participate in extracurricular activities such as hiking in or near woodland areas. Blood or spinal fluid samples can be tested for LACV.

There are no specific treatments for LACV infections. In most cases, bed rest, fluids and measures to reduce fever will successfully reduce the common symptoms associated with LACV. In some more severe cases, hospitalization will be necessary to receive treatment for seizures, encephalitis and other more serious symptoms of LACV. Individuals with more severe neuroinvasive cases often require long-term physical and occupational therapy and/or educational support.

STEPS TO PREVENT MOSQUITO BITES

Since there is no vaccine for LACV, it is necessary to prevent mosquito bites which can reduce the potential for transmission of LACV. The amount of time spent outdoors without protective clothing or use of repellents will increase the risk of acquiring LACV. Since mosquitoes may fly indoors, it is also important to prevent them from entering the home or business.

- Maintain intact screens on windows and doors.
- Avoid known areas when mosquitoes are active.
- Wear protective clothing such as long-sleeved shirts and long pants when outdoors.
- Use EPA approved repellent and reapply if necessary. Learn more: epa.gov/insect-repellents/find-repellent-right-you

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