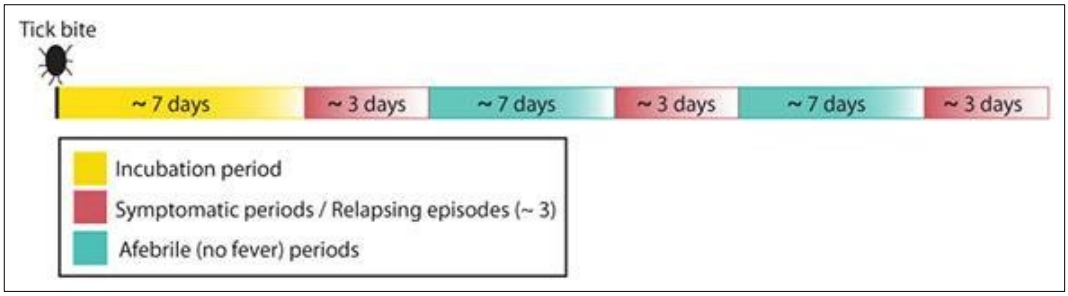
Soft tick relapsing fever (STRF), also known as tickborne relapsing fever (STRF), occurs in the western United States and is usually linked to camping or sleeping in rustic, rodent-infested cabins in mountainous areas and high elevations[1–4] . The term "soft tick relapsing fever" helps differentiate relapsing fever transmitted by soft ticks from relapsing fever transmitted by hard ticks.STRF. STRF cases occur sporadically in Arizona (0–3 cases annually), with the exception of two small outbreaks in 2005 and 2014[1–6]. Historic (1973–2014) cases of STRF in Arizona were exposed in Coconino County, while more recent (2013–2018) cases of STRF were exposed in the White Mountains region of Arizona.[5–7]

A. Agent:

Soft tick relapsing fever (STRF) is most commonly caused by *Borrelia hermsii and B.turicatae*, but can be caused by at least 14 other *Borrelia* species. These bacteria are gram negative spirochetes (cork-screw shaped) and are visible with light microscopy[1–4].

B. Clinical Description:

Soft tick relapsing fever is a systemic spirochetal disease in which periods of fever lasting 2–7 days alternate with afebrile periods of 4–14 days; the number of relapses varies from 1–10 without treatment[1–4]. Febrile periods are often associated with shaking chills, sweats, headache, muscle and joint pain, and can be associated with a rash. Photophobia, eye pain, dizziness, dry cough, nausea, vomiting, or lack of appetite can also occur. Symptoms can be more severe without treatment[1–4].



Optimal management of STRF requires both prompt diagnosis and careful observation during the initial phases of treatment[1–4]. With appropriate treatment the mortality rate is very low. The mortality rate without treatment is estimated at 5–10%[1–4]. STRF contracted during pregnancy can cause spontaneous abortion, premature birth, and neonatal death[1–44]. In general, pregnant women have higher spirochete loads and more severe symptoms than non-pregnant women. Higher spirochete loads have not, however, been found to correlate with fetal outcome[1–4].

C. Reservoirs:
In tick-borne relapsing fever, the vector is a soft tick. In the U.S., the soft tick species *Ornithodoros hermsii* and *O. turicatae* most commonly transmit the infection. *O. hermsii* is typically found at higher altitudes[1–4].

The most common reservoirs appear to be wild rodents, such as deer mice, squirrels, chipmunks, and rats[1–4]. Soft ticks become infected by feeding on wild rodents and then remain infective for their lifespan, with females passing the infection to their progeny[1–4]. *Ornithodoros* ticks tend to live for many years (10–20 years) and take infrequent blood meals, but once infected they harbor the pathogen for life[1–4]. Either the nymphal or adult stage tick can transmit the infection[1–4].

D. Mode of Transmission [1-4] :
Humans are infected by bites from infected soft ticks. Unlike hard ticks, soft ticks usually feed at night. The bites are often not noticed since they generally occur at night and are not painful. In addition, the ticks are small (approximately 3 mm), feed quickly (in 5–20 minutes) and then leave the host. The ticks live in rodent nests, which may be under flooring or between walls. If rodents are scarce or nests are disturbed, the ticks may bite other warm-blooded animals, including humans, for their blood meals. Tick-borne relapsing fever is not directly transmitted from person-to-person, but theoretically might be transmitted by blood transfusion. STRF is often associated with rustic mountain cabins with rodent infestations.

E. Incubation Period:
The incubation period is usually about 7 days but can range from 2–18 days. The pattern of illness includes about 3 days of symptoms followed by 7 asymptomatic days[1–4].

F. Period of Communicability:
Tick-borne relapsing fever is not directly transmitted person-to-person. Tick-infested cabins may be difficult to decontaminate; ticks may also be reintroduced from wood piles or firewood brought indoors[1–4].

G. Susceptibility and Resistance:
N/A

H. Treatment:
STRF spirochetes are susceptible to penicillin and other beta-lactam antimicrobials, as well as tetracyclines, macrolides, and possibly fluoroquinolones[1].
Consider the following regimens for patients who are not pregnant and do not have neurologic complications.[11]

Age category	Drug	Dosage	Duration (days)
Adults	Doxycycline, intravenous or oral (preferred)	100 mg every 12 hours	10
	Azithromycin, oral	500 mg daily	10
	Penicillin G, intravenous	4,000,000 units every 6 hours	10
	Ceftriaxone, intravenous	2 g daily	10
Children	Doxycycline, intravenous or oral (preferred)	2.2 mg/kg per dose, every 12 hours, maximum 100 mg dose	10
	Azithromycin, oral	10 mg/kg daily, maximum 500 mg/day	10
	Penicillin G, intravenous	50,000-100,000 units/kg every 6 hours, maximum 4,000,000 units/dose	10
	Ceftriaxone, intravenous	50-75 mg/kg daily, maximum 2 g/day	10

For patients who are pregnant or when neurologic involvement is present, initial parenteral therapy with a beta-lactam antibiotic is advised. Treatment should be continued for 10 to 14 days with close monitoring given the potential for severe complications. [11]

When initiating antibiotic therapy, all patients should be observed during the first 4 hours of treatment for a Jarisch-Herxheimer reaction[1]. The reaction, a worsening of symptoms with rigors, hypotension, and high fever, occurs in over 50% of cases and may be difficult to distinguish from a febrile crisis. In addition, acute respiratory distress syndrome requiring intubation has been described recently in several patients undergoing treatment for STRF[1–4].

Disease Management

I. Clinical Case Definition[9]:

An acute febrile disease with headache, fever, shaking chills, and myalgia. Symptoms may relapse after a febrile period of 2–4 days.

J. Laboratory Criteria for Diagnosis[1,9]:

- Demonstration of visible spirochetes in a peripheral blood smear, OR
- Demonstration of spirochetemia in inoculated swiss mice, OR
- Serological evidence of non-treponemal spirochetes in persons not visiting an endemic Lyme disease area.

K. Case Classification
Refer to the ADHS Case Definition Manual.

L. Classification of Import Status:
N/A

M. Laboratory Testing[1,9]:

- Diagnosis of STRF is most commonly made through observation of *Borrelia* spirochetes in peripheral blood smears, usually when a person has a fever. Dark field microscopy is best, but organisms can be detected using Wright-Giemsa or acridine orange stains. Cerebrospinal fluid can also be used to detect bacteria.
- Blood samples obtained before antibiotic treatment can be cultured using Barbour Stoner Kelly (BSK) medium or by inoculating immature mice. The spirochete will usually be evident within 24 hours if the blood was drawn during a febrile episode.
- Although not valuable for making an immediate diagnosis, serologic testing may be available through public health laboratories and some private laboratories. Acute serum should be taken within 7 days of symptom onset and convalescent serum should be taken at least 21 days after symptoms start. Early antibiotic treatment may blunt the antibody response and the antibody levels may wane quickly during the months after exposure.
- Diagnosis may be delayed if not recognized as persons who typically acquire illness in rural areas often seek medical care in the desert metropolitan communities; physicians there might not be aware of the differences in the diseases or their host habitats in these mountains compared with the lower-elevation deserts of Arizona.

M. Assessing Laboratory Results[1,9]:

- To confirm the diagnosis of STRF, *Borrelia* specific antibody titers should increase 4-fold between acute and convalescent serum samples, and convalescent serum antibody levels should be at least two standard deviations above pooled negative controls; a single elevated IgG is also confirmatory. Serologic testing for STRF is not standardized and results may vary by laboratory. Patients with STRF may have false-positive tests for Lyme disease because of the similarity of proteins between the two organisms.
- Incidental laboratory findings include normal to increased white blood cell count with a left shift towards immature cells, a mildly increased serum bilirubin level, mild to moderate thrombocytopenia, elevated erythrocyte sedimentation rate (ESR), and slightly prolonged prothrombin time (PT) and partial thromboplastin time (PTT)[1-4,8,9].

Investigation Guidelines

N. Outbreak Definition:
An unexplained, unexpected increase in cases of relapsing fever that is clustered by time, place, or person. Arizona typically has 0–3 cases of STRF annually.

O. Time Frame of Reporting:
STRF is not a nationally notifiable condition, but prompt reporting within 1 working day for healthcare providers and 5 working days for laboratories is required in Arizona. Local county public health is responsible for conducting an investigation on any reported cases.

P. Investigation and Reporting Formats:
Please refer to the Department-provided formats for submitting Epidemiologic Investigation Reports [Excel] for guidance on the required investigation fields and forms for the relevant morbidity. All the investigation forms can be found on the ADHS Forms for Reporting and Investigation.

Q. Investigation Steps:

- **Identify Sources of Infection**
    a. Did the patient spend time or sleep outside, in a cabin (particularly on or near the floor or walls), or other places with evidence of rodent activity in the two weeks prior to symptom onset?
    b. Does the patient recall any tick or insect bites, or the potential for exposure, including carrying firewood from a woodpile indoors or sitting outside at night where there could be rodent habitation?

- **Identify Potentially Exposed Persons**
  Identify other people who may have shared the exposure with the case (i.e. slept in the same cabin) and educate about STRF and the need to seek medical care if symptoms develop.

- **Environmental Evaluation[1]**
    - The local environmental health and vector control program can be involved in evaluation of the cabin or space of exposure if identified.
    - Areas that have been rodent-proofed without tick control may be high risk sources of exposure for STRF. Work with owners or property managers for environmental evaluation and decontamination.
    - If the site of exposure is determined to be a tick and rodent-infested building/area, provide the following information to the owner or property manager:
        a. Educate about tick-borne relapsing fever (also consider warning about hantavirus, which is also transmitted by rodents in Arizona).
        b. Recommend removal of woodpiles from under/around cabins to prevent rodent infestation outside the cabin.
        c. Recommend sealing the building, cabin, or home including roof, walls, doors, windows, around crevices on flooring to prevent rodents from entering.
        d. Recommend placing food in secondary containers to keep rodents from entering.
        e. Recommend hiring a professional pest control company to provide soft tick control and decontamination.

- **Prevention**[1]
    - People should avoid sleeping in rodent infested buildings
    - People should rodent-proof buildings to prevent future colonization by rodents and follow up with vector control procedures to prevent soft ticks:
        i. Inspect buildings on a regular basis for rodent activity.
        ii. Eliminate rodent nesting areas.
        iii. Use proper food and waste handling practices that eliminate food sources for rodents.
        iv. Rodent-proof buildings by sealing holes in foundation and walls and use screens to prevent rodent entry.

Resources

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10. Clinical Guidance for Soft Tick Relapsing Fever. Centers for Disease Control and Prevention; 2025. Available from: https://www.cdc.gov/relapsing-fever/hcp/soft-tick-relapsing-fever/index.html