

How Many People Get Lyme Disease?

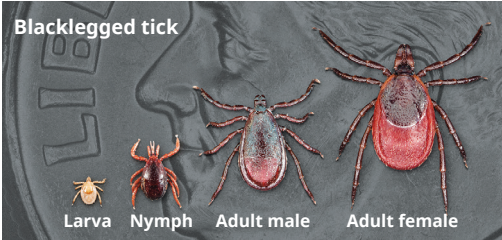
- Estimated 476,000 people in US are diagnosed and treated for Lyme disease each year

Where Does Lyme Disease Occur?

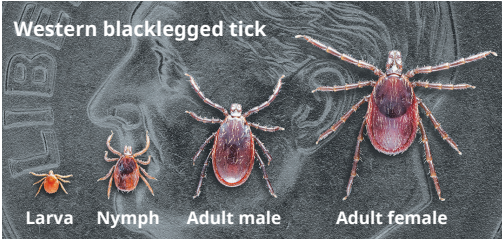
- Most cases occur in Northeastern, mid-Atlantic and North Central states
- Sometimes, cases occur along the North Pacific coast

How is Lyme Disease Transmitted?

- Blacklegged ticks attached for at least 24 hours
- The deer tick (blacklegged tick) spreads the infection in Northeastern, mid-Atlantic and North Central states

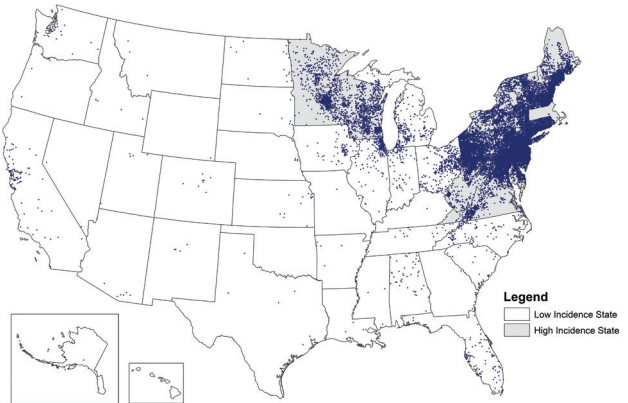


- The Western blacklegged tick spreads the infection along the North Pacific coast



Used with permission: Centers for Disease Control and Prevention, <https://www.cdc.gov/lyme/index.html>

Reported Cases of Lyme Disease – United States, 2019



Each dot represents one case of Lyme disease and is placed randomly in the patient's county of residence. The presence of a dot in a state does not necessarily mean that Lyme disease was acquired in that state.

Used with permission: Centers for Disease Control and Prevention, <https://www.cdc.gov/lyme/datasurveillance/maps-recent.html>



SCAN HERE
For more information regarding reported cases of Lyme disease...

Tick and Mosquito Repellents

Higher concentration corresponds to how long you are protected, not how well you are protected.

DEET (N, N-diethyl-m-toluamide)

- Safe and effective for children aged 2 months and older
- 10-30% concentration effective for 3 to 5 hours

Picaridin

- Safe and effective for children aged 2 months and older
- 10% concentration effective for 2 to 3 hours
- Similar to a natural compound found in black pepper plants

Oil of Lemon Eucalyptus

- Safe and effective for children aged 3 years and older
- 30% concentration effective for 4 hours
- Sourced from the gum eucalyptus tree

IR 3535

- Safe and effective for children aged 2 months and older
- 20% concentration effective for 2 to 3 hours

Permethrin

- Applied to **clothing and gear** - do NOT apply to skin
- Safe and effective for toddlers, children and teens
- 0.5% concentration
- Effective for multiple washes



SCAN HERE
For more information regarding Tick and Mosquito Repellents...

Additional Tick Bite Prevention Strategies

- Avoid tall grass and brushy areas when possible
 - Ticks don't fly or jump, they wait for a host to brush up against them
 - Mow yards regularly, keep tall grasses and bushes away from busy yard areas

- Check your child's body, and your own, for ticks after being outdoors

- Tumble dry clothes on high heat for 10 minutes to kill ticks on clothing; if the clothes require washing first, hot water is recommended

- Shower soon after spending time outdoors to help wash off unattached ticks

- Examine gear such as clothing, boots, bags and tents after being outdoors

- Outdoor/indoor pets should be checked for ticks as well, even if they are on a tick medication or have been vaccinated to protect against Lyme disease; talk to your veterinarian about tick prevention products for your dog

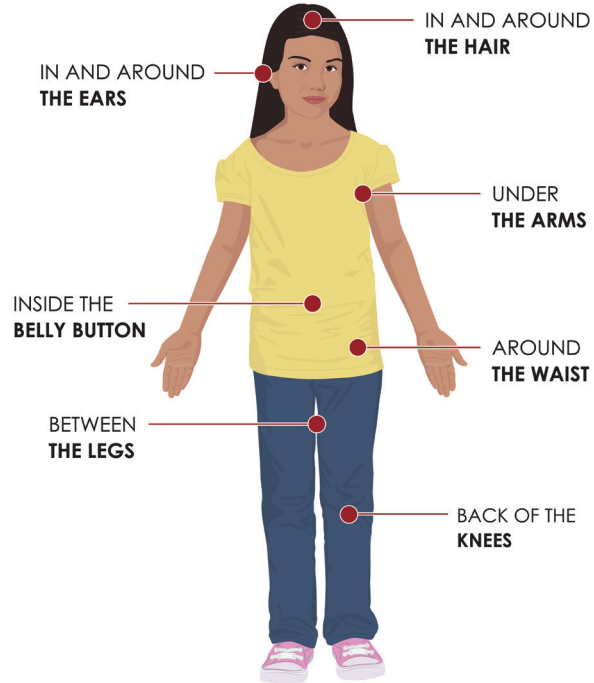
Image at right used with permission: Centers for Disease Control and Prevention, https://www.cdc.gov/lyme/prev/on_people.html



SCAN HERE
For more information regarding Prevention Strategies...

Full Body Tick Check

Check ALL parts of the body, with careful inspection of these areas.



SCAN HERE
To use the **Tick Bite Bot**:
A tool to assist people in removing attached ticks and seeking health care, if appropriate, after a tick bite.

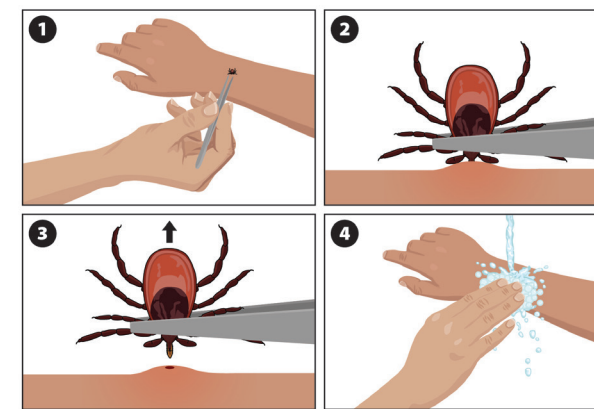
Removing a Tick

- Use clean, fine-tipped tweezers to grasp the tick as close to the skin's surface as possible

- Pull upward with steady, even pressure. Don't twist or jerk the tick; this can cause the mouth-parts to break off and remain in the skin. If this happens, remove the mouth-parts with tweezers. If you cannot remove the mouth easily with tweezers, leave it alone and let the skin heal.

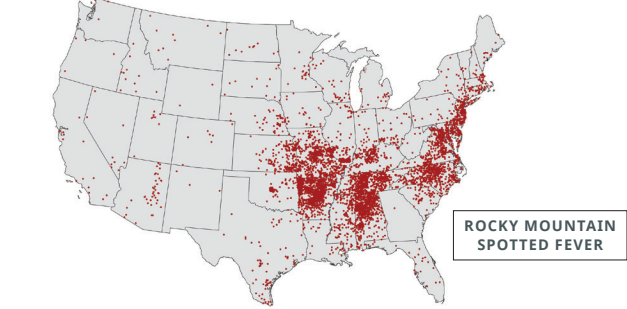
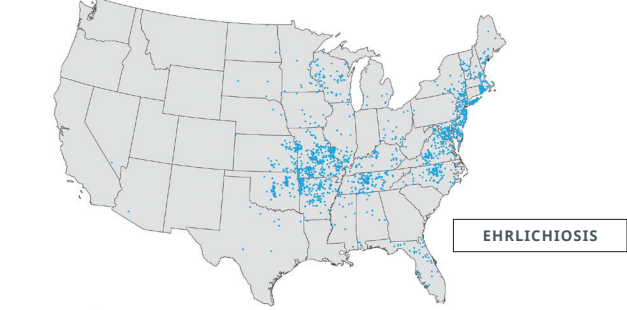
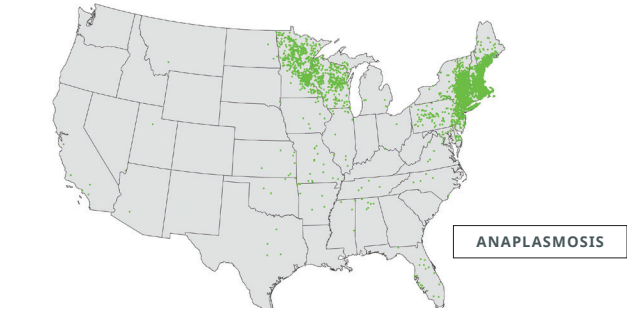
- After removing the tick, thoroughly clean the bite area and your hands with rubbing alcohol or soap and water

- Never crush a tick with your fingers. Dispose of a live tick by:
 - Putting it in alcohol
 - Placing it in a sealed bag/container
 - Wrapping it tightly in tape
 - Flushing it down the toilet



Used with permission: Centers for Disease Control and Prevention, https://www.cdc.gov/ticks/pdfs/FS_TickBite-508.pdf

Other Tickborne Diseases Reported to CDC



Note: Ticks can transmit diseases other than Lyme disease. An overview of tickborne diseases in the US, including maps where these diseases are reported, can be found at:
<https://www.cdc.gov/ticks/tickbornediseases/overview.html>

Maps used with permission: Centers for Disease Control and Prevention, <https://www.cdc.gov/ticks/>



Lyme Disease and Tick Bite Prevention

The National Association of Pediatric Nurse Practitioners (NAPNAP) values our members and their commitment to pediatric health care. The Lyme disease (LD) pocket guide is both a practice tool and caregiver education resource!

Side A is designed as a clinician companion, providing you with exactly what you need to know to effectively care for children at risk for Lyme disease. Educating patients and their families is one of many strengths of the pediatric nurse practitioner, so when you're ready to educate, flip this pocket guide over to side B and share the information designed to help families become part of the health care team working to improve the outcome of children at risk for Lyme disease.

NAPNAP is proud to bring this practice tool to you. Our hope is that it becomes a tool you can rely on in daily practice.

Faculty

Ashley N. Gyura, DNP, CPNP-PC, Children's Minnesota Infectious Disease Clinic, Minneapolis, MN. Dr. Gyura has disclosed no relevant financial relationships.

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What Is Lyme Disease?

- Tickborne illness caused by the spirochete *Borrelia burgdorferi*
- Usually causes a local rash; if not treated, can disseminate to other sites over days to weeks

Diagnosing Lyme Disease

- Early infection with classic erythema migrans rash in Lyme disease endemic areas is a clinical diagnosis (i.e. laboratory testing not required); in all other cases diagnosis of Lyme disease should be supported by laboratory testing
- Serology is the mainstay of testing and is most useful for patients with suspected disseminated disease
- Culture or PCR of blood or CSF specimens generally not recommended due to poor sensitivity

Erythema Migrans Skin Lesions (photos next panel)

- May occur within 3 to 30 days of bite
- Flat to slightly raised erythematous expanding lesion, typically larger than 5 centimeters
- May not appear as classic bull's-eye lesion or have central clearing
- One or multiple lesions may be present

DISCLAIMER

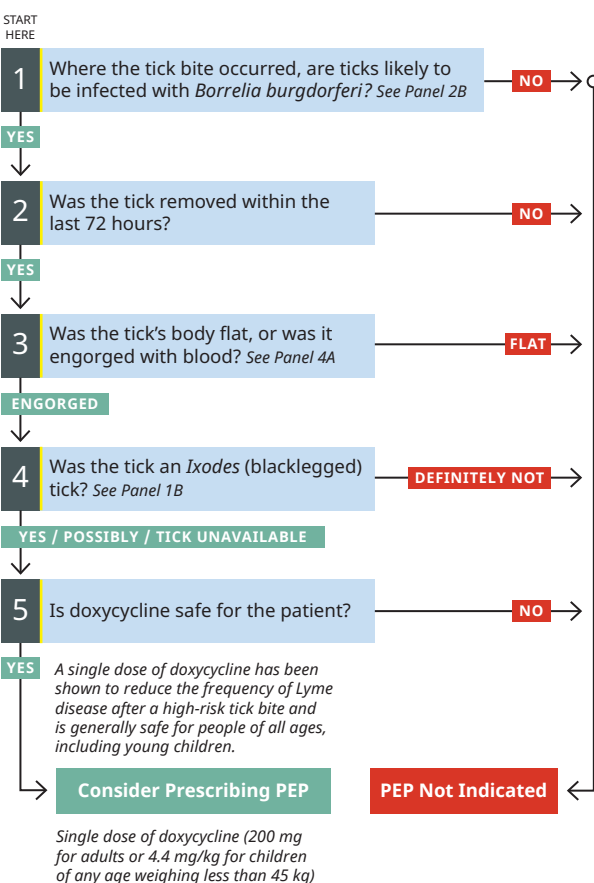
Participants have an implied responsibility to use the newly acquired information to enhance patient outcomes and their own professional development. The information presented in this activity is not meant to serve as a guideline for patient management. Any medications, diagnostic procedures, or treatments discussed in this publication should not be used by clinicians or other health care professionals without first evaluating their patients' conditions, considering possible contraindications or risks, reviewing any applicable manufacturer's product information, and comparing any therapeutic approach with the recommendations of other authorities.

Visual Examples: Erythema Migrans Skin Lesions



Photo credits: **A.** Crusted centers: ©DermAtlas, Bernard Cohen. Used with permission; Reprinted from Bhate C, Schwartz RA. Lyme disease: Part 1. *Advances and Perspectives*. Am Acad Dermatol 2011;64:619-36, with permission from Elsevier; **B.** More than one rash: ©DermAtlas, Bernard Cohen. Used with permission; **C.** Classic bull's-eye lesion: James Gathany, <http://phil.cdc.gov/phil> **D.** Skin of color: Brown Skin Matters, <https://brownskinmatters.com/525>

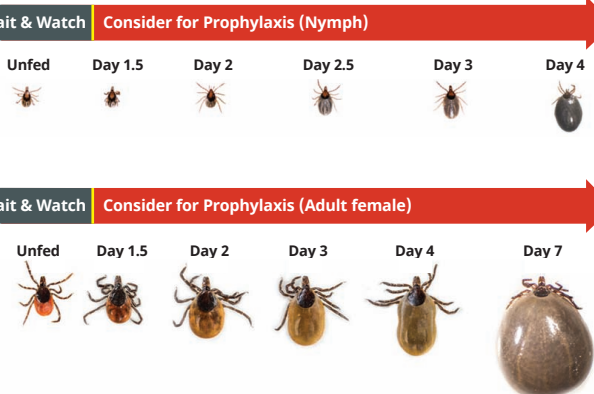
Lyme Disease Post-Exposure Prophylaxis (PEP)



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LD Risk Increases with Longer Tick Attachment

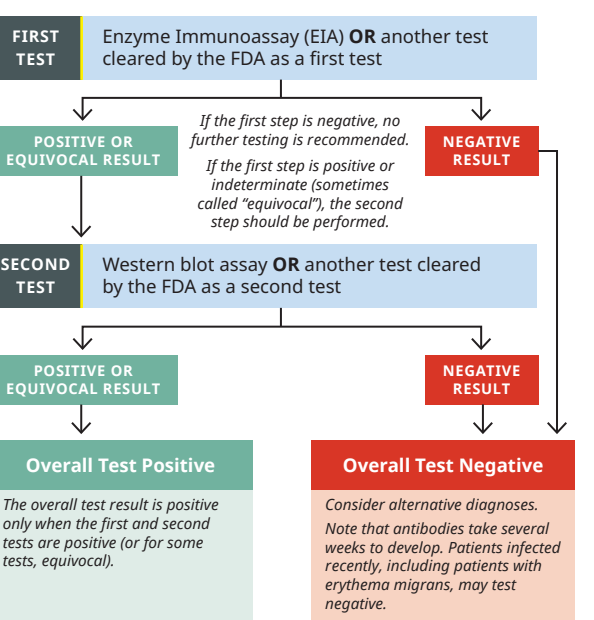
- Ticks become increasingly engorged with blood the longer that they are attached
- Transmission of the *Borrelia burgdorferi* spirochete typically occurs after at least 24 hours of tick attachment; Lyme disease risk increases with longer tick attachment times
- Removing an attached tick as soon as possible is important to reduce risk of Lyme disease



Note: These images are not actual size. Nymphal blacklegged ticks are approximately the size of a poppy seed, and adult blacklegged ticks are approximately the size of a sesame seed.

Figure reprinted from Lantos PM, Rumbaugh J, Bockenstedt LK, et al. Clinical Practice Guidelines by the Infectious Diseases Society of America (IDSA), American Academy of Neurology (AAN), and American College of Rheumatology (ACR): 2020 Guidelines for the Prevention, Diagnosis and Treatment of Lyme Disease. *Clinical Infectious Diseases*. 2021;72(1):e1–e48. Copyright 2020, with permission of Oxford University Press.

Lyme Disease Serology Testing



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Interpretation of LD Western Blot Results

Positive IgM At least 2 of these 3 bands	23/24, 39, 41 kDa
Positive IgG At least 5 of these 10 bands	18, 23/24, 28, 30, 39, 41, 45, 58, 66, 93 kDa

The IgM Western blot is only useful if symptom onset was in the last 30 days. If symptoms have been present for more than 30 days, consider ONLY the IgG Western blot. This is because the IgM result is more prone to false-positive results than the IgG.

Table 4. Treatment of Specific Manifestations of Lyme Disease

Disease Manifestation	Drug	Route	Medication	Duration, days (range) ^a
Erythema migrans ^b	Doxycycline	Oral	Doxycycline	10
	Amoxicillin or cefuroxime axetil		Amoxicillin or cefuroxime axetil	14
Meningitis or radiculopathy	Azithromycin ^c	Oral	Azithromycin ^c	7 (range: 5–10)
Cranial nerve palsy	Doxycycline	Oral	Doxycycline	14–21
	Ceftriaxone	IV ^d	Ceftriaxone	14–21
Carditis	Doxycycline	Oral ^e	Doxycycline, amoxicillin, or cefuroxime axetil	14–21
	Ceftriaxone	IV ^d	Ceftriaxone	14–21
Arthritis	Doxycycline, amoxicillin, or cefuroxime axetil	Oral	Doxycycline, amoxicillin, or cefuroxime axetil	28
Recurrent or refractory arthritis	Doxycycline, amoxicillin, or cefuroxime axetil	Oral	Doxycycline, amoxicillin, or cefuroxime axetil	28
Anorectitis chronic atrophic	Ceftriaxone	IV	Ceftriaxone	14 ^f
Borrelia lymphocytoma	Doxycycline, amoxicillin, or cefuroxime axetil	Oral	Doxycycline, amoxicillin, or cefuroxime axetil	21–28
	Doxycycline, amoxicillin, or cefuroxime axetil	Oral	Doxycycline, amoxicillin, or cefuroxime axetil	14

Abbreviation: IV, intravenous.
^aRegimens are given where different durations have been studied, and the optimal duration remains uncertain.
^bThis recommendation applies both to solitary and multiple erythema migrans.
^cBecause of concerns for lower efficacy, macrolide antibiotics including azithromycin are considered second-line agents, and should be reserved for patients in whom other antibiotic classes are contraindicated. Azithromycin has not been sufficiently studied for manifestations of Lyme disease other than erythema migrans.
^dThe preferred IV agent is ceftriaxone. Ceftriaxone and penicillin G are alternatives.
^eInitial IV therapy is recommended for patients requiring hospital admission. Therapy can be completed orally for the same total 14-day duration. Patients with Lyme carditis who do not require hospital admission can be treated orally.
^fRepeat IV therapy can be extended to 28 days if inflammation is not resolving.

Table 3. Drug Doses

Drug	Dosage for Adults	Dosage for Children
Oral Regimens		
	Preferred	
	Amoxicillin ^a	50 mg/kg divided 3 times daily (maximum 500 mg per dose)
	Doxycycline ^b	4.4 mg/kg divided twice daily (maximum 200 mg daily)
Intravenous Therapy		
	Preferred	
	Ceftriaxone	50–75 mg/kg once daily (maximum 2000 mg per dose)
	Alternative	150–200 mg/kg divided 3–4 times daily (maximum 6000 mg daily)
Penicillin G ^c	2000 mg three times daily	200 000–400 000 units/kg divided every 4 hours (maximum 18–24 million units daily)
	18–24 million units divided every 4 hours	

Regardless of the treatment regimen, complete response to treatment may be delayed beyond the treatment duration. Release may occur with any of these regimens; patients with objective signs of relapse may need a second course of treatment.
^aDoses of some beta-lactam antibiotics (amoxicillin, penicillin, cefuroxime, and ceftriaxone) may require adjustment for patients with impaired renal function.
^bThere is increasing favorable information on the safety of short courses of doxycycline in young children, which should impact the risk-to-benefit ratio of using the antibiotic in patients with various manifestations of Lyme disease; see the General Principles and the Individual Treatment Sections of this guideline for further discussion.
^cThe oral suspension of cefuroxime is currently not available in the USA.
^dBecause of concerns for lower efficacy, macrolide antibiotics including azithromycin are considered second-line agents, and should be reserved for patients in whom other antibiotic classes are contraindicated.

Presentations of Disseminated Lyme Disease

Lyme Carditis
Lyme carditis typically presents as atrioventricular nodal block. Varying degrees of heart block can occur, which can progress to or fluctuate between complete heart block. Pericarditis and myocarditis can also occur. Symptoms may include:
• dyspnea
• palpitations
• syncope
• chest pain
• exercise intolerance
• edema

An ECG does not need to be performed routinely on all patients with Lyme disease. However, an ECG should be performed urgently for any patient with suspected Lyme carditis.

Lyme Arthritis
Marked swelling primarily affecting large joints, most commonly the knee. This is the most common presentation of late Lyme disease in children. Predictors of Lyme arthritis include:
• known history of tick bite
• isolated knee involvement
• lack of fever



Lyme arthritis can be difficult to differentiate from septic arthritis. Predictors of septic arthritis may include:
• absolute neutrophil count ≥10k cells/mm³
• ESR ≥40 mm/hour
• hip involvement
• pain with short arc motion

Image used with permission: Centers for Disease Control and Prevention, https://www.cdc.gov/lyme/signs_symptoms/index.html

Presentations of Disseminated Lyme Disease

Cranial Neuritis
Cranial neuritis usually involves the facial nerve (CN VII) and less often, the trigeminal (CN V), oculomotor and abducens (CN III, VI), and vestibulocochlear nerves (CN VIII). When the cranial nerves are affected, facial palsy can occur on one or both sides of the face.



Lyme Meningitis
Presentation is similar to enteroviral and other aseptic meningitis. This may include:
• fever
• headache
• photosensitivity
• neck stiffness or pain
• CSF lymphocytic pleocytosis

The presence of the following increases likelihood of Lyme meningitis:
• co-occurrence of facial nerve palsy
• mononuclear cell predominant CSF pleocytosis

Radiculoneuritis
This presentation is rare in children, but if present, may include:
• numbness
• tingling
• “shooting” pain
• weakness in arms or legs

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