

Soft Tick Relapsing Fever (STRF)

Borrelia hermsii, *B. parkeri*, *B. turicatae*

Investigative Guidelines (IG)

** This IG does NOT include Hard Tick Relapsing Fever (HTRF, caused by *Borrelia miyamotoi* and transmitted by *Ixodes pacificus*), nor Louse Borne Relapsing Fever (LBRF, caused by *Borrelia recurrentis* and transmitted by lice).

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1. DISEASE REPORTING

1.1 Purpose of Reporting and Surveillance

1. To identify cases and potential clusters of tickborne relapsing fever (STRF), including areas of exposure in Oregon and elsewhere.
2. To perform public health follow-up of reported cases, possibly including:
 - remediation measures when a tick-infested property is identified
 - identification of persons with a shared exposure history to facilitate early diagnosis and treatment, and
 - prophylaxis for exposed pregnant women.
3. To describe the epidemiology of STRF in Oregon so as to inform clinicians and to facilitate prevention through targeted educational efforts and follow up with STRF cases.

1.2 Laboratory and Physician Reporting Requirements – Reportable within One Public Health Working Day

Physicians and others providing health care must report confirmed or suspected cases to the local public health authority within one public health working day. More specifically, any of the following should be reported:

1. Clinical diagnosis of STRF
2. Detection of antibodies to *Borrelia hermsii*, *B. parkeri* or *B. turicatae* in cerebrospinal fluid or serum by enzyme immunoassay (EIA) or immunofluorescent antibody (IFA) or Western immunoblot testing.
4. Identification of *Borrelia hermsii*, *B. parkeri*, or *B. turicatae* in culture of a clinical specimen.
5. Detection of *Borrelia hermsii*, *B. parkeri*, or *B. turicatae* nucleic acid in a clinical specimen (e.g., by polymerase chain reaction [PCR] testing).

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1.3 Local Public Health Authority Reporting and Follow-up Responsibilities

1. Begin follow-up investigation within one working day and enter the relevant data in Orpheus. Please notify via case creation in Orpheus or contact OHA's Acute and Communicable Disease Prevention section (ACDP) STRF epidemiologist if you receive a report of *Borrelia hermsii*, *Borrelia parkeri*, or *Borrelia turicatae* infection. Always ask about knowledge of others with same exposures, e.g., a family member who stayed at the same cabin, with similar symptoms, even in months or years prior.
2. If the diagnosis is not confirmed, secure any already-obtained acute serum and EDTA whole blood for testing at CDC, along with subsequently obtained convalescent serum. Serology *can* be useful for surveillance; however, antibody response may not be detectable in acute samples. A negative test result may be repeated if early in disease. Antibodies stimulated by other *Borrelia* spp. infections (e.g., *B. miyamotoi*, which is also endemic to Oregon but transmitted by *Ixodes pacificus*, the same tick that transmits Lyme disease) are expected to cross-react on **STRF** serologic assays. The vast majority of Oregon's STRF cases occur on the east side of the Cascades in high-elevation (>1,500 feet) dwellings, where it is unlikely to encounter *Ixodes pacificus*, which transmits Lyme disease and *Borrelia miyamotoi*. If the suspect case had non-specific serology with symptoms such as fever (sometime relapsing), chills, muscle aches, fatigue, joint pain and headaches and had no exposures that include >1,500 feet elevation, but with other potential tick exposures in areas where Lyme disease is likely to occur (mainly on the west side of the Cascades), then this would be a good scenario to pursue PCR testing at CDC. Likewise, tests for other spirochetal infections (e.g., Lyme disease) may be falsely positive in a patient infected with relapsing fever *Borrelia* spp. Epidemiological information including exposure history is crucial to differentiate positive serology results. Please consult with ACDP **STRF** epidemiologist when in doubt about interpreting **STRF** serology or needing investigation assistance.

The following is a non-exhaustive summary of testing options; bottom line is to work with STRF epi at OHA to arrange for testing at CDC, which has the gold standard test for distinguishing among the *Borrelia* species. The most important step for the LHA is to obtain acute EDTA whole blood or serum ASAP and to work with STRF epi at OHA to coordinate with OSPHL in having blood or serum sent to CDC for confirmatory testing.

- CDC's PCR detects and differentiates all known relapsing fever *Borrelia*: *B. miyamotoi*, *B. turicatae*, *B. parkeri*, *B. miyamotoi*, and *B. recurrentis*. The optimal specimen is acute EDTA whole blood, but serum is adequate. Work with STRF epidemiologist, who will coordinate with OSPHL to send specimens to CDC. CDC's Test Directory with submission instruction for human specimens:

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[Test Directory | Submitting Specimens to CDC | Infectious Diseases Laboratories | CDC](#)

- www.cdc.gov/laboratory/specimen-submission/detail.html?CDCTestCode=CDC-10532
- Borrelia Molecular Detection - Relapsing Fever CDC-10532
- ARUP has a PCR assay to detect Relapsing Fever *Borrelia* species. It does not differentiate species, but will detect *B. miyamotoi*, and it does not cross-react with *B. burgdorferi*
- Imugen (Quest) has a PCR assay to detect *Borrelia* species and a PCR to detect *B. miyamotoi* (specific)
- The Mayo Clinic has a PCR assay to detect *B. miyamotoi*
- Less reliable:
 - CDC has a serological test that detects IgM/IgG antibodies to *B. hermsii*, but it's expected to cross-react with other relapsing fever species, possibly including *B. miyamotoi*.
 - Imugen (Quest) detects IgG antibody to *B. miyamotoi* by ELISA & IgM/IgG to *B. miyamotoi* protein (GlpQ). Recommend specimens be at least 3 weeks out (convalescent only).
 - IGeneX detects IgM/IgG antibodies specific to relapsing fevers (*B. hermsii*, other potential pathogenic [and maybe not pathogenic] species, and including *B. miyamotoi*). It's essential to obtain an accurate onset date, exposure history, and clinical symptom data before interpreting IGeneX results for STRF, which are generally associated with chronic disease; STRF is not a chronic disease. Mark case status as suspect in Orpheus, pending follow up of clinical information and exposure history.

2. THE DISEASE AND ITS EPIDEMIOLOGY

2.1 Etiologic Agent

1. Infecting *Borrelia* species

STRF is an illness caused by infection with some members of the genus *Borrelia*, including *Borrelia hermsii*, *Borrelia parkeri*, and *Borrelia turicatae* (1-4). *Borrelia* spirochetes that cause STRF are transmitted to humans through the bite of infected soft ticks of the genus *Ornithodoros* (2-4). Each relapsing fever-group *Borrelia* species is usually associated with a specific tick species: *B. hermsii* is transmitted by *O. hermsi*, *B. parkeri* is transmitted by *O. parkeri*, and *B. turicatae* by *O. turicata* ticks (1-4). In Oregon, *B. hermsii* is transmitted by *O. hermsi* and is maintained in enzootic cycles involving small rodent hosts (5,6).

2. Tick vectors

For STRF infections, tick exposures are not commonly or easily recognized, the vectors for these species are nesting “soft ticks” of the genus *Ornithodoros*. Most people don't know they were bitten by a tick – *Ornithodoros hermsi* does not attach to its host for very long, sometimes

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minutes, and can sometimes be found caught in bed sheets or sleeping bags. It's important to ask about camping out in the woods or staying in remote cabins, as well as inquiring about rodent activity nearby, e.g., squirrels, chipmunks, rodent droppings in cabins, etc.

a. *O. hermsi* (which transmits *Borrelia hermsii*), the tick responsible for most cases in the United States, is indigenous to Oregon and is the vector for most cases here. It prefers coniferous forests at altitudes of 1500–8000 feet and in Oregon is most often found east of the Cascades Mountain range, where it primarily feeds on tree squirrels and chipmunks; however, any warm-blooded animal, including humans, is fair game.

b. *O. parkeri* (which transmits *B. parkeri*) is found at lower elevations in the U.S. Southwest and inhabits burrows of prairie dogs, ground squirrels and burrowing owls.

c. *O. turicata* (which transmits *B. turicatae*) lives in caves and in the nests and burrows of prairie dogs and ground squirrels in the Plains regions of the Southwest.

2.2 Description of Illness

Illness is characterized by periods of fever, often exceeding 38.8°C (102°F), lasting 2–7 days and alternating with afebrile periods of 4–14 days (2,3,6). Febrile periods are often accompanied by shaking chills, sweats, headache, muscle and joint pain, vomiting, or nausea (2). STRF may be fatal in 5%–10% of untreated cases. STRF contracted during pregnancy can cause spontaneous abortion, premature birth, and neonatal death (4,7,8).

2.3 Reservoirs

Generally diurnal rodents, e.g., chipmunks and tree squirrels. Although transovarial transmission is rare with regard to *B. hermsii* in *O. hermsi*, it does occur more frequently with regard to *B. turicatae* in *O. turicata*; less is known with regard to transovarial transmission of *B. parkeri* in *O. parkeri* (2).

2.4 Sources and Routes of Transmission

STRF is transmitted by a tick bite from “soft ticks,” (*Ornithodoros* spp.), but unlike Lyme disease or hard tick relapsing fever (HTRF), both of which are transmitted by a *Ixodes pacificus*, duration of tick attachment is not relevant to probability of *Borrelia* transmission, because *Ornithodoros* ticks generally feed on hosts quickly and can therefore transmit the spirochete within minutes, as opposed to hours. *Ornithodoros* spp. are “nesting” ticks that typically live in rodent nests; they can literally crawl out of the woodwork, bite a sleeping, unsuspecting human, and crawl back to their nest without ever been noticed. Their bites are often imperceptible.

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2.5 Incubation Period

Disease incubation averages one week following a tick bite (range: 2–18 days).

2.6 Period of Communicability

Not transmitted from person-to-person

3. CASE DEFINITIONS, DIAGNOSIS, AND LABORATORY SERVICES

Exposure is defined as living in, working in, or visiting a county in which *Ornithodoros* spp. are present or where a confirmed autochthonous case of STRF has been previously reported. Exposure activities include entering, sleeping, or working in cabins, caves, around firewood, or other possible soft tick habitat within 2–18 days before symptom onset.

3.1 Confirmed Case

- Isolation of *Borrelia hermsii*, *B. parkeri*, or *B. turicatae* from blood using a *Borrelia*-specific medium such as Barbour-Stoenner-Kelly (BSK) broth medium, OR
- *Borrelia hermsii*, *B. parkeri*, *B. turicatae* detection through nucleic acid testing, such as PCR, which differentiates soft-tick relapsing fever *Borrelia* spp. from other relapsing fever *Borrelia* spp., OR
- A clinically compatible illness (fever $>38.8^{\circ}\text{C}$ [102°F] OR ≥ 1 episode of lower measured or subjective fever AND ≥ 2 of the following: headache, myalgia, nausea/vomiting, or arthralgia) in a person with presumptive laboratory evidence (below) and meets the above criteria for exposure or epidemiologic linkage.

3.2 Presumptive Case

- Identification of *Borrelia* spirochetes in peripheral blood, bone marrow, or cerebrospinal fluid (CSF), OR
- Serologic evidence of *Borrelia hermsii*, *B. parkeri*, or *B. turicatae* infection by EIA, immunofluorescence assay (IFA), IgM or IgG western immunoblot (WB), or another method specific for relapsing fever *Borrelia* species. (Serology is less reliable than isolation, PCR, or visualization of spirochetes.), OR
- Onset of clinically compatible illness in a person who was in the same exposure location as a confirmed case.

3.3 Suspect Case

- A case who meets the clinical and exposure criteria above, with no laboratory testing performed, OR
- A case with non-specific serologic evidence of infection but no clinical, exposure, or epidemiologic linkage information available.

3.4 Criteria to distinguish a new case of STRF from reports or notifications which should not be counted as a new case for surveillance

A case can be epi-linked by having the same exposure, e.g., the same cabin, and compatible clinical symptoms as a confirmed or presumptive case. A new case (of the same person) can be created four months after their previous onset. **3.4 Services Available at Oregon State Public Health Laboratory (OSPHL)**

OSPHL does not conduct PCR for HTRF, but can help facilitate testing at CDC.

4. CASE INVESTIGATION

4.1 Identify Source of Infection

For *B. hermsii* infections, it's important to note that typical signs of tick exposures are not commonly or easily recognized, as the vector for *B. hermsii* is a nesting soft tick (*Ornithodoros hermsi*), typically found in remote cabins at >1,500 feet elevation. Most people don't know they were bitten by a tick – *O. hermsi* does not stay for long on its host, and its bites are painless. It's important to ask about camping out in the woods or staying in remote cabins.

4.2 Identify Other Potentially Exposed Persons

Inquire of the case about knowledge of others with similar symptoms and exposures, e.g., a family member who had had a similar illness at the family cabin the year or years prior.

4.3 Environmental Evaluation

Please contact ACDP STRF epidemiologist to arrange for on-site environmental evaluation.

5. CONTROLLING FURTHER SPREAD

5.1 Education

Refer case patients to CDC's Relapsing Fever Prevention web site:

www.cdc.gov/relapsing-fever/prevention/index.html.

- Avoid sleeping in rodent-infested buildings whenever possible. Although rodent nests may not be visible, other evidence of rodent activity (e.g., droppings) are a sign that a building may be infested.
- Prevent tick bites. Use insect repellent containing DEET (on skin or clothing) or permethrin (applied to clothing or equipment).

5.2 Environmental Measures

- Contact owner if person was renting a cabin and noticed a rodent infestation.
- If case patient owned the cabin or structure, have them consult a licensed pest control professional who can safely:

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- Identify and remove any rodent nests from walls, attics, crawl spaces, and floors. (Other diseases can be transmitted by rodent droppings—leave this job to a professional!)
- Treat “cracks and crevices” in the walls with pesticide.
- Establish a pest control plan to keep rodents out
- Refer them to CDC’s Recommendations for Reducing Risk of Tick-Borne Relapsing Fever, available at www.cdc.gov/relapsing-fever/resources/STRFfollowup-508.pdf.

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UPDATE LOG

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