



Just the Facts...

Tick-Borne Encephalitis

What is tick-borne encephalitis (TBE)?

Tick-borne encephalitis (TBE) is a serious disease of humans that affects the central nervous system. It is transmitted by certain species of ticks in the genus *Ixodes*. In different regions, TBE goes by a variety of names, including Central European TBE, Far Eastern TBE, Russian spring-summer encephalitis, viral meningoencephalitis, biphasic meningoencephalitis and diphasic milk fever.

What is the infectious agent that causes TBE?

TBE is caused by the tick-borne encephalitis virus (TBEV), a member of the family Flaviviridae. TBEV was initially isolated in 1937. There are three subtypes of TBEV: Central European, Far Eastern, and Siberian.

How do people get TBE?

Humans acquire TBE almost exclusively by the bite of an infected tick, but also, rarely, by consumption of unpasteurized dairy products (especially raw milk from sheep and goats). Person-to-person transmission has not been reported. Transmission from mother to fetus has rarely occurred. Infection with TBEV confers lifelong immunity.

Which ticks transmit TBEV?

Two species of ticks are the primary vectors (transmitters) of the TBE virus: *Ixodes ricinus* (castor bean or European sheep tick) in Central and Western Europe, and *Ixodes persulcatus* in Russia and the Far East. These ticks also act as reservoirs



Distribution map of central European (orange) and both Far Eastern/Siberian (pink) TBEV subtypes, with overlap (red). (International Scientific Working Group on TBE, 2006)

the area between latitudes 39-65 degrees, extending from western France to the island of Hokkaido in Japan. The tick vector species, and the associated TBEV subtypes that they carry, overlap in Eastern Europe (see map). The tick vectors are most active in warm, moist conditions; thus, there are two peaks of disease in Central Europe: May/June and September/October. In cooler climates there is a single peak in the summer.

How common is TBE?

The countries most heavily impacted by TBE include Austria, Belarus, the Czech Republic, Estonia, Germany, Hungary, Latvia, Lithuania, Poland, Romania, Russia, Slovenia, Slovakia, Sweden, Switzerland, and the Ukraine. Among these, Latvia is considered the TBE-endemic country with the highest incidence in the world, while Russia reports the largest number of cases at several thousand per year. Reliability of reporting varies, and overall, the disease is thought to be under-reported.

What are the symptoms of TBE?

The incubation period for TBE is usually 7-14 days. The disease then progresses in a biphasic (two-phase) pattern. The initial, mild phase (known as the viremic phase) lasts 2-4 days and is marked by non-specific flu-like symptoms that may include fever, headache, fatigue, muscle aches, nausea, vomiting, and general malaise. After an asymptomatic (symptom-free) period of about 8 days, the second phase (known as the neurologic phase) of the disease occurs in 20-30% of patients and involves the central nervous system. These symptoms are more severe, and are characterized by meningitis (inflammation of the meninges: membranes that surround the brain and spinal cord, resulting in high fever, severe headache, stiff neck), encephalitis (inflammation of the brain, resulting in drowsiness, confusion, sensory disturbances, and/or motor abnormalities such as paralysis), or meningoencephalitis (a combination of both conditions).



Ixodes ricinus, from right to left: Adults (female and male), nymph, larva
Photo: Fedor Gassner, Wageningen Universiteit

for the virus because they maintain, and can therefore transmit, infection throughout their whole life. Their life cycle generally takes two years and involves four developmental stages: egg, larva, nymph, and adult. Once a tick is infected by feeding on an infected host animal, usually a rodent, such as a mouse, it maintains the infection both transtadially (from larva to nymph to adult stage) and transovarially (from adult female to her eggs). Humans are accidental hosts. The ticks also feed on larger animals such as deer, but these animals do not play a role in maintenance of the virus.

Where and when does TBE occur?

TBE occurs in temperate regions of Europe and Asia where the specific tick vectors are established. This encompasses

Are there any complications and is TBE ever fatal?

The European form of TBE tends to be milder than the Far Eastern subtypes, with a mortality rate of 1-2%. Mortality rates as high as 20-40% have been reported during some outbreaks of the Far Eastern/Siberian subtypes. In patients who progress to the second phase of disease, the convalescent period can be long and can result in long-term or permanent neurologic damage.

How is TBE diagnosed?

Blood tests are used to diagnose TBE. During the first phase of the disease, the most common laboratory abnormalities are a low white blood cell count (leucopenia) and a low platelet count (thrombocytopenia). After the onset of neurologic disease during the second phase, an increase in the number of white blood cells in the blood and the cerebrospinal fluid (CSF) is found. TBEV can be isolated from the blood during the first phase of the disease. Specific diagnosis usually depends on detection of specific IgM antibodies in either blood or CSF during the second phase of the disease.

How is TBE treated?

There is no specific drug therapy for TBE. Meningitis, encephalitis, or meningoencephalitis require hospitalization and supportive care based on the severity of the symptoms. Anti-inflammatory drugs, such as corticosteroids, may be considered under specific circumstances for symptomatic relief. Intubation and ventilatory support may be necessary.

Who is at risk for TBEV infection?

In endemic areas (regions where the disease is established), people who have recreational or occupational exposure to rural or outdoor settings (e.g. hunters, campers, forest workers, farmers) are at risk for infection by contact with infected ticks. Exposure is most likely to occur in locations with high grass, weeds, or brush near forested areas. The disease is seldom found in urban areas. Tourists, and military personnel, traveling or deployed to such disease-endemic regions may also be at risk.

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How can TBE be prevented?

A vaccine is available in some disease endemic countries, but not in the United States. Prevention centers on individual action to avoid tick bites. When in tick habitat (tall grass and weeds, scrubby areas, woods and leaf litter), follow these precautions:

- Examine your clothing and body frequently, and **remove any attached ticks immediately**. Use tweezers to firmly grasp the tick's mouthparts up against the skin, and pull back firmly and steadily. After removal, wash the wound site and apply an antiseptic. See a physician immediately if you develop disease symptoms.
- Wear proper clothing as a physical barrier against ticks – long pants tucked into boots or tightly-woven socks; long sleeve shirt; shirt tucked into pants; and light-colored clothing so as to more easily spot ticks.
- Use both skin and clothing repellents that have been approved by the Environmental Protection Agency (EPA). They are safe and effective.
 - For your skin, use a product that contains 20-50% **DEET** (N,N-diethyl-meta-toluamide). **DEET** in higher concentrations is no more effective.
 - Apply **DEET** lightly and evenly to exposed skin; do not use underneath clothing. Avoid contact with eyes, lips, and broken or irritated skin.
 - To apply to your face, first dispense a small amount of **DEET** onto your hands and then carefully spread a thin layer.
 - Use **DEET** sparingly on children, and don't apply to their hands, which they often place in their eyes and mouths.
 - Wash **DEET** off when your exposure to ticks, mosquitoes, and other arthropods ceases.
- For your clothing, use a product that contains **permethrin**. **Permethrin-treated clothing is especially effective against ticks.** **Permethrin** is available commercially as 0.5% spray formulations. Clothing that is factory-impregnated with permethrin may also be purchased commercially. Permethrin will withstand numerous launderings.
 - **Permethrin** should only be used on clothing, never on skin.
- When using any insect repellent, always FOLLOW LABEL DIRECTIONS.
- Do not inhale aerosol formulations.

• For optimum protection, soldiers should utilize the **DOD INSECT REPELLENT SYSTEM**. In addition to proper wear of the field uniform (ACUs, BDUs, DCUs)(pants tucked into boots, sleeves down, undershirt tucked into pants), this system includes the concurrent use of both skin and clothing repellents:

- Standard military skin repellent: 33% **DEET** lotion, long-acting formulation, one application lasts up to 12 hours, **NSN 6840-01-284-3982**.
- Standard military clothing repellents: either aerosol spray, 0.5% **permethrin**, one application lasts through 5-6 washes, **NSN 6840-01-278-1336**; or impregnation kit, 40% **permethrin**, one application lasts the life of the uniform (at least 50 washes), **NSN 6840-01-345-0237**. Factory permethrin-treated ACUs are also available via contract [Contact the Armed Forces Pest Management Board (AFPMB) for details, DSN 295-7476; CM (301) 295-7476].

