LYME BORRELIOSIS

Disease Overview

Lyme borreliosis is caused by the spirochete *Borrelia burgdorferi*. In Eastern Canada, Lyme disease is transmitted by the bite of an infected blacklegged tick (*Ixodes scapularis*) after it has been attached and feeding on blood for at least 24 -36 hours. Historically, Lyme disease has been a rare condition in Canada. However, since 2003 there have been an increasing number of areas where ticks are established and breeding in southern Canada, including New Brunswick.

It is possible to be bitten by an infected tick in New Brunswick. The risk is higher in areas of known endemic blacklegged tick populations - see Tick-Borne Diseases (gnb.ca). It is very likely ticks will spread and new Lyme disease risk areas will become established in other parts of the province.

Symptoms

The first sign of infection is usually a circular rash called erythema migrans or EM. This rash occurs in about 70-80 per cent of infected people. It begins at the site of the tick bite after a delay of three days to one month. EM is a round or oval expanding erythematous rash ("bull's eye") greater than 5 cm in diameter and enlarging slowly over a period of several days to weeks. Other common symptoms are flu like illness and include fatigue, chills, fever, headache, muscle pain, joint pain, and swollen lymph nodes.

If untreated, the second stage of the disease, known as disseminated Lyme disease, can last up to several months and include:

- central and peripheral nervous system disorders
- multiple skin rashes
- arthritis and arthritic symptoms
- heart palpitations
- extreme fatigue and general weakness.

If the disease remains untreated, the third stage can last months to years with symptoms that can include recurring arthritis and neurological problems.

Reservoir

Blacklegged ticks.

Mode of Transmission

Vector borne transmission. Lyme borreliosis is transmitted via bites from infected blacklegged ticks after it has been attached and feeding on blood for at least 24-36 hours.

Incubation period

The incubation period for EM is 3 to 30 days (commonly 7 to 10 days) after tick exposure. However, the early stages of the disease may go undetected and the patient may present with later manifestations.

Period of communicability

No evidence of natural transmission from person to person.

Risk Factors

Increased risk for acquiring/severe illness:

- Exposure to blacklegged ticks

- Exposure to Lyme disease risk areas

Surveillance Case Definition

Confirmed case

Clinical evidence of illness with laboratory confirmation by one of the following methods:

- Isolation of *Borrelia burgdorferi* from a clinical specimen as specified by current guidelines.
- Detection of *B. burgdorferi* DNA by PCR in tissues/samples and by methods specified by current guidelines.

OR

- Clinical evidence of illness with a history of residence in, or visit to, a Lyme disease risk area[1]; and with laboratory evidence of infection in the form of a positive serologic test using the two-tiered approach[2]. The two-tiered testing approach consists of a screening ELISA followed by an immunoblot assay. Immunoblots include traditional Western blots or newer line blots, and both formats target an identical set of *B. burgdorferi* immunoreactive proteins.

Probable Case

- Clinical evidence of illness without a history of residence in, or visit to, a Lyme disease risk area; and with laboratory evidence of infection in the form of a positive serologic test as defined above under confirmed cases.

OR

- Clinician-observed erythema migrans without laboratory evidence but with history of residence in, or visit to, a Lyme disease risk area.

The **clinical information** presented below is not intended to describe the complete range of signs and symptoms that may be used in a clinical diagnosis of Lyme disease. Symptoms of early or late disseminated disease are described in the 2006 clinical practice guidelines of the Infectious Diseases Society of America. Other symptoms that are (or have been suggested to be) associated with Lyme disease, including those of so-called "chronic" Lyme disease and post Lyme disease syndromes, are

---

[1] **Lyme disease risk area** in Canada is defined as a locality in which there is evidence for the occurrence of reproducing populations of known tick vector species (particularly *Ixodes scapularis* and *Ixodes pacificus*) and the likely transmission of *B. burgdorferi* as determined by one of the following methods: i) active field surveillance involving capture of wild rodent reservoirs as well as drag sampling on multiple occasions to ensure that ticks have become established (as evidenced by demonstration of all three feeding stages of the tick over more than one year) and that *B. burgdorferi* is being transmitted (as evidenced by molecular detection or culture of ticks or rodent samples) ; ii) active field surveillance involving only drag sampling for ticks ; iii) evidence from passive tick surveillance when using field-validated methods of analysis of these data to improve their specificity in detecting tick populations (these may include high numbers of submitted ticks , immature ticks and multiple ticks found feeding on humans or animals); iv) field-validated signals from human case surveillance; or v) field-validated ecological/niche models that predict risk . Method (i) is recommended to confirm the first occurrence of Lyme disease risk areas in Provinces and Territories where these have not been identified to date. Methods (ii), (iii), (iv) and (v) are recommended only for those Provinces and Territories after the occurrence of one or more reproducing populations of tick vectors, and *B. burgdorferi* transmission, has been confirmed using method (i).

[2] Canadian Public Health Laboratory Network. The laboratory diagnosis of Lyme borreliosis: guidelines from the Canadian Public Health Laboratory Network. *Can J Infect Dis Med Microbiol* 2007; 18:145-8.

considered too non-specific to define cases for surveillance purposes, whether or not they may be caused by *B. burgdorferi* infection.

The following signs and symptoms constitute objective clinical evidence of illness for surveillance purposes for Lyme disease:

Objective evidence of Lyme disease includes the following, when an alternative explanation is not found:

In simple terms Lyme disease has three stages if left untreated:

i) Early Lyme disease characterised by a red rash (>5cm; called erythema migrans or EM) that spreads from the site of the tick rash (as described below);

ii) Early disseminated Lyme disease characterised by multiple EM rashes and/or neurological (facial paralysis or meningitis-like) manifestations and/or heart problems (palpitations caused by heart block) which may last several weeks to months; and

iii) Late disseminated Lyme disease which is most commonly intermittent arthritis and may last months to over a year.

Erythema migrans (EM): a round or oval expanding erythematous area of the skin greater than 5 cm in diameter and enlarging slowly over a period of several days to weeks. It appears one to two weeks (range 3-30 days) after infection and persists for up to eight weeks. Some lesions are homogeneously erythematous, whereas others have prominent central clearing or a distinctive target-like appearance.

On the lower extremities, the lesion may be partially purpuric. Signs of acute or chronic inflammation are not prominent. There is usually little pain, itching, swelling, scaling, exudation or crusting, erosion or ulceration, except that some inflammation associated with the tick bite itself may be present at the very centre of the lesion.

Note: An erythematous skin lesion present while a tick vector is still attached or that has developed within 48 hours of detachment is most likely a tick bite hypersensitivity reaction (i.e. a non-infectious process), rather than erythema migrans. Tick bite hypersensitivity reactions are usually < 5 cm in largest diameter, sometimes have an urticarial appearance and typically begin to disappear within 24-48 hours. Diagnosis of EM requires careful examination by a physician to eliminate alternative types of skin rash. Note that it is recommended that physicians would normally treat patients with EM without recourse to serological testing as specific antibodies are often not detectable in early Lyme disease.

OR

Objective evidence of disseminated Lyme disease includes any of the following when an alternative explanation is not found:

- **Multiple erythema migrans:** EM lesions, similar to the single erythema migrans lesions described above, but in multiple locations on the body and may be smaller (< 5cm).
- **Neurological** – Early neurological Lyme disease: acute peripheral nervous system involvement, including radiculopathy, cranial neuropathy and mononeuropathy multiplex (multifocal involvement of anatomically unrelated nerves), and CNS involvement, including lymphocytic meningitis and, rarely, encephalomyelitis (parenchymal inflammation of brain and/ or spinal cord with focal abnormalities). Late neurologic Lyme disease may present as encephalomyelitis, peripheral neuropathy or encephalopathy.
- **Musculoskeletal** – Lyme arthritis is a monoarticular or oligoarticular form of arthritis most commonly involving the knee, but other large joints or the tempero-mandibular joint may be involved. Large effusions that are out of proportion to the pain are typical. Lyme arthritis is often intermittent if untreated, with episodes of joint inflammation spontaneously resolving after a few

weeks to a few months. Persistent swelling of the same joint for 12 months or more is not a usual presentation.

- **Cardiac** – Cardiac involvement associated with Lyme disease includes intermittent atrioventricular heart block often involving the atrioventricular node (although heart block may occur at multiple levels) and sometimes associated with myopericarditis. Carditis can occur in the early stages of the disease.

Criteria for serologic testing are described by the guidelines of the Canadian Public Health Laboratory Network. Serologic evidence is confirmatory only in patients with objective clinical evidence of disseminated Lyme disease, and a history of residence in, or visit to, a Lyme disease risk area. Serologic testing is not recommended in patients with early localized Lyme disease with exposure from a Lyme disease risk area.

Diagnosis and Laboratory Guidelines

The diagnosis of Lyme disease is based on an assessment of exposure risk, clinical signs and symptoms, in addition to laboratory testing where warranted. A clinical diagnosis of Lyme disease may be made by a clinician if the patient presents with a skin rash typical of erythema migrans (EM) and has been in a region where blacklegged tick populations are established.

Serological testing is recommended for patients with characteristic neurological, cardiac or joint involvement with a risk of exposure to black-legged ticks. Testing is also recommended when patients have a rash suggestive of EM, outside of the appropriate season in a tick-established area or in an area of the country where the tick population is not established.

The reference method for laboratory diagnosis of LD is serology, and testing using standard two-tier testing (STTT) and guidelines have been established by the Public Health Agency of Canada. STTT detects antibodies to *Borrelia burgdorferi* using an initial screening enzyme immunoassay (EIA) followed by a confirmatory IgM and/or IgG Western blot (WB) or immunoblot (IB). Testing for antibodies to *B. burgdorferi* solely by immunoblot, without a prior positive or equivocal first-tier EIA, is strongly discouraged due to an increased rate of false-positive results.

The performance characteristics of the STTT algorithm depend on the stage of infection. The timing of sample collection is important. If serum is obtained too early following exposure, seroconversion may not have occurred and a false-negative results may occur. In this setting, if the clinical suspicion is high and the patient has not been treated, repeat testing is recommended three to six weeks later. Antibiotic treatment in the early stages of *Borrelia* infection can impact the immune response, and antibodies may not develop and serological testing may remain negative.

Following exposure to *B. burgdorferi*, immunoglobulin M (IgM) antibodies are produced in the early stages of infection, often within two weeks of the associated tick bite. These initial antibodies begin to decline in the following weeks, though may persist for months or even years despite effective antibiotic treatment. Immunoglobulin G (IgG) antibodies develop subsequent to IgM, typically four weeks following exposure, and generally persist for years.

While the sensitivity of serology for LD is poor in early localized infection, the algorithm performs well in the later stages of infection. Furthermore, improved sensitivity has been demonstrated using a modified two-tiered testing (MTTT) approach, in which a second EIA is used to confirm initial positives, rather than the traditional WB or IB. With confirmation of improved accuracy, less subjectivity, opportunities for improved test turn-around time and improved cost-effectiveness, the MTTT is gradually replacing the STTT in the Canadian setting.

In Canada the STTT algorithm will be maintained using European-specific assays on Canadians with suspect LD acquired outside of North America. In addition, the use of IBs may still have value in patients with manifestations of late-stage LD such as Lyme arthritis or in suspect false-positive cases where serologic results do not fit with the clinical presentation.

Standard Two-Tiered Testing (STTT)

The STTT algorithm involves an initial screening EIA. With this sensitive screen, a negative result is considered final. With a positive screening EIA, reflex testing is performed using a confirmatory WB or IB. STTT test results and interpretations are shown below.

Table: STTT Test Results and Interpretation

Screening Test (EIA IgM/IgG)	Confirmatory Test (gM Immunoblot)	Confirmatory Test (IgG Immunoblot)	Interpretation	Comments
Symptoms ≤ 30 days				
NEGATIVE	NA	NA	No laboratory evidence of infection with B. burgdorferi. Likely not a case	Negative results may occur in patients very recently infected. If signs and symptoms consistent with LD persist, recommend repeat testing in 3-6 weeks.
POSITIVE or EQUIVOCAL	NEGATIVE	NEGATIVE	No laboratory evidence of infection with B. burgdorferi. Likely not a case	Negative results may occur in patients very recently infected. If signs and symptoms consistent with LD persist, recommend repeat testing in 3-6 weeks.
POSITIVE or EQUIVOCAL	POSITIVE	NEGATIVE OR BORDERLINE	Results are consistent with recent infection with B. burgdorferi.	Results indicate recent infection in patients presenting within 30 days of symptom onset. IgM immunoblot results in patients with symptoms lasting >30 days is discouraged because of risk of false positives.
POSITIVE or EQUIVOCAL	NEGATIVE or BORDERLINE	POSITIVE	Results are consistent B. burgdorferi infection in the recent or remote past.	Timing of infection (recent vs remote past) cannot be determined. Correlation with clinical signs is required. Results consistent with an infection greater than 3-4 weeks duration. IgG-class antibodies may remain detectable for months to years following resolution of infection
POSITIVE or EQUIVOCAL	POSITVE	POSITIVE	Results are consistent B. burgdorferi infection in the recent or remote past.	Timing of infection (recent vs remote past) cannot be determined. Correlation with clinical signs is required. Antibodies may remain detectable for months to years following resolution

				of infection.
Symptoms ≥ 30 days				
POSITIVE or EQUIVOCAL	NA	NEGATIVE OR BORDERLINE	No laboratory evidence of infection with B. burgdorferi. Not a case	Consider alternative diagnosis.
POSITIVE or EQUIVOCAL	NA	POSITIVE	Results are consistent B. burgdorferi infection in the recent or remote past.	Timing of infection (recent vs remote past) cannot be determined. Correlation with clinical signs is required. Antibodies may remain detectable for months to years following resolution of infection.

Modified Two-Tiered Testing (MTTT) and Interpretation of Results

Improving the sensitivity of testing in early localized infections is important in identifying patients with LD, allowing for early treatment and potentially preventing infection from disseminating and causing more severe disease.

Table: MTTT Test Results and Interpretation

Screening Test (EIA IgM/IgG)	Confirmatory Test (EIA IgM/IgG)	Interpretation	Comments
NEGATIVE	NA	No laboratory evidence of infection with B. burgdorferi. Likely not a case	Negative results may occur in patients very recently infected. If recent infection is suspected, recommend repeat testing in 3-6 weeks.
POSITIVE or EQUIVOCAL	NEGATIVE	No laboratory evidence of infection with B. burgdorferi. Likely not a case	Negative results may occur in patients very recently infected. If recent infection is suspected, recommend repeat testing in 3-6 weeks.
POSITIVE or EQUIVOCAL	POSITIVE or EQUIVOCOL	Results are consistent B. burgdorferi infection in the recent or remote past.	Timing of infection (recent vs remote past) cannot be determined. Correlation with clinical signs is required. If both tests are equivocal consider repeat testing in 3-6 weeks.

Reporting

Per Policy 2.2 Disease and Event notification to OCMOH and Disease and Event Reporting section

- Enhanced surveillance. For all confirmed and probable cases, an enhanced surveillance form should be completed and information sent to OCMOH within 5 days of completing interview.
- Routine surveillance (RDSS) for all confirmed cases.

Case Management

Education

Case or relevant caregiver should be informed about:

- Nature of infection, length of communicable period, mode of transmission and disease ecology
- Tick bite prevention

Investigation

Obtain travel history, outdoor activity, and tick exposure to determine if source of infection occurred within a recognized endemic focus or not.

Exclusion/Social Distancing

Not applicable.

Treatment

Lyme disease is treatable with antibiotics.

Immunization

Not applicable.

Contact Management

Education

Not applicable

Investigation

Contacts of cases are not at risk as there is no person to person transmission.

Exclusion/Social Distancing

Not applicable.

Prophylaxis

Not applicable.

Outbreak Management

Activate the local outbreak plan when an outbreak is declared.