Lyme Disease

Signs and Symptoms	• Early localized Lyme disease: erythema migrans (EM) target-shaped rash, may have fatigue, chills and fever, headache, myalgia, arthralgia, and lymphadenopathy • Early disseminated Lyme disease: may be multiple EM lesions, lymphocytic meningitis, cranial neuropathy (e.g., facial palsy), peripheral radiculoneuritis, migratory joint and muscle pain, transient atrioventricular (AV) blocks • Late disease: arthritis usually of a few large joints, neurologic, or cardiac findings	
Incubation	Usually 3 to 10 days (range 3-30 days), days to weeks after EM for early disseminated Lyme disease, weeks to months for late disease	
Case classification (not used for clinical diagnosis)	**Clinical criteria**: Systemic disease with various manifestations including dermatologic (healthcare provider-diagnosed) EM ≥ 5 cm, rheumatologic, neurologic, and cardiac abnormalities; late disease: recurrent joint swelling (brief attacks of weeks or months), lymphocytic meningitis, cranial neuritis, particularly facial palsy (may be bilateral), radiculoneuropathy, encephalomyelitis, acute onset high-grade (2° or 3°) AV block lasting days to weeks **Laboratory**: Confirmed: culture, species-specific NAAT, immunohistochemistry on biopsy or autopsy, two-tiered testing (EIA/IFA + Western blot or second EIA); Presumptive: IgG WB	
	Confirmed: A clinically compatible case that meets confirmatory laboratory criteria	**Probable**: A clinically compatible case that meets presumptive laboratory criteria **Suspect**: EM with no laboratory evidence or laboratory evidence with no clinical information
Differential diagnosis	Cellulitis, urticaria, rickettsiosis, STARI, local reaction to tick bite, viral rash illness, facial nerve palsy, viral meningitis, heart block, inflammatory arthritis, gout, neuropathy	
Treatment	See: https://www.cdc.gov/lyme/Treatment/index.html for appropriate antibiotics.	
Duration	Erythema migrans lasts 3-4 weeks untreated, late manifestations may be permanent	
Exposure	Vector: *Ixodes pacificus* in Washington, other species elsewhere. All tick stages are potential vectors with most bites occurring May through August. Tick habitat includes wooded, brushy, or grassy areas.	
Laboratory testing	Local health jurisdiction (LHJ) and Communicable Disease Epidemiology (CDE) can arrange testing at CDC if a person was likely exposed in Washington • **Best specimens**: acute and convalescent sera, skin biopsy in BSK culture medium (take before treatment) • Keep human specimens **cold, ship cold** according to PHL requirements: https://doh.wa.gov/public-health-provider-resources/public-health-laboratories/lab-test-menu	
Public health actions	LHJ can consult with CDE 877-539-4344 for testing • Identify potential exposures • Notify CDE promptly for locally acquired cases (e.g., no out-of-state travel) • Educate about avoiding tick exposure • Recommend prompt tick removal, since 24-36 hours of attachment may be needed to transmit *Infection Control:* standard precautions, no person-to-person transmission	

Lyme Disease

1. DISEASE REPORTING

A. Purpose of Reporting and Surveillance

1. To determine the incidence of Lyme disease, the degree of endemicity, and potential risk of contracting Lyme disease in Washington State.
2. To identify endemic geographic areas within Washington State.
3. To educate people about how to reduce their risk of infection.

B. Legal Reporting Requirements

1. Health care providers and Health care facilities: notifiable to **local health jurisdiction** within 3 business days.
2. Laboratories: notifiable to **local health jurisdiction** within 24 hours; submission on request – specimen associated with positive result, within 2 business days
3. Veterinarians: animal cases notifiable to Washington State Department of Agriculture https://app.leg.wa.gov/WAC/default.aspx?cite=16-70.
4. Local health jurisdictions: notifiable to the Washington State Department of Health (DOH) Communicable Disease Epidemiology (CDE) within 7 days of case investigation completion or summary information required within 21 days.

C. Local Health Jurisdiction Investigation Responsibilities

1. For cases exposed outside of endemic areas (especially those exposed in the Pacific Northwest), facilitate the transport of specimens to Public Health Laboratories for confirmatory testing. Call CDE to discuss appropriate specimens to collect.
2. Report all *confirmed, probable*, and *suspect* cases using the Lyme disease case report form https://www.doh.wa.gov/Portals/1/Documents/5100/210-036-ReportForm-Lyme.pdf. Enter the data into the Washington Disease Reporting System (WDRS).

2. THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic Agent

In the United States, Lyme disease is caused primarily by infection with *Borrelia burgdorferi* sensu stricto. Another related species, *Borrelia mayonii*, a pathogenic *Borrelia burgdorferi* sensu lato genospecies, has also been shown to cause Lyme disease in the upper midwestern United States.

B. Description of Illness

1. Early Localized Lyme Disease

The most common and distinctive feature of early Lyme disease is erythema migrans (EM), though it only occurs in 70%-80% of cases. Classic EM lesions have a “bull’s eye” (or target-shaped) appearance with partial central clearing, but may appear as a solid red rash with a vesicular center. The rash is of variable diameter, generally >5 cm to 30 cm.

EM begins at the site of the tick bite, commonly the thigh, groin, or armpits. It may be warm, but is generally not painful. EM develops 3–30 days after the tick bite; lesions occurring within hours of a bite and disappearing within 24 hours are not caused by Lyme disease. EM usually resolves spontaneously within 3–4 weeks, if untreated, and within one week if treated.

Early localized illness is usually marked by one or more non-specific signs and symptoms: fatigue, chills and fever, headache, myalgias, arthralgias, and lymphadenopathy.

2. Early Disseminated Lyme Disease

Lyme disease spirochetes disseminate from the site of the tick bite by cutaneous, lymphatic and blood borne routes. The signs of early disseminated infection usually occur days to weeks after the appearance of a solitary erythema migrans lesion. Early disseminated infection may manifest in many ways including multiple (secondary) EM lesions and disease of the nervous system, the musculoskeletal system, or the heart.

Early neurologic manifestations include lymphocytic meningitis, cranial neuropathy (especially facial palsy), and peripheral radiculoneuritis. Musculoskeletal manifestations may include migratory joint and muscle pains with or without objective signs of joint swelling. Cardiac manifestations are rare but may include transient atrioventricular blocks of varying degree.

3. Late Disease

Infection in the untreated or inadequately treated patient may progress to late disseminated disease weeks to months after infection. The most common objective manifestation of late disseminated Lyme disease is intermittent swelling and pain of one or a few joints, usually large, weight-bearing joints such as the knee. Lyme disease is rarely fatal.

C. Lyme Disease in Washington State and the United States

In recent years, 24 to 43 reports of Lyme disease meeting case definition are received annually. Almost all Washington cases are the result of tick exposure out of state; endemic Lyme disease is not common, with generally only 0 to 3 cases per year. The risk of infection in-state is low throughout Washington. Between January 2005 and December 2021, only 21 *confirmed* Lyme cases with in-state exposure were documented.

Lyme disease has a wide distribution in northern temperate regions of the world. Lyme disease is the most commonly reported vector-borne disease in the United States with the reported incidence highest in the Northeast and upper Midwest states.

D. Vectors and Reservoirs

The vectors of Lyme disease are certain *Ixodes* species of ticks. In Washington and the rest of the western U.S. coast, *I. pacificus* is the only recognized vector. Tick collection studies in Washington during the late 1990s and from 2010-2016 have found *I. pacificus* primarily west of the Cascade Mountains, but some have been found in the central counties on the eastern slopes of the Cascades. In six years of tick surveillance, only 19 of 1147 (1.7%) of *I. pacificus* tested in Washington were found to be positive for *B. burgdorferi*. These positive ticks were collected from Clallam, Mason, Yakima, and

Klickitat counties. Tick collection has not yet occurred in all counties in Washington. In the rest of the U.S., *I. scapularis* is the major vector.

Important reservoirs in the western U.S. may include wood rats and other *Ixodes* species that do not themselves feed on humans. Deer and other rodents may be of less importance here than in the eastern U.S., although this is uncertain.

The usual two-year life cycle of the tick includes larval, nymphal, and adult stages. Larvae and nymphs typically become infected while feeding on small rodents and remain infected as they mature (transstadial transmission).

E. Modes of Transmission

Lyme disease is acquired by a tick bite. While all stages of *Ixodes* ticks can feed on humans, nymphs are probably the most important source of human infections. In North America, most infections are acquired between May and August, when *Ixodes* nymphs are most active. Transmission of *B. burgdorferi* is directly correlated with duration of tick attachment. Studies suggest that attachment for at least 24 to 48 hours is required for spirochete transmission to occur. Thus, prompt removal of ticks can prevent transmission. *Ixodes* tick bites are generally painless and many Lyme disease patients have no recollection of a tick bite, so the absence of a tick bite history is not inconsistent with a diagnosis of Lyme disease.

F. Incubation Period

Typically 3 to 10 days (range: 3 to 30 days).

G. Period of Communicability

There is no evidence of person-to-person transmission.

H. Treatment

For specific antibiotic regimens for treatment of all stages of Lyme disease, refer to: https://www.cdc.gov/lyme/Treatment/index.html.

Patients should be observed at the start of antibiotic therapy for a Jarisch-Herxheimer-like reaction which occurs in ~15 percent of patients with disseminated infection.

Prophylaxis is not recommended for asymptomatic persons with histories of tick bites. It may be appropriate when infected tick prevalence is high, the tick on a person can be reliably identified as a vector species, and the tick has been attached for more than 36 hours. See the IDSA guidelines for current recommendations. https://www.idsociety.org/practice-guideline/lyme-disease/

3. CASE DEFINITION

This surveillance case definition was developed for national reporting of Lyme disease; it is not intended to be used in clinical diagnosis. It may be appropriate to treat a patient for Lyme disease who does not meet the surveillance case definition.

A. Clinical Criteria for Diagnosis

An illness characterized by one of the following early or late-stage manifestations, as reported by a healthcare provider, and in the absence of another known etiology:

- Erythema migrans (EM) rash. For purposes of surveillance, EM is defined as a

skin lesion (observed by a healthcare provider) 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 a size of ≥5 cm in diameter.
Note: Secondary lesions also may occur.

- *Musculoskeletal system.* Recurrent, brief attacks (weeks or months) of objective joint swelling in one or a few joints.

  Note: Objective joint swelling may sometimes be followed by chronic arthritis in one or a few joints.

- *Nervous system.* Any of the following that cannot be explained by another etiology, alone or in combination: lymphocytic meningitis, cranial neuritis, particularly facial palsy (unilateral or bilateral), radiculo-neuropathy, or encephalomyelitis.
- *Cardiovascular system.* Acute onset of high-grade (2nd-degree or 3rd-degree) atrioventricular conduction defects that resolve in days to weeks. Note: Atrioventricular conduction defects may sometimes be associated with myocarditis.

B. Laboratory Criteria for Diagnosis

For the purposes of surveillance, laboratory evidence is given below.

Confirmatory laboratory evidence:

1. Isolation of *B. burgdorferi* sensu stricto or *B. mayonii* in culture, OR

2. Detection of *B. burgdorferi* sensu stricto or *B. mayonii* in a clinical specimen by a *B. burgdorferi* group-specific NAAT assay, OR

3. Detection of *B. burgdorferi* group-specific antigens by immunohistochemical assay on biopsy or autopsy tissues, OR

4. Positive serologic tests[1] in a two-tier or equivalent format, including:

   a. Standard two-tier test (STTT): a positive or equivocal first-tier screening assay, often an enzyme immunoassay [EIA] or immunofluorescence assay [IFA] for IgM, IgG, or a combination of immunoglobulins, followed by a concordant positive IgM[2] or IgG[3] immunoblot interpreted according to established criteria, OR

   b. Modified two-tier test (MTTT): positive or equivocal first-tier screen, followed by a different, sequential positive or equivocal EIA in lieu of an immunoblot as a second-tier test[4].

Presumptive laboratory evidence:

1. Positive IgG immunoblot, interpreted according to established criteria[3], without positive or equivocal first-tier screening assay

[1]Currently, there are no serologic tests available for *B. mayonii* infection, but cross-reactivity with *B. burgdorferi* testing may occur.

[2]IgM WB is considered positive when at least two of the following three bands are present: 24 kDa (OspC)*, 39 kDa (BmpA), and 41 kDa (Fla). Low incidence states should disregard IgM results for specimens collected >30 days after symptom onset. *Depending upon the assay, OspC could be indicated by a band of 21, 22, 23, 24 or 25 kDA.

[3]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 (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.

[4]The MTTT algorithm should be performed using assays specifically cleared by the US Food and Drug Administration (FDA) for this purpose. (Mead et al, 2019)

C. Case Definition (2021)

Washington is considered a low-incidence state for the purpose of Lyme disease classification (incidence of <10 confirmed cases/100,000 population for a period of three consecutive years).

A clinically compatible case is defined as a case that meets the clinical criteria defined above.

Confirmed: A clinically compatible case that meets confirmatory laboratory criteria.

Probable: A clinically compatible case that meets presumptive laboratory criteria.

Suspect:

a) a case of EM (as defined above) with no laboratory evidence of infection; OR

b) a case with confirmatory or presumptive laboratory evidence of infection but no clinical information available (e.g., a laboratory report).

A new case of Lyme disease is one that has not been reported within the same calendar year (January through December).

4. DIAGNOSIS AND LABORATORY SERVICES

A. Diagnosis

The diagnosis of early Lyme disease is based primarily on clinical findings since serologic testing is insensitive during the first week after onset. In later stages, the diagnosis is commonly based on clinical findings with support from serologic tests.

1. Serology: Serologic tests from some commercial labs have been found to be unreliable.* Serology from patients who were likely exposed in Washington should be confirmed through CDC. Although antibiotic treatment in early localized disease may blunt the antibody response, patients with early disseminated or late-stage disease usually have strong immunoglobulin G (IgG) serological reactivity. Antibodies often persist for months or years following successfully treated or untreated infection. Thus, sero-reactivity alone cannot be used as a marker of active disease.

   * CDC. Notice to Readers: Caution Regarding Testing for Lyme Disease. MMWR 2005; 54(05):125. Available at: https://www.cdc.gov/mmwR/preview/mmwrhtml/mm5405a6.htm.

2. Tick identification: Identifying the species of tick removed from a patient may help to determine which pathogens should be considered if the person becomes ill. However, identification of a vector species neither guarantees nor rules out the possibility a person will develop Lyme or any other tickborne disease (see below).

3. Tick testing: In general, testing of ticks is not useful for individual health and diagnostic purposes because: (a) negative results cannot rule out exposure to *B. burgdorferi* or *B. mayonii* since the person may have been unknowingly bitten by different undetected ticks

that could have transmitted the agent; and (b) even if the tick tests positive, the agent may not have been transmitted to the host (it usually takes at least 24-36 hours of attachment). Moreover, the tick could be infected with other agents of tickborne disease so the patient could still become ill although not with Lyme disease. Thus ticks are not routinely tested in Washington through the public health system. Clinicians are encouraged to make treatment decisions based on the patient's clinical presentation, not positive or negative results from the tick. If a provider wants to test a tick, some commercial laboratories provide fee-based testing for *B. burgdorferi* by DFA, IFA, or PCR. Ticks need to be submitted alive for DFA or IFA but can be dead for PCR.

B. Services Available at the Washington State Public Health Laboratories (PHL)

PHL does not perform serologic testing for Lyme disease but will forward serum or CSF (for serology) or skin biopsies (for culture) to the CDC for testing for cases upon request. PHL requires approval from the local health jurisdiction and the DOH Office of Communicable Disease Epidemiology (206 418-5500).

Note that PHL require all clinical specimens have two patient identifiers, a name **and** a second identifier (e.g., date of birth) both on the specimen label and on the submission form. Due to laboratory accreditation standards, specimens will be rejected for testing if not properly identified. Also include specimen source and collection date. Ship according to PHL requirements: https://doh.wa.gov/public-health-provider-resources/public-health-laboratories/lab-test-menu.

Neither PHL nor CDC routinely test ticks for pathogens (bacteria, viruses). However, PHL provide year-round identification services; tick genus and species will be reported.

C. Specimen Collection

Serologic tests: For antibody testing, 1–2 mL of serum or CSF is needed. Ideally, acute serum should be collected at least 2 weeks after onset; the convalescent serum should be obtained 2–4 weeks later. Place labeled tubes in individual self-sealing plastic bags. Use sufficient absorbent material to secure contents and contain any leakage. If the specimen is refrigerated, then ship cold with regular ice packs. If the specimen is already frozen, keep frozen during shipping using dry ice. Submit with a completed PHL Serology form https://www.medialab.com/dv/dl.aspx?d=1615463&dh=e4b87&u=69790&uh=0e2a1.

Culture: For culture, place skin biopsy (2-mm punch biopsy) directly into BSK culture medium, and ship cold (not frozen). Skin biopsies should be taken prior to treatment because the organism recovery rate decreases substantially after only one day of antibiotic therapy. Submit with a completed PHL Microbiology form https://www.medialab.com/dv/dl.aspx?d=1887088&dh=52b1a&u=69790&uh=0e2a1.

Tick submission: A health care provider or LHJ can request tick identification when a tick is removed from a person. The tick should be removed properly to ensure the mouthparts remain intact, as they are important for identification. Guidelines on tick removal are available at: https://www.cdc.gov/ticks/after-a-tick-bite/?CDC_AAref_Val=https://www.cdc.gov/ticks/removing_a_tick.html. Ticks can be submitted alive or dead. They should be placed in a sealed unbreakable container (e.g. urine cup) and submitted with a completed PHL Microbiology form https://www.medialab.com/dv/dl.aspx?d=1887088&dh=52b1a&u=69790&uh=0e2a1.

Check "parasitology" and document the geographic location the tick was acquired in the Comments section.

5. ROUTINE CASE INVESTIGATION

Interview the case and others who might provide pertinent information.

A. Evaluate the Diagnosis

Using the case report form, itemize patient-reported symptoms, documented clinical findings, and lab results. Obtain copies of lab reports that support the diagnosis and medical reports from the provider. **It is important to consult the medical records or the provider in evaluating all positive Lyme disease reports, as many of the clinical findings required by case definition must be objectively verified by a provider,** not subjectively reported by the patient. CAUTION: Tick testing results should not be considered as part of the patient diagnosis (see Section 4-A above).

For cases exposed outside of highly endemic areas (especially those exposed in the Pacific Northwest), call Communicable Disease Epidemiology (206-418-5500) to arrange for confirmatory laboratory testing.

B. Manage the Case

Hospitalized patients should be cared for using standard precautions. There is no need for patient isolation or work/day care restrictions.

Educate patients/others about avoiding exposure to ticks in the future.

C. Identify Potential Sources of Infection

Ask about tick exposure, including known tick bites and likely duration of tick attachment. If no tick bite is recalled, inquire about outdoor activities, particularly time spent in potential hard tick habitats (e.g., woods, tall grasses, etc). Document the likely exposure location in the WDRS case report. If the presumed exposure occurred in the Pacific Northwest, get a detailed description of the geographic area where the exposure likely occurred, including street address or trail head location. For example, "case was hiking on XYZ trail at X National Park."

D. Identify Potentially Exposed Persons

Inquire about similar illness in persons who participated with the case in any of the activities above.

E. Management of Other Exposed Persons

Educate others potentially exposed about Lyme disease symptoms to facilitate early diagnosis. Refer symptomatic persons to healthcare providers. Prophylactic antibiotics are not recommended for asymptomatic persons with a history of a tick bite, unless the person had a known tick bite in a highly endemic area (ie. not in WA) with attachment for more than 36 hours, and the tick was identified as *Ixodes* spp. vector species.

F. Environmental Evaluation/Measures

Notify local environmental health program and/or vector control of locally acquired

cases. CDE will notify the DOH Public Health Entomologist, who may be able to perform or help facilitate an environmental assessment and tick drag in the area of likely exposure.

6. ROUTINE PREVENTION

A. Immunization Recommendations

A Lyme disease vaccine is not currently available.

B. Prevention Recommendations

When spending time outdoors in risk areas, persons should:

1. Wear long pants and a long-sleeved shirt. Tuck pant legs into socks or boots and shirt into pants to help keep ticks on the outside of clothing where they can be more easily spotted and removed.
2. Wear light colored, tightly woven clothing which will allow the dark tick to be seen more easily. The tight weave makes it harder for the tick to attach itself.
3. Use tick repellent on exposed skin and clothing. Products containing DEET or permethrin are very effective. Carefully follow instructions on the label. Take special care when using repellents on children.
4. Tumble clothes in a dryer on high heat for 10 minutes to kill ticks on dry clothing after you come indoors.
5. Bathe or shower within 2 hours of outdoor activity to wash off unattached ticks and to perform a thorough tick check.
6. Check yourself, your children, pets, and gear thoroughly for ticks. Carefully inspect areas around the head, neck and ears. If you find a tick attached to your skin, promptly remove it. Grasp the tick using tweezers as close to the skin as possible. With a steady motion, pull the tick straight out. Wash your hands and apply antiseptic to the bite. Do not crush ticks; this could result in direct inoculation of spirochetes. For more information about removing a tick, visit: https://www.cdc.gov/ticks/after-a-tick-bite/?CDC_AAref_Val=https://www.cdc.gov/ticks/removing_a_tick.html.
7. Monitor the bite and be alert for early symptoms of tick-borne disease, e.g. fever or rash over the next month or so. If symptoms develop, contact your health care provider.

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UPDATES

January 2008: Section 3 was revised to reflect the 2008 CSTE case definition changes.

January 2011: The Legal Reporting Requirements section has been revised to reflect the 2011 Notifiable Conditions Rule revision. Epidemiology in Washington and clinical description were updated (Section 2). The laboratory assays were updated to reflect 2011 CSTE/CDC case definition changes (Section 3). Specimen

collection details and submission form links were updated (Section 4). Additional guidance on evaluating the diagnosis, determining the likely exposure, and environmental follow up were provided (Section 5).

September 2014: New tick surveillance findings were added (Section 2D). A new reference was added for 2-tier test interpretation (Section 3B) and specimen submission guidance was updated (Section 4). The Routine Case Investigation and Controlling Further Spread sections were combined (Section 5).

December 2016: Section 2 was updated to reflect current trends and findings in Washington. The clinical, laboratory, and exposure criteria were updated to reflect changes to the 2017 CSTE case definition (See section 3). Front page was added.

January 2019: Routine updates.

March 2019: Addition of Appendix A.

December 2021: Edited to reflect the updated case definition , removal of appendix A.

December 2022: For 2023 WAC revision combined provider and facility reporting requirement, updated laboratory submission (Section 1B).

June 2024: CDC links updated.