

Lyme Disease

(Borrelia burgdorferi)

DISEASE REPORTABLE WITHIN 24 HOURS OF DIAGNOSIS

Per NJAC 8:57, health care providers and administrators shall report by mail or by electronic reporting within 24 hours of diagnosis, confirmed cases of Lyme disease to the health officer of the jurisdiction where the ill or infected person lives, or if unknown, wherein the diagnosis is made. A directory of local health departments in New Jersey is available at <http://localhealth.nj.gov>.

If the health officer is unavailable, the health care provider or administrator shall make the report to the Department by telephone to 609-826-5964 between 8:00 A.M. and 5:00 P.M. on non-holiday weekdays or to 609-392-2020 during all other days and hours.



1 THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic Agent

In the United States, Lyme disease (LD) is caused by the corkscrew-shaped bacterium (spirochete) *Borrelia burgdorferi*. *Borrelia mayonii* is a new bacterial species recently found to cause LD in people who live in the upper Midwestern United States. Worldwide, LD is caused by three main species of bacteria: *B. burgdorferi*, *B. afzelii*, and *B. garinii*.

B. Clinical Description

Untreated LD can produce a wide range of symptoms, depending on the stage of infection. Approximately 70-80% of persons will develop an erythema migrans (EM) rash, which can assist in diagnosis (https://www.cdc.gov/lyme/signs_symptoms/rashes.html), but depending on the location of the tick bite, it may be undetected. A small bump or redness at the site of a tick bite that occurs immediately and resembles a mosquito bite is common. This irritation generally goes away in 1-2 days and is not a sign of LD. Early signs and symptoms can last for several weeks in untreated patients. Within weeks to months following infection, patients may develop neurological or cardiac abnormalities. Weeks to years following infection (mean 6 months), patients may develop intermittent episodes of swelling and pain in large joints, leading to chronic arthritis, or rarely chronic neurological manifestations. Late-stage symptoms can persist for several years but tend to resolve spontaneously.

Early Signs and Symptoms (3 to 30 days after tick bite)

- Flu-like symptoms: fever, chills, headache, fatigue, muscle and joint aches, stiff neck, and swollen lymph nodes (lymphadenopathy)
- Erythema migrans (EM) rash:
 - Begins at the site of a tick bite after a delay of 3 to 30 days (average is about 7 days)
 - Expands gradually over several days reaching up to 12 inches or more (30 cm) across
 - May feel warm to the touch but is rarely itchy or painful
 - Sometimes clears as it enlarges, resulting in a target or “bull’s-eye” appearance
 - May appear on any area of the body

Later Signs and Symptoms (days to months after tick bite)

- Severe headaches and neck stiffness
- Additional EM rashes on other areas of the body (secondary lesions indicate that the infection has spread into the blood, resemble the primary lesion but tend to be smaller)
- Arthritis with severe joint pain and swelling, particularly the knees and other large joints.
- Facial palsy (loss of muscle tone or droop on one or both sides of the face)
- Intermittent pain in tendons, muscles, joints, and bones
- Heart palpitations or an irregular heart beat (Lyme carditis)

- Episodes of dizziness or shortness of breath
- Inflammation of the brain and spinal cord (meningitis, encephalitis)
- Nerve pain
- Shooting pains, numbness, or tingling in the hands or feet
- Problems with short-term memory

Treatment

Patients treated with appropriate antibiotics in the early stages of LD usually recover rapidly and completely. CDC recommends the 2006 guidelines for treatment developed by the Infectious Diseases Society of America (<https://www.cdc.gov/lyme/treatment/index.html>).

C. Reservoirs

The primary vector for LD in New Jersey is the blacklegged or deer tick, *Ixodes scapularis*.

Ticks become infected as larvae or nymphs when they feed on infected animals, especially the white-footed mouse, and they remain infected for life. Nymphal ticks pose the greatest threat of transmitting infectious organisms to animals and humans because they are small in size (< 2mm) and may go undetected. Nymphs are most abundant between May and July, and they are typically found in wooded areas, brush, and grassy areas near woodland edges. Toward the end of summer through fall, the nymphs mature to the adult stage. Although adult ticks remain capable of transmitting *B. burgdorferi* to humans, they are larger in size and easier to detect. As such, adult ticks are often removed before they can transmit LD. Deer are an important source of food for adult ticks, but do not transmit *B. burgdorferi*.

D. Modes of Transmission

LD is acquired from the bite of an infected tick. In most cases, the tick must be attached for 36 to 48 hours or more before the LD bacteria can be transmitted. Ticks can attach to any part of the human body but are often found in hard-to-see areas such as the groin, armpits, and scalp. As a result, cases of diagnosed LD frequently have no known history of a tick bite.

LD acquired during pregnancy may lead to infection of the placenta and possible stillbirth; however, no negative effects on the fetus have been found when the mother receives appropriate antibiotic treatment. There are no reports of LD transmission from breast milk. LD could potentially be transmitted through blood transfusion, although there are no documented reports.

Dogs and cats can get LD, but there is no evidence that they spread the disease directly to their owners. However, pets can bring infected ticks into the home or yard.

E. Incubation Period

EM typically develops 7 to 10 days after exposure (range: 3 to 30 days). However, early signs of illness may be unapparent and the patient may present with later manifestations, which could be several months later.

F. Period of Communicability or Infectious Period

LD is not generally communicable from person to person, although there is a potential risk of transmission through blood transfusion and some case reports of LD in pregnancy.

G. Epidemiology

Reports of LD have increased dramatically in the United States since 1975 when the disease was first recognized in Lyme, Connecticut. Each year, approximately 30,000 cases of LD are reported to CDC, but annual incidence is estimated at around 300,000 cases. While cases have been reported from nearly every state, LD cases are concentrated in the Northeast and upper Midwest. In 2015, 95% of confirmed LD cases were reported from 14 states: Connecticut, Delaware, Maine, Maryland, Massachusetts, Minnesota, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia and Wisconsin. In 2015, New Jersey had the sixth highest incidence of LD at 43.9 cases per 100,000 population.

Reports of LD in New Jersey have remained relatively constant since 2010. An average of 3,966 confirmed and probable cases were reported each year between 2012-2016 in New Jersey. In 2016, there were 4,350 reported confirmed and probable LD cases.

In New Jersey, the highest risk for acquiring LD occurs in wooded rural or suburban environments. However, all parts of the state are considered endemic for LD, and human cases have been reported from all counties in New Jersey. Hunterdon, Sussex, and Warren counties had the highest LD incidence in 2015. Most cases occur between May and October.

2 CASE DEFINITION

The NJDOH Infectious & Zoonotic Disease Program follows the most current Lyme disease case definition as published on the CDC National Notifiable Disease Surveillance System (NNDSS) website.

Lyme Disease Case Definition: <https://www.cdc.gov/nndss/conditions/lyme-disease/>

Case definitions enable public health to classify and count cases consistently across reporting jurisdictions, and should not be used by healthcare providers to determine how to meet an individual patient's health needs.

A. Clinical Description

For purposes of surveillance, EM is defined as 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 single primary lesion must reach greater than or equal to 5 cm in size across its largest diameter. Secondary lesions also may occur. For most patients, the expanding EM lesion is accompanied by other acute symptoms, particularly fatigue, fever, headache, mildly stiff neck, arthralgia, or myalgia. These symptoms are typically intermittent. The diagnosis of EM must be made by a physician.

For purposes of surveillance, late manifestations 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, arthralgia, myalgia, or fibromyalgia syndromes alone are not criteria for musculoskeletal involvement.
- Nervous system. Any of the following signs that cannot be explained by another etiology: lymphocytic meningitis; cranial neuritis, particularly facial palsy (may be bilateral); radiculoneuropathy; or, rarely, encephalomyelitis.
 - Headache, fatigue, paresthesia, or mildly stiff neck alone, are not criteria for neurologic involvement.
- Cardiovascular system. Acute onset of high-grade (2nd-degree or 3rd-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 criteria for cardiovascular involvement.

B. Laboratory Criteria

For the purposes of surveillance, laboratory evidence includes:

- A positive culture for *B. burgdorferi*, **OR**
- A positive two-tier test. (defined as a positive or equivocal enzyme immunoassay (EIA) or immunofluorescent assay (IFA) followed by a positive Immunoglobulin M¹ (IgM) or Immunoglobulin G² (IgG) western immunoblot (WB) for Lyme disease) **OR**
- A positive single-tier IgG² WB test for Lyme disease

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¹ IgM WB is considered positive when at least two of the following three bands are present: 24 kilodalton (kDa) outer surface protein C (OspC)*, 39 kDa basic membrane protein A (BmpA), and 41 kDa (Fla). **Disregard IgM results for specimens collected >30 days after symptom onset.**

² IgG WB is considered positive when at least five of the following 10 bands are present: 18 kDa, 24 kDa (OspC)*, 28 kDa, 30 kDa, 39 kDa (BmpA), 41 kDa flagellin (Fla), 45 kDa, 58 kDa (not GroEL), 66 kDa, and 93 kDa.

*Depending upon the assay, OspC could be indicated by a band of 21, 22, 23, 24 or 25 kDa.

Exposure

Exposure is defined as having been (\leq 30 days before onset of EM) in wooded, brushy, or grassy areas (i.e., potential tick habitats) of LD vectors. NJ is considered a high-incidence state for LD and exposure should be assumed for all reported cases. A list of high and low-incidence states is available at <https://www.cdc.gov/lyme/stats/tables.html>. A history of tick bite is not required.

C. Case Classification

CONFIRMED

- A case of EM with exposure in a high incidence state (e.g., New Jersey), **OR**
- A case of EM with laboratory evidence of infection and a known exposure in a low incidence state, **OR**
- A case with at least one late manifestation that has laboratory evidence of infection

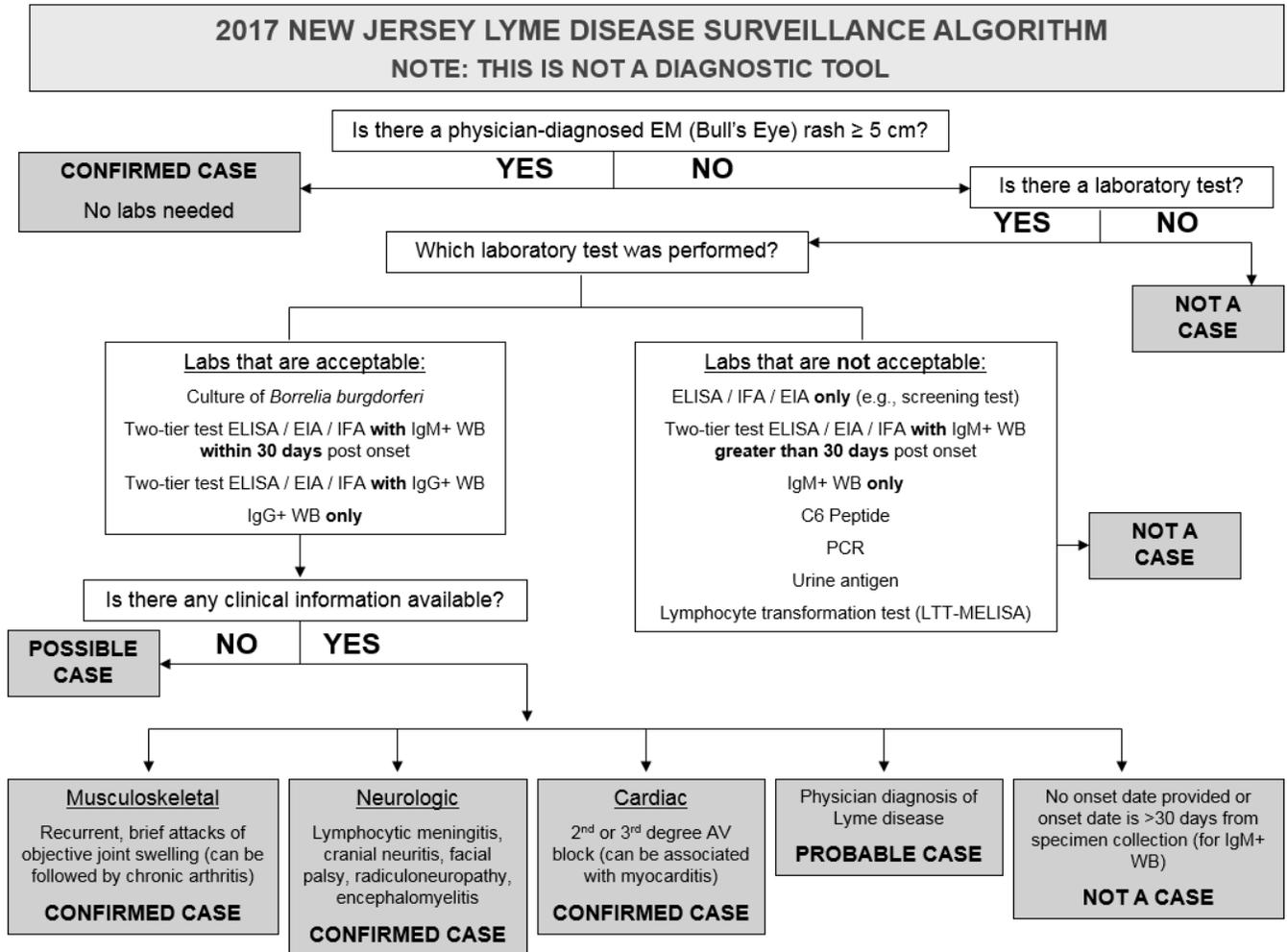
PROBABLE

- Any other case of physician-diagnosed LD that has laboratory evidence of infection

POSSIBLE

- A case of EM where there is no known exposure (as defined above) and no laboratory evidence of infection, **OR**
- A case with evidence of infection but no clinical information available (e.g., a laboratory report)

NOTE: Lyme disease reports are not considered cases if the healthcare provider specifically states this is not a case of Lyme disease, or the only symptom listed is "tick bite" or "insect bite."



3 LABORATORY TESTING

Several forms of laboratory testing for LD are available, some of which have not been adequately validated. Most recommended tests are blood tests that measure IgM and IgG antibodies made in response to the infection. During the first few weeks of infection, such as when a patient has an EM rash, serologic tests are expected to be negative. Several weeks after infection, currently available ELISA, EIA and IFA tests and two-tier testing have very good sensitivity.

CDC currently recommends a two-step process when testing blood for evidence of antibodies against the LD bacteria. Both steps can be done using the same blood sample. The first step uses a testing procedure called “EIA” (enzyme immunoassay) or rarely, an “IFA” (indirect immunofluorescence assay). If this first step is negative, no further testing of the specimen is recommended. If the first step is positive or indeterminate (sometimes called "equivocal"), the second step should be performed. The second step uses a test called an immunoblot test, commonly, a “Western blot” test. If the patient has had symptoms for less than or equal to 30 days,

an IgM Western Blot is performed. If the patient has had symptoms for more than 30 days, the IgG Western Blot is performed. The IgM should not be used if the patient has been ill for more than 30 days. Results are considered positive only if the EIA/IFA and the immunoblot are both positive.

Enzyme-linked immunoassay (EIA or ELISA) or IFA determines if a person has developed antibodies to LD. These tests are sometimes called LD screens and can be reported as positive results or as titers. These tests normally measure the amount of IgM and IgG together, although testing can be ordered for IgM or IgG independently. All tests should be interpreted using the reference range provided by the ordering laboratory. These tests are designed to be very “sensitive,” meaning that almost everyone with LD, and some people who do not have LD, will test positive. If the ELISA or IFA is negative, it is highly unlikely that the person has LD, and no further testing is recommended.

The immunoblot is a laboratory test that looks for antibodies against specific *B. burgdorferi* antigens. A Western Blot (WB) is a type of immunoblot that requires interpretation of bands. Immunoblot tests for LD testing can detect two different classes of antibodies: IgM and IgG. IgM antibodies are made earlier, so testing for them can be helpful for identifying patients during the first few weeks of infection. The downside of testing for IgM antibodies is that they are more likely to give false positive results. Tests for IgG antibodies are more reliable, but can take 4-6 weeks for the body to produce large enough quantities for the test to detect them. Used appropriately, this test is designed to be “specific,” meaning that it will usually be positive only if a person has been truly infected. If the WB is negative, it suggests that the first test was a false positive.

CDC does not recommend a WB without first performing an ELISA or IFA. Doing so increases the potential for false positive results. Such results may lead to patients being treated for LD when they do not have it and not getting appropriate treatment for the true cause of their illness.

LD tests whose accuracy and clinical usefulness have not been adequately established include urine antigen tests, immunofluorescent staining for cell-wall-deficient forms of *B. burgdorferi*, lymphocyte transformation tests, and “reverse western blots.” In general, the CDC does not recommend these tests. Patients are encouraged to ask their physicians whether their LD test was performed using validated methods and whether results were interpreted using appropriate guidelines.

The NJDOH Public Health and Environmental Laboratories (PHEL) does not provide human testing for the detection of *B. burgdorferi*.

4 PURPOSE OF SURVEILLANCE AND REPORTING

- To better understand the local epidemiology of infection with *B. burgdorferi*
- To recognize areas in New Jersey where LD incidence has changed (increased or decreased)
- To focus LD preventive education

5 CASE INVESTIGATION

A. Investigation

Local health departments are asked to investigate LD reports and close cases in CDRSS within 3 months of case creation. Cases that remain open for three months or more and have no investigation or update notes will be closed by NJDOH. Local health departments can fax the CDS-14 Lyme Disease Case Investigation form (Attachment A) to the patient’s healthcare provider to collect information needed to classify the case. Case report forms should NOT be sent to NJDOH. Document all information in CDRSS.

A minimum of 3 attempts should be made to obtain information from the patient’s healthcare provider. After 3 attempts, enter what is known into CDRSS, including attempts to obtain information (dates and results of the attempts), and classify/close the case according to the case definition. It is NOT necessary to interview the patient.

B. Key CDRSS Fields Specific for Lyme Disease

CDRSS Screen	Required Information
Signs/Symptoms	<ul style="list-style-type: none"> • Check appropriate boxes for signs and symptoms and indicate their onset/resolution dates. Onset dates are important to interpret laboratory test results (IgM WB vs IgG). • If an exact onset date was not provided, but the healthcare provider indicates if symptom onset was greater than 30 days, write this in the “Attribute” field next to that sign/symptom • Add/select reported signs/symptoms even if they are not part of case definition.
Case Comments	<ul style="list-style-type: none"> • Note if the physician diagnosed the patient with LD • If requested information was not provided by the patient’s healthcare provider, list the dates attempts were made to obtain information and the outcomes. For example, 1/12/17 faxed form to provider; 1/31/17, spoke with office manager and re-sent form; 2/15/17, re-faxed form to provider. Provider non-responsive.
Case Classification	If information was not provided by the healthcare provider, despite multiple attempts, next to Report Status / Reason for Status, select “UNABLE TO OBTAIN INFO FROM MD”

6 CONTROLLING FURTHER SPREAD

C. Isolation and Quarantine Requirements / Protection of Contacts of a Case

There are no isolation or quarantine restrictions.

D. Managing Special Situations

Removing a Tick

Ticks should be removed as soon as they are found on the skin. Fine-tipped tweezers should be used to firmly grasp the tick very close to the skin. Using a steady motion, the tick's body should be pulled away from the skin. Efforts should be made to not twist or jerk the tick - this can cause the mouth-parts to break off and remain in the skin. If this happens, the mouth-parts should be removed with tweezers. If they can't be removed, it isn't cause for concern. Once the mouthparts are removed from the rest of the tick, it can no longer transmit the LD bacteria. After the tick is removed, the bite area should be cleaned with rubbing alcohol, an iodine scrub, or soap and water.

Dispose of a live tick by submersing it in alcohol, placing it in a sealed bag/container, wrapping it tightly in tape, or flushing it down the toilet. Never crush a tick with fingers.

Petroleum jelly, a hot match, nail polish, or other products should not be used to remove a tick. An area of redness occurring within several hours of a tick bite represents a hypersensitivity reaction and does not represent an EM. The date of tick attachment should be documented so if symptoms develop, this information can be relayed to a healthcare provider.

Tick Testing and Identification:

Tick testing of individual ticks is not useful because:

- If the test shows that the tick contained disease-causing organisms, that does not necessarily mean that the person has been infected.
- If someone has been infected, s/he will probably develop symptoms before results of tick testing are available. Treatment should not be delayed while waiting for tick testing results.
- Negative results can lead to false assurance. For example, the person concerned may have been unknowingly bitten by a different tick that was infected.

Tick identification may be of value when discussing tick bite exposures with a healthcare provider. County mosquito control agencies or agricultural extension offices may offer tick identification services. The TickEncounter Resource Center has tick identification resources online: http://www.tickencounter.org/tick_identification.

E. Preventive Measures

Preventing ticks in the yard: Prevention of LD involves keeping wildlife (especially deer and rodents) out of the backyard and making it less attractive to ticks.

- Clear tall grasses and brush around homes and at the edge of lawns.
- Place a 3-ft wide barrier of wood chips or gravel between lawns and wooded areas and around patios and play equipment. This will restrict tick migration into recreational areas.
- Mow the lawn frequently and keep leaves raked.
- Stack wood neatly and in a dry area (discourages rodents that ticks feed on).
- Keep playground equipment, decks, and patios away from yard edges and trees and place them in a sunny location, if possible.
- Remove any old furniture, mattresses, or trash from the yard that may give ticks a place to hide.
- When using acaricides (tick pesticides) around the home, always follow the label instructions and never use near streams or other bodies of water.

Preventing ticks on pets: Although dogs and cats can get LD, there is no evidence that they spread the disease directly to their owners. However, pets can bring infected ticks into the home or yard. For these reasons, it's important to use a tick preventive product for dogs.

Preventing tick bites on people: The best preventive measure is to avoid tick-infested areas. In areas where contact with ticks may occur, individuals should be advised to do the following:

- Wear long-sleeved shirts and long, light-colored pants tucked into socks or boots.
- Stay on trails when walking or hiking and avoid high grass.
- Use repellent that contains 20 percent or more DEET, picaridin, or IR3535 on exposed skin for protection that lasts several hours. Always follow product instructions. Parents should apply this product to their children, avoiding hands, eyes, and mouth.
- Use products that contain permethrin on clothing. Treat clothing and gear, such as boots, pants, socks and tents with products containing 0.5% permethrin. It remains protective through several washings.
- Bathe or shower as soon as possible after coming indoors (preferably within 2 hours) to wash off and more easily find ticks that are crawling on you.

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- Conduct a full-body tick check using a hand-held or full-length mirror to view all parts of your body upon return from tick-infested areas. Parents should check their children for ticks under the arms, in and around the ears, inside the belly button, behind the knees, between the legs, around the waist, and especially in their hair.
- Examine gear and pets. Ticks can ride into the home on clothing and pets, then attach to a person later, so carefully examine pets, coats, and day packs.
- Tumble dry clothes in a dryer on high heat for 10 minutes to kill ticks on dry clothing after you come indoors.

Tick Bite Prophylaxis

The Infectious Disease Society of America (IDSA) does not generally recommend antimicrobial prophylaxis for prevention of LD after a recognized tick bite. However, in areas that are highly endemic for LD (i.e., New Jersey), a single dose of doxycycline may be offered to adult patients (200 mg) who are not pregnant and to children older than 8 years of age (4 mg/kg up to a maximum dose of 200 mg) when all of the following circumstances exist:

- Doxycycline is not contraindicated
- The attached tick can be identified as an adult or nymphal *I. scapularis* tick
- The estimated time of attachment is ≥ 36 h based on the degree of engorgement of the tick with blood or likely time of exposure to the tick
- Prophylaxis can be started within 72 h of tick removal
- LD is common in the county or state where the patient lives or has recently traveled, (i.e., CT, DE, MA, MD, ME, MN, NH, **NJ**, NY, PA, RI, VA, VT, WI).

Additional information is available at <https://www.cdc.gov/ticks/tickbornediseases/tick-bites-prevention.html>

F. Immunization

A LD vaccine is no longer available. The vaccine manufacturer discontinued production in 2002. Protection provided by this vaccine diminishes over time. Therefore, persons who received the LD vaccine before 2002 are probably no longer protected against LD.

Additional Information

NJDOH: <http://www.nj.gov/health/cd/topics/lyme.shtml>

CDC: <https://www.cdc.gov/lyme/>

References

Centers for Disease Control and Prevention. National Notifiable Diseases Surveillance System (NNDSS), Case Definitions: <https://www.cdc.gov/nndss/conditions/lyme-disease/case-definition/2017/>

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Nadelman, R.B., Nowakowski, J., Durland, F., et al. *Prophylaxis with Single-Dose Doxycycline for the Prevention of Lyme Disease after an Ixodes scapularis Tick Bite*. N Engl J Med 345:79-84.

Appendix A: NJDOH Lyme Disease Case Investigation Form, CDS-14

NJDOH LYME DISEASE CASE INVESTIGATION FORM		CDRSS #: _____
PATIENT INFORMATION		
Name:		DOB: ____ / ____ / ____
Address:		Phone: ()
Race <input type="checkbox"/> White <input type="checkbox"/> Black <input type="checkbox"/> American Indian or Alaskan Native <input type="checkbox"/> Asian <input type="checkbox"/> Native Hawaiian/Pacific Islander		Ethnicity <input type="checkbox"/> Hispanic <input type="checkbox"/> Non-Hispanic
CLINICAL INFORMATION		
Has the clinician diagnosed this patient with Lyme disease? <input type="checkbox"/> Yes, date _____ <input type="checkbox"/> No (Definition of diagnosis for NJDOH surveillance purposes may include clinical findings, laboratory results, or diagnosis of exclusion)		Onset Date (mm/dd/yy) ____ / ____ / ____ If exact onset date is unknown, did symptoms develop greater than 30 days before specimen collection? <input type="checkbox"/> Yes <input type="checkbox"/> No
SIGNS OR SYMPTOMS (NOT EXPLAINED BY ANOTHER ETIOLOGY):		
Rash <input type="checkbox"/> Erythema migrans (EM) rash > 5 cm	Musculoskeletal <input type="checkbox"/> 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	Neurologic <input type="checkbox"/> Lymphocytic meningitis <input type="checkbox"/> Cranial neuritis <input type="checkbox"/> Facial palsy <input type="checkbox"/> Radiculoneuropathy <input type="checkbox"/> Encephalomyelitis
Cardiac <input type="checkbox"/> Acute onset of high-grade (2 nd or 3 rd -degree) atrioventricular conduction defects that resolve in days to weeks and are sometimes associated with myocarditis		
Additional signs/symptoms:		
RISK FACTORS		
Was there exposure to tick infested areas? <input type="checkbox"/> Yes Date: ____ / ____ / ____ <input type="checkbox"/> No <input type="checkbox"/> Unknown		Did the patient have a recent tick bite? <input type="checkbox"/> Yes Date: ____ / ____ / ____ <input type="checkbox"/> No <input type="checkbox"/> Unknown
TREATMENT		
Name of antibiotic(s)	Dosage and duration	Dates of treatment
<input type="checkbox"/>		____ / ____ / ____ to ____ / ____ / ____
<input type="checkbox"/>		____ / ____ / ____ to ____ / ____ / ____
<input type="checkbox"/> Not treated		
ADDITIONAL COMMENTS		

JULY 2017

RETURN COMPLETED FORM BY FAX TO: _____