Lyme Disease
Table of Contents

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Case Definition – 2022 Case Definition – Lyme Disease

Overview

- ***Agent*** – Lyme disease is a bacterial infection caused predominantly by *Borrelia burgdorferi* sensu stricto. Rare infections can be caused by *Borrelia mayonii*.
- ***Reservoir*** – The primary reservoirs for Lyme disease are small wild rodents, especially *Peromyscus* spp. in the northeastern and midwestern parts of the US. *Ixodes* ticks (*I. scapularis*, the blacklegged tick or deer tick, and *I. pacificus*, the western blacklegged tick) become infected after feeding on an infected reservoir host. Ticks often become infected at either the larval or nymphal stage and remain infected for life.
- ***Occurrence*** – Lyme disease has been reported in many countries, including the U.S., Canada, Europe, Russia, China, Korea, Mongolia, and Japan. In the U.S., infection is often acquired following travel and exposure to tick habitat in the northeastern or upper midwestern regions of the country. These are areas where the primary tick vector, *Ixodes scapularis*, is widely present, and states in these regions are considered high incidence states for Lyme disease.
- ***Risk Factors –*** Susceptibility is general, and people of all ages can become infected. Risk for Lyme disease infection is higher for those who reside, work, or recreate outdoors in high-incidence states in the upper midwestern and northeastern regions of the U.S.
- ***Mode of Transmission*** – Transmission primarily occurs through the bite of an infected *Ixodes* tick. Although a case has never been documented, *B. burgdorferi* can be present in blood that has been stored for donation. Receipt of blood or blood products could also be a potential mode of transmission.
- ***Incubation Period*** – 3-30 days
- ***Clinical Illness*** – Lyme disease manifestations are divided into three stages: early localized, early disseminated, and late disseminated illness. The primary symptom of early localized infection is a characteristic skin lesion known as an erythema migrans (EM) rash. This rash has a classic "bulls-eye" appearance and is reported in 70-90% of cases in the U.S. Most patients will develop a single lesion (≥5 cm in diameter), but some patients may go on to develop additional secondary lesions at a later time if infection is untreated. Along with EM rash, patients may also report nonspecific symptoms including fever, headache, myalgia, arthralgia, fatigue, and malaise. Early disseminated illness can include neurologic impacts such as the development of facial nerve palsies, lymphocytic meningitis, and cardiac impacts (atrioventricular blocks). Late disseminated illness often presents with recurrent, brief attacks of arthritis that occur in individuals who were not treated at an earlier stage of infection. Lyme arthritis typically impacts the large joints, especially the knees. Polyneuropathy, encephalomyelopathy, and encephalitis are rare late manifestations of infection.

- ***Laboratory Testing*** – Testing for tickborne diseases including Lyme disease can be obtained through many commercial laboratories. The Missouri State Public Health Laboratory (MSPHL) does not currently conduct tickborne disease testing. In special cases, arrangements can be made to send specimens to CDC for testing. Requests for testing through CDC should be coordinated through the Bureau of Communicable Disease Control and Prevention (BCDCP) Zoonotic Disease Program.
- ***Treatment*** – Antibiotics can be used to treat patients with Lyme disease infection. Specific treatment guidance can be obtained from the Infectious Diseases Society of America (IDSA), the American Academy of Neurology (AAN), and the American College of Rheumatology (ACR).
- ***Priority*** **–** Routine; Lyme disease should be reported to DHSS within 3 days.

Quick References / Factsheets

- Health Professionals:
  - CDC Clinical Resources for Lyme Disease
  - Continuing Education Trainings for Providers on Lyme Disease
  - Tickborne Diseases of the United States – A Reference Manual for Health Care Providers, Sixth Edition, 2022 (CDC)
  - Improving Care for Patients with Prolonged Symptoms and Concerns about Lyme Disease: A Clinician Toolkit

Forms

- Disease Case Report (CD-1)
- Lyme Disease Case Report Form (MO 580-1807)
- Missouri Outbreak Report Form (MORF)

Notifications

- If Lyme disease is suspected, the local public health agency (LPHA) should notify the District Epidemiologists or the Missouri Department of Health and Senior Services (MDHSS) Bureau of Communicable Disease Control and Prevention (BCDCP), phone (573) 751-6113, Fax (573) 526-0235.

Reporting Requirements

- Lyme disease is a Category 3 disease and shall be reported to the local health authority or to the MDHSS within three (3) calendar days of first knowledge or suspicion.
- Lyme disease is a nationally notifiable condition in the standard reporting category. The MDHSS reports confirmed and probable cases to the CDC by routine electronic transmission.
- Lyme disease reporting includes the following:
  1. For all cases, complete a Disease Case Report (CD-1).

2. For confirmed and probable cases, complete the Lyme Disease Case Report Form (MO 580-1807).
3. All outbreaks or suspected outbreaks must be reported as soon as possible (by phone, fax or e-mail) to the District Epidemiologists. This can be accomplished by completing the Missouri Outbreak Report Form (MORF).
4. Within 90 days from the conclusion of an outbreak, submit the final outbreak report to the District Communicable Disease Coordinator.

Laboratory Testing and Diagnosis

Laboratory confirmation of infection is vital to understanding the epidemiology and public health impact of tickborne diseases, including Lyme disease. Routine Lyme disease diagnostic testing is available through commercial laboratories. The Missouri State Public Health Laboratory (MSPHL) does not perform any tickborne disease diagnostic testing. In special situations, testing for Lyme disease can be conducted by CDC. All requests for Lyme disease testing to be performed by CDC should be coordinated through the BCDCP Zoonotic Disease Program.

A two-step testing process is currently recommended by CDC to test for Lyme disease. Both steps can be done using the same blood sample. If the first step is negative, no further testing is recommended. If the first step is positive or indeterminate (sometimes called "equivocal"), the second step should be performed. The overall result is positive only when the first test is positive (or equivocal) and the second test is positive (or, for some tests, equivocal). Standard two-tier testing (STTT) uses enzyme immunoassay (EIA) or, rarely, immunofluorescence assay (IFA) as the first step and western blotting (WB) for the second step. Increasingly, laboratories are using a modified two-tier testing (MTTT) process in which both steps of the testing are EIA tests. In patients who have been symptomatic for less than 30 days, IgM testing may be helpful for diagnosis. After 30 days from the date of onset, IgM antibody testing results should be disregarded. After approximately 30 days, individuals should have a detectable IgG antibody response. Cross-reaction on EIA or IFA tests is a possibility. False positive results can occur in patients with syphilis, herpes simplex, relapsing fever, leptospirosis, Rocky Mountain spotted fever, infectious mononucleosis, lupus, or rheumatoid arthritis.

For more information about Lyme disease diagnostic testing, please see the following resources:

- Updated CDC Recommendation for Serologic Diagnosis of Lyme Disease
- APHL Guidance and Interpretation of Lyme Disease Serologic Test Results
- Testing and Diagnosis for Lyme disease

Conducting the Investigation

- **Verify the diagnosis**. What laboratory tests were conducted, and what were the results? Obtain demographic, clinical, and laboratory information on the case from the provider,

laboratory, and/or patient. Complete both the Disease Case Report (CD-1) and the Lyme Disease Case Report Form (MO 580-1807).

In addition to EIA or Western Blot testing, patients may have had complete blood cell count or comprehensive metabolic blood testing done that may indicate anemia, thrombocytopenia, leukopenia, and/or liver enzyme elevation. If the patient was hospitalized during their illness, verify the availability of these results as part of the investigation.

The accuracy of antibody tests depends on how long an individual has been infected. Antibody tests may appear falsely negative if the patient is tested during the first few weeks of infection, typically when an EM rash would be present, but FDA-cleared assays for Lyme disease have good sensitivity after 4-6 weeks have passed. As described above, false positive cross-reactions may occur in patients with other conditions. Once an individual tests positive for antibodies to Lyme disease, they will likely continue to do so for months to years even when the bacteria are no longer present.

- **Establish the extent of the illness.** The investigation should consider family members, pets, and other contacts who have or have recently had a febrile illness and shared environmental exposures with the patient.

- **Establish the source of infection.** Prior to symptom onset:
  - What was the patient's travel history (including specific locations and start/end travel dates)?
  - Was the patient's likely tick exposure in-state, out-of-state, or out-of-country?
  - Are there household or other contacts with a similar illness?
  - Rule out non-tick transmission pathways (which may fall outside the two-week timeframe):
    - Does case work in a laboratory or clinical setting?
    - Is the case a neonate, pregnant, or breastfeeding?
    - Has the patient recently received any blood, blood products, tissues, or organs?
  - If the patient is a recent organ, tissue (e.g., corneas, skin), or blood donor or recipient within the last 30 days:
    - Notify your District Epidemiologists.
    - Ensure that relevant partners have been notified (blood collection agencies, hospitals, etc.).
    - Determine the patient/donor identification numbers and any other available details regarding blood products/organs donated or received.
    - Assure quarantine of any remaining co-component blood or tissues.

- If necessary, investigate all recipients of transfused co-components from the implicated donation and other potentially contaminated donations from implicated donor(s).

Control Measures

In the United States, there is currently no licensed vaccination to prevent Lyme disease in humans. Aside from cases potentially associated with blood donation, tissue, or organ transplants, contact tracing is not required because Lyme disease infections are not transmitted from person to person.

The best way to avoid infection with Lyme disease is to avoid tick bites. Key personal prevention methods for avoiding tick bites include:

- Whenever possible, avoid tick habitat during the peak time of year when ticks are most active (generally April through September). Ticks are generally found in areas with tall grass, brush, or in heavily wooded areas. However, they can also be present in neighborhoods and backyards.
- Use an insect repellent product with at least 20% DEET, picaridin, or other EPA-registered active ingredients labeled specifically for ticks. Apply to all exposed skin before going outdoors.
  - The American Academy of Pediatrics has recommended that repellents containing up to 30% DEET are safe to use on children over 2 months of age.
  - For other active repellent ingredients, check the product label for minimum age requirements before applying them to children.
  - EPA offers an insect repellent search tool that can be used by the public to identify repellent products that work best for their needs.
- Weather-permitting, wear long sleeves and pants to help reduce the amount of exposed skin. This will make it harder for ticks to find a place to attach.
  - Wearing light colored clothing can make it easier to spot ticks that may be crawling on clothing when you are outdoors.
- Consider applying permethrin to clothing, boots, and outdoor gear when spending time in tick habitat. Permethrin binds tightly to fabric and will remain effective after multiple washings.
  - This product should not be applied directly to the skin. Product directions and labels should be read carefully before use.

Resources

1. American Academy of Pediatrics. [Lyme Disease]. In: Kimberlin DW, Barnett, ED, Lynfield, R, Sawyer, MH, eds. *Red Book: 2021 Report of the Committee on Infectious Diseases*. 32nd ed. Itasca, IL: American Academy of Pediatrics; 2021: [482-489]

2. American Public Health Association. [Lyme Disease]. In: Heymann DL, ed. *Control of Communicable Diseases Manual*. 21st ed. Washington, DC: American Public Health Association; 2022 [378-382]
3. Centers for Disease Control and Prevention. Lyme Disease. https://www.cdc.gov/lyme/index.html (05/25)