PUBLIC HEALTH REFERENCE SHEET
Arboviral Diseases

****Includes mosquito-borne and tick-borne diseases****

Name	INCLUDES: West Nile fever, West Nile encephalitis, Japanese encephalitis, and other mosquito-borne viruses (western equine encephalitis, eastern equine encephalitis, St. Louis encephalitis, California virus encephalitis), tick-borne viruses (Powassan virus, tick-born encephalitis, Colorado tick fever), and others EXCLUDES: chikungunya virus, dengue virus, Lyme disease, relapsing fever, Rift Valley fever, spotted fever rickettsiosis, yellow fever virus, and Zika virus. See respective case definitions
Reservoir & Transmission	The viruses are maintained through an enzoonotic cycle between mosquitos and amplifying vertebrate hosts, primarily birds. Several species of mosquito can transmit the viruses.
Incubation Periods	2–14 days for mosquito-borne viruses • West Nile: most often 2–6 days, ranges up to 2–14 days, and up to 21 days in immunocompromised people • JE: 5–15 days • WEE: 5–15 days • EEE: 4–10 days • SLE: 5–15 days • CE: 3–7 days
Common Symptoms	Depends on type
Gold Standard Diagnostic Test	May require specialized testing
Risk Groups	Depends on type
Geographic Significance	Some types in specific geographic regions, others present worldwide

Name	**Tick-borne diseases:** • Powassan virus (PV) • Tick-borne encephalitis (TBE) • Colorado tick fever virus
Reservoir & Transmission	Reservoir: Enzoonotic cycle between white-footed mice and *Ixodae* ticks Transmission: Through the bite of an infected tick, most commonly *Ixodes scapularis* or the black-legged tick. Humans are considered 'dead end hosts' and cannot spread the virus to other humans or to ticks. Transmission of TBE can occur following consumption of raw milk from infected goats, sheep, or cows. Infection of mother to fetus is possible.

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Incubation Period	3–4 days for tick-borne viruses • PV: 7–30 days • TBE: 7–14 days (shorter exposure in milk-borne exposure)
Common Symptoms	PV: Many are asymptomatic; symptoms may include: fever, headache, vomiting, weakness, confusion, loss of coordination, speech difficulties, and seizures. Approx. 50% of cases have permanent neurological symptoms; approx. 10% of virus encephalitis cases are fatal. TBE: fever, malaise, anorexia, muscle aches, headache, nausea, and/or vomiting; second phase may occur with symptoms involving central nervous system (e.g., fever, headache, stiff neck), encephalitis, or meningoencephalitis
Gold Standard Diagnostic Test	• PV: Serologic testing with virus-specific IgM antibody in serum or CSF combined with a consistent clinical presentation in an endemic area • TBE: ▪ Phase 1: Leukopenia, thrombocytopenia, elevated liver enzymes ▪ Phase 2: Increase in white blood cells and CSF; IgM from serum or CSF
Risk Groups	Anyone with exposure to ticks in endemic areas
Geographic Significance	Northeastern and Great Lakes regions of the U.S. during late spring, early summer, and mid-fall

What are arboviral diseases?
Arboviral disease (arthropod-borne viruses) is a general term used to describe infections caused by a group of viruses spread to people by the bite of infected arthropods (mosquitoes, ticks, sandflies, biting midges). The virus families responsible for most arboviral infections in humans are *Bunyaviridae, Flaviviridae, Reoviridae*, and *Togaviridae*. More than 100 arboviruses are known to cause human disease.

Arboviral diseases include West Nile fever, West Nile encephalitis, Japanese encephalitis, and other mosquito-borne viruses (western equine encephalitis, eastern equine encephalitis, St. Louis encephalitis, California virus encephalitis), tick-borne viruses (Powassan virus, tick-borne encephalitis, Colorado tick fever).

Other diseases spread by infected arthropods that are not arboviral diseases include chikungunya virus, dengue virus, Lyme disease, relapsing fever, Rift Valley fever, spotted fever rickettsiosis, yellow fever virus, and Zika virus.

What is the occurrence of arboviral infections?
West Nile virus (WNV), transmitted primarily through mosquitos, is the leading cause of arboviral disease in the continental United States, but other arboviruses cause sporadic cases of neuroinvasive disease (Fagre et al., 2023). From the 2021 surveillance data reported to Centers for Disease Control and Prevention (CDC) by U.S. jurisdictions for nationally notifiable arboviruses, 49 States and the District of Columbia reported 3,035 cases of domestic arboviral disease, including those caused by West Nile (2,911), La Crosse (40), Jamestown Canyon (32), Powassan (24), St. Louis encephalitis (17), unspecified California serogroup (6), and eastern

equine encephalitis (5) viruses. Among the WNV disease cases, 2,008 (69%) were classified as neuroinvasive disease, for a national incidence of 0.61 cases per 100,000 population (Fagre et al., 2023). Epidemiological and environmental surveillance for arboviruses is facilitated by ArboNET, the national arbovirus surveillance system.
https://www.cdc.gov/mosquitoes/mosquito-control/professionals/ArboNET.html

How are arboviral infections transmitted?
Arboviral infections are transmitted through the bite of infected arthropods (mosquitoes, ticks, sandflies, biting midges). Rare transmission may occur by blood transfusion, organ transplantation, sexual contact, and from mother to child during birth depending on the specific virus involved. In the laboratory setting, percutaneous and aerosol transmission can occur.

Who is at risk for arboviral infections?
Risk of infection is generally determined by exposure to infected vectors and is dependent on many factors including environmental conditions, seasons, and human activities. Illness occurs mainly in children, visitors, or people new to an endemic area.

What are the signs and symptoms of arboviral infections?
Most infections are subclinical. Symptomatic illness usually manifests as 1 of 4 primary clinical syndromes: systemic febrile illness; polyarthritis and rash; acute central nervous system disease; or hemorrhagic fever. Many arboviral infections can have more than one primary clinical syndrome. Symptoms range from mild febrile illness to severe encephalitis (see Table 1).

For disease reporting, arboviral infections are categorized into two clinical presentations:

Non-neuroinvasive disease

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

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.

What are potential complications of arboviral infections?
Arboviruses can cause multiple neurological diseases, including myelitis, neuritis, myositis, meningitis, and encephalitis (Mangat and Louiew, 2023). Mortality rates related to these infections increase with the diagnosis of encephalitis (Mangat and Louie, 2023).

How are arboviral infections diagnosed?
Arboviral infections that cause a febrile syndrome are most often confirmed by measurement of virus-specific antibody in serum; neuroinvasive arboviral infections are confirmed in cerebrospinal fluid. Acute-phase specimens should be tested for virus-specific immunoglobulin

class M (IgM) antibody. Serum IgG antibody generally is detectable shortly after IgM and persists for years.

How are arboviral infections treated?
Symptomatic management includes treatment with analgesics and antipyretics. Avoid further mosquito or sandfly exposure for a few days after the onset of symptoms.

How can arboviral infections be prevented?
Infection with an arbovirus may provide immunity to that specific virus and perhaps to related viruses. In highly endemic areas, adults may acquire natural immunity following subclinical or mild infection in childhood.

Primary prevention of arboviral diseases involves both vector control and personal protective measures. For infection control, standard precautions are sufficient. To prevent transfusion associated transmission, defer blood donations for 6 months, especially from patients infected with Colorado tick fever virus. A vaccine for Japanese Encephalitis, JE-VC (IXIARO®), is the only FDA-approved vaccine for JE prevention available in the U.S. and may be required for Service members and other DoD beneficiaries stationed or traveling to endemic areas per Combatant Command (CCMD), USINDOPACOM, Force Health Protection requirements. A U.S. Food and Drug Administration approved tick-borne encephalitis (TBE) vaccine is available for use in the United States for travelers at risk for exposure in endemic areas; there is no specific CCMD recommendation or requirement for the TBE vaccine. However, according to the Health Affairs Memorandum, Tick-Borne Encephalitis Vaccination, dated 11 January 2023, TBE is endemic in several central, northern, and eastern European countries, with the highest incidence of disease historically found in the Baltic and central European countries. All DoD military medical treatment facilities (MTFs) will make the U.S. FDA-approved TBE vaccine available within the MTF for all eligible beneficiaries for whom vaccination is indicated based on official or non-official travel to affected areas and for any DoD Civilian employees who are engaging in official travel to such areas, according to current CDC guidelines.

How are some public health considerations?
- For DRSi:
  - **INCLUDES**: West Nile fever, West Nile encephalitis, Japanese encephalitis, Western Equine encephalitis, and other mosquito-borne viruses (western equine encephalitis, eastern equine encephalitis, St. Louis encephalitis, California virus encephalitis) and tick-borne viruses (Powassan virus, tick-borne encephalitis, Colorado tick fever) and others
  - **EXCLUDES**: chikungunya virus, dengue virus, Lyme disease, relapsing fever, Rift Valley fever, spotted fever rickettsiosis, yellow fever virus, and Zika virus (see respective case definitions)
- Specify the etiologic/causative agent.
- Document relevant travel and deployment history occurring within the incubation period.
- Document the circumstances under which the case patient was exposed including duty exposure, occupational activities, environmental exposures, or other high-risk activities.
- Note the patient's disease specific immunization history.
- Check with the local civilian health department to know if they have implemented arboviral version 1, series HL7 case notifications to the National Notifiable Diseases Surveillance System (NNDSS). https://www.cdc.gov/nndss/trc/onboarding/arboviral.html

- The state health department may submit specimens to the CDC's Division of Vector-Borne Diseases (DVBD) Arbovirus Diagnostic Laboratory, which includes the Arboviral Diseases Branch (ADB) and the Arbovirus Reference Collection (ARC). They provide reagents to public health laboratories for arbovirus diagnostics for which no commercial assays are available. The collection also serves as an arbovirus repository for reference strains. https://www.cdc.gov/ncezid/dvbd/specimensub/arboviral-shipping.html; https://www.cdc.gov/ncezid/dvbd/specimensub/arc/

References

"Arbovirus," Centers for Disease Control and Prevention (CDC), last reviewed October 26, 2023. https://www.cdc.gov/ncezid/dvbd/specimensub/arc/

ArboNET National Arbovirus Surveillance System, last reviewed June 16, 2023. https://www.cdc.gov/mosquitoes/mosquito-control/professionals/ArboNET.html

Assistant Secretary of Defense Memorandum: Tick-Borne Encephalitis Vaccination, January 11, 2023. (https://health.mil/Reference-Center/Policies/2023/01/11/OASDHA-Memo-Tick-Borne-Encephalitis-Vaccination)

Defense Health Agency. 2022. *Armed Forces Reportable Medical Events: Guidelines and Case Definitions.* https://www.health.mil/Reference-Center/Publications/2022/11/01/Armed-Forces-Reportable-Medical-Events Guidelines

Fagre AC, S Lyons, JE Staples, and N Lindsey. 2023. "West Nile Virus and Other Nationally Notifiable Arboviral Diseases — United States, 2021." *MMWR Morb Mortal Wkly Rep* 72(34):901–6. DOI: http://dx.doi.org/10.15585/mmwr.mm7234a1

Heymann, David L. ed. 2022. *Control of Communicable Diseases Manual*. 21st Edition. Washington, DC: APHA Press.

Mangat R and T Louie. 2024. "Arbovirus Encephalitides," In: StatPearls [Internet]. Treasure Island (FL): *StatPearls Publishing*. https://www.ncbi.nlm.nih.gov/books/NBK560866/

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Table 1. Description of Arboviruses

Disease	Vector(s)	Common Symptoms	Incubation Period	Duration of Symptoms	Geographic Distribution	Does Infection Provide Lifelong Immunity?
California virus Encephalitis	Aedes species of mosquito, primarily *Aedes melanimon*	Fever, chills, nausea, vomiting, headache, lethargy, abdominal pain, may lead to encephalitis	3–7 days	10–14 days	USA and Canada. In U.S., primarily in midwest States	Unk
Eastern Equine Encephalitis	Mosquito; Culiseta melanura; some *Aedes* species*; Coquillettidia,* and *Culex* species	Asymptomatic for some; chills, fever, malaise, arthralgia, and myalgia. Death occurs in 1/3 of cases 2–10 days after onset.	4–10 days	7–14 days	North and South America. In U.S., mostly in States along Mississippi and along the east coast	Yes
Japanese Encephalitis	*Culex* mosquitoes*,* especially *Culex tritaeniorhynchus*	Asymptomatic in most cases; fever, headache, fatigue, nausea, and vomiting	5–15 days		Southeast and East Asia	Yes
Powassan Virus disease	Tick; *Ixodes* species*,* primarily *Ixodes cookei* and *Ixodes scapularis* in North America; *Ixodes persulcatus* and *Haemaphysalis longicornis* in Russia	Asymptomatic most cases; fever, headache, vomiting, weakness, confusion, loss of coordination, speech difficulties, and seizures	7–30 days	May lead to permanent neurological symptoms	Canada, USA, Russia. In U.S., mostly in Minnesota and Wisconsin and in northeastern States north of North Carolina	Unk

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Table 1. Description of Arboviruses (continued)

Disease	Vector(s)	Common Symptoms	Incubation Period	Duration of Symptoms	Geographic Distribution	Does Infection Provide Lifelong Immunity?
St. Louis Encephalitis	Mosquito; *Culex* species	Asymptomatic or mild non-specific flu-like symptoms in most cases; fever, headache, stiff neck, disorientation, and altered level of consciousness	5–15 days		North and South America. Periodic outbreaks along the Mississippi Valley and along the Gulf Coast	Yes
Tick-borne Encephalitis	Ticks: *Ixodes scapularis*, Ixodes ricinus, and Ixodes persulcatus; also caused by unpasteurized dairy products from infected goats, sheep, or cows	Fever, headache, muscle pain, nausea, vomiting, meningitis, and encephalitis	7–14 days		Eastern Europe and Southern Russia	Yes
West Nile Encephalitis	*Culex* mosquitoes	Asymptomatic in most cases; fever, headache, fatigue, nausea, vomiting, rash	2–15 days	3–6 days	North America, Europe, West and Central Asia, Oceania, and Africa	Yes
Western Equine Encephalitis	Mosquito; *Culex tarsalis*	Asymptomatic or mild non-specific flu-like symptoms in most cases; fever, headache, stiff neck, vomiting, or weakness	5–15 days	About 50% of surviving infants have permanent brain damage. Fatal in 5–15% of cases.	North and South America. In U.S., occurs mostly in States bordering the Mississippi River and States along the east coast	Yes

For more information on vectors, please visit http://www.wrbu.org/index.html