JUNE 2023 | VOLUME 2 | ISSUE 6

Evidence-Based Urgent Care

High-Yield Clinical Education • Practical Application

CLINICAL CHALLENGES:

- **Which** tick-borne illnesses are most common in the United States, and in what regions are they most prevalent?
- **How** are tick-borne illnesses diagnosed in the urgent care setting?
- **When** is prophylactic treatment indicated?
- **What** treatment regimens are recommended for specific tick-borne illnesses?

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Prior to beginning this activity, see "CME Information" on page 2.

Tick-Borne Illness: A Diagnostic Approach for the Urgent Care Clinician

■ Abstract

Tick-borne illnesses, including Lyme disease and Rocky Mountain spotted fever, are becoming increasingly common in the United States. Presentations of various tick-borne illnesses are sometimes nonspecific, but timely and effective diagnosis are critical for optimal outcomes. Urgent care clinicians play an important role in identifying and treating tick-borne illnesses. This issue discusses the diagnosis of the tick-borne illnesses most commonly seen in urgent care settings in the United States, including the key clinical findings of the history and physical examination, and diagnostic testing options. Tick removal technique, indications for prophylactic treatment, and treatment recommendations for specific tick-borne illnesses are also reviewed.

EB MEDICINE

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Needs Assessment: The need for this educational activity was determined by a practice gap analysis; a survey of medical staff; review of morbidity and mortality data from the CDC, AHA, NCHS, and ACEP; and evaluation responses from prior educational activities for urgent care and emergency medicine physicians.

Target Audience: This internet enduring material is designed for physicians, physician assistants, nurse practitioners, and residents in the urgent care and family practice settings.

Goals: Upon completion of this activity, you should be able to: (1) identify areas in practice that require modification to be consistent with current evidence in order to improve competence and performance; (2) develop strategies to accurately diagnose and treat both common and critical urgent care presentations; and (3) demonstrate informed medical decision-making based on the strongest clinical evidence.

CME Objectives: Upon completion of this activity, you should be able to: (1) identify the most common tick-borne illnesses in the United States and their endemic areas; (2) recognize the presenting signs and symptoms of common tick-borne illnesses; (3) determine whether prophylactic treatment is indicated for a suspected tick bite; and (4) make appropriate treatment decisions based on the type of tick-borne illness and its stage.

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QUICK READ

Points & Pearls

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Tick-Borne Illness: A Diagnostic Approach for the Urgent Care Clinician

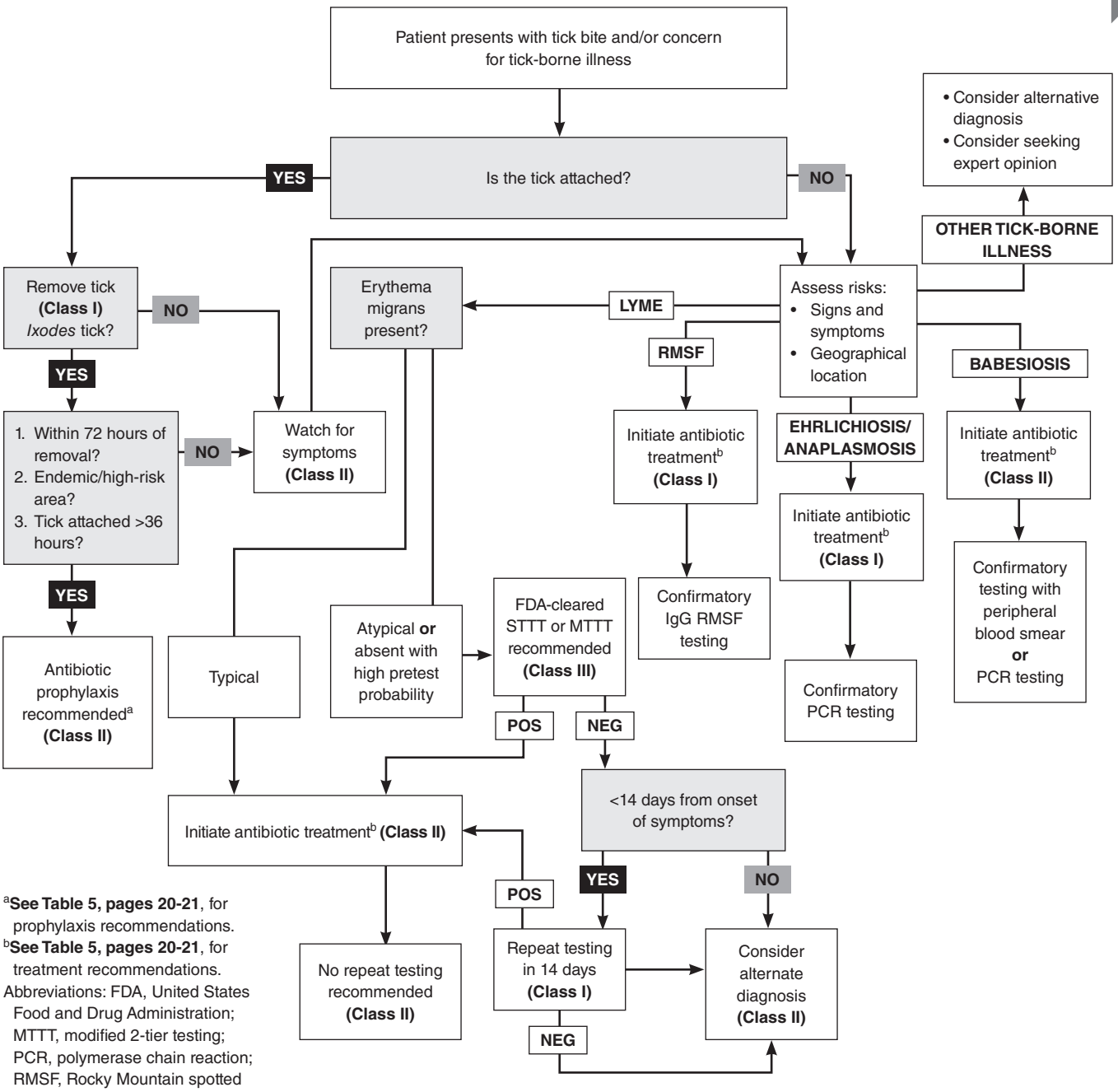
Points

- Lyme disease, Rocky Mountain spotted fever (RMSF), ehrlichiosis, anaplasmosis, and babesiosis account for 99% of all reported tick-borne illnesses in the US. Lyme disease is most common and RMSF has the highest case-fatality rate. Other known tick-borne illnesses in the US include tularemia, southern tick-associated rash illness (STARI), *Rickettsia parkeri* rickettsiosis, tick-borne relapsing fever, and viral diseases such as Powassan disease, Colorado tick fever, Heartland virus, and Bourbon virus.
- The geographical footprints of ticks and tick-borne illnesses have significantly expanded since 2000. There is overlap of the geographic footprints of anaplasmosis, babesiosis, and Lyme disease, as well as of the geographic footprints of RMSF and ehrlichiosis. **(See Figures 1, 2, 3, and 4.)**
- Patients with a tick-borne illness may not recall a tick bite, so the lack of a tick or a known tick bite should not eliminate consideration for tick-borne illness. Many activities of daily living (yard work, hikes, playing with pets) can result in exposure to ticks.
- The hallmark symptom of Lyme disease is erythema migrans, a rash that presents 3 to 30 days after the initial tick bite.[21] It typically has a "bull's-eye" appearance with central clearing, and is rarely itchy or painful.
- The early symptoms of RMSF are nonspecific and may mimic viral infections (eg, fever, headaches, myalgias, malaise, nausea, vomiting, and anorexia). Symptoms may be severe. A petechial rash in particular is an indication of severe disease.
- Fever without an obvious explanation, such as upper respiratory symptoms or urinary tract symptoms, should raise the suspicion of a tick-borne illness, particularly during the warmer months when ticks are most active.
- Although visual identification of a tick can be helpful for diagnosis, testing of ticks is not recommended. The presence or absence of pathogens in the tick does not reliably predict the likelihood of clinical infection and should not impact management.
- There is no diagnostic test for RMSF that can reliably diagnose the disease in time to prevent significant morbidity and mortality. Treatment is most effective in preventing severe illness if initiated within the first 5 days of symptom onset, and it is essential to initiate treatment within 8 days. Empiric treatment should be initiated immediately if RMSF is suspected.
- Tick species can carry and transmit multiple diseases, so coinfections should always be considered.
- Doxycycline is the preferred first-line agent for treatment of RMSF and other rickettsial diseases; ehrlichiosis and anaplasmosis; and early-stage Lyme disease. **(See Table 5.)** Recent studies have shown the risk of adverse effects of doxycycline in pregnancy and in children to be extremely low, especially when compared to the potential risk for morbidity and mortality of tick-borne illnesses in these populations.[92,93,99,100]

Pearls

- Rash alone cannot be consistently relied on as a diagnostic clue for tick-borne illness, as rash may be absent or atypical in appearance. One exception is erythema migrans, which is diagnostic for Lyme disease.
- Geographic location can help to differentiate rash associated with STARI from erythema migrans. STARI is more likely in an area where the lone star tick is prevalent, while erythema migrans should be more strongly considered in a Lyme-endemic area.
- *Rickettsia parkeri* is associated with the appearance of an inoculation eschar at the site of the tick bite, which can help to differentiate from RMSF. **(See Figure 6.)**
- Alpha-gal syndrome is a noninfectious but potentially life-threatening allergic reaction to the ingestion of mammalian meat or dairy products that can result from the bite of the lone star tick.[49]
- Antibiotic prophylaxis for Lyme disease should be initiated if these criteria are met: (1) the tick is identified as an *Ixodes* tick; (2) the bite occurred in a Lyme-endemic area; (3) the tick was attached for ≥36 hours; and (4) prophylaxis can be initiated within 72 hours of tick removal.

Clinical Pathway for Urgent Care Management of Tick-Borne Illness



[a]**See Table 5, pages 20-21**, for prophylaxis recommendations.
[b]**See Table 5, pages 20-21**, for treatment recommendations.
Abbreviations: FDA, United States Food and Drug Administration; MTTT, modified 2-tier testing; PCR, polymerase chain reaction; RMSF, Rocky Mountain spotted fever; STTT, standard 2-tier testing.

Class of Evidence Definitions

Recommendations in the clinical pathways section of *Evidence-Based Urgent Care* receive a score based on the following definitions.

Class I
- Always acceptable, safe
- Definitely useful
- Proven in both efficacy and effectiveness

Level of Evidence:
- One or more large prospective studies are present (with rare exceptions)
- High-quality meta-analyses
- Study results consistently positive and compelling

Class II
- Safe, acceptable
- Probably useful

Level of Evidence:
- Generally higher levels of evidence
- Nonrandomized or retrospective studies: historic, cohort, or case control studies
- Less robust randomized controlled trials
- Results consistently positive

Class III
- May be acceptable
- Possibly useful
- Considered optional or alternative treatments

Level of Evidence:
- Generally lower or intermediate levels of evidence
- Case series, animal studies, consensus panels
- Occasionally positive results

Indeterminate
- Continuing area of research
- No recommendations until further research

Level of Evidence:
- Evidence not available
- Higher studies in progress
- Results inconsistent, contradictory
- Results not compelling

Case Presentations

CASE 1

A 24-year-old man presents to urgent care for a rash...

- The patient reports an "unusual rash" on his right lower leg that started 3 days ago, but the rash has gradually enlarged each day. He does not report or recall a tick bite.
- He reports fatigue and malaise but is afebrile and otherwise asymptomatic.
- He notes that, until last week, he was working as a camp counselor at a summer camp in the Catskill Mountains in New York state.
- On examination, there is a well-demarcated erythematous patch in a "bull's-eye" pattern measuring 8 cm in diameter on his right lower leg.
- You recognize his rash as erythema migrans, and consider whether Lyme disease testing is necessary in this patient…

CASE 2

A 54-year-old woman presents to an urgent care center for an embedded tick on her abdomen...

- The patient says she noticed a bump this morning while taking a shower 2 hours prior to arrival and, upon closer inspection, found an embedded tick.
- There is slight erythema around the bite site, but she is otherwise asymptomatic.
- In addition to prompt tick removal, you wonder if any testing or antibiotic therapy will be needed...

CASE 3

A 27-year-old woman presents to urgent care for follow-up care after an upper respiratory illness...

- The patient states that 2 weeks ago, she had a febrile upper respiratory illness. At another urgent care center, she was tested for Rocky Mountain spotted fever and given a prescription for doxycycline. She says she never started the medication because her symptoms quickly resolved.
- Yesterday she was notified by phone that her "tick test was positive" and that she should seek medical attention immediately.
- You consider whether this patient should start antibiotic treatment at this point, given that she is now asymptomatic, or if additional testing is needed...

■ Introduction

Emerging tick-borne illnesses are a significant health threat in the United States (US). According to the US Centers for Disease Control and Prevention (CDC), ticks now account for 77% of vector-transmitted disease, with the number of reported tick-borne illnesses doubling from 2004 to 2016.[1] Geographic expansion of ticks and their related illnesses have also been noted, contributing to significant health care burdens.[2] Most clinicians are familiar with Rocky Mountain spotted fever (RMSF) and Lyme disease; however, ticks also harbor and transmit other bacterial, viral, and parasitic pathogens.

There are several more- and less-obvious presentations seen in the urgent care setting that should prompt consideration of tick-borne illness in the differential diagnosis. Potential presentations range from a known tick bite to febrile illness. Otherwise benign activities of daily living (eg, working in the backyard) can greatly increase risk for tick exposure and subsequent development of disease.[3] Early diagnosis and prompt treatment of tick-borne illness is associated with good outcomes, while delays in treatment may lead to significant morbidity and mortality. However, early diagnosis can be challenging because initial symptoms are often nonspecific, patients may not recall a tick bite, the characteristic rash is not always present, and there is a lack of reliable testing.[4] Knowledge of the pathophysiology of tick-borne illnesses, as well as careful review of the patient's history and a detailed physical examination, will assist the clinician in making an accurate diagnosis and determining appropriate management. This issue of *Evidence-Based Urgent Care* reviews the current recommendations for the recognition and management of the tick-borne illnesses most likely to be encountered in US urgent care centers.

■ Etiology and Pathophysiology

There are at least 18 known tick-borne pathogens and at least 20 tick-related illnesses identified in the US.[5] **(See Table 1, page 6.)** The tick-borne illnesses that urgent care clinicians should be most aware of

and watchful for include Lyme disease (most common); RMSF (highest case-fatality rate); ehrlichiosis and anaplasmosis (both of which can cause fatal disease); and babesiosis (also potentially fatal), a tick-borne parasitic infection.[6] Those illnesses represent 99% of all reported tick-borne illness in the US, but there are others that may be encountered in urgent care. Powassan disease, a potentially fatal encephalitis caused by a flavivirus, was recognized as a human pathogen in 1958 after discovery of a case in Powassan, Ontario.[7] Tularemia is a rare but severe and potentially fatal infection that can be transmitted by ticks. The Heartland virus[8] and Bourbon virus[9] have received public attention in recent years; both are most common in the Midwest and Southern states in the US. New tick-transmitted infections and pathogens continue to be identified due to advances in molecular testing, especially within the last decade.

Among the ticks that are native to the US, only a small percentage transmit disease.[10] Important tick species in the transmission of tick-borne illness in humans include the blacklegged tick (*Ixodes scapularis, I pacificus*), the American dog tick (*Dermacentor variabilis, D similis*), the brown dog tick (R*hipicephalus sanguineus*), the Gulf Coast tick (*Amblyomma maculatum*), the Rocky Mountain wood tick (*D andersoni*), and the lone star tick (*A americanum*).

The geographic distribution of each tick species **(see Figure 1, page 7)** is an important factor to consider, but disease transmission is influenced by multiple risk factors beyond tick presence.[11] **Figure 2 on page 8** shows the geographic distribution of selected tick-borne diseases. Anaplasmosis, babesiosis and Lyme disease show notable overlap in geographic footprints, as do RMSF and ehrlichiosis.[12] **(See Figure 3, page 9.)** The geographical footprint of ticks and tick-borne illness is noted to have significantly expanded since the early 2000s, a change that is thought to be secondary to climate change and changes in host populations. **Figure 4 on page 10** shows the change in the geographical footprint of Lyme disease from 2001 to 2019, with significant southward and westward expansion of the disease.

Ticks are obligate blood-feeding ectoparasites that feed on a wide variety of vertebrate hosts including mammals, birds, reptiles, and amphibians. Worldwide, ticks are second only to mosquitoes in transmission of pathogens, but in the US, ticks are responsible for more human disease than any other insect. Transmission of pathogens occurs through the process of feeding. Once the tick finds its host, it will grasp the skin, cut the surface, and insert its feeding tube. The tick may secrete a cement-like substance to keep itself attached, and the feeding tube may have barbs to help hold it in place. During feeding, ticks can secrete small amounts of saliva with anesthetic or toxic properties. The tick slowly sucks blood from the host and becomes engorged over the course of several days. Most ticks go through 4 life stages (egg, larva, nymph, and adult), and feeding on blood is required for survival at every stage.[13] **(See Figure 5, page 11.)**

Ticks typically live in wooded, brush-covered areas that are commonly inhabited by and provide food for host animals. The same environment also provides moisture and humidity to prevent ticks from desiccating. Although active throughout the year, ticks are most active during the warmer months, especially from late spring to summer. Contrary to folklore, ticks do not jump or fly in the air. Rather, they will search for hosts from the tips of low-lying vegetation, such as grass and shrubs. Hosts come in contact with ticks when they brush up against the vegetation, and the tick then crawls to find a suitable place to feed.

Table 1. Tick-Related Illnesses in the United States

Bacterial
- Anaplasmosis
- *Borrelia ayonii*
- *Borrelia miyamotoi*
- Ehrlichiosis
- Lyme disease
- *Rickettsia parkeri* rickettsiosis
- Rocky Mountain spotted fever
- Tick-borne relapsing fever
- Tularemia
- 364D rickettsiosis

Viral
- Bourbon virus
- Colorado tick fever
- Heartland virus
- Powassan disease

Parasitic
- Babesiosis

Noninfectious
- Tick paralysis
- Alpha-gal syndrome

Lyme Disease

In 1975, an unexplained cluster of arthritis was reported in children who lived in and around Lyme, Connecticut. After 2 years of investigation, it was determined that these patients had a transmissible disease linked to being bitten by the *Ixodes scapularis* tick (also known as the blacklegged tick or deer tick). In 1982, scientist William Burgdorfer and his team identified the causative organism (later named *Borrelia burgdorferi*) of what is now known as Lyme disease.[6] Today, Lyme disease accounts for the majority of all tick-borne illnesses in the US.[14]

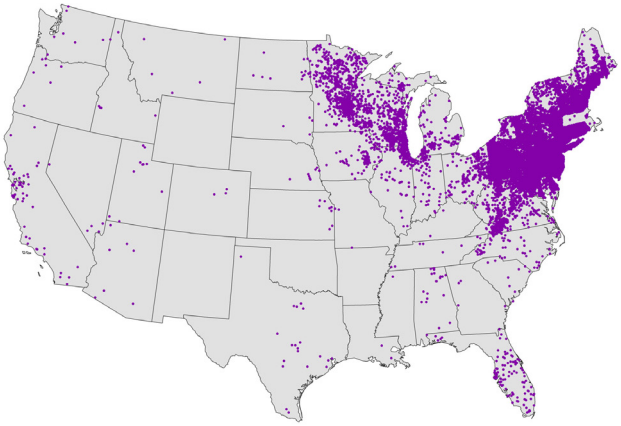
While *B burgdorferi* is the primary pathogen that causes Lyme disease in the US, *B mayonii* has also been isolated in the upper Midwest. Transmission occurs through the bite of a harboring tick (*I scapularis* in the east and *I pacificus* along the Pacific coast).[15] The CDC estimates that approximately 30% of *Ixodes* ticks carry *B burgdorferi*, though the percentage varies from 1% to 50% depending on geographic location and concentration of tick life stage.[16] The relatively small size of blacklegged ticks, especially in the nymphal stage, makes detection difficult, and thus nymphal ticks are more likely to transmit disease.

Lyme disease has been reported in all 50 states; however, in areas without *Ixodes* ticks, the disease is attributed to host travel from an endemic area. Currently, 95% of Lyme cases are found in 14 states, all in the northeastern and upper Midwest.[12,17] The highest percentage of *Ixodes* ticks carrying Lyme disease are found in New England, with studies finding that 35.7% of ticks in Connecticut[18] and 29.6% of ticks in Massachusetts[19] were carrying *B burgdorferi*. Although *Ixodes* ticks are also endemic to the southern US, there is a low prevalence of disease in this region. At the present time, it is rare for ticks there to carry

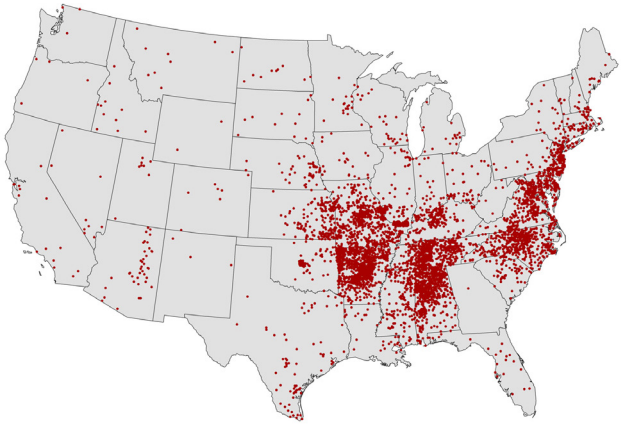
Figure 1. Geographic Distribution of Selected Tick Species in the United States

United States Centers for Disease Control and Prevention. Available at: https://www.cdc.gov/ticks/geographic_distribution.html

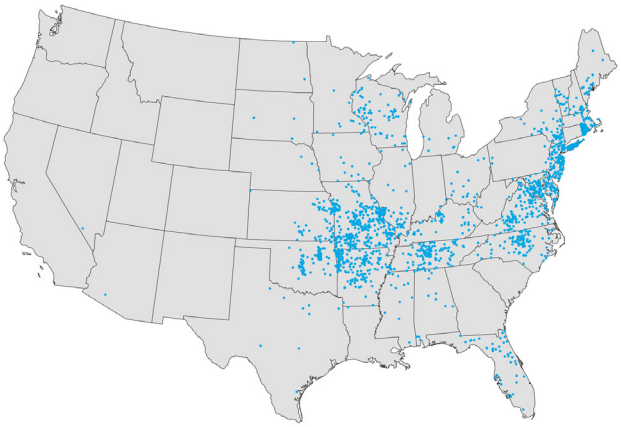
Figure 2. Geographic Distribution of Key Tick-Borne Diseases in the United States in 2018



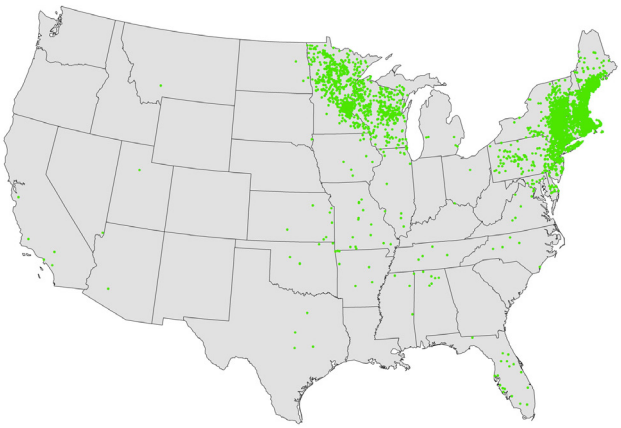
Lyme Disease[a]



Spotted Fever Rickettsiosis
(Including Rocky Mountain Spotted Fever)

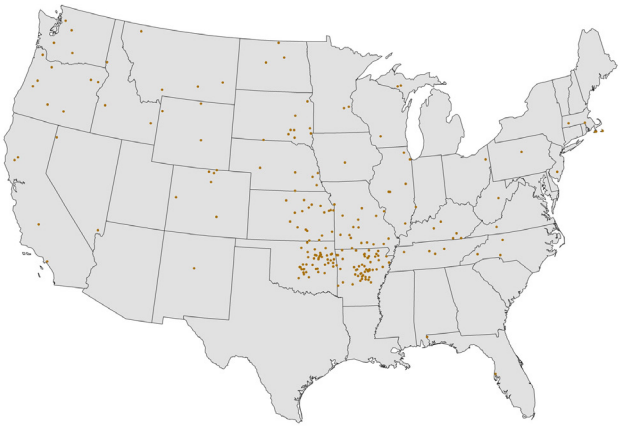


Ehrlichiosis



Anaplasmosis

Babesiosis



Tularemia

[a]Changes in state surveillance practices have decreased cases reported by Massachusetts in recent years; Lyme disease remains common in the state. United States Centers for Disease Control and Prevention. Available at: https://www.cdc.gov/ticks/tickbornediseases/overview.html

the *B burgdorferi* pathogen. A 2018 study suggested that the natural hosts of *Ixodes* ticks may play a role in this distribution, as southern *Ixodes* ticks primarily feed on reptiles, whereas ticks in areas of high Lyme prevalence feed primarily on mammals.[20] However, there has been marked geographic expansion of Lyme disease recently, including southward expansion down the Appalachian Mountains into North Carolina, as well as west into Ohio and Indiana. **(See Figure 4, page 10.)**

The true incidence and prevalence of Lyme disease in the US is highly debated and likely underreported. There are approximately 50,000 reported cases each year, but insurance claim data suggest up to 476,000 cases a year. Reported case figures may underestimate the true number of infections because suspected cases are often treated without confirmatory testing performed. Likewise, insurance claim data may overestimate the true number of infections because patients treated for Lyme disease may not have actually been infected. Regardless, Lyme disease represents a significant disease burden.[12,17]

Figure 3. Geographical Risk for Tick-Borne Illness in the Contiguous United States[a]

Abbreviations: RMSF, Rocky Mountain spotted fever; STARI, southern tick-associated rash illness.

[a]This map represents areas with the highest incidence of selected tick-borne illness, but tick-borne illness is not limited to geographical boundaries.

Early Signs and Symptoms

The hallmark symptom of Lyme disease is erythema migrans, a rapidly expanding rash that presents 3 to 30 days after the initial bite (7 days on average).[21] The classic description of erythema migrans is an erythematous "bull's-eye" rash with central clearing. It may be warm to touch but is rarely itchy or painful. The rash is typically >5 cm in diameter with a median diameter of 10 to 16 cm.[22] Unfortunately, this is not something for a clinician to consistently rely on, as rash may be absent in 30% of cases and atypical rash is frequent.[23] Systemic symptoms of early Lyme disease may include fever, chills, headaches, fatigue, muscle and joint aches, and lymphadenopathy.[24]

Late Signs and Symptoms

If left untreated, Lyme disease may progress to neurologic, cardiac, or rheumatologic disease. Neurologic Lyme disease can manifest as Bell palsy, meningitis, or radiculoneuropathy.[25] Lyme carditis occurs in approximately 1 of 100 cases of Lyme disease that are reported to CDC and can manifest as heart block or other unexplained cardiac symptoms.[26,27] Rheumatologic manifestations, which are reported in 1 of 4 cases of Lyme disease, largely present as arthritic changes with swelling and pain in one or more joints.[28]

Southern Tick-Associated Rash Illness

Southern tick-associated rash illness (STARI), which is seen following bites of the lone star tick, features a rash similar to that seen in Lyme disease. The etiology of STARI is currently unknown.[29]

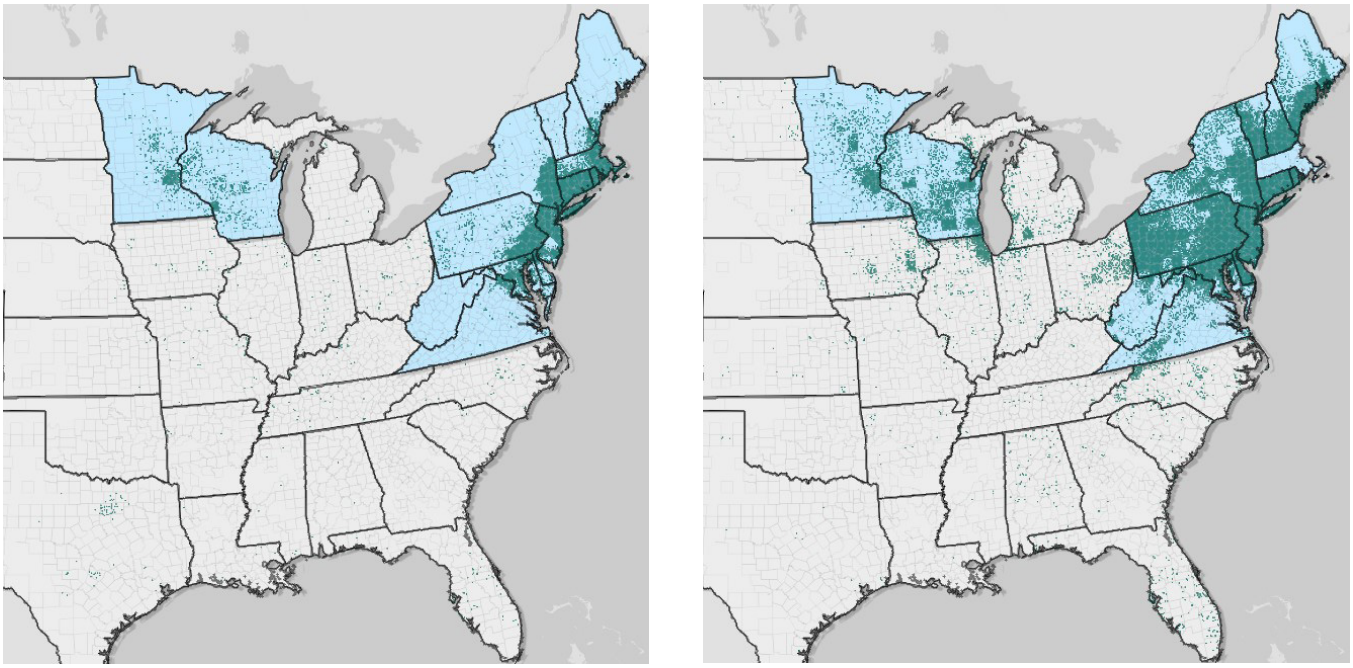
Rocky Mountain Spotted Fever

RMSF was the first tick-borne illness identified in the US. In the late 19th century, settlers in western Montana reported a deadly disease of unknown origin. First called "black measles," the disease was characterized by a severe, dark rash and had an 80% fatality rate. Although local folklore attributed the disease to drinking melted snow water during the spring runoff, Dr. Howard Ricketts, a pathologist at the University of Chicago, demonstrated in 1906 that the illness was transmissible. Ricketts found that the causal organism (later named *Rickettsia rickettsii*) was carried by the Rocky Mountain wood tick, and RMSF was officially identified.[30] RMSF was the most commonly identified tick-borne illness in the US until it was surpassed by Lyme disease in the 1980s.[31]

Due to its fatality rate, which is the highest among all tick-borne illnesses, RMSF is the most significant illness of a subset of illnesses known as spotted fever rickettsiosis. Currently, the case fatality rate of RMSF in the US ranges from 5% to 10%, with higher fatality rates seen in children aged <10 years.[32]

Transmission of RMSF occurs through a bite from an American dog tick in the eastern, central, and western US; a Rocky Mountain wood tick in the Rocky Mountain states; and a brown dog tick in the southwestern US. While RMSF is found throughout most

Figure 4. Reported Cases of Lyme Disease in 2001 Versus 2019[a]



2001 2019[b]

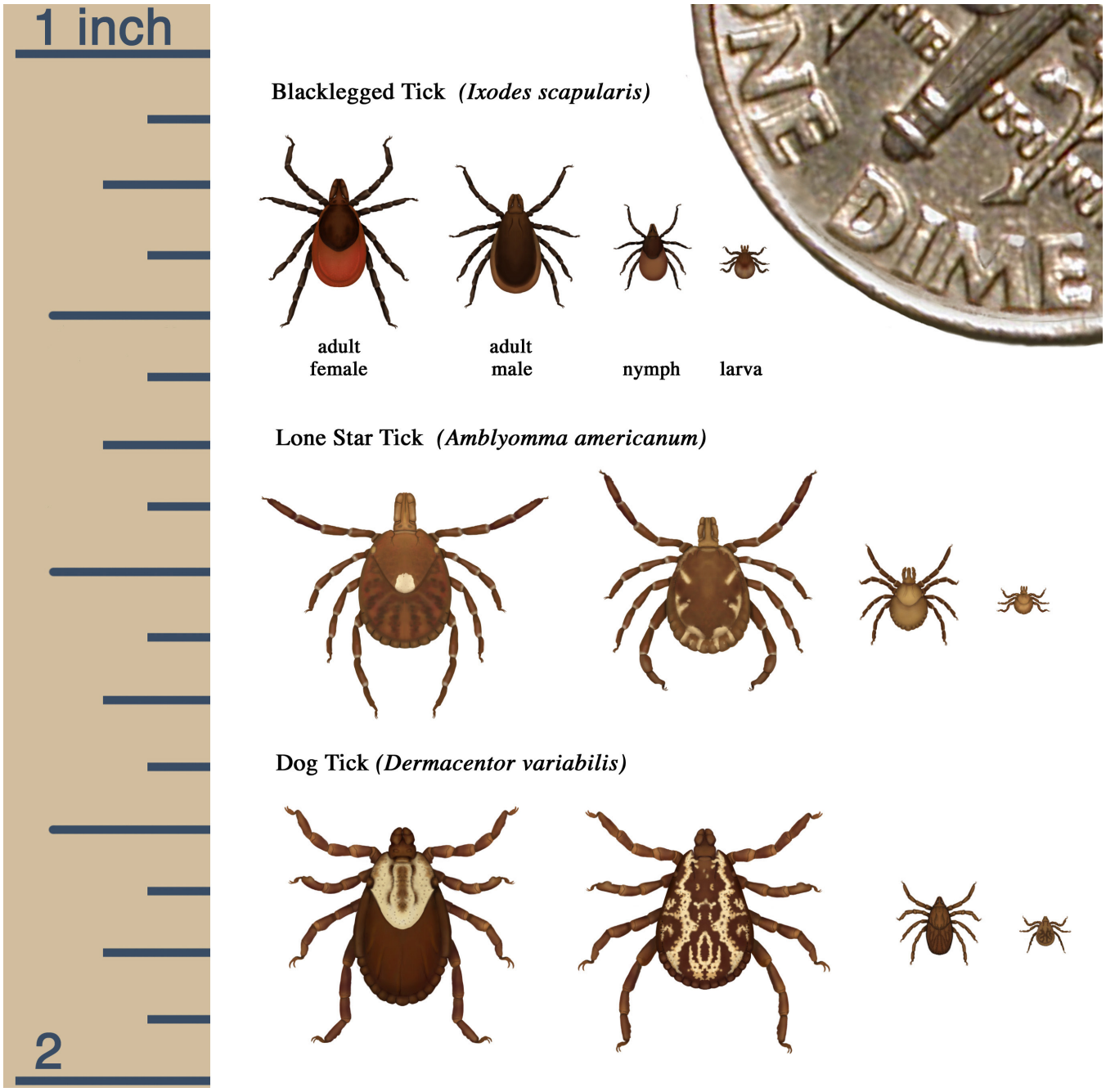
Note the significant westward and southern expansion of cases. Blue indicates high-incidence states for Lyme disease.
[a]Due to the COVID-19 pandemic, 2019 data from some jurisdictions may be incomplete.
[b]Changes in state surveillance practices have decreased cases reported by Massachusetts in recent years; Lyme disease remains common in the state.
United States Centers for Disease Control and Prevention. Available at: https://www.cdc.gov/lyme/datasurveillance/lyme-disease-maps.html

of the contiguous US, just 5 states (North Carolina, Oklahoma, Arkansas, Tennessee, and Missouri) account for >60% of cases.[32] More recently, RMSF cases have been reported in Arizona due to dog ticks.[33]

As with Lyme disease, early symptoms of RMSF are nonspecific and may mimic viral infections. Symptoms include fever, headaches, myalgias, malaise, and gastrointestinal symptoms such as nausea, vomiting, and anorexia. These symptoms are often severe (eg, high fever and headaches). Early rash due to small vessel vasculitis typically occurs 2 to 5 days after onset of symptoms and is characterized by small, flat, pink, nonitchy macules on the wrists, forearms, and ankles that then spread to the trunk, palms, and soles. Rash should not be used alone to make a decision to initiate treatment. While 90% of patients will eventually develop a rash, up to 50% of patients will have delayed onset. A delay in initiation of treatment has been shown to have worse outcomes.[34]

Late rash is considered after at least 6 days from onset of symptoms and is petechial in nature. Petechial rash is a sign of progression to severe disease. If

Figure 5. Relative Sizes Across Life Stages of Selected Tick Species



United States Centers for Disease Control and Prevention. Available at: https://www.cdc.gov/ticks/gallery/index.html

untreated, symptoms can progress to altered mental status, coma, cerebral edema, respiratory compromise, liver failure, sepsis, and shock.[35-38]

Rickettsia parkeri Rickettsiosis

Rickettsia parkeri is closely related to *R rickettsii*, the causative agent of RMSF. *R parkeri* rickettsiosis is associated with the appearance of an inoculation eschar at the site of the tick bite, which is not typically seen with RMSF. **(See Figure 6.)** Although treatment for *R parkeri* rickettsiosis is the same as for RMSF, it is generally a mild and self-limited disease in comparison.[39]

Ehrlichiosis

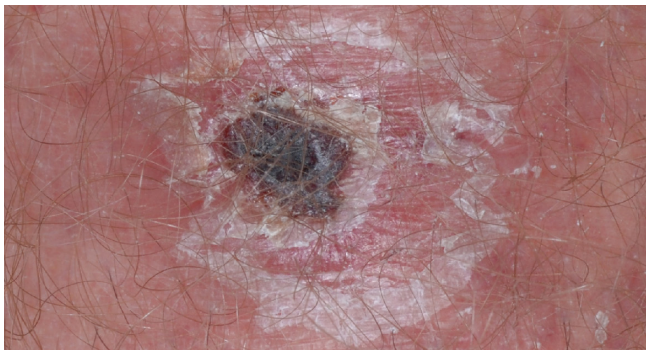
Ehrlichiosis is an infection caused by *Ehrlichia chaffeensis, E ewingii*, and *E muris eauclairensis*. The lone star tick is the main carrier of *E chaffeensis* and *E ewingii*, while *Ixodes* ticks carry *E muris eauclairensis*. Because of this, geographic distribution of disease tends to correspond with the distribution of tick species. In 2019, 4 states (Missouri, Arkansas, North Carolina, and New York) accounted for nearly half of the cases of ehrlichiosis.[40]

The incubation period for ehrlichiosis is 5 to 14 days and the initial presentation is nonspecific. Symptoms include fever, chills, headaches, malaise, myalgias, and gastrointestinal symptoms such as nausea, vomiting, and diarrhea. In severe cases, altered mental status, sepsis, and shock may occur. *E chaffeensis*, in particular, has been associated with fatal illness, though case fatality rates are lower than with RMSF. Patients who are most susceptible to severe disease are the elderly, the immunocompromised, and children.[40,41]

Anaplasmosis

Previously called human granulocytic ehrlichiosis, anaplasmosis is caused by an obligate intracellular bacterium (*A phagocytophilum*) that lives primarily in granulocytes and is transmitted via *Ixodes* ticks. Fatality is rare, but delayed treatment may cause significant morbidity as late disease initiates a severe systemic inflammatory response.[42]

Figure 6. Eschar Seen at the Site of a Tick Bite Associated With *Rickettsia parkeri* Infection



United States Centers for Disease Control and Prevention. Available at: https://www.cdc.gov/mmwr/volumes/68/wr/mm685152a2.htm

Babesiosis

Babesiosis is caused by an intraerythrocytic parasite, *Babesia*, that infects the red blood cells of the host. Transmission occurs via the *Ixodes* species, so there is geographic overlap with Lyme disease; in fact, up to 20% of patients with babesiosis may be coinfected with Lyme disease. Clinical presentation can be highly variable. Approximately 20% of adults and 50% of children with babesiosis are asymptomatic; however, the disease was nicknamed the "malaria of Long Island" due to its association with prolonged fevers, weight loss, chills, headaches, sweats, and myalgias. Because *Babesia* infects red blood cells, the infection can also be acquired through blood transfusion or transplacental transmission. Infection with babesiosis increases the risk of anemia, splenic rupture, and the pathology associated with hemolysis. Patients who are immunodeficient (particularly asplenic patients) and older patients are most likely to suffer from severe symptoms. In severe disease, a mortality rate of up to 20% has been reported.[43]

Tick-Borne Relapsing Fever

Tick-borne relapsing fever (TBRF) is transmitted by soft ticks of the genus *Ornithodoros*. Soft tick bites generally are brief and soft ticks live in rodent burrows. Symptoms are characterized by recurring and relapsing bouts of fever, headaches, myalgias, joint aches, and nausea. **(See Figure 7, page 13.)** This mainly occurs in the western US and is associated with sleeping in rustic, rodent-infested cabins in the mountains. It is also associated with cave exposures, especially in the southwestern regions of the US.[44,45]

Borrelia miyamotoi is another pathogen that causes relapsing fever, transmitted by *Ixodes* species, thus there is overlay with the geographical distribution of Lyme disease.

Tularemia

Tularemia is an infection caused by the bacterium *Francisella tularensis*. Tularemia can be transmitted by direct contact with an infected animal, inhalation of dust containing the bacterium, and by tick or deer fly bites. Ticks that transmit *F tularensis* bacteria to humans include the dog tick, Rocky Mountain wood tick, and lone star tick.

There are many forms of tularemia, including ulceroglandular, glandular, oculoglandular, oropharyngeal, and pneumonic, although tick bites primarily cause ulceroglandular and glandular disease. Ulceroglandular disease is the most common form of tularemia associated with a tick bite and is characterized by ulceration at the site of the bite; swollen

lymph nodes; and systemic symptoms including fever, chills, body aches, and malaise. Glandular tularemia is similar to ulceroglandular disease, except an ulceration is not present. Tularemia is a rare disease, with approximately 250 cases reported annually,[46] but its symptoms can be severe and fatal.

Viral Tick-borne Illnesses

While relatively uncommon, viral tick-borne illnesses include Powassan disease, Colorado tick fever, Heartland virus, and Bourbon virus. Symptoms are usually nonspecific and may include headaches, myalgias, fever, chills, and fatigue. Many patients will have no or mild symptoms. In severe cases, however, illness may progress to encephalitis and meningitis.[47]

Noninfectious Pathologies

Noninfectious tick pathologies also exist and are caused by toxins in or an allergic reaction to the saliva of various ticks. Although rare, tick paralysis is the most dangerous noninfectious tick-related process. The exact mechanism is largely unknown at this time, but animal studies suggest tick saliva may contain a toxin that causes acetylcholine release in levels that cause neurotoxicity and an ascending flaccid paralysis. Removal of the tick leads to resolution of symptoms.[48]

Alpha-gal syndrome, also a noninfectious but potentially life-threatening process, is an allergic reaction attributed to the bite of the lone star tick. The exact mechanism is unknown; however, subsequent exposure to foods containing the carbohydrate galactose-alpha-1,3 galactose found in mammalian meat leads to a hypersensitivity reaction that can include rash, gastrointestinal upset, and anaphylaxis.[49]

Significant Tick-borne Illnesses Outside the United States

African tick bite fever is the most commonly diagnosed rickettsial disease among international travelers returning to the US. Symptoms are nonspecific and life-threatening complications are rare.[50]

Tick-borne encephalitis (TBE), which is endemic in focal areas of Europe and Asia but not in the US, can result in severe disease.[51] From 2010 through 2020, 6 cases of TBE among US civilian travelers to Europe and Russia were reported.[52] TBE is transmitted through the bite of infected *I ricinus* (castor bean tick or deer tick) or *I persulcatus* ticks. In 2021, a TBE vaccine was approved for individuals aged ≥1 year; however, this is only recommended for people traveling or moving to a TBE-endemic territory who might be exposed to outdoor areas with high concentrations of ticks.[53] A vaccine for TBE (TicoVac™) is available in the US.

■ Differential Diagnosis

Rash at the Site of the Tick Bite

In urgent care, the initial presentation for ticks and tick-borne illness may be a tick bite (confirmed or suspected, with or without the tick present) and rash. Although not always present, a characteristic rash is associated with several of the tick-borne illnesses and can offer the clinician early diagnostic clues.

Patients' first tendency is to assume the development of a rash indicates Lyme disease, so they come to urgent care requesting testing and treatment. However, tick bite is just one of many possible explanations for a rash. The most common differential diagnoses when considering a rash present at the site of a tick bite include local hypersensitivity reaction, cellulitis, abscess, and of course, erythema migrans. The onset and associated symptoms of these differential diagnoses vary subtly. **(See Table 2, page 14.)** Other less common differential diagnoses may include eczema, granuloma annulare, plant dermatitis, tinea corporis (ringworm), and skin contusion.[54]

The rash associated with STARI can be very similar to—and difficult to distinguish from—erythema migrans.[55] Because the underlying tick vector is different, the geographic location can help with differentiation. For example, if a patient presents with a rash concerning for STARI or Lyme disease in the Deep South, where the lone star tick is prevalent and Lyme disease is rare, STARI is more likely. If a patient reports a similar rash in a Lyme-endemic area, erythema migrans should be more strongly consid-

Figure 7. Timeline for Tick-Borne Relapsing Fever

United States Centers for Disease Control and Prevention. Available at: https://www.cdc.gov/relapsing-fever/symptoms/index.html

ered. In a study that compared physical examination findings from STARI patients in Missouri with Lyme disease patients in New York,[56] several key differences were noted:

- Patients with STARI were more likely to recall a tick bite than were patients with Lyme disease.
- The time from tick bite to onset of a skin lesion was shorter among patients with STARI (6 days, on average).
- STARI patients with a rash were less likely to have other symptoms than were Lyme disease patients with a rash.
- STARI patients were less likely to have multiple skin lesions, had lesions that were smaller in size than Lyme disease lesions (6-10 cm in STARI vs 6-28 cm in Lyme disease), and had lesions that were more circular in shape with more central clearing.
- After antibiotic treatment, STARI patients recovered more rapidly than did Lyme disease patients.

Table 2. Differential for Rash at the Site of a Tick Bite

Presentation	Time of Onset	Symptoms	Appearance
Local hypersensitivity reaction	Minutes to hours	• Redness • Warmth • Itching	 A
Cellulitis	Hours to days	• Redness • Warmth • Tenderness	 B
Abscess	Days	• Redness • Warmth • Tenderness • Fluctuance	 C
Erythema migrans/STARI	3-30 days	Usually asymptomatic, but there may be associated itching and/or a central clearing Consider patient's geographical location or recent travel when determining diagnosis	 D

Abbreviation: STARI, southern tick-associated rash illness.
Image A source: Tomfy, CC BY 3.0, via Wikimedia Commons.
Image B source: RafaelLopez at the English-language Wikipedia, CC BY-SA 3.0, via Wikimedia Commons.
Image C source: US Centers for Disease Control and Prevention/Brune Coignard, MD; Jeff Hageman, MHS. Available at: https://phil.cdc.gov/Details.aspx?pid=7826
Image D source: Hannah Garrison, CC BY-SA 2.5, via Wikimedia Commons.

Systemic Symptoms

Early symptoms of tick-borne illnesses are nonspecific and can be difficult to distinguish from a variety of other diseases, such as viral syndromes. Clinicians need to maintain a high index of suspicion in order to make an early diagnosis and initiate appropriate treatment. **Table 3** lists differential diagnoses of the most common tick-borne illnesses.

Several of the tick-borne illnesses initially present with fever and systemic rash. Eighty percent of patients with Lyme disease present with a solitary erythema migrans lesion (early localized disease); however, almost 50% of those patients advance to multiple lesions (early disseminated disease). Systemic rash is also frequently seen in RMSF (90% of cases, though <50% of patients have a rash during the first 3 days of illness) and ehrlichiosis (up to 60% of children, <30% of adults) as well. Because rash is rarely seen in anaplasmosis (<10%) and babesiosis (≤12% of hospitalized patients), if present, alternative diagnoses or coinfection should be considered.[57,58]

Many viral illnesses may also present with fever and rash, including Epstein-Barr virus, enterovirus infection, typhus, measles, viral hepatitis, coxsackievirus infections, erythema infectiosum, and varicella. Other pathologies associated with fever and rash include secondary syphilis, disseminated gonococcal infections, leptospirosis, typhus, and various hematological and vascular disorders.[59] Late manifestations of Lyme disease are particularly difficult to diagnose because the potential differential diagnoses are extensive.

Table 3. Differential Diagnosis of Tick-Borne Illnesses[60-66]

Tick-borne Illness	Differential Diagnoses
Rocky Mountain spotted fever	• Measles • Meningococcemia • Influenza • Enterovirus • Leptospirosis • Mononucleosis • Viral hepatitis • Typhoid fever • Idiopathic or thrombotic thrombocytopenia purpura • COVID-19 • Gastroenteritis[64]
Ehrlichiosis	• Thrombotic thrombocytopenia • Hematologic malignancy • Hepatitis A • Pneumonia • Other viral disease (eg, mononucleosis)
Babesiosis	• Malaria[65] • Drug reactions • Sickle cell crisis • Thrombotic thrombocytopenic purpura • Hemolytic uremic syndrome • Mononucleosis[61] • Malignancy
Lyme arthritis	• Septic arthritis[66] • Autoimmune diseases, including: ◦ Rheumatoid arthritis ◦ Reactive arthritis ◦ Scleroderma ◦ Ankylosing spondylitis
Lyme carditis	• Rheumatic fever • Viral myocarditis • Systemic lupus erythematosus • Bacterial endocarditis • Syphilis
Neurological Lyme disease	• Malignancy • Primary psychiatric disorders • Chronic fatigue syndrome • Myalgic encephalomyelitis • Fibromyalgia

■ Prevention

Before outdoor activities, it is recommended to treat clothing and gear with products containing the insecticide 0.5% permethrin. The use of US Environmental Protection Agency-registered repellents containing DEET, picaridin, IR3535, Oil of Lemon Eucalyptus, para-menthane-diol, or 2-undecanone can further reduce the risk of tick exposure. While outdoors, avoid wooded and brushy areas with high grass or leaf litter. After outdoor activities, a thorough tick check of clothing, gear, pets, and oneself should be performed. Showering within 2 hours of coming indoors has also been shown to reduce the risk of tick bites and tick-borne illness.[42,67]

■ Urgent Care Evaluation

History

Studies show that very few patients with tick-borne illness recall a tick bite, so the lack of a tick or a known tick bite should not eliminate consideration of tick-borne illness. This is especially important to keep in mind because it is rare to encounter a patient who is not at some level of risk for tick exposure. Common activities like yard work, gardening, or hiking put people in environments favored by ticks. Pets (eg, dogs and outdoor cats) can act as hosts for ticks. Occupation is also a factor, as outdoor workers including farmers, landscapers, and surveyors are at particularly high risk.[43,67]

The initial presentation of tick-borne illnesses is often nonspecific and difficult to distinguish from other disease processes. Common symptoms can include headaches, fever, myalgias, fatigue, and gastrointestinal symptoms such as nausea, vomiting, and diarrhea. There may also be a characteristic rash such as erythema migrans associated with Lyme disease,

or the "spotted rash" associated with RMSF. If the tick bite occurred in an area endemic for a specific tick-borne illness, the clinician should have a higher index of suspicion for that illness. Consider seasonal trends; for example, during periods of low prevalence of influenza-like illnesses, a higher index of suspicion for tick-borne illness is needed. A comprehensive travel history may help to identify patients who have been to a tick-endemic area.[43,67]

If a tick is present, it is important to consider these questions:

- What type of tick is it? Note that data from the University of Rhode Island's online tick identification program indicate that up to 83% of ticks are misidentified.[68]
- Did the bite occur in an area that is endemic for 1 or more tick-borne illnesses?
- How long was the tick attached, and is it engorged with blood? An engorged tick implies longer attachment.
- Can prophylactic treatment be initiated with 72 hours of tick removal?

Physical Examination

As always with any signs or symptoms of an emergent condition, prompt referral to the emergency department (ED) is vital.

A whole-body evaluation should be performed to look for embedded ticks. Ticks frequently are found in crevices and skin folds and can be easily missed. Careful attention should be paid to areas behind the knees, between the legs, around the waist, inside the belly button, under the arms, in and around the ears, and in and around hair. **(See Figure 8.)** Nymphal ticks are extremely small and can be easily missed or mistaken for a mole or skin lesion.[69,70] A chaperone should be utilized when performing a whole-body examination.

If a rash is present, a detailed description of the rash, including the location, appearance, and the timeline, may help to differentiate between tick-borne and other diseases. Fever without an obvious explanation, such as upper respiratory symptoms or urinary tract symptoms, should raise the suspicion of a tick-borne illness. In late-stage RMSF, ehrlichiosis, and anaplasmosis, vascular collapse and disseminated intravascular coagulation may be present. Patients may appear to be in shock, develop petechiae and purpura, and have hematuria or rectal bleeding. Late-stage Lyme disease may present with a variety of systemic symptoms including swollen joints (Lyme arthritis); Bell palsy (neurological Lyme); or heart block, pericarditis, myocarditis, or valvular heart disease (Lyme carditis).[42]

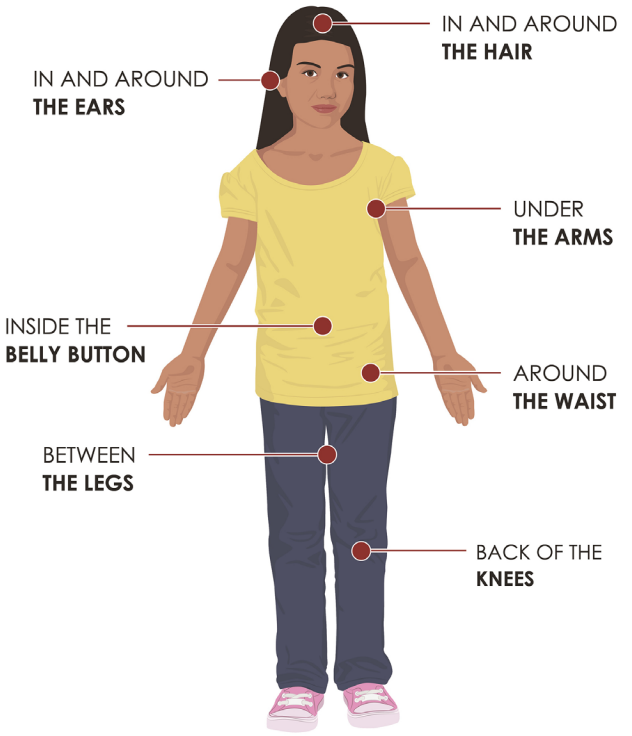
Attached Tick

If a tick is found on examination, prompt and proper removal is advised. Avoid "home remedies" such as burning the tick with a match, applying a heat source, or coating the tick with petroleum jelly or noxious chemicals to coax it to detach. Gently grasp the tick as close to the skin as possible. Take care to avoid squeezing the tick. Apply consistent, upward pressure (ie, do not twist) to tent the skin, and the tick will detach. Wash the affected area thoroughly with soap and water.[71,72] **(See Figure 9, page 17.)** Dispose of the tick by drowning it in alcohol, flushing it down the toilet, or wrapping it in adhesive tape. Do not squeeze or crush the tick in your fingers as this may spread disease. A variety of commercial products are marketed as "tick removal" devices, but forceps or a hemostat can suffice. If there is a retained tick part that you are unable to easily remove, no further action is recommended, as risk of tick-borne disease is extremely low in this case but risk for development of infection increases with manipulation of the area.

■ Diagnostic Studies

Many tick-borne illnesses can be diagnosed based on clinical signs and symptoms alone. General laboratory testing is often of limited diagnostic use, especially early in disease, as initial findings are usually normal or nonspecific. Tick-specific tests are relatively expensive, need to be sent out to a reference labora-

Figure 8. Common Tick Locations on the Human Body



United States Centers for Disease Control and Prevention. Available at: https://www.cdc.gov/ticks/avoid/on_people.html

tory, generally take several days to report, and can be tricky to interpret. Misinterpretation of test results has been shown to occur in >65% of cases[1] and may lead to unnecessary treatment and costs.[67,73]

Tick Testing

Patients may bring a tick to the urgent care clinic and request to have it tested for disease. Although there are commercial entities that offer tick testing, the Infectious Diseases Society of America (IDSA), recommends against this, primarily because the presence or absence of disease in the tick does not reliably predict the likelihood of clinical infection. A positive result showing that the tick contains a disease-causing organism does not mean that the patient has become infected, while a negative result does not exclude infection and may lead to a false sense of assurance.[67]

General Laboratory Testing

General laboratory tests such as complete blood count, electrolytes, liver enzymes, etc, are usually normal in early tick-borne disease, and any abnormalities are nonspecific. Abnormalities seen in ehrlichiosis and anaplasmosis may include leukopenia, thrombocytopenia, and mild-to-moderate elevated liver enzymes (seen in up to 70% of anaplasmosis cases). Nonspecific laboratory abnormalities in babesiosis include decreased white blood cell count, atypical lymphocytes, and elevated erythrocyte sedimentation rate and C-reactive protein. Lactate dehydrogenase and bilirubin may also be elevated due to intravascular hemolysis. As disease progresses, laboratory findings correlate with organ damage.[74-77]

Tick-Borne Illness–Specific Testing

Tests specific to tick-borne illnesses are either serological tests (indirect tests) or molecular tests (direct tests). Serological tests, also known as enzyme-linked immunosorbent assay (ELISA) or indirect fluorescent antibody (IFA) assay, measure antibody levels produced by the immune system in response to an infection. Molecular tests such as polymerase chain reaction (PCR) detect specific DNA sequences unique to the tick-borne pathogen of interest.

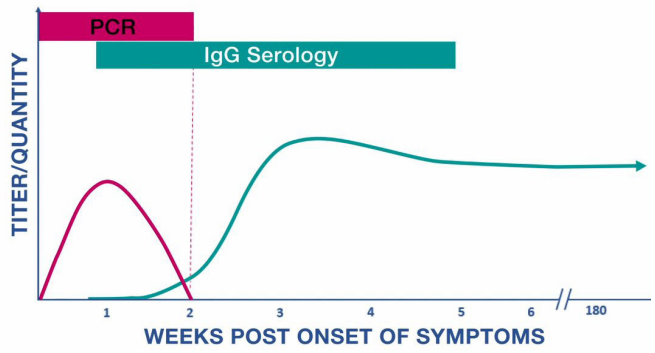
Because molecular tests detect DNA, they can be sensitive to infection even early in the course of disease.[78,79] Unfortunately, many tick-borne pathogens do not have sufficient circulating levels in the blood, therefore PCR cannot be used reliably to diagnose or exclude certain tick-borne illnesses.

Serological tests can be challenging to interpret. Antibodies take days to weeks to develop, and antibodies to tick-borne diseases in particular frequently cross-react with other viral, bacterial, and autoimmune antigens. Because of this, false positives may occur, and a single antibody test early in the disease course cannot reliably confirm or exclude infection. In addition, antibodies may persist for months to years after an initial infection, making a single positive test ineffective in determining if there is active or previous disease. **Figure 10** shows the timing windows for diagnostic PCR and IgG serologic assays in rickettsial disease.

Testing for Lyme Disease

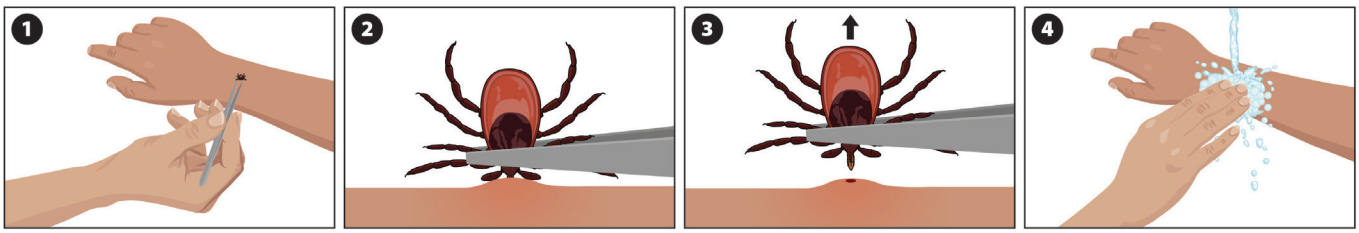
The diagnosis of Lyme disease can be made based on clinical findings alone. No routine testing is required, and it is recommended against if exposure to an Ixodes tick is unlikely (eg, without travel to or residence in a Lyme-endemic area). See the "Treatment—Antibiotic Prophylaxis After a Tick Bite" section on page 18 for the criteria for initiating prophylactic treatment for Lyme disease.

Figure 10. Timing of Diagnostic Assays in Rickettsial Disease



United States Centers for Disease Control and Prevention. Available at: https://www.cdc.gov/ehrlichiosis/healthcare-providers/diagnosis.html

Figure 9. Tick Removal Technique



United States Centers for Disease Control and Prevention. Available at: https://www.cdc.gov/ticks/gallery/

Testing for Lyme disease is complex, and interpretation is not straightforward. If testing is indicated, verify that the laboratory performing the testing is cleared by the US Food and Drug Administration.[80] The CDC and IDSA recommend a 2-step testing protocol that involves an immunoassay as the first test and, if equivocal or positive, reflexes to an immunoblot test. This is known as standard 2-tier testing (STTT). Modified 2-tier testing (MTTT) was adopted by the CDC in July 2019,[79-81] allowing for the second test to be an immunoassay. Both immunoassay tests may be performed on the same sample.

Because antibodies against Lyme disease can take several weeks to develop, if testing is performed <14 days from the onset of symptoms, false negative rates of 20% to 30% are reported. Therefore, repeat testing is advised after at least 14 days have elapsed. IgM testing is only of value if testing is performed <30 days from onset of symptoms, as it is only indicative of acute infection. As such, only IgG results should be used for interpretation if testing is performed ≥30 days from onset of symptoms. PCR tests are not currently recommended for the diagnosis of Lyme disease due to the poor sensitivity of blood tests for *Borrelia*.[79-81]

Testing for Lyme disease is not recommended to monitor response to treatment. Routine Lyme disease testing should also be avoided in the following clinical situations: screening in psychiatric illness, screening for developmental or behavioral disorders in children, and screening in patients with chronic cardiomyopathy.[67,80]

Testing for Rocky Mountain Spotted Fever

At this time, there is no diagnostic test for RMSF that can reliably diagnose the disease in time to prevent significant morbidity and mortality. Although a PCR test of whole blood is available, sensitivity is poor because *R rickettsii* invades endothelial cells and the antigen load in whole blood is low. If a PCR test is positive, it is diagnostic of RMSF. However, a negative PCR test does not rule out disease. For antigen testing, cross-reactivity is also extremely common, especially with IgM titers.[82,83] A 2019 study found that among Georgia blood donors, 11.1% demonstrated antibodies reactive with *R rickettsii* at titers ≥64. Only 28% of these patients met inclusion criteria for spotted fever rickettsiosis.[84] To absolutely confirm rickettsial disease via blood work, a 4-fold increase in antibody titers is required at 2 to 4 weeks apart.

Treatment of RMSF is most effective in preventing severe illness if initiated within the first 5 days of symptom onset; it is essential to initiate treatment within 8 days, as that is how quickly death can occur. **(See Table 4.)** Because of the limitations of RMSF testing and the risk associated with delay of treatment, clinicians should not rely on testing and instead should initiate empiric treatment immediately if RMSF is suspected.

Testing for Ehrlichiosis, Anaplasmosis, Babesiosis, and *Borrelia miyamotoi* Infections

If symptoms have been present for ≤10 days, PCR testing is preferred for these types of pathogens, as the sensitivity is higher. Still, a negative test does not rule out infection. In the setting of a negative PCR test, or if symptoms have been present >10 days (and especially if the patient is considered high risk), serological testing 2 to 4 weeks apart is recommended for confirmation of disease.[85-88]

Testing for Tularemia

Confirmatory testing for tularemia includes isolation of *F tularensis* from a clinical specimen such as a swab or sampling of ulcers, blood cultures, or seroconversion from negative to positive IgM and/or IgG antibodies in paired sera. Because *F tularensis* is slow-growing in nature, extended incubation periods may be needed.

Peripheral Blood Smears

Peripheral blood smears may be diagnostic in the following tick-borne illnesses: TBRF, babesiosis, ehrlichiosis, and anaplasmosis. A Wright-Giemsa stain will show intraerythrocytic rings, exoerythrocytic rings, and "Maltese crosses" in babesiosis, and is also the preferred stain to diagnose TBRF. Since findings require a high parasitic burden, sensitivity can be poor. In anaplasmosis and ehrlichiosis, morula will be visualized in neutrophils and monocytes respectively.[87]

Specialized Testing

Specialized testing is not applicable in the urgent care setting due to scope of practice limitations. Cultures and immunohistochemistry assays can be performed on biopsies of rashes or other skin lesions to confirm *R rickettsii*; however, these types of tests are only available at specialized laboratories.

Cerebral spinal fluid analysis is another specialized test to consider in patients who present with symptoms concerning for neurological Lyme disease.

Table 4. Laboratory Findings in Rocky Mountain Spotted Fever

Days 1-2
- Laboratory results (including white blood cell count, platelet count, and sodium level) are generally normal

Days 2-4
- Liver function tests are mildly elevated with mild thrombocytopenia
- White blood cell count is usually normal

Days 5-7
- Worsening thrombocytopenia, elevated liver function tests, and hyponatremia

Days 7-9
- Severe thrombocytopenia with elevated creatinine, creatine kinase, lactic acid, and white blood cell count

This is unnecessary to confirm Lyme meningitis, but can be utilized to rule out other disease processes such as bacterial meningitis.[88]

■ Treatment

In all cases, prompt referral to a specialist or the ED is indicated if there is evidence of advanced disease.

Antibiotic Prophylaxis After a Tick Bite

The benefits of antibiotic prophylaxis for Lyme disease outweigh the risks when the following conditions are met:

- The tick is identified as an *Ixodes* tick.
- The bite occurred in an area endemic for Lyme disease.
- The tick was attached for ≥36 hours.
- Prophylaxis can be initiated within 72 hours of tick removal.

If these criteria are met, a single 200 mg dose of doxycycline is recommended for prophylaxis in adults. A single 4.4 mg/kg dose of doxycycline is recommended for children of any age who weigh ≤45 kg. **(See Table 5, page 20.)** Of note, 36 hours is the established time needed to transmit disease; however, there is concern that transmission may occur earlier and this is the subject of ongoing research.[67]

Antibiotic prophylaxis is not recommended for any other type of tick bites or tick-borne illness. Tularemia prophylaxis is only recommended in cases of laboratory exposure and not due to a tick bite.

Lyme Disease Treatment

Early Localized Disease

Erythema migrans can be treated based on clinical findings alone. Treatment regimens include doxycycline, amoxicillin, or cefuroxime. **(See Table 5, page 20.)** When determining appropriate therapy, consider the patient's ability to avoid sun exposure, stage of disease, ease of dosing, and drug allergies. Alternative regimens include azithromycin and clarithromycin, but these should be avoided if possible due to higher efficacy of other agents.[67]

Early Disseminated and Late Disease

Although unlikely to be managed in an urgent care setting, it is good to be familiar with the treatment regimens for neurologic Lyme disease, Lyme carditis, and Lyme arthritis. Because treatment regimens may need to be adjusted depending on patient's age, history, and underlying health conditions, and because treatment varies based on the specific condition, specialty consultation is recommended.

For Lyme carditis, mild disease is treated with doxycycline, amoxicillin, or cefuroxime, whereas severe disease is treated with IV ceftriaxone. For neurologic Lyme disease, facial palsy is treated with doxycycline, whereas Lyme meningitis or radiculoneuritis are treated with doxycycline or IV ceftriaxone. For Lyme arthritis, the initial recommended course is doxycycline, amoxicillin, or cefuroxime, with IV ceftriaxone recommended if there is no response after the initial treatment course.[67] **(See Table 5, page 20.)**

Rocky Mountain Spotted Fever Treatment

The decision to initiate treatment for RMSF is often based upon clinical judgment alone as the disease can rarely be confirmed or disproved in its early phase. Doxycycline is the treatment of choice. **(See Table 5, page 20.)** If doxycycline is contraindicated, the clinician must weigh the risks and benefits of initiating therapy. Chloramphenicol was previously cited as an alternative treatment regimen; however, given lack of efficacy, poor outcomes, and minimal availability, it has fallen out of favor. Instead, rapid desensitization to doxycycline has been shown to be most successful.[89]

Ehrlichiosis and Anaplasmosis Treatment

Treatment should be initiated in all patients suspected of having ehrlichiosis or anaplasmosis. Doxycycline is the treatment of choice. **(See Table 5, page 21.)** In patients for whom doxycycline is contraindicated, a case of successful treatment with rifampin has been reported.[90] Some patients who present with subclinical illness can make a full recovery without treatment. Unlike Lyme disease, lack of treatment for ehrlichiosis or anaplasmosis has not shown to be linked to longer-term symptoms.[42]

Babesiosis Treatment

Treatment for babesiosis is indicated in patients who are symptomatic and have had infection confirmed with blood smear or PCR testing. Preferred treatment regimens consist of azithromycin plus atovaquone, or clindamycin plus quinine, both for 7 to 10 days. **(See Table 5, page 21.)** In otherwise healthy individuals with mild to moderate disease symptoms will begin to improve in as little as 48 hours and completely resolve in 1 to 2 weeks.[42,91] Monitor *Babesia* parasitemia during active disease with peripheral blood smears. Fatigue may persist for months after treatment, but by itself is not an indication for active monitoring. Immunocompromised patients may require longer treatment duration, and treatment decisions should be individualized with specialty consultation. Severe disease may require red blood cell exchange transfusion.

Tularemia Treatment

Because tularemia is a rare disease, consultation with an infectious disease specialist is advised for individual treatment decisions. For severe disease, streptomycin or gentamicin is advised. Other treatment options include ciprofloxacin and doxycycline. **(See Table 5, page 21.)**

Table 5. Recommended Treatment Regimens for Tick-Borne Illnesses[11]

Indication	Medication/ Intervention[a,b]	Adult Dosage	Pediatric Dosage	Route	Duration
Lyme Disease					
Prophylaxis[c]	Doxycycline[d]	200 mg once	≤45 kg = 4.4 mg/kg once (max 200 mg) >45 kg = adult dosing	PO	N/A
Early localized: Erythema migrans (first-line agents)	Doxycycline (preferred)	100 mg 2 times a day	4.4 mg/kg/day (max 100 mg/dose), divided into 2 doses	PO	10-14 days
	Amoxicillin	500 mg 3 times a day	50 mg/kg/day (max 500 mg/dose), divided into 3 doses	PO	14 days
	Cefuroxime	500 mg 2 times a day	30 mg/kg/day (max 500 mg/dose), divided into 2 doses	PO	14 days
Early localized: Erythema migrans (alternative agents if patient is unable to take a first-line agent)[e]	Azithromycin	500 mg 1 time a day	10 mg/kg/day (max 500 mg/dose)	PO	5-10 days
	Clarithromycin	500 mg 2 times a day	15 mg/kg/day (max 500 mg/dose)	PO	14-21 days
Early disseminated: Neurologic with facial palsy	Doxycycline	100 mg 2 times a day	4.4 mg/kg/day (max 100 mg/dose), divided into 2 doses	PO	14-21 days
Early disseminated: Neurologic with evidence of meningitis or radiculoneuritis	Doxycycline	100 mg 2 times a day	4.4 mg/kg/day (max 100 mg/dose), divided into 2 doses	PO	14 -21 days
	Ceftriaxone	2 g 1 time a day	50-75 mg/kg (max 2 g/dose)	IV	14-21 days
Early disseminated: Mild carditis (first-degree AV block with PR interval <300 ms)	Doxycycline	100 mg 2 times a day	4.4 mg/kg/day (max 100 mg/dose), divided into 2 doses	PO	14-21 days
	Amoxicillin	500 mg 3 times a day	50 mg/kg/day (max 500 mg/dose), divided into 2 doses	PO	14-21 days
	Cefuroxime	500 mg 2 times a day	30 mg/kg/day (max 500 mg/dose), divided into 2 doses	PO	14-21 days
Early disseminated: Severe carditis (symptomatic, first-degree AV block with PR interval ≥300 ms, second- or third-degree AV block)	Ceftriaxone	2 g 1 time a day	50-75 mg/kg (max 2 g/dose)	IV	14-21 days
Late: Arthritis (first-line agents)	Doxycycline	100 mg 2 times a day	Age >8 years: 4.4 mg/kg/day (max 100 mg/dose), divided into 2 doses	PO	28 days
	Amoxicillin	500 mg 3 times a day	50 mg/kg/day (max 500 mg/dose), divided into 3 doses	PO	28 days
	Cefuroxime	500 mg 2 times a day	30 mg/kg/day (max 500 mg/dose), divided into 2 doses	PO	28 days
Late: Arthritis—resistant disease (after oral antibiotics or recurrence after initial episode)	Ceftriaxone	2 g 1 time a day	50-75 mg/kg day (max 2 g/dose)	IV	14-28 days
Rocky Mountain Spotted Fever					
Recommended treatment	Doxycycline	100 mg 2 times a day	≤45 kg = 2.2 mg/kg/dose 2 times a day (max 200 mg/day) >45 kg = adult dosing	PO or IV	At least 3 days after fever subsides and there is clinical improvement, with a minimum duration of 5-7 days

Continued on page 21.

Abbreviations: AV, atrioventricular; IV, intravenous; N/A, not applicable; PO, by mouth.
[a]Unless otherwise specified, the medications listed are options for treatment, not to be used in combination.
[b]Unless otherwise specified, the medications listed are options for first-line treatments.
[c]Administer prophylaxis only if these criteria are met: (1) the tick is identified as an *Ixodes* tick; (2) the bite occurred in an area endemic for Lyme disease; (3) the tick was attached for >36 hours; and (4) prophylaxis can be initiated within 72 hours of tick removal.
[d]If patient is unable to take doxycycline, do not administer an alternative agent for prophylaxis.
[e]Less effective than first-line agents. Monitor closely to ensure resolution.

■ Special Considerations

Pregnancy and Breastfeeding

Tick-borne illness can lead to a variety of complications in pregnant patients, including miscarriage, preterm labor/delivery, and perinatal disease transmission. Pregnancy also presents the challenge of determining which treatment is appropriate for both the mother and the fetus. When there is a concern for Lyme disease in the setting of pregnancy, amoxicillin or cefuroxime are the preferred treatment agents, although doxycycline can be used if there is no other acceptable alternative. Doxycycline is preferred when rickettsial disease is of specific concern. Recent studies have shown the risk of adverse effects of doxycycline in pregnancy (including cosmetic staining of primary fetal dentition, enamel hypoplasia, and depression of fetal bone growth) to be extremely low, especially when compared to the potential risk for morbidity and mortality associated with tick-borne illness.[92,93]

Table 5. Recommended Treatment Regimens for Tick-Borne Illnesses[11] (Continued)

Indication	Medication/ Intervention[a,b]	Adult Dosage	Pediatric Dosage	Route	Duration
Ehrlichiosis and Anaplasmosis					
Recommended treatment	Doxycycline	100 mg 2 times a day	≤45 kg = 2.2 mg/kg/dose 2 times a day (max 200 mg/day) >45 kg = adult dosing	PO or IV	At least 3 days after fever subsides and there is clinical improvement, with a minimum duration of 5-7 days
Babesiosis					
First-line agents	Azithromycin **PLUS** Atovaquone[91]	Azithromycin 500-1000 mg once on day 1, then 250-1000 mg once a day on days 2-5 **PLUS** Atovaquone 750 mg 2 times a day	Azithromycin 10 mg/kg/day (max dose 1000 mg), once on day 1, then 5 mg/kg once a day on days 2-5 **PLUS** Atovaquone 20 mg/kg 2 times a day (max 750 mg/dose)	PO	7-10 days Treatment decisions should be individualized. Patients at risk for severe or relapsing infections may need longer durations.
Alternative agents	Clindamycin **PLUS** Quinine sulfate[91]	Clindamycin 600 mg 3 times a day **PLUS** Quinine sulfate 650 mg 3 times a day	Clindamycin 7-10 mg/kg every 6-8 hours (max 500 mg/dose) **PLUS** Quinine sulfate 8 mg/kg 3 times a day (max 650 mg/dose)	PO	7-10 days Treatment decisions should be individualized. Patients at risk for severe or relapsing infections may need longer durations.
Tularemia					
Severe infection	Gentamicin	5 mg/kg once a day, with desired peak serum levels of ≥5 mcg/mL	2.5 mg/kg 3 times a day; once daily dosing could be considered in consultation with a pediatrics infectious disease specialist and a pharmacist	IV or IM	Minimum of 10 days
	Streptomycin	10 mg/kg every 12 hours (max 2 g/day)	30-40 mg/kg per day in divided doses every 12 hours (max 2 g/day)	IM	7-10 days
Moderate disease	Ciprofloxacin	500 mg 2 times a day	15 mg/kg 2 times a day	PO	10-14 days
	Doxycycline	100 mg 2 times a day	Not recommended. Doxycycline use in children is associated with increased risk of treatment failure.	PO	14-21 days

Abbreviations: IM, intramuscular; IV, intravenous; PO, by mouth.
[a]Unless otherwise specified, the medications listed are options for treatment, not to be used in combination.
[b]Unless otherwise specified, the medications listed are options for first-line treatments.

Drug Allergies

Alternative therapies for treatment of Lyme disease in patients with drug allergies include azithromycin and clarithromycin. For RMSF, ehrlichiosis, and anaplasmosis, the only alternative agent cited is chloramphenicol; however, this drug has been associated with poorer outcomes, irreversible aplastic anemia (1 in 25,000-40,000 cases), and gray baby syndrome.[94] Because of this, combined with its lack of availability, chloramphenicol is rarely used in current practice.[94]

■ Controversies and Cutting Edge

Clinicians should be aware that significant controversy remains regarding the management of Lyme disease. While this article addresses the CDC and IDSA recommendations, other groups have issued alternative guidelines.

Lyme Disease Vaccination

While there is a Lyme vaccine available for canines, there is currently not a vaccine for humans. LYMERix®, the only previously marketed Lyme vaccine for human use, was discontinued by its manufacturer in 2002 due to insufficient consumer demand.[95] Clinical trials of new vaccines and monoclonal antibodies as pre-exposure prophylaxis for Lyme disease are currently underway. One vaccine candidate (VLA15) targets the outer surface protein A of *Borrelia*.[96]

Post-treatment Lyme Disease Syndrome

Post-treatment Lyme disease syndrome (PTLDS) is a condition that can affect up to 10% of patients who are diagnosed with Lyme disease. This is seen when a patient continues to have symptoms of pain, fatigue, and/or difficulty thinking ("brain fog") that lasts for more than 6 months despite completion of appropriate treatment. Some clinicians have used more lengthy courses of antibiotics for initial treatment, with the thought that the initial course of antibiotics may not completely clear the infection. However, studies funded by the US National Institutes of Health do not show improved long-term outcomes in patients who received longer courses of antibiotics versus placebo. Additionally, unnecessary antibiotic use has been associated with potentially serious complications, including *Clostridioides difficile* colitis, antibiotic-resistant infections, and allergic reactions.[97]

■ Disposition

Most patients seen in urgent care for a tick bite, with or without suspected tick-borne illness, can be discharged home with close follow-up. If empiric therapy against Lyme disease is not indicated, follow-up care is especially important so that any disease progression can be monitored and managed appropriately. Similarly, management should be deferred to primary care if there are any concerns for chronic illness, as more comprehensive testing can be performed and management can be monitored in the long term. If the clinician suspects advanced, complicated, or end-stage disease, especially if central nervous system symptoms are present, the patient should quickly be transferred to the ED for more in-depth evaluation, broader availability of treatment options, and the ability for close monitoring. RMSF in particular is associated with a high risk of clinical deterioration.[67]

Required Disease Reporting

Depending on the disease and region, suspected or confirmed tick-borne illness may be reportable to state or local health departments. Lyme disease has been a nationally notifiable condition in the US since 1991. Other tick-borne illnesses, such as spotted fever rickettsiosis, anaplasmosis, ehrlichiosis, babesiosis, and tularemia, are required to be reported in some states but not in others. Clinicians should contact their local or state health department regarding specific reporting requirements.[101]

KidBits: Tick-borne Illnesses in Children

Due to the nonspecific nature of tick-related illness, combined with decreased body awareness, tick bites and their associated symptoms can often be less conspicuous in children, and easier to overlook or attribute to an alternative diagnosis. This is important to remember, especially with rickettsial disease, because while children represent 6% of all reported cases of RMSF, they account for 22% of fatalities.[98] Children's style of play (outdoors, with pets, etc) may place them at increased risk for tick exposure. Because of this, familiarity with the pathophysiology of tick-borne disease is essential to making an accurate diagnosis and treatment plan. Preferred pediatric treatment regimens for Lyme disease include doxycycline, amoxicillin, or cefuroxime. Doxycycline is especially indicated if neurological symptoms are present. The preferred agent for treatment of RMSF, ehrlichiosis, and anaplasmosis in pediatric patients is also doxycycline. **(See Table 5, pages 20-21.)** As with pregnancy, the adverse effects of doxycycline in children (in particular, teeth staining) have been largely disproved in recent studies.[99,100]

Case Conclusions

CASE 1

For the 24-year-old man with erythema migrans...

You knew that early, localized Lyme disease can be presumed and treated based on clinical findings alone, and also remembered that only around 25% of patients with erythema migrans recall a tick bite. Although a tick bite was not reported or recalled by this patient, you determined that treatment for Lyme disease was indicated in this case because he presented with a rash consistent with erythema migrans in the setting of recent travel to an area endemic for Lyme disease, where he frequented the outdoors. You did not order any lab work because the criteria for testing were not met. Upon discharge, the patient was advised to monitor for symptoms of other tick-borne diseases, due to the risk of coinfections.

CASE 2

For the 54-year-old woman with an embedded tick on her abdomen...

You removed the tick using fine-tipped tweezers, then cleansed the wound. You consulted the IDSA guidelines on Lyme disease and confirmed that prophylaxis for Lyme disease is indicated only if the following criteria are met:

- The tick can be identified as an *Ixodes* tick.
- The tick bite occurred in an area endemic for Lyme disease.
- The tick was attached for ≥36 hours.
- Doxycycline can be started within 72 hours of removal of the tick.

The patient did not live in a Lyme-endemic area and denied recent travel. She did not know how long the tick had been attached, and it did not appear to be an *Ixodes* tick. Because the patient did not meet the criteria for prophylaxis, you did not initiate antibiotic therapy. You explained to her that a "wait-and-watch" approach was indicated and advised her to monitor and return for signs and symptoms of tick-borne illness, as well as signs and symptoms of local cellulitis or abscess.

CASE 3

For the 27-year-old woman seeking care for tick-borne illness after a positive test result...

You recalled that a single antibody test for RMSF cannot be utilized to make clinical decisions and therefore cannot be considered diagnostic. You also recalled that the CDC does not recommend the use of RMSF IgM titers for diagnostic purposes because of known high cross-reactivity. Because this patient's test was performed in early disease, it was most likely that the positive IgM result was a false-positive due to cross-reactivity with another antigen.

You advised the patient that repeat testing could be considered since 2 weeks had passed since the initial illness. You recalled that a 4-fold increase in IgG is required for confirmatory testing to be considered positive in the convalescence phase (ie, 2-4 weeks after initial presentation), a 4-fold increase in IgG is required. Since this criteria requires knowledge of the previous test result, you requested and obtained the records from her previous test. The results showed the following: RMSF IgM positive, RMSF IgG negative. Although she had not taken the prescribed antibiotics, as the patient's symptoms had completely resolved, you advised her that no further treatment was currently indicated.

Summary

Tick-borne illness has recently grown as a health threat in the US, currently accounting for the majority of vector-transmitted disease. Early diagnosis can be challenging, as symptoms are often nonspecific, a tick bite is not always recalled, and there is a lack of reliable testing early in the disease course. There are more than 20 known tick-borne illnesses in the US alone. Ninety-nine percent of cases of tick-borne illnesses are accounted for by Lyme disease (most common), RMSF (most fatal), ehrlichiosis, anaplasmosis, and babesiosis. There are also viral, parasitic, and noninfectious pathologies related to tick bites. Many tick-borne illnesses can be diagnosed based on clinical signs and symptoms alone. Laboratory testing is often of limited diagnostic use because initial findings are typically normal or nonspecific. Tick-specific tests are confirmatory rather than diagnostic and should not be relied upon to make management decisions in urgent care. Research is underway to develop new testing protocols, pathways, and technologies. Important factors used to help determine appropriate treatment include what type of tick was involved, the geographic location where the bite occurred, and how long the tick was attached. If indicated, doxycycline is the mainstay

of treatment regardless of which tick-borne illness is being targeted, even in pediatric patients. Most patients seen in urgent care for tick-related conditions are stable and can be discharged home.

■ Time- and Cost-Effective Strategies

- Among patients who present to urgent care with concern for tick-borne illness, Lyme disease is a frequent concern. Patients may request diagnostic testing for reassurance of the absence of disease. It is important to keep in mind that in most cases of Lyme disease, test results should not and ultimately do not change management. False-positive results can lead to undue stress and unnecessary treatment. Avoiding over-ordering of tests reduces costs, but also improves quality of management and prevents false alarm or false reassurance.
- Rather than ordering tests for all possible tick-borne diseases, the prevalence of local tick-borne illnesses should always be considered, and testing for specific tick-borne illnesses should be selected based on geographic considerations and patient risk.
- Though patients often bring ticks into the clinic, the tick should not be sent for testing but should only be used for visual identification of the tick species.
- The persistent duration of antibodies makes follow-up testing unnecessary to confirm resolution of illness. Rather, clinicians and patients can be assured if appropriate treatment was initiated in a timely manner.

Risk Management Pitfalls for Tick-Borne Illness in Urgent Care

1. **"My practice is not located in a Lyme disease-endemic area, so there's no way this patient has Lyme disease."** Although 95% of Lyme disease cases are reported in 14 states in the Northeast and upper Midwest regions of the US, the geographic footprint of Lyme disease is expanding. In states where Lyme disease is not endemic, positive cases are usually attributed to patient travel (eg, a backpacker in the Adirondack Mountains who returns home to San Diego after vacation). Clinicians should always obtain a complete travel history.

2. **"My patient told me she didn't have any tick bites, so I didn't consider tick-borne illness."** A significant number of patients do not recall a tick bite. Patients also may have the misperception that tick bites only occur in the woods and therefore overlook potential exposures in backyards, developed areas, etc.

3. **"I didn't start doxycycline in my 8-year-old patient because I was concerned about the effects on his teeth and bones."** Doxycycline is the first-line treatment for all suspected rickettsial infections in the pediatric population. Recent studies have shown no adverse effects when the antibiotic is used in short courses. Children are at higher risk for serious disease and death from tick-borne illnesses and prompt treatment is critical to minimize this risk.

4. **"My patient was diagnosed with babesiosis, but I didn't realize he also had Lyme disease."** Coinfections should always be considered, as tick species often can carry and transmit multiple diseases. *Ixodes* ticks are vectors for anaplasmosis, Lyme disease, babesiosis, Powassan disease, and *B miyamotoi* disease. Rash is infrequently seen with babesiosis, so if rash is also present, coinfection should strongly be considered.

5. **"I clinically diagnosed my patient with influenza. RMSF wasn't in my differential diagnosis."** The initial symptoms of spotted fever rickettsiosis are nonspecific and cannot be easily differentiated from viral illnesses such as influenza and COVID-19. Clinicians must maintain a high index of suspicion, especially if a patient presents with "flu-like" symptoms during the spring and summer months.

6. **"The tick serology test was negative, so I ruled out tick-borne illness."** Serology testing measures antibodies produced by the body in response to an illness, a process that takes a few days. If testing was performed too early in the disease course, antibodies would not be detectable. For this reason, a 4-fold increase in antibody titers is needed 2 to 4 weeks apart for laboratory confirmation of disease. In RMSF or ehrlichiosis, the disease can be fatal before laboratory confirmation is finalized.

5 Things That Will Change Your Practice

1. Many patients with tick-borne illness never report finding a tick.
2. Do not rely on serological tests to make a clinical decision or to initiate antibiotic treatment.
3. Doxycycline is the first-line antibiotic treatment for Lyme disease, RMSF, ehrlichiosis, and anaplasmosis in patients of all ages. Recent research shows no evidence of tooth staining when doxycycline is used in short courses in pediatric patients.
4. Prophylactic treatment is not needed for tick bites, except for prevention of Lyme disease transmission when the recommended criteria are met. See the "Treatment—Antibiotic Prophylaxis After a Tick Bite" section on page 19 for these criteria.
5. The presence of an erythema migrans rash in a patient at risk for Lyme disease is diagnostic and treatment should be initiated without testing.

■ Critical Appraisal of the Literature

A literature search was performed on PubMed using the search terms *tick-borne illness, Rocky Mountain spotted fever, ehrlichiosis, anaplasmosis, Lyme disease,* and *babesiosis*. Titles, abstracts, and full articles were reviewed for content. The National Guideline Clearinghouse was also searched using the terms *tick bites, tick-borne illness, Rocky Mountain spotted fever, ehrlichiosis, anaplasmosis, Lyme disease,* and *babesiosis*. Excluded articles included those that referenced tick-borne illnesses not endemic to the US. Important guidelines reviewed include those created by the IDSA, American Academy of Neurology, American College of Rheumatology, and the CDC. The literature was supplemented with a more recent National Center for Biotechnology Information/National Institutes of Health search on Lyme disease testing.

■ References

Evidence-based medicine requires a critical appraisal of the literature based upon study methodology and number of subjects. Not all references are equally robust. The findings of a large, prospective, randomized, and blinded trial should carry more weight than a case report.

To help the reader judge the strength of each reference, pertinent information about the study is included in bold type following the reference, where available. In addition, the most informative references cited in this paper, as determined by the authors, are noted by an asterisk (*) next to the number of the reference.

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By Bradley Laymon, PA-C, CPC, CEMC

Medical Decision Making

Documentation and coding for urgent care presentations of tick-borne illnesses are crucial to address the problems associated with these diseases. Accurate documentation helps to ensure proper reimbursement for the services rendered and can help prevent claim denials. Proper coding allows for tracking of the prevalence of tick-borne illnesses, which is critical for public health. In order to determine the correct evaluation and management (E/M) code for an encounter with a patient with a suspected or confirmed tick-borne illness, clinicians must consider the categories of Problems Addressed, Complexity of Data, and Risk of Morbidity and Mortality.

Problems Addressed

The level of Problems Addressed for a patient with a tick-borne illnesses will depend on the patient's presenting symptoms, the history and examination findings, and the presence of any comorbid conditions that increase the complexity of the patient encounter. Patients with tick-borne illnesses may present with nonspecific symptoms such as fever, headache, muscle aches, and rash. Any patient who meets the Systemic Inflammatory Response Syndrome (SIRS) criteria will satisfy the criteria for an "acute illness with systemic symptoms," which is Moderate, Level 4, in the category of Problems Addressed. A tool for assessing the SIRS criteria is available at https://www.mdcalc.com/calc/1096/sirs-sepsis-septic-shock-criteria In severe cases of tick-borne illness, patients may develop neurological symptoms such as confusion, seizures, and paralysis. For patients with underlying medical conditions (eg, immunocompromised conditions or a current diagnosis of cancer), a more complex and extensive examination may be required to properly diagnose and treat the issue.

Complexity of Data

Complexity of Data for a patient with a tick-borne illness will vary depending on the severity of the illness and the need for laboratory testing. If laboratory testing is indicated, the criteria may be met for Moderate, Level 4, in the category of Complexity of Data (eg, ordering 3 point-of-care and/or send-off lab tests). In some cases, the urgent care clinician might need to speak with an infectious disease specialist, which would meet the criteria for "discussion of management with an external physician or other qualified healthcare professional," which would also be Moderate, Level 4.

Risk of Morbidity and Mortality

The risk of morbidity and mortality is significant in patients with tick-borne illnesses, and proper management is essential to prevent complications. Clinicians must carefully evaluate a patient's risk level and the severity of their symptoms to determine the appropriate level of service required. If medication is prescribed (eg, an antibiotic), the level in the Risk category will be Moderate, Level 4. In some cases, patients with tick-borne illness may require hospitalization and aggressive treatment to manage the condition effectively. If the patient is unstable and EMS transport to the ED is required, the level would be High, Level 5.

Documentation

When billing for services rendered for patients with tick-borne illnesses, clinicians should ensure accurate documentation of the patient's symptoms, history and physical examination findings, any laboratory testing performed, and any medications that are administered or prescribed.

Summary

When selecting the appropriate E/M code for presentations of tick-borne illness, consider the criteria for each of categories that make up the elements of medical decision making. Accurate documentation and coding will ensure appropriate reimbursement for the services rendered, as well as allowing for tracking of the prevalence of tick-borne illnesses.

Coding Challenge: Determine the correct service code for an urgent care presentation of tick-borne illness at: https://foamed.ebmedicine.net/category/urgent-care/coding-challenge-uc/

Content on the FOAMed blog is not eligible for CME credit.

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■ CME Questions

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1. Which of the following tick-borne illnesses is caused by a viral pathogen?
a. Rocky Mountain spotted fever
b. Lyme disease
c. Powassan disease
d. Ehrlichiosis

2. Which of the following tick-borne illnesses is NOT endemic to the US?
a. Tick-borne encephalitis
b. Tick-borne relapsing fever
c. *Rickettsia parkeri* infection
d. *Borrelia miyamotoi* infection

3. Which of the following statements regarding tick behavior is INCORRECT?
a. Tick bites are most commonly reported in warmer months, especially in the late spring and summer.
b. Patients who spend time outdoors are at increased risk for tick bites.
c. Nymphal *Ixodes* ticks are easily missed because of their small size.
d. Ticks can fly from low-lying vegetation to intended hosts.

4. If prophylaxis for Lyme disease is indicated, what is the recommended treatment for an adult?
a. Doxycycline 100 mg orally 2 times a day for 10 days
b. Doxycycline 200 mg orally once
c. Amoxicillin 500 mg orally 3 times a day for 14 days
d. Cefuroxime 500 mg orally 2 times a day for 14 days

5. A 30-year-old woman presents to urgent care with fever of 39.5°C, headache, body aches, and nausea. She has recently been hiking in the Great Smoky Mountains National Park. You suspect Rocky Mountain spotted fever (RMSF). The patient does not have any known adverse drug reactions or allergies. The most appropriate next step in the management of this patient is to:
a. Order RMSF serology testing; initiate antibiotic treatment only if the test is positive.
b. Order blood an RMSF PCR test; initiate antibiotic treatment only if the test is positive.
c. Start doxycycline 100 mg orally 2 times a day for 10 to 14 days.
d. Start doxycycline 100 mg orally 2 times a day for at least 3 days after resolution of fever and clinical improvement, with a minimum course of treatment of 5 of 7 days.

6. Regarding the prevention of tick bites, all of the following statements are correct EXCEPT:
a. Effective vaccines are available in the US for Lyme disease.
b. Ticks found on the body should be removed immediately.
c. Prophylactic antibiotics are not necessary for rickettsial disease.
d. Pretreatment of clothing with an insecticide may minimize risk of tick attachment.

7. Which of the following techniques is appropriate when removing a tick?
a. Grasp the tick with a tweezer and apply gentle upward pressure until the tick detaches.
b. Apply petroleum jelly.
c. Use a heat source to coax out the tick.
d. Wait for the tick to detach on its own.

8. For which of the following diseases is doxycycline NOT first-line therapy?
a. Ehrlichiosis
b. Babesiosis
c. Rocky Mountain spotted fever
d. Anaplasmosis

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