

Lyme Borreliosis: Answers to Commonly asked Questions

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What is Human Lyme Disease?

Lyme disease is the most common vector-borne infectious disease in the United States, with over 300,000 cases reported annually. Multiple genospecies of the spirochete bacteria *Borrelia burgdorferi* cause Lyme disease in the U.S. and the rest of North America. Other etiologic agents of Lyme disease include the *Borrelia* species *B. afzelii* and *B. garinii* which cause disease in Europe and Asia. Lyme disease can be difficult to diagnose and treat, due to the bacteria's ability to quickly exit the bloodstream, penetrate multiple tissues and organs, and persist in the presence of an immune response, resulting in a complex infectious disease whose varied pathologies are caused by the immune system's inflammatory response to invading and persistent spirochetes. Lyme disease *Borrelia* cause both acute and chronic disease, as patients present with a wide variety of clinical signs, many of which can be non-specific and mimic other infectious or autoimmune diseases, complicating the physician's ability to quickly and accurately diagnose and treat the infection.

How do people get Lyme Disease?

Lyme disease *Borrelia* are transmitted via the bite of hard ticks belonging to the genus *Ixodes*. These ticks are commonly found in wooded or grassland areas of temperate climates. *I. scapularis* and *I. pacificus* are North American vectors, whereas *I. ricinus* and *I. persulcatus* are the main European and Asian vectors, respectively. Ixodid ticks are very small and difficult to detect, as they often attach in hard-to-see areas of the body. They also secrete numerous anti-inflammatory agents that allow them to feed without causing pain. *Borrelia* are transmitted via the tick's saliva into the human skin. The bacteria migrate through the skin, then penetrate the blood vessels to briefly enter the bloodstream for transit to distal tissues and organs where they take up residence, initiate inflammation, and cause pathology.

Where do most cases of Lyme disease occur?

Although cases have been reported in the majority of U.S. states, Lyme disease is most prevalent in the Northeast and mid-Atlantic states, the upper Midwest, and Northern California. However, as climate change and housing development alters the ecosystem and erodes natural boundaries between humans and nature, the geographic and spatial location of *Ixodes* ticks has become more fluid, resulting in a spike of cases in areas not previously associated with disease prevalence. An enhanced awareness of Lyme disease by both physicians and patients has also contributed to an increase in the location and number of reported Lyme disease cases.

What are the symptoms of Lyme Disease?

Lyme disease *Borrelia* cause both acute and chronic infections, as the bacteria transit to many different tissues and organs where they initiate inflammation and destructive pathology. Initial or

chronic clinical presentation (e.g. headache, fever, fatigue, malaise, muscle soreness) may be non-specific and mimic clinical signs of other infections. Localized or disseminated erythema migrans (EM), and history of tick exposure or bite are important, but not exclusive, early clinical indicators, as not all patients present with these clinical and historical findings.

Symptoms may include, but are not limited to:

- Headache
- Fever
- Malaise
- Fatigue or chronic fatigue
- Muscle soreness
- Sleeplessness
- Depression
- Anorexia
- Fibromyalgia
- History of tick exposure/bite
- Localized or disseminated EM
- Joint pain
- Neurological symptoms such as facial paralysis, blindness
- Muscle/limb impairment or paralysis
- Arthritis
- Carditis or heart block

How is Lyme Disease diagnosed?

Physicians diagnose Lyme disease based on a combination of clinical presentation and results from laboratory testing. Current CDC guidelines stipulate that if a patient presents with an EM rash they should automatically receive antibiotic therapy for Lyme disease without awaiting laboratory test results. The ILADS guidelines also recommend antibiotic treatment for EM rashes. However, many patients do not present with an EM rash, so physicians rely on results from diagnostic tests. The CDC recommends that a two-tier test be utilized to aid in the serodiagnosis of Lyme disease. The first tier utilizes IgM or IgG -based ELISAs, or IFA, to determine if the patient has antibodies consistent with a diagnosis of Lyme disease. If the serum sample tests negative, no further testing is required. If early acute infection is strongly suspected, but the IgM ELISA is negative, the physician can have a convalescent sample drawn for re-testing. Patient samples that test “positive” or “equivocal” proceed to the second tier of the testing protocol. The second tier employs IgM and/or IgG Western blot testing. An IgM Western blot is considered “positive” if patient serum is reactive to 2 out of 3 diagnostic antigens. An IgG Western blot is considered to be “positive,” if the patient’s serum contains antibodies that react with 5 out of 10 diagnostic antigens. According to the CDC, both the ELISA and the Western blot tests must be “equivocal/positive” or “positive/positive” for a patient to satisfy optimal serodiagnostic criteria for Lyme disease. However, physicians may utilize different testing protocols and alternate guidelines to interpret test results.

The IgM ELISA and Western blot tests should only be used to test patients with suspected early (< 30 days) Lyme disease. All serological assays assess whether a patient's blood sample contains antibodies that recognize Lyme *Borrelia* antigens, so they provide evidence of exposure to *Borrelia*, but are not indicators of active infection. Although two-tier testing is highly sensitive and specific for the diagnosis of Lyme disease in a proportion of patients, it is prone to false negatives in patient populations with acute early, or certain types of chronic Lyme disease. PCR-based protocols are also utilized by several reference laboratories, and the C6 peptide-based ELISA has shown promise for the diagnosis of early acute disease. A lot of research is focused on the development of new and improved laboratory tests for the accurate diagnosis of human Lyme disease.

How is Lyme disease treated?

Lyme disease is treated with antibiotic therapy, but the type(s) of antibiotics utilized and the duration of treatment varies with the nature of the infection, and must be evaluated by a physician on a case-by-case basis.

How can Lyme disease be prevented?

The easiest way to prevent Lyme disease is to perform routine tick checks and avoid tick bites after being outdoors in grass, leaf litter, or wooded areas.

Precautions include:

- Wear long sleeves/pants and hat when hiking in grassy or wooded areas
- Wear light colored clothing as ticks will be easier to see
- Tuck pant legs into tall/hiking socks
- Avoid tall grass/brush/leaf litter areas and stay in center of path/trail
- Apply tick repellent containing 20-30% DEET
- Spray clothing with 0.5% permethrin to repel ticks
- Wash clothing in hot water, dry with high heat for minimum of 10 minutes
- Shower within two hours of return to wash off potentially crawling ticks
- Perform thorough tick checks, including the following areas, after being outdoors in wooded, grass, or leaf litter areas:
 - Behind the ears
 - Hair/scalp
 - Back of the neck near base of skull
 - Belly button
 - Underarms
 - Behind the knees
 - Inside/between the legs
 - Ankles

Additional Resources:

- 1.) Marques, AR. 2010. Lyme disease: a review. *Curr Allergy Asthma Rep.* 10: 13-20. PMID: 20425509. DOI:[10.1007/s11882-009-0077-3](https://doi.org/10.1007/s11882-009-0077-3).

- 2.) Johnson, BJB. 2011. Laboratory diagnostic testing for *Borrelia burgdorferi* infection. In: JJ Halperin (ed.) Lyme Disease: An Evidence Based Report. CAB International.
https://www.cdc.gov/lyme/resources/Halperin_2012_Chap4_JohnsonB.pdf.
- 3.) Marques, AR. 2015. Laboratory diagnosis of Lyme disease – advances and challenges. Infect Dis Clin North Am. 29: 295-307. DOI:[10.1016/j.idc.2015.02.005](https://doi.org/10.1016/j.idc.2015.02.005). PMID: 25999225. Free PMC article.
- 4.) **ILADS guidelines for the treatment of Lyme disease:** Cameron DJ, LB Johnson, and EL Maloney. 2014. Evidence assessments and guideline recommendations in Lyme disease: the clinical management of known tick bites, erythema migrans rashes and persistent disease. Expert Rev. Anti Infect. Ther. 12: 1103–1135. DOI: 10.1586/14787210.2014.940900. <http://dx.doi.org/10.1586/14787210.2014.940900>.
- 5.) **Lyme Disease Association, Inc.** <https://lymediseaseassociation.org/>.
- 6.) **CDC Lyme Disease.** <https://www.cdc.gov/lyme/>.