Tick-borne encephalities

Last update: 2025-07-09

Key facts

To better understand public health terms included in this Disease Tool (e.g. What is a case definition? or What is an infectious agent?), consult our page on Key concepts in epidemiology.

Importance

Tick-borne encephalitis (TBE) is a viral infection of the central nervous system occurring occurring in eastern, central, northern and increasingly western European countries, and in northern China, Mongolia, and the Russian Federation. The causative pathogen, Tick-borne encephalitis virus, is a member of the viral family Flaviviridae.

About 10,000 – 12,000 cases are reported each year, but this estimation is believed to be significantly lower than the actual total number of clinical cases. Most of these infections result from bites of infected ticks, which often remain firmly attached to the skin for days. On rare occasions, infection can result from consumption of unpasteurized milk from infected goats, sheep or cows.

TBE is a growing public health challenge in Europe and other parts of the world, with about 400% increase in the number of human cases in the last 30 years in all endemic regions of Europe, spread of the risk areas and newly discovered foci.

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Case definition

A **case definition** is a set of uniform criteria used to define a disease for public health surveillance. It enables public health officials to classify and count cases consistently.

The following are standard case definitions to allow national health authorities to interpret data in an international context. However, during an outbreak case definitions may be adapted to the local context and the Red Cross Red Crescent should use those agreed/established by national health authorities. NB: Consider that during community-based surveillance, ***volunteers*** *should use broad (simplified) case definitions (referred to as community case definitions) to recognize most or all possible cases, provide relevant risk communication and appropriate actions and encourage them to seek care. Other actors such as* ***healthcare workers or investigators*** *studying the cause of a disease, on the other hand, can use more specific case definitions that may require laboratory confirmation.*

Case definition

Clinical Criteria

An individual with symptoms of inflammation of the central nervous system including:

- Meningitis
- Meningoencephalitis
- Encephalomyelitis
- Encephaloradiculitis

Laboratory Criteria

Laboratory criteria for a probable case:

- Detection of TBE-specific IgM-antibodies in a unique serum sample

Laboratory criteria for case confirmation - at least one of the following five:

- Detection of TBE specific IgM AND IgG antibodies in blood
- Detection of TBE specific IgM antibodies in CSF
- Seroconversion or four-fold increase of TBE-specific antibodies in paired serum samples
- Detection of TBE viral nucleic acid in a clinical specimen,
- Isolation of TBE virus from clinical specimen

Case Classification

1. Probable case - An individual meeting the clinical and the laboratory criteria for a probable case, OR An individual meeting the clinical criteria with an epidemiological link
2. Confirmed case - An individual meeting the clinical and laboratory criteria for case confirmation

Note: Serological results should be interpreted according to previous exposure to other flaviviral infections and the flavivirus vaccination status. Confirmed cases in such situations should be validated by serum neutralization assay or other equivalent assays.

https://www.ecdc.europa.eu/en/tick-borne-encephalitis/facts/factsheet

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Alert / epidemic threshold

An **alert threshold** is the pre-defined number of alerts that suggest the beginning of a possible disease outbreak and therefore warrant immediate notification.
Epidemic thresholds are the minimum number of cases indicating the beginning of a particular disease's outbreak.

Single case

Risk factors

- In endemic areas, people with recreational or occupational outdoor activities (e.g. hunting, fishing, camping, collecting mushrooms and berries, forestry, farming, military training) are potentially at risk of infection due to possible proximity to infected ticks.
- Travelling to endemic communities during the warmer spring and summer months.

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Attack rate (AR)

The **attack rate** is the risk of getting a disease during a specific time period (such as during an outbreak).

Attack rates will vary from one outbreak to another. In case of an outbreak, consult the latest information provided by health authorities.

- Generally low and depends on the type of exposure

Groups at increased risk of severe illness (most vulnerable)

- Older people

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Infectious agent

Infectious agents are bacteria, viruses, fungi, prions and parasites. A disease caused by an infectious agent or its toxic products is defined as an infectious disease.

TBE is a viral infectious disease of the central nervous system that can result in long-term neurological symptoms, and even death. It is caused by a virus (*Flavivirus* genus, family Flaviviridae) with three subtypes:

- European subtype - transmitted by the *Ixodes ricinu*s ticks and endemic in rural and forested areas of the central, eastern and northern Europe;
- Far eastern subtype - transmitted mainly by *I. persulcatus* and endemic in far-eastern Russia and in forested regions of China and Japan; and
- Siberian subtype - transmitted by *I. persulcatus* and endemic in the Urals region, Siberia and far-eastern Russia, and also in some areas in north-eastern Europe.

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Reservoir / host

A **reservoir of infection** is a living organism or material in or on which an infectious agent lives and/or usually multiplies. Reservoirs include humans, animals and the environment.

A **susceptible host** is a person at risk of being infected. The level of susceptibility depends on age, sex, ethnicity and genetic factors, specific immunity also depends on other factors that affect an individual's ability to resist infection or to limit its ability to cause infection.

A **zoonotic disease** or **zoonosis** is an infectious disease that has jumped from a non-human animal to humans.

> Competent reservoirs/hosts of TBE virus are mainly small rodents (voles, mice), and insectivores and carnivores. Different species of wild and domestic mammals, including foxes, bats, hares, deer, wild boar, sheep, cattle, goats, dogs, also support virus circulation indirectly as indicator hosts by enabling tick multiplication. Humans are accidental and dead-end hosts.

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How disease is spread (modes of transmission)

Categorisation of **modes of transmission** varies from one agency to another. In addition, some infectious agents can be transmitted by more than one mode. A list of modes of transmission can be found in the key concepts to serve as guidance to better understand the diseases included in this website.

> The TBE virus is transmitted by the bite of infected ticks. The infection can also be transmitted through the consumption of infected unpasteurised dairy products. There is no human-to-human transmission, apart from the possibility of transmission from an infected mother to a child during breastfeeding. Laboratory accidents from needle-stick injuries as well as aerosol infection have also been reported.

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Incubation period

This time from when infection occurs to the onset of symptoms is called the **incubation period**. It is a range of days and it can be different for each disease.

> 2–28 days (most commonly 7–14 days) for infections from tick bites.
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> The incubation after foodborne infection is usually shorter, around four days.

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Period of infectiousness

Period of infectiousness is the time interval during which an infected person can transmit the infection to other susceptible persons.

> Humans are not infectious.

Clinical signs and symptoms

Most infections are asymptomatic.

In clinical cases, TBE often has a biphasic course. The first viremic phase lasts for approximately five (range 2–10) days, and is associated with non-specific symptoms including fever of ≥38 °C, fatigue, headache, myalgia, malaise, anorexia and nausea.

This phase is followed by an asymptomatic period lasting seven (range 1–33) days and subsequently, the second phase. The second phase is associated with fever frequently exceeding 40°C and signs of the central nervous system's involvement such as seizures, photophobia, headache, stiff neck drowsiness, confusion, sensory disturbances, paralysis, etc. Other symptoms include altered mental status, cognitive dysfunction, difficulty walking, etc.

The European subtype often results in milder disease, with 20–30% of patients experiencing the second phase, mortality rates of 0.5–2%, and severe neurological sequelae in up to 10% of patients. The second phase of the illness is usually limited to meningitis for children. However, adults older than 40 years are at increased risk of developing encephalitis, with higher mortality and long-lasting sequelae in adults over the age of 60.

The Far Eastern subtype typically results in more severe disease: monophasic illness, with no asymptomatic interval prior to the onset of neurological disease, mortality rates of up to 35%, and higher rates of severe neurological sequelae.

The Siberian subtype is associated with a less severe disease (fatality rate of 1–3%), with a tendency for patients to develop chronic or extremely prolonged infections.

https://www.nhs.uk/conditions/tick-borne-encephalitis/

Other diseases with similar clinical signs and symptoms

Other similar arboviruses include West Nile, Usutu, and Japanese encephalitis viruses. In patients with known exposure to ticks, other tick-borne diseases might be considered, including Lyme borreliosis.

Diagnosis

- The diagnosis of TBE is based on the detection of specific IgM antibodies in cerebrospinal fluid and/or serum, mainly by ELISA.
- Detection by detection of viral RNA by reverse transcription-polymerase chain reaction (RT-PCR) can also be used for an early differential diagnosis of TBE.
- Virus isolation using cerebrospinal fluid or serum samples, especially for immunocompromised patients.

Vaccine or treatment

Please refer to the appropriate local or international guidelines for clinical management. All clinical management including the administration of a treatment or vaccine should be conducted

by a health professional.

- There is no specific treatment for tick-borne encephalitis. Treatment relies on supportive management.
- Immunization offers the most effective protection.

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Immunity

There are two types of immunity:
- **Active immunity** results when exposure to an agent triggers the immune system to produce antibodies to that disease.
- **Passive immunity** is provided when a person is given antibodies to a disease rather than producing them through his or her own immune system.

Specific IgM antibodies can persist for up to 10 months in vaccines or individuals who acquired the infection naturally.

Which interventions are most effective for prevention and control?

The following is a list of activities considered for Red Cross Red Crescent volunteers to take part in. It is not an exhaustive list of all prevention and control activities for the specific disease.

- Communicate risks about the disease or epidemic, not only to share information on prevention and mitigation measures, but also to encourage informed decision-making, positive behaviour change and maintenance of trust in the Red Cross Red Crescent response. This includes the identification of rumours and misinformation around disease—frequent during health emergencies—to manage them appropriately. Volunteers should use the most context-appropriate communication techniques (ranging from social media to face-to-face interactions).
- Community education and engagement activities to encourage the adoption of protective behaviours including:
  - wearing appropriate clothing, including long sleeves, long trousers and closed footwear, when hiking or camping in countries or areas at risk;
  - application of tick repellents;
  - avoiding wooded and brushy areas in places where TBE is endemic;
  - daily inspection of the whole body and prompt removal of any attached ticks using tweezers or forceps;
  - the consumption of unpasteurized dairy products should also be avoided;
  - In rare cases, TBE virus can be transmitted through blood transfusion or solid organ transplantation. Hence, infected persons should not donate blood for 120 days (4 months) after their illness. Also, any case of TBE virus transmission via/associated with blood transfusion or solid organ transplantation should be reported promptly to the appropriate state health department.
- Social mobilization to support vaccination efforts in endemic areas, where possible. This includes extensive Information, Education and Communication (IEC) activities on the benefits of the vaccines, vaccination

schedules and where/when to get the vaccines.

Epidemic characteristics and RCRC indicators and targets

The first table below includes data that should be gathered from health authorities and relevant non-governmental actors to understand the progress and characteristics of the epidemic in the specific country and area of intervention. The second table includes a list of suggested indicators that can be used for monitoring and evaluating Red Cross Red Crescent activities; wording of indicators may be adapted to specific contexts. Target values for a specific indicator can vary widely from one context to another and therefore managers should define them based on the specific population, area of intervention and programmatic capacity. Exceptionally, some indicators in this website may include target values when these are globally agreed as a standard; e.g. 80 per cent of individuals who slept under an insecticide-treated net (ITN) the previous night—the normative World Health Organization benchmark for universal coverage with ITNs.

Epidemic characteristics and progression
Suspected cases per week (disaggregate by age, sex)
Confirmed cases per week (disaggregate by age, sex)
Case fatality rate

Indicators for Red Cross Red Crescent activities
Number of volunteers trained on a specific topic (e.g. Epidemic Control for Volunteers (ECV); Community-based surveillance (CBS); WASH training; CBHFA training, etc.) ***Numerator*:** Number of volunteers trained Source of information: Training attendance sheets
Suspect cases detected by volunteers who were encouraged to seek healthcare and who arrived at a health facility ***Numerator:*** TBE suspect cases detected by volunteers in a determined period preceding this survey (e.g. two weeks) for whom advice or treatment was sought from a health facility ***Denominator:*** Total number of people who are TBE suspect cases in the same period preceding the survey Source of information: Survey

Indicators for Red Cross Red Crescent activities
Percentage of people recognizing at least one transmission route and at least one measure for preventing it ***Numerator*:** Total number of people who recognized at least one transmission route and at least one measure for preventing it during the survey ***Denominator*:** Total number of people surveyed Source of information: Survey
Percentage of people who know the cause, symptoms, treatment or preventive measures ***Numerator*:** Number of people who cite the cause, symptoms, treatment or preventive measures ***Denominator*:** Number of people surveyed

See also:

- For Community Engagement and Accountability (CEA) indicators for activities accompanying ECV actions, please refer to:

IFRC *CEA toolkit (Tool 7.1: Template CEA logframe, activities and indicators).* Available at: https://www.ifrc.org/document/cea-toolkit

- For community-based surveillance guidance please see:

IFRC, Norwegian Red Cross, Croix-Rouge de Belgique (2022), *Community Based Surveillance Resources*. Available at: www.cbsrc.org/resources.

Impact on other sectors

Sector	Link to the disease
WASH	Routine sanitation, clearing vegetation and maintaining cleanliness around living areas can reduce tick habitats and exposure.
Food security	The infection can be transmitted through the consumption of infected unpasteurised milk or dairy products. Thorough pasteurisation and preservation of milk or dairy products will prevent TBE.
Nutrition	Tick-borne encephalitis can indirectly affect nutrition by increasing nutritional needs in the affected person and reducing the ability to limiting work, gather food, or care for livestock—impacting household food security

Sector	Link to the disease
Shelter and settlements (including household items)	Housing located close to forests and vegetation are at risk of tick infestation, subsequently leading to TBE infection.
Psychosocial support and Mental health	TBE can have several negative impacts on psychological, social and emotional aspects of a person's life, particularly the long-term sequelae. This includes "anxiety, depression, panic attacks, hallucinations, delusions, and pain—ranging from headaches to neck stiffness and arthritis". https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9323096/
Sex and Gender	In areas where tick-borne encephalitis (TBE) is present, men and women are often exposed in different ways due to their daily routines and livelihoods. Men are more likely to work in forestry, farming, or outdoor occupations that increase contact with ticks, while women may be at risk through activities like collecting firewood, farming, or caring for livestock near tick-infested areas. Despite these risks, women are often less likely to receive targeted information or training on prevention and early symptoms. To reduce the spread of TBE and ensure early care-seeking, it's important to provide both men and women with gender-sensitive health messaging, protective tools, and access to healthcare services tailored to their specific risks and roles.
Education	Importantly, schools and other facilities dedicated to children and youth can offer an important space for them to engage, mobilize and raise awareness around health education issues. With support, trust and appropriate capacity-building, young people can be effective advocates for the adoption of preventive measures during an epidemic and are those best placed to mobilize their peers.
Livelihoods	Humans generally acquire the disease via tick bites and contaminated dairy products. Control in cattle is therefore the key to reducing incidence. Livelihoods based on cattle breeding or dairy products can be significantly affected during outbreaks (quarantine of herds, slaughtering of livestock). Another impact on livelihoods is the reduction in work activity and to the diversion of resources to seek medical treatment when sick, particularly for patients with severe forms of TBE and long-term sequelae.

Resources:

- ECDC. (2024). *Fact sheet about tick-borne encephalitis (TBE)*. Available at: https://www.ecdc.europa.eu/en/tick-borne-encephalitis/facts/factsheet
- WHO. (2024). *Tick-borne encephalitis*. Available at: https://www.who.int/health-topics/tick-borne-encephalitis#tab=tab_3
- CDC. (2024) *Treatment and Prevention of Tick-borne Encephalitis*. Available at: https://www.cdc.gov/tick-borne-encephalitis/hcp/treatment-prevention/index.html