

Lyme Disease

(Also known as Lyme Borreliosis and Tickborne Meningopolyneuritis)



Section 1:

ABOUT THE DISEASE

A. Etiologic Agent

Lyme disease (LD) is a tickborne disease caused by *Borrelia burgdorferi*, a corkscrew-shaped bacterium (spirochete).

B. Clinical Description

There are three general stages in the clinical manifestation of LD: early localized, early disseminated, and late. The chronology of LD signs and symptoms can vary significantly, so there may be overlap within these stages.

<p>Early Localized</p>	<p>Signs and symptoms during early localized illness usually occur within 3–32 days of exposure to infected ticks, and they tend to be nonspecific. Symptoms may include fever, muscle aches, headache, swollen lymph glands, fatigue, mild neck stiffness, and joint pain. A distinctive rash called erythema migrans (EM) occurs at the site of the tick bite in approximately 80% of cases, although when these painless lesions occur in a location hidden from view (e.g., armpit, back), they may not be seen by the patient. Typically, EM rashes are circular and grow to a diameter of 5–15 cm, though the shape can be triangular, oval, or irregular as well. EM frequently clears in the center, resulting in the classic “bull’s-eye” presentation, but this does not always occur. The rash may be reported as warm or itchy, but it is usually painless.</p> <p><i>Note: Recognition of LD as early as possible is important because prompt treatment will help prevent later complications.</i></p>
<p>Early Disseminated</p>	<p>Without appropriate antibiotic treatment, the spirochete may begin affecting multiple organ systems within 3–5 weeks after the tick bite. A patient with disseminated infection may have constitutional symptoms of fever and fatigue (often profound). There may be multiple EM lesions, diffuse redness of the skin, or hives. Muscle and joint aches are commonly reported. Swollen lymph glands, sore throat, non-productive cough, and conjunctivitis may also be noted. Neurologic symptoms may include headache, stiff neck (aseptic meningitis), Bell’s (facial) palsy, and pain or tingling sensations in the extremities, as well as impairments of mood, memory, or sleep patterns. Less commonly, people may experience heart problems such as atrioventricular block or inflammation of the heart or of the sac surrounding the heart.</p>

Late

In the absence of effective treatment of early LD, late manifestations of LD may become apparent weeks to even years after the initial infection. People may experience arthritis, commonly involving the large joints, such as the knees or the shoulders. The joint swelling and pain may be recurrent. Lyme arthritis may be confused with other forms of arthritis, particularly if the tick bite was unrecognized and early symptoms were undiagnosed. People with late LD may also continue to experience neurologic or heart complications. The symptoms of late LD can be debilitating and can persist for prolonged periods of time.

C. Vectors and Reservoirs

The primary vector for LD in the northeastern U.S. is the black-legged deer tick (*Ixodes scapularis*). Deer ticks are generally found near the ground in brushy or wooded areas. They can be active year-round, as long as the temperature is above freezing. Deer ticks have three life stages: larva, nymph, and adult. Nymphal deer ticks are only the size of a poppy seed, while adult deer ticks are the size of a sesame seed. Ticks become infected with *B. burgdorferi* as larvae when they feed on infected animals. In the northeastern U.S., the most common reservoir for *B. burgdorferi* is the white-footed mouse (*Peromyscus leucopus*). Once infected, the tick remains capable of spreading *B. burgdorferi* throughout its life cycle.

Note: In addition to LD, there are two other diseases found in Massachusetts that are known to be transmitted by the deer tick: babesiosis and human granulocytic ehrlichiosis (HGE). A deer tick may be co-infected with and capable of simultaneously spreading any two or all three of these tickborne diseases.

D. Modes of Transmission

LD is acquired through the bite of an infected tick. The tick must generally remain attached to the body for 24–48 hours before the transmission of *B. burgdorferi* is likely. Since deer tick bites are often painless and may occur on parts of the body that are difficult to observe, cases of diagnosed LD frequently have no known history of a tick bite.

E. Incubation Period

Symptoms of early LD, such as EM and/or flu-like symptoms, usually develop between 7–10 days following an exposure, but the incubation period for early LD can range from 3–32 days.

F. Period of Communicability or Infectious Period

LD is not communicable from person to person.

G. Epidemiology

The incidence of LD is associated with the density of infected tick vectors. While most cases in the U.S. have been reported in the Northeast, the western states, and the upper Midwest, nearly all states have reported cases. LD incidence varies greatly among states, among counties, and by season. In Massachusetts, the highest risk of exposure occurs during the spring and early summer for nymphs and later summer into fall for adult ticks. Most cases occur between April and October, when the risk of contact with nymphal ticks is greatest.

In Massachusetts, the areas of highest risk for acquiring LD include Cape Cod and southeastern Massachusetts, Nantucket and Martha's Vineyard, areas north of Boston, areas along the Quabbin Reservoir Watershed and Connecticut River Valley in western Massachusetts, and in Berkshire County. However, all parts of the state are considered to have LD, and human cases have been reported from all counties in Massachusetts in individuals without a travel history to high-risk areas.

H. Bioterrorist Potential

This pathogen is not considered to be of risk for use in bioterrorism.



Section 2:

REPORTING CRITERIA AND LABORATORY TESTING

A. What to Report to the Massachusetts Department of Public Health (MDPH)

Report any case of LD diagnosed by a health care provider based on clinical signs and symptoms, regardless of whether or not laboratory confirmation testing was done.

Note: See Section 3C for information on how to report a case.

B. Laboratory Testing Services Available

Laboratory confirmation of infection with *B. burgdorferi* requires isolation of the spirochete from a tissue or body fluid; detection of diagnostic levels of immunoglobulin M (IgM) or immunoglobulin G (IgG) antibodies to the spirochete in serum or cerebrospinal fluid (CSF); or detection of a significant change in antibody levels in paired acute and convalescent serum samples. Since the immune response to spirochetes is relatively slow, serological tests often remain negative for several weeks after exposure. The Centers for Disease Control and Prevention (CDC) recommends initial testing of serum specimens by a sensitive test, such as enzyme immunoassay (EIA) or immunofluorescent assay (IFA). Samples with positive or equivocal results from these tests should be re-tested with a standardized Western Blot procedure.

The MDPH State Laboratory Institute (SLI), Viral Serology Laboratory performs confirmatory testing for LD by Western Blot assay on specimens with either a positive or equivocal result by EIA or IFA. The SLI will also perform EIA under special circumstances, after approval for testing has been obtained from the MDPH Division of Epidemiology & Immunization at (617) 983-6800 or (888) 658-2850.

For additional information on specimen submission, contact the SLI Viral Serology Laboratory at (617) 983-6396.

*Note: The SLI does not perform tick identification or testing of ticks for *B. burgdorferi*.*



Section 3:

REPORTING RESPONSIBILITIES AND CASE INVESTIGATION

A. Purpose of Surveillance and Reporting

- ◆ To identify where LD occurs in Massachusetts.
- ◆ To recognize areas in Massachusetts where LD incidence has changed (increased or decreased).
- ◆ To focus prevention education.
- ◆ To target tick control measures.

B. Laboratory and Health Care Provider Reporting Requirements

LD is reportable to the local board of health (LBOH). The MDPH requests that health care providers immediately report to the LBOH in the community where the case is diagnosed, all confirmed or suspect cases of LD, as defined by the reporting criteria in Section 2A.

Laboratories performing examinations on any specimens derived from Massachusetts residents that yield evidence of *B. burgdorferi* infection shall report such evidence of infection directly to the MDPH within 24 hours.

C. Local Board of Health (LBOH) Reporting and Follow-up Responsibilities

Reporting Requirements

MDPH regulations (*105 CMR 300.000*) stipulate that LD is reportable to the LBOH and that each LBOH must report any confirmed case of LD or suspect case of LD, as defined by the reporting criteria in Section 2A. Cases should be reported to the MDPH Bureau of Communicable Disease Control, Office of Integrated Surveillance and Informatics Services (ISIS) using a MDPH *Lyme Disease Case Report Form* (found at the end of this chapter). Refer to the *Local Board of Health Timeline* at the end of this manual's *Introduction* section for information on prioritization and timeliness requirements of reporting and case investigation.

Case Investigation

1. It is the responsibility of the LBOH to complete the MDPH *Lyme Disease Case Report Form* (found at the end of this chapter) by interviewing the case's health care provider and others who may be able to provide pertinent information. Much of the information required on the form can be obtained from the health care provider or from the medical record.
2. Use the following guidelines to assist in completing the form:
 - a. Demographic information: Accurately record the contact information on the case as well as the case's age, sex, race, and occupation.
 - b. Clinical information: Since LD is a clinical diagnosis, **it is vital that this section be completed as thoroughly and accurately as possible**. Note the symptom onset date, and check off all symptoms that apply. Also determine whether the case has been previously diagnosed with LD, and if so, whether the physician believes the case's current symptoms or laboratory results are related to that past infection. There is space to note other symptoms not already listed on the form.

- c. **Laboratory information:** Record the name of the laboratory performing LD testing, if done, and attach any laboratory test results. Also note if the case was tested for ehrlichiosis or babesiosis.
 - d. If the case was diagnosed with LD and another tickborne disease (such as ehrlichiosis or babesiosis) at the same time, please refer to other chapters in this manual corresponding with these diseases and complete the appropriate case report forms.
 - e. **Exposure information:**
 - i. **Tick bite history:** Determine if the case was bitten by a tick. If yes, ask about and record information about date(s) and geographic location(s) where he/she was bitten.
 - ii. **Travel history:** Determine the geographic area(s) visited by the case, particularly known areas of high risk, such as Cape Cod, Martha's Vineyard, and Nantucket.
 - f. If you have made several attempts to obtain case information but have been unsuccessful (e.g., the case or health care provider does not return your calls or respond to a letter, or the case refuses to divulge information or is too ill to be interviewed), please fill out the form with as much information as you have gathered. Please note on the form the reason(s) why it could not be filled out completely.
3. After completing the form, attach laboratory report(s) and fax or mail (in an envelope marked "Confidential") to ISIS. The confidential fax number is (617) 983-6813. Call ISIS at (617) 983-6801 to confirm receipt of your fax. The mailing address is:

**MDPH, Office of Integrated Surveillance and Informatics Services (ISIS)
305 South Street, 5th Floor
Jamaica Plain, MA 02130
Fax: (617) 983-6813**

4. Institution of disease control measures is an integral part of case investigation. It is the responsibility of the LBOH to understand, and if necessary, institute the control guidelines listed in Section 4.



Section 4:

CONTROLLING FURTHER SPREAD

A. Isolation and Quarantine Requirements (*150 CMR 300.200*)

None.

B. Protection of Contacts of a Case

None.

C. Managing Special Situations

Response to a Tick Bite

The longer a tick remains attached to someone, the higher the likelihood of disease transmission. Whenever an attached tick is removed from one's body, one should monitor one's health for the appearance of rash, fever, or flu-like symptoms, and should immediately seek the advice of a health care provider if any symptoms occur, especially if the tick was attached for more than 24 hours. It may be helpful to save the tick after removal for two reasons: 1) if the person who was bitten goes on to develop signs or symptoms such as fever, flu-like symptoms or a rash, it may be helpful for the physician to know the type of tick; and 2) depending on the circumstances of the bite (i.e., when a person was bitten, the type of tick, how long it was attached), a physician may choose to treat the person who was bitten. The tick may be kept either securely sealed within a small plastic bag or attached, with clear tape, to a piece of paper. For individuals who do not wish to keep the tick, it can be either drowned in rubbing alcohol or flushed down the toilet.

The MDPH does not provide tick identification or tick testing services. A listing of agencies that provide these services for a fee is available on the MDPH website at www.mass.gov/dph/cdc/epii/lyme/lymehp.htm.

If someone chooses to have the tick tested, the following information should be taken into account:

- ◆ Tests performed on ticks are not perfect, and they do not test for all infections that ticks may carry. Therefore, even with a negative result, people should still monitor for the appearance of rash, fever, or other unusual symptoms and should immediately seek the advice of a health care provider if any symptoms occur.
- ◆ If someone has been infected by a tick bite, symptoms may begin to occur even before the results of tick testing are available. People should not wait for tick testing results before seeking medical advice, should any symptoms develop.
- ◆ A positive test on a tick is not an automatic indication that treatment is needed. A positive test indicates that the tick was infected but not that the tick was successful in spreading the infection to the person bitten. The longer a tick is attached, the greater the chance that it will spread infection. Positive test results should be discussed with a health care provider.

D. Preventive Measures

Environmental Measures

Offer the following advice to the public to reduce risk for LD:

- ◆ Keep grass cut short.
- ◆ Remove leaf litter and brush from around the yard.
- ◆ Prune low lying bushes to let in more sunlight.
- ◆ Keep woodpiles and bird feeders off the ground and away from the home.
- ◆ Keep the plants around stone walls cut short.
- ◆ Use a three-foot wide woodchip, mulch, or gravel barrier where the lawn meets the woods, and remind children not to cross that barrier.

- ◆ Ask a landscaper or local nursery about plants to use in the yard that do not attract deer.
- ◆ Use deer fencing (for yards 15 acres or more).

If an individual chooses to use a pesticide to reduce the number of ticks on his/her property, he/she should hire a licensed applicator experienced with tick control. A local landscaper or arborist may be a licensed applicator. In general, good tick control can be achieved with no more than two pesticide applications in any year. When selecting an applicator, ask if they will provide a written pest control plan that includes information on the pesticide to be used, information about non-chemical pest control alternatives, and signs to be posted around the property after the application.

Personal Preventive Measures

There is no vaccine to protect humans against LD. If someone lives, works, or spends leisure time in an area likely to have ticks, they should be advised of the following:

- ◆ The single most important thing one can do to prevent a tickborne disease is to check oneself for ticks once a day. Favorite places ticks like to go on the body include areas between the toes, back of the knees, groin, armpits, neck, along the hairline, and behind the ears. Remember to check children and pets, too. Promptly remove any attached tick using fine-point tweezers. The tick should not be squeezed or twisted, but grasped close to the skin and pulled straight out using steady pressure. (See Section 4C for more information.)
- ◆ Stick to main pathways and the centers of trails when hiking.
- ◆ Wear long-sleeved, light-colored shirts and long pants tucked into socks.
- ◆ Talk to a veterinarian about the best ways to protect pets and livestock from ticks.
- ◆ Use repellents containing DEET (N,N-diethyl-m-toluamide), and choose a product that will provide sufficient protection for the amount of time spent outdoors. Product labels often indicate the length of time that someone can expect protection from a product. DEET is considered safe when used according to the manufacturer's directions. The efficacy of DEET levels off at a concentration of 30%, which is the highest concentration recommended for children and adults. DEET products should not be used on children <2 months of age. Mosquito netting may be used to cover infant carriers or to protect other areas for children <2 months of age. The following precautions should be observed when using DEET products:
 - Avoid using DEET products that combine the repellent with a sunscreen. Sunscreens may need to be reapplied too often, resulting in an over application of DEET.
 - Apply DEET on exposed skin, using only as much as needed.
 - Do not use DEET on the hands of young children, and avoid applying repellent to areas around the eyes and mouth.
 - Do not use DEET over cuts, wounds, or irritated skin.
 - Wash treated skin with soap and water after returning indoors, and wash treated clothing.
 - Avoid spraying DEET products in enclosed areas.

Permethrin-containing products will kill mosquitoes and ticks on contact. Permethrin products are not designed to be applied to the skin. Clothing should be treated and allowed to dry in a well-ventilated area prior to wearing. Because permethrin binds very tightly to fabrics, once the fabric is dry, very little of the permethrin gets onto the skin.

A Lyme Disease Public Health Fact Sheet is available from the MDPH Division of Epidemiology and Immunization or on the MDPH website at www.mass.gov/dph. Click on the “Publications and Statistics” link, and select the “Public Health Fact Sheets” section under “Communicable Disease Control.” Additional information on LD as well as other diseases spread by ticks in Massachusetts can be found on the MDPH Tickborne Disease Website at www.mass.gov/dph/cdc/epii/lyme/lymehp.htm.



ADDITIONAL INFORMATION

The following is the formal CDC and Council of State and Territorial Epidemiologists (CSTE) surveillance case definition for LD. It is provided for your information only and should not affect the investigation or reporting of a case that fulfills the criteria in Section 2A of this chapter. (The CDC and the MDPH use the CDC case definitions to maintain uniform standards for national reporting.) For reporting to the MDPH, always use the criteria outlined in Section 2A.

Note: The most up-to-date CDC case definitions are available on the CDC website at www.cdc.gov/epo/dphsi/casedef/case_definitions.htm.

Case Classification (for Surveillance Purposes Only)

- ◆ A person with a physician-diagnosed erythema migrans: 5 cm; or
- ◆ A person with at least one late manifestation and laboratory confirmation of infection.

Definitions of Terms Used in the Case Classification

Erythema Migrans (EM)

For purposes of surveillance, EM is a skin lesion that typically begins as a red macule or papule and expands over a period of days to weeks to form a large round lesion, often with partial central clearing. A solitary lesion must reach at least 5 cm in size. Secondary lesions may also occur. EM does not always present as a classic “bull’s eye.” It may present as an irregular erythematous patch (with or without central clearing), as an oval or triangular erythematous lesion, as an elongated erythematous lesion, or as multiple erythematous lesions. Annular erythematous lesions occurring within several hours of a tick bite represent hypersensitivity reactions and do not qualify as EM. In most patients, the expanding EM lesion is accompanied by other acute symptoms, particularly fatigue, fever, headache, mild stiff neck, arthralgias, or myalgias. These symptoms are typically intermittent. A physician must make the diagnosis of EM. Laboratory confirmation is recommended for persons with no known exposure.

Late Manifestations

These include any of the following when an alternate explanation is not found:

Musculoskeletal System	Recurrent, brief attacks (weeks or months) of objective joint swelling in one or a few joints, sometimes followed by chronic arthritis in one or a few joints. Manifestations not considered as criteria for diagnosis include chronic progressive arthritis not preceded by brief attacks and chronic symmetrical polyarthritis. Additionally, arthralgias, myalgias, or fibromyalgia syndromes alone are not currently accepted as CDC/CSTE criteria for musculoskeletal involvement.
Nervous System	Lymphocytic meningitis, cranial neuritis, particularly facial palsy (may be bilateral), radiculoneuropathy, or rarely, encephalomyelitis alone or in combination. Encephalomyelitis must be confirmed by showing antibody production against <i>B. burgdorferi</i> in the CSF, demonstrated by a higher titer of antibody in CSF than in serum. Headache, fatigue, paresthesias, or mild stiff neck alone are not currently accepted as CDC/CSTE criteria for neurologic involvement.
Cardiovascular System	Acute onset, high-grade (2 nd degree or 3 rd degree) atrioventricular conduction defects that resolve in days to weeks and are sometimes associated with myocarditis. Palpitations, bradycardia, bundle branch block, or myocarditis alone are not currently accepted as CDC/CSTE criteria for cardiovascular involvement.

Laboratory Confirmation

Laboratory confirmation of infection with *B. burgdorferi* is established when a laboratory isolates the spirochete from tissue or body fluid, detects diagnostic levels of IgM or IgG antibodies to the spirochete in serum or CSF, or detects a significant change in antibody levels in paired acute and convalescent serum samples.



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FORMS & WORKSHEETS

Lyme Disease

*(Also known as Lyme Borreliosis and
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LBOH Action Steps

This form does not need to be submitted to the MDPH with the case report form. It is for LBOH use and is meant as a quick-reference guide to Lyme disease case investigation activities.

LBOH staff should follow these steps when Lyme disease is suspected or confirmed in the community. For more detailed information, including disease epidemiology, reporting, case investigation, and follow-up, refer to the preceding chapter.

- Obtain copies of relevant laboratory reports.
- Fill out a MDPH *Lyme Disease Case Report Form* (attach laboratory results).
- Send the completed case report form, with the attached laboratory reports, to the MDPH Bureau of Communicable Disease Control, Office of Integrated Surveillance and Informatics Services (ISIS).