

PUBLIC HEALTH REFERENCE SHEET

Relapsing Fever



Name	<i>Borrelia</i> species
Reservoir & Transmission	Humans or wild rodents Tick-borne relapsing fever (TBRF) also called soft tick relapsing fever (STRF): bite of infected soft ticks of the genus <i>Ornithodoros</i> Louse-borne relapsing fever (LBRF): human-to-human by body louse <i>Pediculus humanus humanus</i> Hard tick relapsing fever (HTRF): also called <i>Borrelia miyamotoi</i> disease: bite of infected blacklegged tick (“deer” tick) (<i>Ixodes scapularis</i>) or Western blacklegged tick (<i>Ixodes pacificus</i>)
Incubation Period	TBRF/STRF: 7 days (range 2–18 days) LBRF: 4 to 8 days (range 5–15 days)
Common Symptoms	High fever, headache, muscle and joint aches, or nausea
Gold Standard Diagnostic Test	Microscopic identification
Risk Groups	TBRF/STRF: staying in rodent or tick-infested cabins LBRF: living in crowded and poor sanitary conditions HTRF: exposed to blacklegged ticks
Geographic Significance	TBRF/STRF: Western United States, in Texas, linked to cave exposures; Western Europe; Middle East; Africa; and Central Asia LBRF: sub-Saharan Africa, Ethiopia, Sudan, Eritrea, Somalia HTRF: In the same places where Lyme disease is found in U.S.: northeastern, mid-Atlantic, upper midwestern States

What is relapsing fever?

Relapsing fever is a bacterial infection. There are three types of relapsing fever:

- Tick-borne relapsing fever (TBRF) also known as soft tick relapsing fever (STRF)
 - Caused by species of *Borrelia*, gram negative bacteria, found in “soft ticks” of genus *Ornithodoros* (*hermsii*; *parkeri*; *turicatae*). The most common is *Borrelia hermsii*.
- Louse-borne relapsing fever (LBRF)
 - Caused by *Borrelia recurrentis*, a spiral-shaped bacteria, transmitted from human-to-human.
- Hard tick relapsing fever (HTRF): *Borrelia miyamotoi* disease
 - A type of spiral shaped bacteria that is closely related to the bacteria that causes TBRF/STRF and more distantly related to the bacteria that causes Lyme disease.

Relapsing fever spirochetes have a unique process of DNA rearrangement that allows them to periodically change the molecules on their outer surface. This process, called antigenic variation, allows the spirochete to evade the host immune system and cause relapsing episodes of fever and other symptoms.

What is the occurrence of relapsing fever?

TBRF/STRF is a rare infection. In the U.S., TBRF/STRF occurs most commonly in 14 western states: Arizona, California, Colorado, Idaho, Kansas, Montana, Nevada, New Mexico, Oklahoma, Oregon, Texas, Utah, Washington, and Wyoming. From 1990 to 2011, 483 cases of TBRF/STRF were reported in the western U.S., with infections most frequently transmitted in California, Washington, and Colorado. Most cases occur in the summer months when sleeping

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in rodent-infested cabins. In the winter months, fires started to warm a cabin can activate ticks resting in the walls and woodwork.

LBRF causes sporadic illness and outbreaks in sub-Saharan Africa, particularly in regions affected by war and in refugee camps. LBRF is commonly found in Ethiopia, Sudan, Eritrea, and Somalia. Illness can be severe, with mortality of 30% to 70% in outbreaks.

HTRF (*B. miyamotoi* disease) is relatively rare in the U.S.

How is relapsing fever transmitted?

TBRF/STRF is spread by three tick species, each of which has a preferred habitat and set of hosts. *Ornithodoros hermsi*, the tick responsible for most cases in the U.S., prefers coniferous forests at altitudes of 1,500 to 8,000 feet where it feeds on tree squirrels and chipmunks. The *O. parkeri* and *O. turicata* species are generally found at lower altitudes in the Southwest where they inhabit caves and the burrows of ground squirrels, prairie dogs, and burrowing owls. Humans typically come into contact with soft ticks when they sleep in rodent-infested cabins. The ticks emerge at night and feed briefly while the person is sleeping. The bites are painless. Between meals, the ticks may return to the nesting materials in their host burrows.

LBRF is a vector-borne disease caused by the spiral-shaped bacteria *Borrelia recurrentis*, a human-restricted pathogen transmitted by the body louse *Pediculus humanus humanus*.

HTRF (*B. miyamotoi* disease) is transmitted by two types of North American ticks, the blacklegged or “deer” tick (*Ixodes scapularis*) and the Western blacklegged tick (*Ixodes pacificus*), which also spread the germs that cause several diseases, including Lyme disease and anaplasmosis.

Who is at risk for relapsing fever?

TBRF/STRF is found in discrete areas throughout the world, including mountainous areas of North America, plateau regions of Mexico, Central and South America, the Mediterranean, Central Asia, and much of Africa. People become exposed when they sleep in cabins and other rustic buildings in which rodents have built nests. These nests are usually located inside the walls or in the attic or crawl space. Soft ticks can live up to 10 years; in certain parts of Russia, the same tick has been found to live almost 20 years. Individual ticks will take many blood meals during each stage of their life cycle, and some species can pass the infection along through their eggs to their offspring. Given the long-life span of soft ticks, once a cabin or homestead is infested, it may remain infested unless the rodent nest is removed.

LBRF: Persons living in crowded and poor sanitary conditions.

HTRF (*B. miyamotoi* disease): Persons exposed to blacklegged ticks.

What are the signs and symptoms of relapsing fever?

In general, relapsing fever is an illness characterized by high fever, headache, muscle and joint aches, or nausea. Fever typically lasts 2 to 9 days and alternates with afebrile periods of 2 to 4 days. The total number of relapses varies from a single incident to over 10.

TBRF/STRF: Non-specific symptoms include high fever (e.g., 103°F), headache, and muscle and joint aches. Symptoms can reoccur, producing a telltale pattern of fever lasting roughly 3 days, followed by 7 days without fever, followed by another 3 days of fever. Without antibiotic

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treatment, this process can repeat several times. Patients typically appear moderately ill and may be dehydrated. Occasionally, a macular rash or scattered petechiae may be present on the trunk and extremities. Less frequently, patients may have jaundice, hepatosplenomegaly, meningismus, and/or photophobia. Although less common, infection with *B. turicatae* is especially likely to result in neurologic involvement.

LBRF: sudden onset of high fever, general malaise, chills, and/or sweats. May also include headache, meningism, myalgia/arthralgia and non-specific gastrointestinal symptoms (nausea and vomiting). Myocutaneous symptoms include conjunctival injection, scattered petechiae, and erythematous rash. Cardio-respiratory symptoms such as tachycardia, mild tachypnea, and non-productive cough can occur. Patients may present with hepatomegaly and splenomegaly, with risk of splenic rupture. Neurological and ocular complications can occur, such as meningitis, meningoencephalitis, neuropathies and cranial-nerve palsy, iritis, and acute ophthalmitis. Hemorrhage is a common complication with epistaxis, blood-tinged sputum, and even central nervous system or gastrointestinal hemorrhage.

HTRF (*B. miyamotoi* disease): fever, chills, headache, body, and joint pain and fatigue. Fewer than 1 in 10 develop a rash.

What are the potential complications of relapsing fever?

TBRF/STRF: Long-term sequelae are rare but include iritis, uveitis, cranial nerve, and other neuropathies.

How is relapsing fever diagnosed?

TBRF/STRF and LBRF are usually diagnosed by microscopic identification of *Borrelia* from a sample of blood, especially obtained during the symptomatic febrile phase. With subsequent febrile episodes, the number of circulating spirochetes decreases, making it harder to detect spirochetes on a peripheral blood smear. Even during the initial episode, spirochetes will only be seen 70% of the time. *Borrelia* may be identified by intraperitoneal inoculation of laboratory rats or mice with blood or by blood culture.

HTRF (*B. miyamotoi* disease): Polymerase chain reaction (PCR) tests detect DNA from the bacteria. Serologic tests detect antibodies made by the human body in response to infection. The CDC provides laboratory diagnostic support at the request of state health departments.

How is relapsing fever treated?

Given appropriate treatment, most patients recover within a few days.

TBRF/STRF: The spirochetes are susceptible to penicillin and other beta-lactam antimicrobials, as well as tetracyclines, macrolides, and possibly fluoroquinolones. The CDC has not developed specific treatment guidelines for TBRF/STRF; however, in general, tetracycline 500mg every 6 hours for 10 days is the preferred oral regimen for adults. Erythromycin, 500mg (or 12.5 mg/kg) every 6 hours for 10 days is an effective alternative when tetracyclines are contraindicated. Parenteral therapy with ceftriaxone 2 grams per day for 10–14 days is preferred for patients with central nervous system involvement, similar to early neurologic Lyme disease. When in treatment, acute respiratory distress syndrome requiring intubation may occur.

LBRF: Medication options include a single dose of tetracycline, penicillin G, erythromycin, or chloramphenicol.

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Antibiotic treatment for TBRF/STRF or LBRF can induce a potentially severe or fatal Jarisch-Herxheimer reaction (JHR). This reaction is often observed a few hours after the first antibiotic treatment and follows two successive phases. These include the chill phase (rigours, high fever, anxiety or confusion, increasing metabolic rate) and the flush phase (decrease in temperature, drenching sweat, and significant decrease in arterial pressure and myocardial dysfunction requiring supportive care for monitoring fluid balance and arterial/venous pressure). JHR is a normal response to effective antibiotic therapy that will usually resolve in 24 hours; it does not, by itself, warrant discontinuing or changing antibiotics but should be differentiated from an allergic or hypersensitivity reaction.

HTRF (*B. miyamotoi* disease): a 2- to 4-week course of the antibiotic doxycycline. Amoxicillin and ceftriaxone have also been successfully used.

How can relapsing fever be prevented?

- Avoid sleeping in rodent-infested buildings. Although rodent nests may not be visible, other evidence of rodent activity (e.g., droppings) is a sign that a building may be infested. Large multistate outbreaks have been linked to rental cabins near national parks and other common vacation locations.
- Prevent tick bites. Use insect repellent containing DEET (on skin or clothing) or permethrin (applied to clothing or equipment).

What are some public health considerations?

- Document relevant travel and deployment history occurring within the incubation period (TBRF/STRF: 2–18 days; LBRF: 5–15 days).
- Document the circumstances under which the case patient was exposed including duty exposure, occupational activities, environmental exposures, or other high-risk activities.
 - Is there documented exposure to lice and/or ticks?

Prompt reporting of TBRF/STRF cases is required in at least 12 states: Arizona, California, Colorado, Idaho, Montana, North Dakota, Nevada, New Mexico, Oregon, Texas, Utah, and Washington.

MitTICK is a free tick testing and identification service available for ticks removed from Department of Defense (DoD) personnel and their dependents. For more information about services provided, including identifying tick species, assessing how long the tick has been attached, and testing the tick for human pathogens, as well as contact information, go to: <https://ph.health.mil/topics/envirohealth/epm/Pages/HumanTickTestKitProgram.aspx>.

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