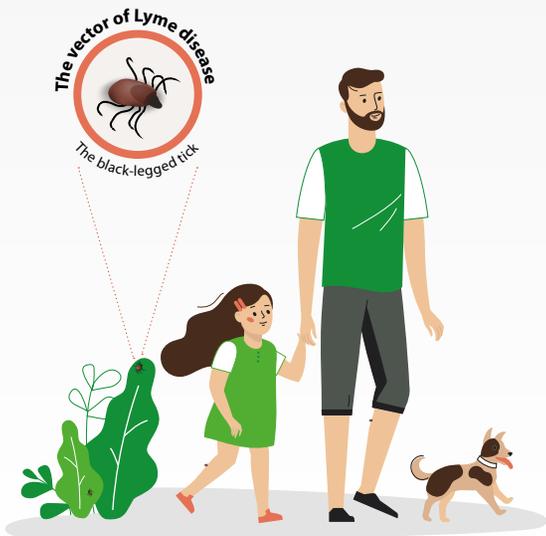


This diagnostic support tool is intended mainly for primary care clinicians. It is provided for information purposes only and should not replace the judgement of the clinician who performs the activities reserved under a statute or regulation. The recommendations in this tool were developed using a systematic process and are supported by the scientific literature and the knowledge and experience of Québec health professionals, experts and patients. For further details, go to the "[Publications](#)" section of INESSS's website [inesss.gq.ca](https://inesss.gq.ca). This tool does not deal with other tick-borne infections or with the much-debated form of Lyme disease, which is sometimes referred to as the chronic form.

## WHAT IS LYME DISEASE ?

- Lyme disease is an infectious disease caused by bacterial genospecies of *Borrelia burgdorferi*, which are transmitted to humans by black-legged ticks that are carriers.
- It is a notifiable disease (MADO) and is on the increase in Québec.
- It can affect several anatomical systems at the same time.



## WHAT ARE THE DIFFERENT STAGES OF THE DISEASE?

**Localized stage** (sometimes called the early stage): **Beginning of the infection before dissemination of the bacteria in the bloodstream.**

- Main manifestation observed:



**Isolated cutaneous manifestation**  
(isolated erythema migrans)

- Not always present or noticed.
- If present, usually appears 3 to 30 days after infection but can appear up to 3 months post-bite.

### Early disseminated stage

Bacterial dissemination via the bloodstream.

- Generally occurs when the local infection has not been detected or has not been treated effectively.
- Occurs a few days after isolated erythema migrans to a few weeks after infection (usually up to 6 months post-bite).
- Can include general systemic symptoms.
- Main manifestations observed:



**Cutaneous** (multiple erythema migrans)



**Neurological** (neuroborreliosis)



**Cardiac** (Lyme carditis)

### Late disseminated stage

Complication of the early disseminated stage.

- Occurs a few weeks or even a few months after infection (usually up to a year post-bite).
- Main manifestation observed in North America:



**Articular** (Lyme arthritis)

## GENERAL INFORMATION

### Patient with a tick

- If tick is attached, refer to the procedure for [removing](#) it.
- Refer to the [tick surveillance procedure](#).
- Consult the [decision support tool](#) or the [Québec's national medical protocol on post-exposure prophylaxis](#).
- Identifying the tick and obtaining proof that it carries *B. burgdorferi* are not required in order to make the diagnosis.

### Disease's presentation

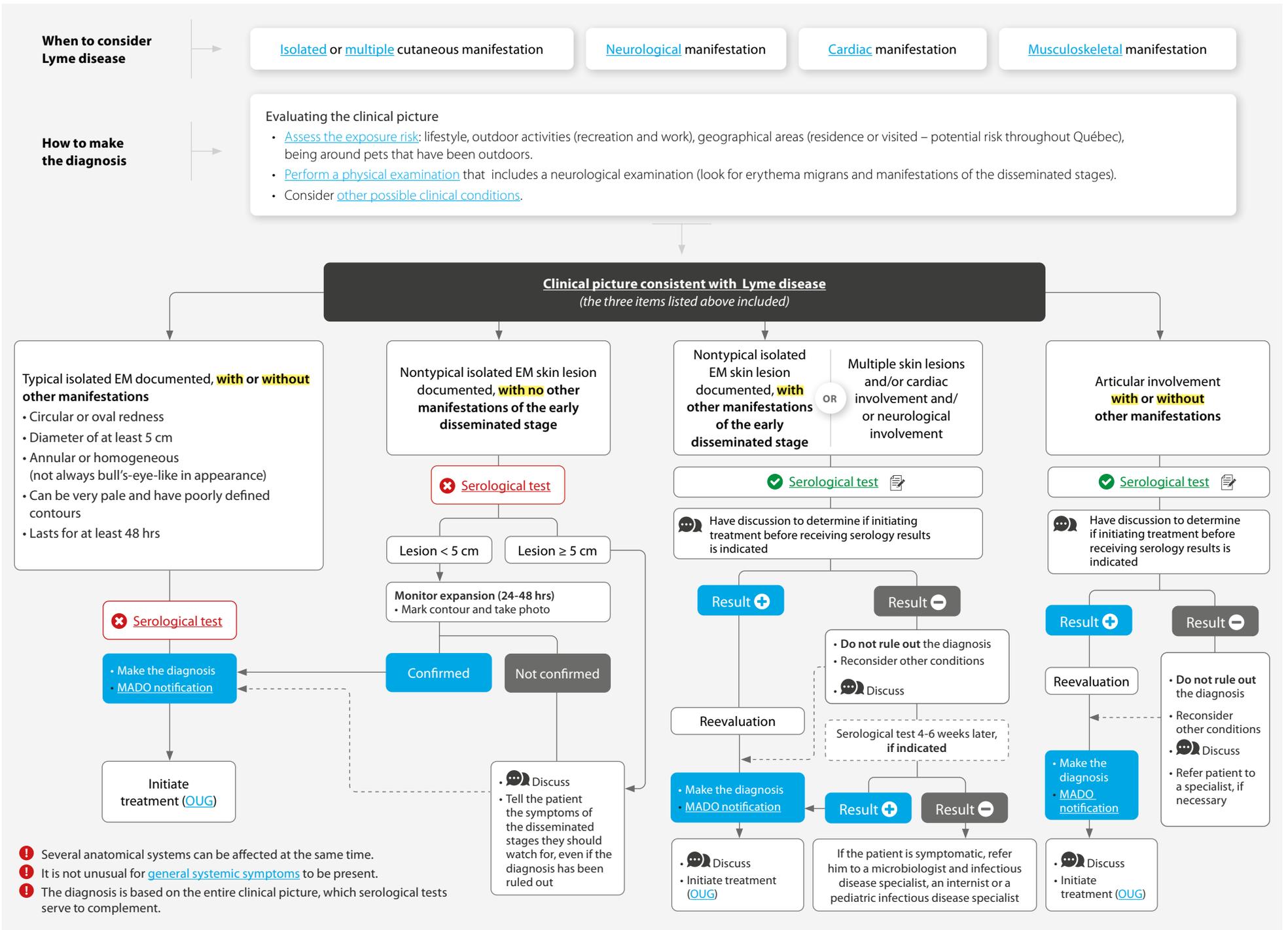
- The presentation, the severity of the manifestations, their duration and the speed of progression of the disease from one stage to the next vary from patient to patient. Arthritis can be the first manifestation.
- The manifestations are not mutually exclusive. Isolated erythema migrans can persist during the early disseminated stage.
- Clinical cases can occur throughout the year. Isolated erythema migrans is less common in the winter.
- It is difficult to link the symptoms to when the bite occurred because the bite often goes unnoticed, can be repeated and does not always lead to an infection.

### Diagnostic principles

- The diagnosis is based on the entire clinical picture.
- Serological tests are not always indicated. If they are, they serve to complement and should be interpreted in light of the clinical picture.
- It is not necessary for the exposure to have occurred in a high-risk area or for the bite to be documented to make the diagnosis.

### Management and monitoring

- Management depends on the manifestations present (consult the [OUG](#)).
- The effectiveness of the treatment is evaluated clinically, not with serological tests.



-----> Action to be taken after a joint discussion with one or more medical specialists or an experienced colleague

🗨️ Talk to one or more medical specialists or an experienced colleague

⊗ Not indicated

✅ Indicated

📄 Indicate the possible continent(s) of exposure on the requisition and when the first symptoms appeared (if known)

## 1 ISOLATED CUTANEOUS MANIFESTATION

**Isolated EM:** An isolated erythematous skin lesion that persists or even progresses for several days. Erythema migrans generally expands concentrically from the bite site to a diameter of 5 cm or greater. It is associated with little or no pain or itching. However, its features (size, shape and appearance) and duration vary considerably from patient to patient. Although a bull's-eye lesion (concentric redness) is not always due to Lyme disease, it is highly suggestive of it in cases of high-risk area exposure.

- Starts during the localized stage but can persist during the early disseminated stage.
- Usually appears 3 to 30 days after infection but can appear up to 3 months post-bite.

### Typical isolated EM

- Circular or oval redness
- At least 5 cm in diameter (does not progress consistently, so is not always appreciable)
- Can be annular or homogeneous (not always bull's-eye-like in appearance)
- Can be very pale in appearance, with poorly defined contours
- Lasts at least 48 hours

### Other possible but less typical features of EM

(not necessarily present at the same time)

- Diameter less than 5 cm (progression generally noticeable)
- Can be hemorrhagic
- Can have vesicles, scales, crusts or petechiae
- Can have a shape other than circular, annular or oval

 The absence of EM should not be used to rule out Lyme disease because it is not always present or noticed.

### Isolated EM vs. local hypersensitivity reaction

#### Early EM more likely if:

- Redness appears a few days post-bite
- Gradually expands for several days (the most specific criterion)
- Size  $\geq$  5 cm (but can be smaller)

#### Hypersensitivity reaction more likely if:

- Redness appears within the first 24 hours post-bite and regresses in a few days
- Is pruriginous (but not always)
- Size  $<$  5 cm

If in doubt about the nature of the redness, it is advisable to monitor its course and to wait for 24 to 48 hours, the patient's overall condition permitting.

#### To monitor the course of the redness:

- Mark the contour and measure the diameter of the redness during the visit. A photo of the redness before and after monitoring may make comparison easier.

### Isolated EM vs. infectious cellulitis

#### Isolated EM more likely if:

- Expands concentrically
- Little pain
- Little heat

#### Infectious cellulitis more likely if:

- Expands proximally
- Pain
- Heat

If in doubt about the nature of the redness, a therapeutic approach suitable for both types of lesion can be adopted (consult the [OUG](#)).

### Isolated EM vs. contact dermatitis

#### Isolated EM more likely if:

- Little itching
- Circular or oval shape
- Lesion smooth and not scaly

#### Contact dermatitis more likely if:

- Pruriginous or burning sensation
- Highly variable shape
- Papules, vesicles or scales

If in doubt about the nature of the redness, it is advisable to discuss the case with a medical specialist or an experienced colleague.

## 2 MULTIPLE CUTANEOUS MANIFESTATIONS

### Multiple erythema migrans 📷:

A set of erythematous skin lesions that appear after bacterial dissemination.

Although they may share certain features of isolated erythema migrans, their presentation (number, colour, shape, appearance and extent) varies widely.

- A manifestation of the early disseminated stage.
- Appear a few days after the isolated EM to a few weeks after infection (usually up to 6 months post-bite).

### The lesions:

- May share certain features with isolated EM
- May be less than 5 cm in diameter
- Are often pale, raised or macular, smooth and non-scaly

[↩ Back to algorithm](#)

ISOLATED ERYTHEMA MIGRANS



1 Granby



2 Granby



3 Saint-Hyacinthe



4 Saint-Hyacinthe



5 Saint-Hyacinthe



6 Saint-Hyacinthe



7 Saint-Hyacinthe



8 Saint-Hyacinthe



9 © CDC (USA)



10 © LDA (UK)



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16 © Hofmann et al. 2017



17 © LDA (UK)



18 © PCDS (UK)



19 © Cureus



20 © New York Times



21 © Brown Skin Matters

MULTIPLE ERYTHEMA MIGRANS



22 Saint-Hyacinthe



23 Granby



24 © PCDS(UK)

OTHER CONDITIONS



25 Local hypersensitivity reaction



26 Infectious cellulitis



27 Contact dermatitis

### 3 MAIN MANIFESTATIONS SUGGESTIVE OF LYME DISEASE OTHER THAN ISOLATED OR MULTIPLE EM (list not exhaustive; more rarely, other systems can be affected as well)

	Definition	Symptoms	Signs and presentation
<b>Neurological manifestations</b>	<p><b>Neuroborreliosis:</b> involvement of the nervous system (peripheral or central) or the meninges in response to the bacterial dissemination. The neurological manifestations vary according to the location of the inflammatory foci and can occur alone or in combination. Some occur as soon as the bacteria spread, while others are more rare and occur months later.</p> <ul style="list-style-type: none"> <li>• A manifestation of the early disseminated stage.</li> <li>• Occurs a few days after isolated EM to a few weeks after infection (usually up to 6 months post-bite).</li> </ul>	<ul style="list-style-type: none"> <li>• Facial palsy (sometimes bilateral)</li> <li>• Facial numbness</li> <li>• Deafness</li> <li>• Diplopia</li> </ul>	<ul style="list-style-type: none"> <li>• Cranial neuritis</li> <li>• Facial palsy</li> <li>• Other involvement of the cranial nerves is possible</li> </ul>
		<ul style="list-style-type: none"> <li>• Lower motor neuron-type weakness affecting one or more nerve or root territories</li> <li>• Paresthesia or hypoesthesia affecting one or more nerve or root territories</li> <li>• Abolition of one or more deep tendon reflexes</li> </ul>	<ul style="list-style-type: none"> <li>• Mononeuropathy</li> <li>• Multiple mononeuritis</li> <li>• Radiculopathy with no other cause</li> <li>• Plexopathy</li> </ul>
		<ul style="list-style-type: none"> <li>• Headache</li> <li>• Nuchal pain or stiffness</li> <li>• Photophobia</li> <li>• Nausea</li> <li>• Vomiting</li> </ul>	<ul style="list-style-type: none"> <li>• Aseptic meningitis</li> </ul>
<p><b>Cardiac manifestations</b></p> <p>More rare in children</p>	<p><b>Lyme carditis:</b> cardiac involvement in response to the bacterial dissemination. Its main manifestation is atrioventricular block.</p> <ul style="list-style-type: none"> <li>• A manifestation of the early disseminated stage.</li> <li>• Occurs a few days after isolated EM to a few weeks after infection (usually up to 6 months post-bite).</li> </ul>	<ul style="list-style-type: none"> <li>• Palpitations</li> <li>• Dizziness</li> <li>• Syncope</li> <li>• Chest pain</li> <li>• Dyspnea</li> </ul>	<ul style="list-style-type: none"> <li>• Atrioventricular block (1<sup>st</sup> to 3<sup>rd</sup> degree)</li> <li>• Nonspecific arrhythmia (SVES/VES)</li> <li>• Pericardial syndrome (with or without block)</li> <li>• Heart failure (rare)</li> </ul>
<p><b>Musculoskeletal manifestations</b></p> <p>Only joint involvement is one of the main manifestations</p> <p>Common in North America</p>	<p><b>Lyme arthritis:</b> inflammation of one or a few joints that begins a few months after the bacterial dissemination. The inflammatory episodes can last for several weeks or even several months, alternate with episodes of remission and migrate from one joint to another.</p> <ul style="list-style-type: none"> <li>• A manifestation of the late disseminated stage.</li> <li>• Occurs a few weeks or even a few months after infection (usually up to 1 year post-bite).</li> </ul>	<ul style="list-style-type: none"> <li>• Joint swelling often worse than the pain and the other associated symptoms</li> <li>• In most cases, the knee is affected</li> </ul>	<ul style="list-style-type: none"> <li>• Swelling of one or more joints (mainly the knee, but other, smaller joints can be affected)</li> <li>• Possible flare-up of arthritis alternating with periods of remission without treatment</li> </ul>

1. For example, the ocular system (non-neurological eye involvement: uveitis, keratitis, conjunctivitis, episcleritis, retinitis and choroiditis).

**EM:** erythema migrans; **VES:** ventricular extrasystole; **SVES:** supraventricular extrasystole.

 [Back to algorithm](#)

#### 4 GENERAL SYSTEMIC SYMPTOMS (list not exhaustive)

These symptoms may occur a few days after isolated EM to a few weeks after infection (usually during the first 2 months post-bite).

- Fever and chills
- Malaise
- Fatigue

- Muscle pain
- Joint pain
- Concentration and memory problems

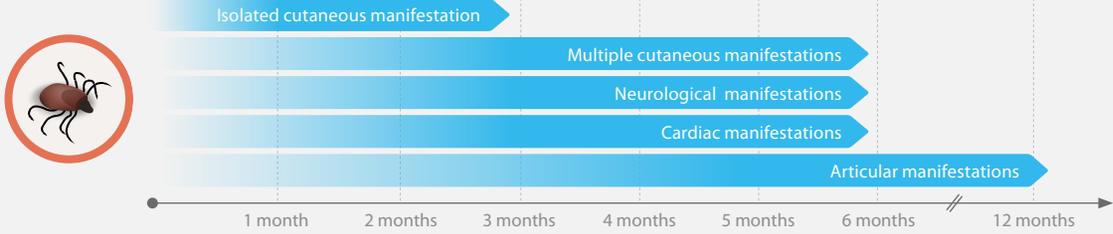
- Headache
- Isolated lymphadenopathy
- Flu-like syndrome  
(consistent with LD, particularly if it occurs during the summer)
- Mononucleosis syndrome  
(consistent with LD, particularly if it occurs during the summer)

- Asthenia
- Lethargy
- Anorexia

**EM:** erythema migrans; **LD:** Lyme disease.

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## 5 CLINICAL PICTURE – TICK EXPOSURE RISK ASSESSMENT AND PHYSICAL EXAMINATION

Tick exposure risk	Consistency of certain information with LD																			
<p><b>Lifestyle</b></p> <ul style="list-style-type: none"> <li>Lifestyle and outdoor activities (recreation and work):           <ul style="list-style-type: none"> <li>→ Ticks prefer damp places (woods, wooded areas and fields, but also gardens, landscaped areas and piles of leaves).</li> </ul> </li> <li>Tick transported by a person or a pet:           <ul style="list-style-type: none"> <li>→ Short survival in household climate (susceptible to desiccation);</li> <li>→ If attached, no significant risk to persons around the individual because ticks generally take a single blood meal per developmental stage;               <ul style="list-style-type: none"> <li>- If present, sign of tick exposure, since other ticks may have been transported.</li> </ul> </li> </ul> </li> </ul> <p><b>Location of exposure</b></p> <ul style="list-style-type: none"> <li>In Québec, there is a potential risk throughout the province:           <ul style="list-style-type: none"> <li>→ Risk higher in certain areas identified by the <a href="#">INSPQ</a>;</li> <li>→ Lower where the environment is less conducive to tick survival.</li> </ul> </li> <li>Risk present in <a href="#">other Canadian provinces</a>, the <a href="#">United States</a>, <a href="#">Europe</a>, North Africa and Asia.</li> </ul> <p><b>Season</b></p> <ul style="list-style-type: none"> <li>Potential risk throughout the year:           <ul style="list-style-type: none"> <li>→ Higher in the summer;</li> <li>→ Minimal in the winter in Québec;</li> <li>→ Independent of the season when traveling to places where the environment is conducive to tick survival.</li> </ul> </li> </ul>	<table border="1" data-bbox="856 207 2003 565"> <thead> <tr> <th rowspan="2">Information</th> <th colspan="3">Consistency with LD</th> </tr> <tr> <th>Low</th> <th>Moderate</th> <th>High</th> </tr> </thead> <tbody> <tr> <td><b>Duration of attachment (if bite documented)</b></td> <td>&lt; 24 hrs if tick is flat, not engorged</td> <td>&lt; 24 hrs if tick engorged</td> <td>&gt; 24 hrs</td> </tr> <tr> <td><b>Location of exposure (residency or place(s) visited)</b></td> <td>Environment not conducive to tick survival (e.g., the Northern Québec)</td> <td>Areas not at high risk where the environment is conducive to tick survival (e.g., Québec City)</td> <td>High-risk area identified by the INSPQ or near such an area</td> </tr> <tr> <td><b>Exposure associated with lifestyle</b></td> <td>Very unlikely</td> <td>Unlikely</td> <td>Possible</td> </tr> </tbody> </table> <p><b>!</b> By integrating all the gathered information, the clinician can determine whether or not the clinical picture is consistent with Lyme disease.</p> <p>→ Example: A patient for whom tick exposure is very unlikely, based on their lifestyle, may nevertheless have a clinical picture consistent with LD if they live in an area where there is a high risk of contracting Lyme disease.</p> <p><b>!</b> Non-tick transmission of the bacterium is poorly documented in the scientific literature and probably rare.</p> <p><b>!</b> A documented bite:</p> <ul style="list-style-type: none"> <li>→ Is evidence of tick exposure;</li> <li>→ Is not necessarily the one at the origin of the infection;</li> <li>→ Estimate of the duration of attachment not always reliable;</li> <li>→ Not necessary for making the diagnosis.</li> </ul> <p><b>!</b> Possible location of exposure</p> <ul style="list-style-type: none"> <li>→ Not necessary to have been in a high-risk area to make the diagnosis.</li> </ul>	Information	Consistency with LD			Low	Moderate	High	<b>Duration of attachment (if bite documented)</b>	< 24 hrs if tick is flat, not engorged	< 24 hrs if tick engorged	> 24 hrs	<b>Location of exposure (residency or place(s) visited)</b>	Environment not conducive to tick survival (e.g., the Northern Québec)	Areas not at high risk where the environment is conducive to tick survival (e.g., Québec City)	High-risk area identified by the INSPQ or near such an area	<b>Exposure associated with lifestyle</b>	Very unlikely	Unlikely	Possible
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<b>Exposure associated with lifestyle</b>	Very unlikely	Unlikely	Possible																	
<p><b>Physical examination</b></p> <ul style="list-style-type: none"> <li>Look for isolated EM, as its presence facilitates the diagnostic process. Often located in places where the tick can go unnoticed and stay attached for a long period of time:           <ul style="list-style-type: none"> <li>→ Examples: chest, axilla, inguinal area, popliteal fossa, lower buttocks, lower back, scalp, behind the ears, eyebrows, navel and between the toes.</li> </ul> </li> <li>Look for other manifestations of the disseminated stage, since:           <ul style="list-style-type: none"> <li>→ The constellation of several manifestations can facilitate the diagnostic process;</li> <li>→ Management depends on the manifestations present (especially neurological manifestations; peripheral nervous system vs. central nervous system and meningitis).</li> </ul> </li> </ul>	<p><b>Course of the disease if untreated</b></p>  <p><b>!</b> It is difficult to link the symptoms to when the bite occurred because the bite often goes unnoticed, can be repeated and does not always lead to an infection.</p> <p><b>!</b> The presentation, the severity of the manifestations, their duration and the speed of progression of the disease from one stage to the next vary from patient to patient.</p> <p><b>!</b> It is not unusual for general systemic symptoms to be present. They can occur a few days after EM to a few weeks after infection (usually during the first 2 months post-bite).</p> <p><b>!</b> Arthritis can be the first manifestation of LD and have been present for a long period of time.</p> <p><b>!</b> Available scientific data do not enable to rule on the plausibility that Lyme disease bacteria cause, directly or indirectly, general systemic symptoms that persists.</p>																			

## 6 CLINICAL PICTURE – OTHER POSSIBLE CLINICAL CONDITIONS (list not exhaustive)

! When ranking the differential diagnoses, it is important to take the patient's clinical picture into account, including the possibility of tick exposure and where the exposure occurred.

<b>Cutaneous system</b>	Isolated lesion	<ul style="list-style-type: none"> <li>Local hypersensitivity reaction due to a bite</li> <li>Nummular eczema</li> <li><i>Tinea corporis</i></li> <li>Infectious cellulitis</li> <li>Pityriasis rosea</li> </ul>	<ul style="list-style-type: none"> <li>Granuloma annulare</li> <li>Erythema nodosum</li> <li>Fixed drug eruption</li> <li>Contact dermatitis</li> <li>Cutaneous herpes simplex infection or herpes zoster</li> </ul>	<ul style="list-style-type: none"> <li>STARI</li> </ul> <p><b>Late phase</b></p> <ul style="list-style-type: none"> <li>Solitary morphea</li> <li>Stasis dermatitis</li> </ul>
	Multiple lesions	<ul style="list-style-type: none"> <li>Local hypersensitivity reaction due to a bite</li> <li>Urticaria</li> <li>Erythema multiforme</li> <li>Pityriasis rosea</li> <li>Sweet's neutrophilic dermatosis</li> </ul>	<ul style="list-style-type: none"> <li>Fixed drug eruption</li> <li>Granuloma annulare</li> <li>Erythema nodosum</li> </ul>	<ul style="list-style-type: none"> <li>Erythema annulare centrifugum</li> <li>Subacute cutaneous lupus erythematosus</li> <li>Urticarial vasculitis</li> <li>Sarcoidosis</li> </ul>
<b>Nervous system</b>	Facial palsy (more common, sometimes bilateral) or other cranial nerve involvement	<ul style="list-style-type: none"> <li>Idiopathic facial palsy (Bell's palsy)</li> <li><i>Herpes zoster oticus</i> (Ramsay Hunt syndrome)</li> <li>Mastoiditis, otitis media</li> </ul>	<ul style="list-style-type: none"> <li>Guillain-Barré syndrome</li> <li>Facial palsy secondary to other infectious processes (e.g. HIV or syphilis)</li> <li>Sarcoidosis (Heerfordt syndrome)</li> </ul>	<ul style="list-style-type: none"> <li>Facial palsy secondary to tumoural processes</li> <li>Sjögren's syndrome</li> <li>Skull base meningitis</li> </ul>
	Aseptic meningitis	<ul style="list-style-type: none"> <li>Viral meningitis</li> <li>Syphilitic meningitis</li> <li>Tuberculous meningitis</li> </ul>	<ul style="list-style-type: none"> <li>Fungal meningitis (cryptococcosis, coccidioidomycosis)</li> <li>Leptomeningeal carcinomatosis</li> </ul>	<ul style="list-style-type: none"> <li>Drug-induced meningitis</li> </ul>
	Peripheral neurological involvement: multiple mononeuritis, polyradiculopathy, plexopathy	<ul style="list-style-type: none"> <li>Secondary nerve root compression (e.g., mechanical involvement, for instance, foraminal stenosis or herniated disc)</li> <li>Mono/polyradiculopathy caused by another pathogenic agent (e.g. HIV or syphilis)</li> </ul>	<ul style="list-style-type: none"> <li>Vasculitis and connective tissue diseases</li> <li>Idiopathic brachial plexopathy (Parsonage-Turner syndrome)</li> <li>Diabetic lumbosacral plexopathy (Bruns-Garland syndrome)</li> </ul>	<ul style="list-style-type: none"> <li>Spondylodiscitis, epidural abscess</li> <li>Leptomeningeal carcinomatosis</li> </ul>
<b>Cardiac system</b>	<ul style="list-style-type: none"> <li>Atrioventricular block (more common)</li> <li>Myo/pericarditis</li> <li>Arrhythmia</li> </ul>	<ul style="list-style-type: none"> <li>ASHD</li> <li>Medication (e.g. <math>\beta</math>-blockers)</li> <li>Viral infections (e.g. coxsackie)</li> <li>Connective tissue diseases</li> <li>Kawasaki disease</li> </ul>	<ul style="list-style-type: none"> <li>AAR</li> <li>Bacterial infection (e.g. <i>Y. enterocolitica</i>)</li> <li>Parasitic infection</li> <li>Rocky Mountain spotted fever</li> </ul>	<ul style="list-style-type: none"> <li>Congenital/acquired heart defect</li> <li>Sarcoidosis</li> </ul>
<b>Musculoskeletal system</b>	<ul style="list-style-type: none"> <li>Arthritis (more common)</li> </ul>	<ul style="list-style-type: none"> <li>Spondyloarthritis (other than reactive), psoriatic arthritis and arthritis associated with inflammatory bowel disease</li> <li>Juvenile idiopathic arthritis</li> </ul>	<ul style="list-style-type: none"> <li>Reactive arthritis</li> <li>Septic arthritis</li> <li>RA</li> <li>Parvovirus B19 infection (5<sup>th</sup> disease)</li> <li>Post-infectious arthritis</li> </ul>	<ul style="list-style-type: none"> <li>Connective tissue diseases or vasculitis</li> <li>Microcrystalline arthritis</li> <li>Gout</li> </ul>
<b>Other tick-borne diseases/Co-infection</b>	<ul style="list-style-type: none"> <li>Anaplasmosis</li> <li>Babesiosis</li> </ul>	<ul style="list-style-type: none"> <li><i>Borrelia miyamotoi</i> infection</li> <li>STARI</li> </ul>	<ul style="list-style-type: none"> <li>Viral arbovirosis (e.g. Powassan encephalitis)</li> </ul>	

## 7 TWO-TIER SEROLOGY

Refer to the [two-tiered serology clinical tool](#) for more details on this laboratory analysis.

### Indication

#### ✓ Indicated

- Manifestations of the early and late disseminated stages if the clinical picture is consistent with Lyme disease and there is no typical isolated EM at the same time.

#### ✗ Not indicated

- If isolated EM, because the sensitivity is too low at this stage and because the result would probably be negative (a single exception is presented in the algorithm).
- For evaluating the effectiveness of antibiotic therapy because the antibodies can stay in the bloodstream for a long period of time.

### Diagnostic value of two-tier serology (North American tests)

- Screening test (ELISA) more sensitive and less specific than the confirmation test (immunoblotting/Western blot). Used sequentially for better sensitivity and specificity.
- Sensitivity low at the beginning of the infection (25 to 60%, depending on the study and the method) and increases gradually with time (40 to 100%, depending on the manifestation, the study and the method).
- Sensitivity high in patients with Lyme arthritis (95 to 100%, depending on the study and the method).
- Sensitivity low for Lyme disease contracted in Europe, Asia or North Africa because the *B. burgdorferi* genospecies are different. If need be, different immunoblotting tests are used (differences in terms of the choice of antigens and positivity criteria).

### Immunoblotting test and positivity criteria

- Performed only on specimens with a positive or equivocal screening test result.
- Consists of two separate assays, one measuring IgM, the other, IgG.
- Positivity criteria recommended by the CDC and used in Canada and the United States:
  - Positive IgM test: at least two bacterial antigens in three are recognized;
  - Positive IgG test: at least five bacterial antigens in ten are recognized.

### Interpreting the results of two-step serological tests

- IgG positive result regardless of the IgM one in a patient **with no manifestations suggestive** of Lyme disease:
  - does not point to Lyme disease because the tests do not distinguish between active and past infection.
- Positive IgG result (IgM positive or negative) in a patient **with manifestations suggestive** of Lyme disease:
  - element in favour of the diagnosis that should be used to complement the clinical picture.
  - ❗ The diagnosis is based on the entire clinical picture, which serological tests serve to complement.
- Positive IgM result and negative IgG:
  - High probability that it is a false positive, especially if the patient has had symptoms for more than 6 weeks.
  - ❗ If Lyme disease is strongly suspected, consider talking to an experienced colleague or a medical specialist to determine if a new requisition for serological tests is needed 4 to 6 weeks later.
- Negative IgM and IgG result in a patient **with manifestations suggestive** of Lyme disease:
  - Does not rule out Lyme disease without an evaluation of the entire clinical picture because:
    - The tests are dependent on the establishment of the immune response;
    - The various *B. burgdorferi* genospecies and their different strains do not all elicit an immune response against the same antigens (e.g. European strains).

### Laboratories that perform two-tiered serology

- Public laboratories and a number of private laboratories perform these tests and interpret the results in accordance with the CDC's recommendations.
- Some private laboratories:
  - Do not perform the two tiers of the serology in sequence;
    - Risk of false positives if Western blot is used alone
  - Use Western blot tests that differ from those recommended in at least one of the following respects:
    - The choice of antigens
    - The number of antigens used
    - The positivity criteria used (possibility of a large number of false positives)
  - Use non-validated tests on which there is little or no scientific literature (e.g. the detection of antigens in urine).

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