



Lyme Disease

Disease Plan

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Last updated: August 17, 2018 by Dallin Peterson

Questions about this disease plan?

Contact the Utah Department of Health Bureau of Epidemiology: 801-538-6191.

✓ **CRITICAL CLINICIAN INFORMATION**

Clinical Evidence
<p>Signs/Symptoms</p> <ul style="list-style-type: none"> • Early localized <ul style="list-style-type: none"> ○ Erythema migrans “bull’s-eye” rash ○ Malaise ○ Fatigue ○ Fever • Early disseminated <ul style="list-style-type: none"> ○ Arthralgia ○ Meningitis ○ Neurologic abnormalities or paralysis • Late disease <ul style="list-style-type: none"> ○ Arthritis ○ Joint pain ○ Swelling
<p>Period of Communicability</p> <ul style="list-style-type: none"> • Not communicable person-to-person
<p>Incubation Period</p> <ul style="list-style-type: none"> • Ranges from 3-23 days, with an average of 7-14 days
<p>Mode of Transmission</p> <ul style="list-style-type: none"> • Lyme disease is spread by the black-legged ticks <i>Ixodes scapularis</i> and <i>Ixodes pacificus</i>
Laboratory Testing
<p>Type of Lab Test (two-tiered)</p> <ul style="list-style-type: none"> • First Test <ul style="list-style-type: none"> ○ Enzyme immunoassay (EIA) or ○ Immunofluorescence Assay (IFA) • Second test <ul style="list-style-type: none"> ○ IgM and IgG Western Blot Serology (also called immunoblot) • Serologic analysis has low sensitivity during the first few weeks of infection while the antibody response is developing. Patients without EM can also present with low sensitivity. It is recommended to collect specimens during early disseminated period for high sensitivity. <p>*Interpretation of lab results can be difficult and caution should be used to avoid patient confusion or misdiagnosis.</p>
<p>Type of Specimens</p> <ul style="list-style-type: none"> • Serum or CSF • Minimum volume required (0.5 mL at 4°C)
Treatment Recommendations
<p>Type of Treatment (treatment is dependent on onset of disease and symptoms)</p> <ul style="list-style-type: none"> • Doxycycline • Amoxicillin • Cefuroxime axetil • Ceftriaxone
Contact Management
<p>Isolation of Case</p> <ul style="list-style-type: none"> • None
Infection Control Procedures
<ul style="list-style-type: none"> • Standard body substance precautions

✓ WHY IS LYME DISEASE IMPORTANT TO PUBLIC HEALTH?

Lyme disease is the most common tick-borne illness in the United States. Utah is not considered an endemic state for Lyme disease; therefore, surveillance efforts to determine where the disease was most likely contracted are critical. Lyme disease can cause mild symptoms and can be completely treatable with antibiotics. However, if left untreated, infection can spread to joints, the heart, and the nervous system, and cause life-long problems.

✓ DISEASE AND EPIDEMIOLOGY

Clinical Description

Symptoms can be vague and diagnosis can be difficult. Clinical manifestations occur in three stages.

Early localized

About 60–80% of infected cases will have a skin lesion that begins as a red macule or papule at the site of the tick bite and expands slowly in a circular manner, often with a central clearing. This skin lesion is referred to as a “bull’s-eye” rash or erythema migrans (EM). EM may be single or multiple. For purposes of surveillance, a single primary lesion must reach 5 cm or 2 inches in diameter to be considered EM. The center of the rash may be vesicular or necrotic. The early localized stage usually occurs within 3–32 days following the tick bite (average 7 days).



Other clinical manifestations include malaise, fatigue, fever, headache, stiff neck, myalgia (muscle aches), arthralgia (joint pain), and/or lymphadenopathy (swollen lymph nodes). The initial disease may last for weeks in untreated patients; symptoms may be intermittent and variable. In some patients, this initial presentation will be inapparent.

Early disseminated

If untreated, approximately 5% of patients will develop chronic disease weeks to months after the initial symptoms. Early disseminated disease can occur several weeks after the primary tick bite and presents as multiple erythema migrans, usually smaller than the primary lesion. Other symptoms may include arthralgia, meningitis, neurologic abnormalities such as facial or Bell’s Palsy, and carditis (see Case Definition).

Late disseminated

Arthritis is the typical manifestation of late disease. Since only 60–80% of cases have a visible acute (or early localized) presentation, late disease may be the first indicator of Lyme disease. Patients with untreated infection may begin to have intermittent bouts of arthritis, with severe joint pain and swelling, particularly in the large joints and knees. Other arthritic presentations are not indicative of Lyme disease.

Causative Agent

Lyme disease is a zoonotic disease caused by the tick-borne spirochete, *Borrelia burgdorferi*.

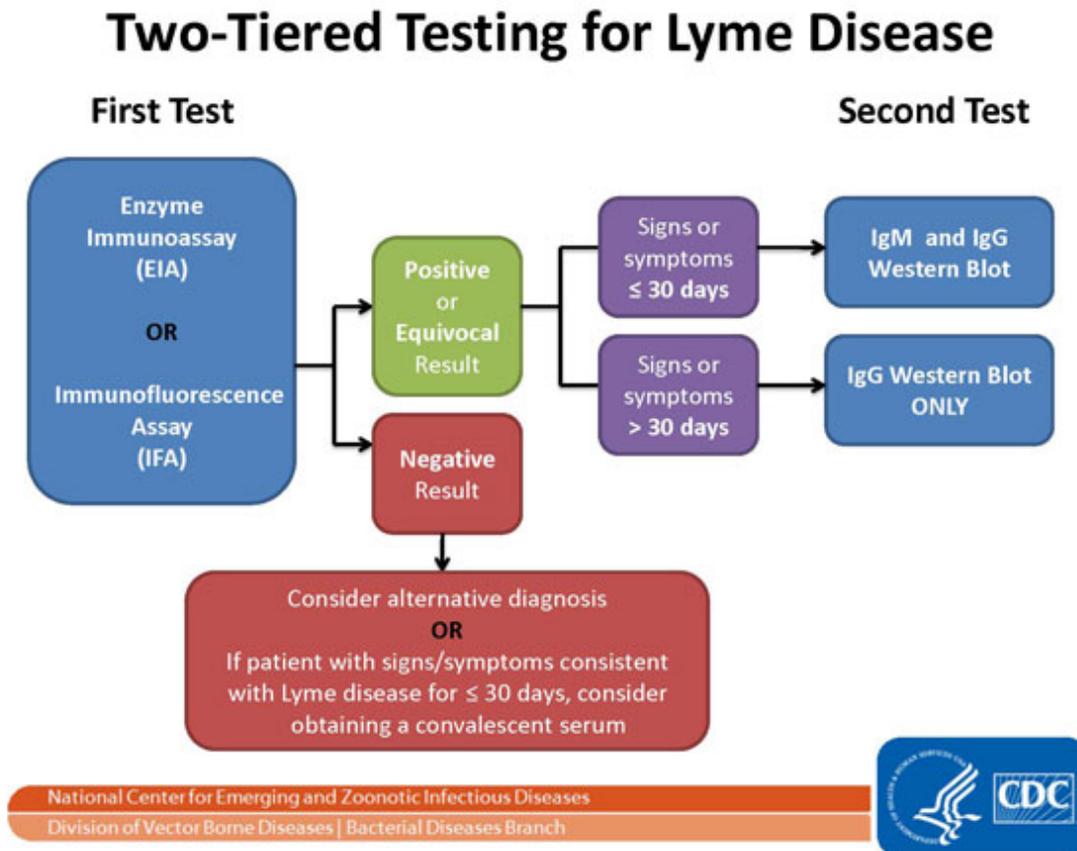
Differential Diagnosis

The differential diagnosis for acute Lyme disease includes dermatologic conditions such as insect bites. For chronic (late disease) Lyme disease, the differential includes Multiple Sclerosis, ALS (Lou Gehrig's Disease), arthritis, Chronic Fatigue Syndrome, ADHD, fibromyalgia, and other difficult-to-diagnose multi-system syndromes.

Laboratory Identification

Laboratory testing is poorly standardized and test results should be interpreted with caution. Testing is generally performed through a two-step process, similar to HIV/AIDS. Initially, serological tests, such as an enzyme immunoassay (EIA) or an indirect immunofluorescence assay (IFA), are used to screen patients. Samples that are reactive or equivocal on the screening tests are then tested with a Western Blot. The usefulness of PCR in routine management of Lyme disease cases has yet to be verified.

Figure 1. Lyme disease testing algorithm



CDC website: <http://www.cdc.gov/lyme/diagnostesting/labtest/twostep/index.html>

Initially, a total immunoglobulin serology test should be performed. If reactive, the following tests should be performed to confirm the diagnosis:

- a. If the symptom onset is <30 days, perform BOTH an IgM Western Blot and IgG Western Blot.
- b. If the symptom onset is >30 days, perform an IgG Western Blot, or test paired acute- and convalescent-phase serum samples.

Interpretation

- Samples may fail to react when the disease is in its early stages, yielding a false negative result.
- Samples may fail to react when a patient is treated early in the disease, also yielding a false negative result.
- The antibodies (IFA or EIA/ELISA) can cross react in patients with antibodies to other spirochetal infections (e.g., syphilis, relapsing fever, or leptospirosis), certain viral infections (e.g., HIV, varicella, Epstein-Barr, or Rocky Mountain spotted fever) or certain autoimmune diseases (e.g., lupus erythematosus or rheumatoid arthritis). The presence of these diseases may yield false positive results on Lyme disease antibody tests.
- Generally, the test sensitivity increases as the disease progresses, but some patients fail to seroconvert even during the chronic phase of the illness.
- IgM Western Blots should not be used to support a diagnosis for Lyme disease when disease manifestations have existed for longer than one month.

Sensitivity

- During the first four weeks of infection, serodiagnostic tests are insensitive and are not generally recommended.
- An IgM EIA or ELISA that uses a recombinant antigen is more sensitive than those using whole cell ELISA.
- An IgG Western Blot that uses VlsE or C6 recombinant antigens increases the sensitivity of the test.
- Culture is difficult and not recommended.
 - There is a “home-brewed” urine culture test that some laboratories use (mainly a Pennsylvania laboratory) that has not been validated by the CDC.

Treatment

Table 1. Treatment of Lyme disease*

	Drug	Adult dosage	Pediatric dosage
Erythema migrans (early disease)[†]			
	Doxycycline ^{Δ◊}	100 mg PO bid x 10 to 21 d	≥8 years: 2 mg/kg PO bid (maximum 100 mg per dose) x 10 to 21 d
	or Amoxicillin	500 mg PO tid x 14 to 21 d	50 mg/kg/day divided tid PO (maximum 500 mg per dose) x 14 to 21 d
	or Cefuroxime axetil	500 mg PO bid x 14 to 21 d	30 mg/kg/day divided bid PO (maximum 500 mg per dose) x 14 to 21 d
Neurologic disease			
Isolated facial nerve palsy (early disseminated disease)	Doxycycline ^{Δ§}	100 mg PO bid x 14 to 28 d	≥8 years: 2 mg/kg PO bid (maximum 100 mg per dose) x 14 to 28 d
More serious disease [¶] (e.g., meningitis, radiculopathy, encephalitis) (early or late disseminated disease)	Ceftriaxone ^{††}	2 g IV once daily x 28 d (range 10 to 28 days)	50-75 mg/kg IV once daily (maximum 2 g per dose) x 28 d (range 10 to 28 days)
Carditis^{**}			
Mild (first-degree atrioventricular block with PR interval <300 milliseconds)	Doxycycline ^Δ	100 mg PO bid x 21 d (range 14 to 21 days)	≥8 years: 2 mg/kg PO bid (maximum 100 mg per dose) x 21 d (range 14 to 21 days)
	or Amoxicillin	500 mg PO tid x 21 d (range 14 to 21 days)	50 mg/kg/day divided tid PO (maximum 500 mg per dose) x 21 d (range 14 to 21 days)
	or Cefuroxime axetil	500 mg PO bid x 21 d (range 14 to 21 days)	30 mg/kg/day divided bid PO (maximum 500 mg per dose) x 21 d (range 14 to 21 days)

Carditis** con't			
More serious disease (symptomatic, second- or third-degree atrioventricular block, first-degree atrioventricular block with PR interval ≥ 300 milliseconds) ^{¶¶}	Ceftriaxone ^{†**}	2 g once/day IV x 21 to 28 d	50-75 mg/kg once/day IV (maximum 2 g per dose) x 21 to 28 d
Arthritis[‡]			
Arthritis without neurologic disease	Doxycycline ^Δ	100 mg PO bid x 28 d	≥ 8 years: 2 mg/kg PO bid (maximum 100 mg per dose) x 28 d
	or Amoxicillin ^{ΔΔ}	500 mg PO tid x 28 d	50 mg/kg/day divided tid PO (maximum 500 mg per dose) x 28 d
Arthritis with neurologic disease	Ceftriaxone [‡]	2 g IV once/day x 28 d	50-75 mg/kg once/day IV (maximum 2 g per dose) x 28 d
Recurrent arthritis (despite adequate prior oral therapy)	Ceftriaxone [‡]	2 g IV once/day x 14 to 28 d	50-75 mg/kg once/day IV (maximum 2 g per dose) x 14 to 28 d
	or Doxycycline ^Δ	100 mg PO bid x 28 d	≥ 8 years: 2 mg/kg PO bid (maximum 100 mg per dose) x 28 d
	or Amoxicillin ^{ΔΔ}	500 mg PO tid x 28 d	50 mg/kg/day divided tid PO (maximum 500 mg per dose) x 28 d
Acrodermatitis chronica atrophicans			
	Doxycycline ^Δ	100 mg PO bid x 21 d	≥ 8 years: 2 mg/kg PO bid (maximum 100 mg per dose) x 21 d
	or Amoxicillin	500 mg PO tid x 21 d	50 mg/kg/day divided tid PO (maximum 500 mg per dose) x 21 d
	or Cefuroxime	500 mg PO bid x 21 d	30 mg/kg/day divided bid PO (maximum 500 mg per dose) x 21 d

FOOTNOTES:

Bid: twice daily; tid: three times daily; PO: oral; IV: intravenous.

* Regardless of the clinical manifestation of Lyme disease, complete response to treatment may be delayed beyond the treatment duration. Relapse has occurred with all of these regimens; patients with objective signs of relapse may need a second course of treatment.

¶ Alternative but less effective therapy for patients unable to tolerate preferred regimens, azithromycin in adults: 500 mg once daily, in children: 10 mg/kg per day x 7–10 days or clarithromycin in adults: 500 mg twice daily, in children: 7.5 mg/kg twice per day x 14–21 days, or erythromycin in adults: 500 mg four times daily, in children: 12.5 mg/kg four times daily x 14–21 days.

Δ Should not be used for children younger than eight years old or for pregnant or lactating women.

◇ Doxycycline also has activity against *Anaplasma phagocytophilum* and *Bartonella henselae* (which causes cat scratch disease), but not against *Babesia microti*.

§ Amoxicillin or cefuroxime are alternatives in patients with contraindications to doxycycline.

¥ In late disease, the response to treatment may be delayed for several weeks or months.

‡ Or cefotaxime 2 g IV q 8 hours x 14–28 days for adults and 150–200 mg/kg/day in 3 divided doses (maximum 6 g per day) for children or penicillin G 18 to 24 million U per day divided into doses given every 4 hours in adults and 200,000 to 400,000 U/kg per day divided every 4 hours (maximum 18–24 million U per day) in children.

† In nonpregnant adult patients intolerant of beta-lactam antibiotics, doxycycline 200 to 400 mg per day orally or intravenously in two divided doses. In children ≥8 years of age, doxycycline 4 to 8 mg/kg per day in 2 divided doses to a maximum daily dosage of 200 to 400 mg.

** A parenteral antibiotic regimen is recommended for initiation of treatment for hospitalized patients. IV antibiotics should be continued until high-grade AV block has resolved and the PR interval has become less than 300 milliseconds. The patient may then be switched to oral therapy to complete a 21 to 28 day course.

¶¶¶ A temporary pacemaker may be necessary.

ΔΔ Cefuroxime may be used as an alternative in patients with contraindications to doxycycline and amoxicillin, although it has not been assessed in clinical studies for this indication.

Case Fatality

If untreated, Lyme disease can cause chronic illness, but is rarely fatal.

Reservoir

Lyme disease is tick-borne disease. Vectors include the black-legged tick, *Ixodes scapularis* (commonly known as the “deer tick”), in the eastern and midwestern United States and the black-legged tick, *Ixodes pacificus*, in the western United States; these ticks are present in Utah. White-tailed deer are an important maintenance host. Dogs, cattle, and horses are all susceptible to this disease.

Transmission

Lyme disease is tick-borne. The length of time of tick attachment for transfer of the spirochete is unknown, but in most cases, the tick must be attached for 24–48 hours or more before Lyme disease bacteria can be transmitted. Maternal transmission of this disease is possible, but has not been well-documented.

Susceptibility

All people are susceptible. Reinfection can occur in people who were treated with antibiotics early in the disease cycle.

Incubation Period

The incubation period from tick bite to EM ranges from 3–32 days with an average of 7–14 days.

Period of Communicability

There is no evidence of person-to-person transmission. There are rare cases of congenital transmission, but without adverse outcomes.

Epidemiology

Lyme disease was first recognized clinically in 1977 as "Lyme arthritis" during studies of a cluster of children in Lyme, Connecticut, who were thought to have juvenile rheumatoid arthritis. The etiology of Lyme disease was discovered to be a spirochete in the early 1980s. The incidence of Lyme disease in the United States has increased steadily since then. The incidence in some regions of Europe may be increasing as well. Lyme disease is currently the most commonly reported tick-borne disease in the United States and Europe. In 2012, 13 states accounted for 95% of all reported cases (confirmed and probable cases combined); these states included Connecticut, Delaware, Maine, Maryland, Massachusetts, Minnesota, New Hampshire, New Jersey, New York, Pennsylvania, Vermont, Virginia, and Wisconsin. In recent years, the incidence of Lyme disease in the northern New England states of Maine, Vermont, and New Hampshire has increased rapidly. An increase in the deer population in the northeastern United States and changes in land management practices have contributed to the rise in incidence of Lyme disease. Lyme disease occurs most commonly in forested regions, which includes some suburban areas such as those near Boston, New York, and Philadelphia. While Utah has tick reservoirs capable of supporting Lyme disease, no cases have been documented with acquisition in Utah to-date.

✓ PUBLIC HEALTH CONTROL MEASURES

Public Health Responsibility

- Determine the probable source (location) of the infection.
- Determine if and where transmission is occurring in Utah.
- Remember that due to the small size of this tick, many patients will not recall a tick bite during the investigation.
- Assess for erythema migrans (EM) (bullseye rash).
- Classify cases according to Centers for Disease Control and Prevention (CDC) and Council for State and Territorial Epidemiologists (CSTE) criteria so that accurate records on Lyme disease can be maintained at the national level.
- If Lyme disease transmission is found to occur in Utah, public health will educate the public about the mode of tick transmission and ways to avoid infection.
- Educate physicians on diagnosis, testing, and reporting.

Prevention

Managing Special Situations: Response to a Tick Bite

The longer a tick remains attached to a person, the higher the likelihood of disease transmission. Individuals should 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. Whenever an attached tick is removed from the body, a person should monitor one's health for the appearance of rash, fever, or flu-like symptoms, and should immediately seek the advice of a healthcare provider should 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 develops 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 (e.g., 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 in 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 alcohol or flushed down the toilet.

Environmental Measures

Prevention of diseases spread by ticks involves making the yard less attractive to ticks:

- 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 be advised to hire a licensed applicator who is 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. Advise individuals to ask, when selecting an applicator, 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.
- Signs to be posted around the property after the application.

Personal Preventive Measures/Education

If a person lives, works, or spends leisure time in an area likely to have ticks, he/she should be advised of the following:

- The single most important thing a person can do to prevent a tick-borne disease is to check 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.
- 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 a person 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. 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.

Chemoprophylaxis

Routine use of antimicrobial prophylaxis is not recommended. The risk of Lyme disease following a tick bite in Utah is low.

Vaccine

There is currently no licensed vaccine available against Lyme disease.

Isolation and Quarantine Requirements

Isolation: None.

Hospital: Standard body substance precautions.

Quarantine: None. Patients with active Lyme disease should not donate blood.

✓ CASE INVESTIGATION

Reporting

Report all suspect and confirmed cases of Lyme disease

Table 2. Criteria for reporting a case of Lyme disease

Criterion	Reporting
<i>Clinical evidence</i>	
Erythema migrans	S
Healthcare record contains a diagnosis of Lyme Disease	S
Death certificate lists Lyme Disease as a cause of death or a significant condition contributing to death	S
<i>Laboratory evidence</i>	
Culture positive for <i>B. burgdorferi</i>	S
Antibody positive for <i>B. burgdorferi</i> by EIA or IFA in serum or CSF	S
Western immunoblot positive for <i>B. burgdorferi</i> -specific IgM	S
Western immunoblot positive for <i>B. burgdorferi</i> -specific IgG	S

Notes:

S = This criterion alone is sufficient to report a case

N = This criterion in conjunction with all other “N” and any “O” criteria in the same column is required to report a case.

O = At least one of these “O” criteria in each category in the same column (e.g., clinical presentation and laboratory findings)—in conjunction with all other “N” criteria in the same column—is required to report a case.

*A requisition or order for any of the “S” laboratory tests is sufficient to meet the reporting criteria.

Case Definition

Lyme Disease

Clinical presentation

A systemic, tick-borne disease with protean manifestations, including dermatologic, rheumatologic, neurologic, and cardiac abnormalities. The best clinical marker for the disease is erythema migrans (EM), the initial skin lesion that occurs in 60–80% of patients.

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 or 2 inches in size across its largest diameter. Secondary lesions also may occur. Annular erythematous lesions occurring within several hours of a tick bite represent hypersensitivity reactions and do not qualify as EM. 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. Laboratory confirmation is recommended for persons with no known exposure.

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, alone or in combination: lymphocytic meningitis; cranial neuritis, particularly facial palsy (may be bilateral); radiculoneuropathy; or, rarely, encephalomyelitis. Encephalomyelitis must be confirmed by demonstration of antibody production against *B. burgdorferi* in the Cerebral Spinal Fluid (CSF), evidenced by a higher titer of antibody in CSF than in serum. Headache, fatigue, paresthesia, or mildly stiff neck alone, are not criteria for neurologic involvement.
- Cardiovascular system. Acute onset of high-grade (2nd 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.

Laboratory criteria

For the purposes of surveillance, laboratory evidence includes:

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

A two-step approach for active disease and for previous infection using a sensitive enzyme immunoassay (EIA) or immunofluorescent assay (IFA) followed by a Western immunoblot is the algorithm of choice. All specimens positive or equivocal by a sensitive EIA or IFA should be tested by a standardized Western immunoblot. Specimens negative by a sensitive EIA or IFA need not be tested further. When Western immunoblot is used during the first four weeks of disease onset (early disease), **both** immunoglobulin M (IgM) and immunoglobulin G (IgG) procedures should be performed. **A positive IgM test result alone is not recommended for use in determining active disease in persons with illness greater than one month's duration because the likelihood of a false-positive test result for a current infection is high for these persons.** If a patient with suspected early Lyme disease has a negative serology, serologic evidence of infection is best obtained by testing of paired acute- and convalescent-phase serum samples. Serum samples from persons with disseminated or late-stage disease almost always have a strong IgG response to *Borrelia burgdorferi* antigens. [1]

Epidemiologic criteria

Exposure is defined as having been (less than or equal to 30 days before onset of EM) in wooded, brushy, or grassy areas (i.e., potential tick habitats) of Lyme disease vectors. Since infected ticks are not uniformly distributed, a detailed travel history to verify whether exposure occurred in a high or low incidence state is needed. An exposure in a high-incidence state is defined as exposure in a state with an average Lyme disease incidence of at least 10 confirmed cases/ 100,000 for the previous three reporting years. A low incidence state is defined as a state with a disease incidence of <10 confirmed cases/100,000.

(<https://www.cdc.gov/lyme/stats/tables.html>) A history of tick bite is not required.

Case classification

Confirmed

- A case of EM with a known exposure in a high incidence state (as defined above), **OR**
- A case of EM with laboratory evidence of infection and without 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 Lyme disease that has laboratory evidence of infection (as defined above).

Suspected

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

Lyme disease reports will not be considered cases if the medical provider specifically states it is not a case of Lyme disease, or the only symptom listed is “tick bite” or “insect bite.”

Table 3. Criteria for defining a case of Lyme disease

Criterion	Case Definition									
	Confirmed					Probable		Suspected		
<i>Clinical Evidence</i>										
Physician diagnosed Lyme disease						N	N			
Medical Provider does not specifically state this is not a case of Lyme disease	N	N	N	N	N	N	N	N	N	N
Erythema migrans			N	N	N					N
Arthritis with objective joint swelling	O	O								
Chronic arthritis	O	O								
Aseptic meningitis	O	O								
Cranial neuritis	O	O								
Facial palsy	O	O								
Radiculoneuropathy	O	O								
Encephalomyelitis	O	O								
AV conduction defects	O	O								
Myocarditis	O	O								
No clinical information is available								N	N	
<i>Laboratory Evidence</i>										
Culture positive for <i>B. burgdorferi</i>	O			O			O	S		
Serum antibody positive for <i>B. burgdorferi</i> by EIA or IFA		N	N			N			N	
Western immunoblot positive for <i>B. burgdorferi</i> -specific IgM (onset ≤30 days)		N	N			N			O	
Western immunoblot positive for <i>B. burgdorferi</i> -specific IgG	O			O			O	S	O	
<i>Epidemiologic Risk Factors</i>										
Possible exposure to infected tick vector	N	N	N	N	N	N	N			
High-incidence state					N					
<i>Criteria to distinguish a new case</i>										
Case not previously reported to public health authorities	N	N	N	N	N	N	N			

Notes:

N = This criterion in conjunction with all other “N” and any “O” criteria in the same column is required to classify a case. O = At least one of these “O” criteria in each category in the same column (e.g., clinical presentation and laboratory findings)—in conjunction with all other “N” criteria in the same column—is required to classify a case.

Case Investigation Process

- Complete CMR in UT-NEDSS. Some of the information on this form must be provided by a clinician or other medical personnel. The patient should not answer the medical questions.
- Verify case status.
- Complete disease investigation form.
- Determine whether patient had travel/exposure history consistent with acquisition of disease in Utah or elsewhere. If the clinician indicates the patient has EM, contact the patient and collect information on possible locations of infection.
- If patient acquired disease in Utah, identify the source of transmission and assist with eliminating it.

Outbreaks

An outbreak will be defined as two or more cases of locally acquired Lyme disease in a county in a 12-month period.

Identifying Case Contacts

None.

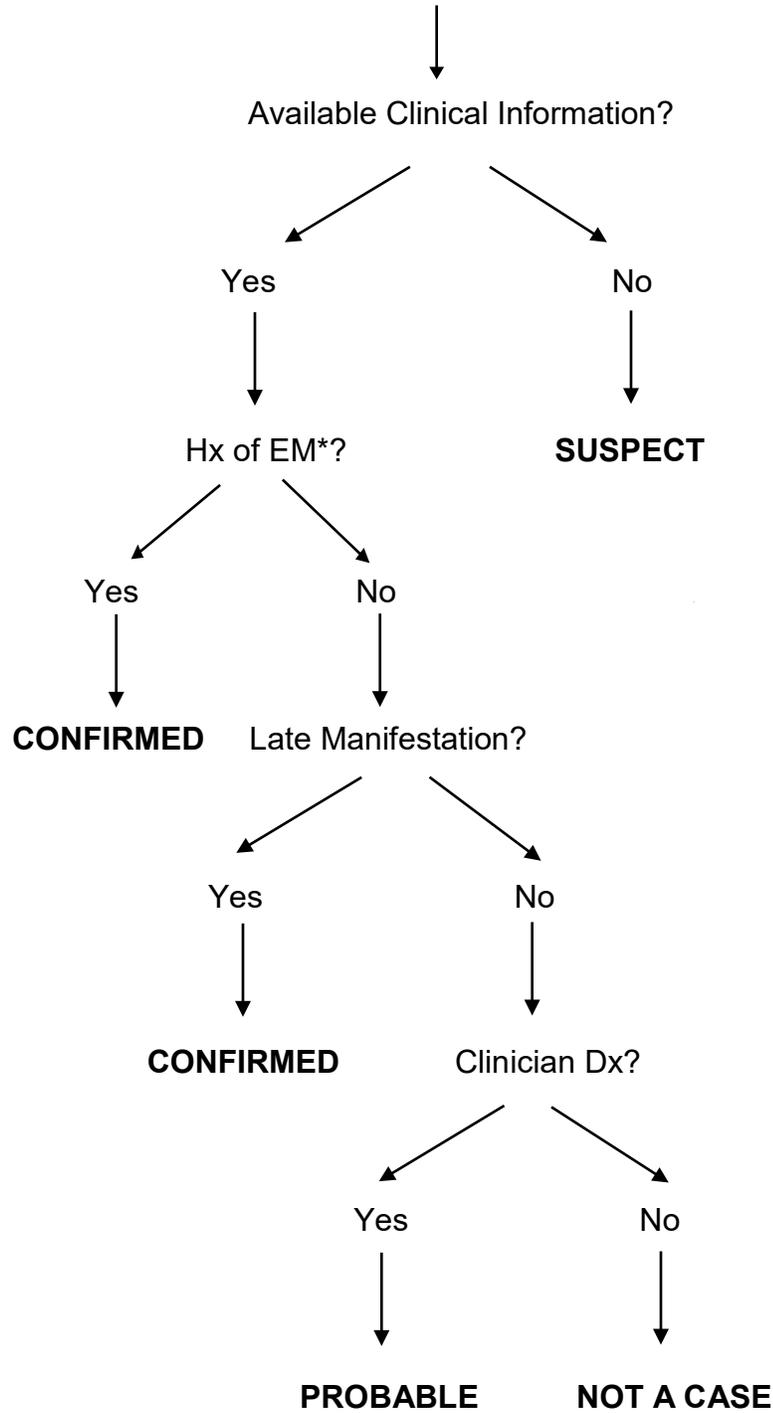
Case Contact Management

None.

Table 4. Interpretation of Lyme disease laboratory test results for determination of case status, Utah 2010

Reported Lab Result(s)			Action
IFA/ELISA	IgM WB	IgG WB	
+ or equivocal	+, - or missing	+	Follow IgG WB interpretation algorithm
+	+	Missing or -	Follow IgM WB interpretation algorithm
Missing	+, - or missing	+	Follow IgG WB interpretation algorithm
Missing	+	-	If clinical information is available and suggests chronic illness, it is NOT A CASE. If clinical information is consistent with acute illness (or if you are unsure), recommend two-tiered (with IgG and IgM WB) testing. Otherwise UNKNOWN.
Missing	+	Missing	Determine if IFA/ELISA and IgG WB testing were done. If not, recommend two-tiered testing. Otherwise UNKNOWN.
+ or equivocal	Missing	Missing	Determine if WB testing was done. If not, recommend two-tiered (with IgG and IgM WB) testing if patient has compatible illness. Otherwise UNKNOWN.
+ or equivocal	-	-	NOT A CASE unless patient has compatible illness and is early in course of illness (< 4 weeks since onset). If early illness, recommend repeat two-tiered testing or paired serology.
-	-	-	NOT A CASE unless patient has a clinician diagnosis or compatible illness and is within 2-3 weeks of onset/exposure, with compatible illness. If so, recommend repeat two-tiered testing.

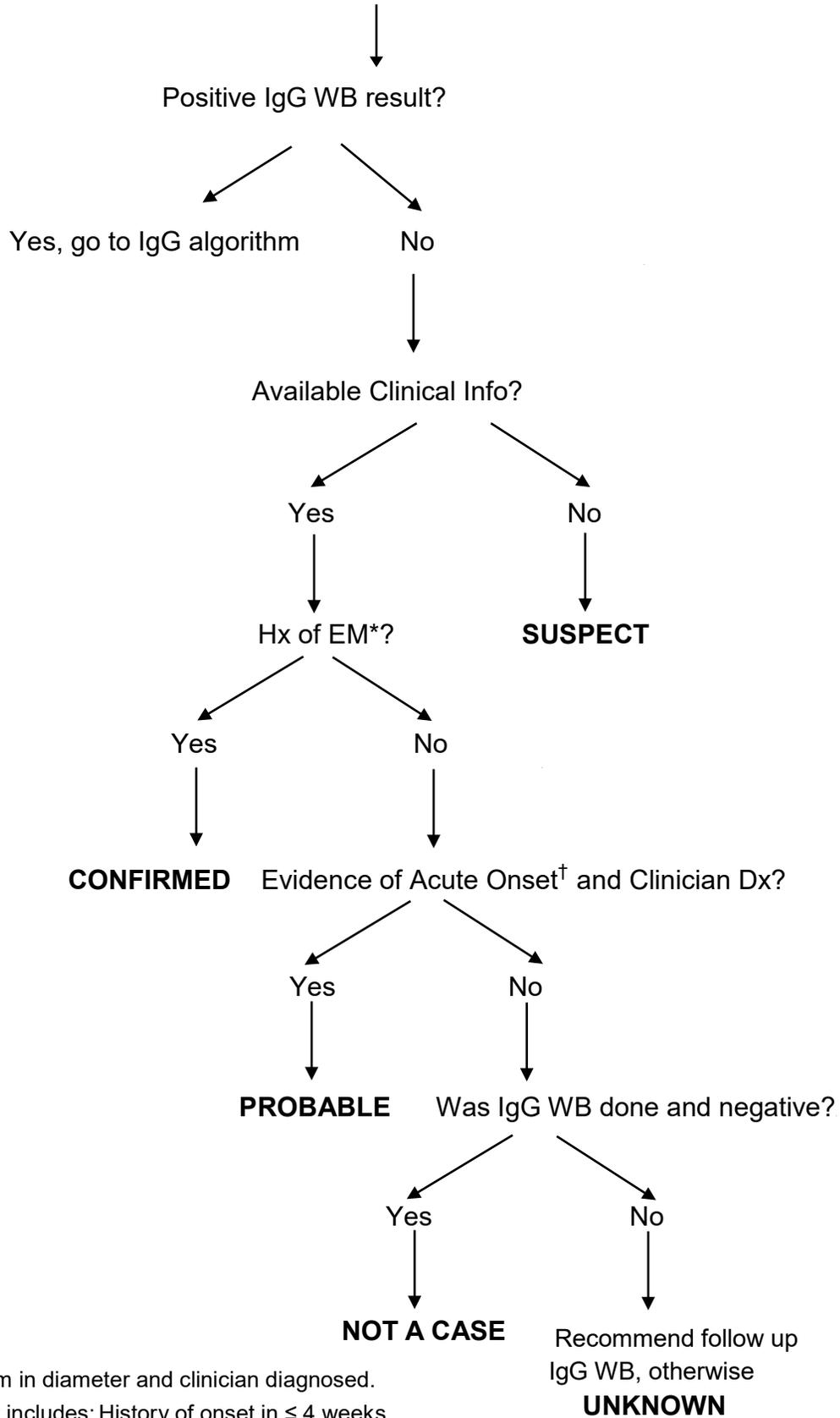
Figure 2. IgG WB and IFA/ELISA or single-tiered IgG WB positive lab results**



*EM must be at least 5 cm in diameter and clinician diagnosed.

**This flowchart can be used when IgM WB only has been ordered/completed and/or testing information is unavailable or not performed.

Figure 3. IgM WB and IFA/ELISA positive lab result



*EM must be at least 5 cm in diameter and clinician diagnosed.

†Evidence of acute onset includes: History of onset in ≤ 4 weeks, symptom duration ≤ 4 weeks, history of tick bite in ≤ 4 weeks, or clinician diagnosis of acute onset Lyme disease.

✓ REFERENCES

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5. Council for State and Territorial Epidemiologists (CSTE) Position statements. Available from URL: <http://www.cste.org/default.asp?page=PositionStatements>.
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✓ VERSION CONTROL

August 2015 Update: Minor updates to most sections. Added minimum data set information.

October 2017 Update: Created CCI, added position statement flow chart, and updated references.

August 2018 Update: Updated CSTE classification and reporting criterion tables per new case definition, and added ELR processing rules.

✓ UT-NEDSS Minimum/Required Fields by Tab

Demographic

- County
- State
- Street
- City
- Zip Code
- Date of Birth
- Birth Gender
- Race
- Ethnicity
- First Name
- Last Name

Clinical

- Date Diagnosed
- Died
- Date of Death
- Disease
- Onset Date
- Did the patient have a physician-diagnosed erythema migrans (EM) at least 5 cm in diameter?
- Date of EM diagnosis
- Did patient have fatigue?
- Did patient have headache?
- Did patient have fever?
- Did patient have mildly stiff neck?
- Did patient have arthralgia?
- Did patient have myalgia?
- Does patient have recurrent, brief attacks (weeks or months) of objective joint swelling in one or a few joints, chronic arthritis in one or a few joints?
- Does patient have lymphocytic meningitis; cranial neuritis, particularly facial palsy (may be bilateral); radiculoneuropathy; encephalomyelitis?
- Does patient have acute onset of high-grade (2nd 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)

- Did patient ever have relapsing fever?
- Did patient ever have infectious mononucleosis?
- Did patient ever have Leptospirosis?
- Did patient ever have Rocky Mountain Spotted Fever?
- Did patient ever have Syphilis?
- Did patient ever have Lupus?

Laboratory

- Organism
- Specimen Source
- Test Result
- Test Type

Epidemiological

- Imported From
- Date of Exposure
- Exposure City
- Exposure Name
- Exposure Place Type
- Exposure Street
- Was patient bitten by a tick?
- Was patient bitten in Utah?
- What date and state did the bite occur?
- Was patient in a wooded, brushy, or grassy area (potential tick habitat) <30 days prior to onset of symptoms?
- Did patient go camping <30 days prior to onset of symptoms? List places and dates
- Did patient go hunting <30 days prior to onset of symptoms? List places and dates
- Did patient visit any parks <30 days prior to onset of symptoms? List places and dates
- Did patient travel outside of Utah <30 days prior to onset of symptoms? List places and dates

Reporting

- Date First Reported to Public Health

Administrative

- Outbreak Name
- State Case Status
- Outbreak Associated

✓ LYME DISEASE RULES FOR ENTERING LABORATORY TEST RESULTS

The following rules describe how laboratory results reported to public health should be added to new or existing events in UT-NEDSS. These rules have been developed for the automated processing of electronic laboratory reports, although they apply to manual data entry, as well.

Test-Specific Rules

Test specific rules describe what test type and test result combinations are allowed to create new morbidity events in UT-NEDSS, and what test type and test result combinations are allowed to update existing events (morbidity or contact) in UT-NEDSS.

Test Type	Test Result	Create a New Event	Update an Existing Event
IgG Antibody	Positive	Yes	Yes
	Negative	No	Yes
	Equivocal	Yes	Yes
IgM Antibody	Positive	Yes	Yes
	Negative	No	Yes
	Equivocal	No	Yes
PCR/amplification	Positive	Yes	Yes
	Negative	No	Yes
	Equivocal	Yes	Yes
Total Antibody	Positive	Yes	Yes
	Negative	No	Yes
	Equivocal	No	Yes
Western (immuno) blot	Positive	Yes	Yes
	Negative	No	Yes
	Equivocal	Yes	Yes

Whitelist Rules

Whitelist rules describe how long an existing event can have new laboratory data appended to it. If a laboratory result falls outside the whitelist rules for an existing event, it should not be added to that event, and should be evaluated to determine if a new event (CMR) should be created.

Lyme Disease Morbidity Whitelist Rule: If the specimen collection date of the laboratory result 2 years or less after the event date, the laboratory result should be added to the morbidity event.

Lyme Disease Contact Whitelist Rule: Never added to a contact.

Graylist Rule

We often receive laboratory results through ELR that cannot create cases, but can be useful if a case is created in the future. These laboratory results go to the graylist. The graylist rule describes how long an existing event can have an old laboratory result appended to it.

Lyme Disease Graylist Rule: If the specimen collection date of the laboratory result is 30 days before to 7 days after the event date of the morbidity event, the laboratory result should be added to the morbidity event.

Other Electronic Laboratory Processing Rules

- If an existing event has a state case status of “not a case,” ELR will never add additional test results to that case. New labs will be evaluated to determine if a new CMR should be created.