



Missouri Telehealth Network

University of Missouri

— Show-Me ECHO —

Tickborne diseases

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Conflicts of Interest

- Moderna COVID-19 vaccine trial



- Review epidemiology of tick-borne infections endemic to MO
- Discuss presentation, diagnosis and management of these infections
- Preventing tick bites and precautions after tick bites



TICKBORNE DISEASES OF THE UNITED STATES

A Reference Manual for Healthcare Providers

Sixth Edition, 2022



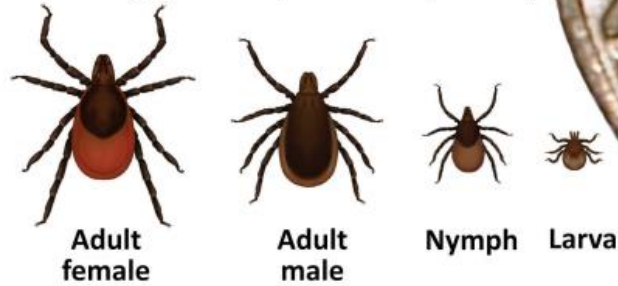
U.S. Department of
Health and Human Services
Centers for Disease
Control and Prevention

Missouri Telehealth Network

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<https://www.cdc.gov/ticks/tickbornediseases/TickborneDiseases-P.pdf>

Blacklegged Tick (*Ixodes scapularis*)



Lone Star Tick (*Amblyomma americanum*)



American Dog Tick (*Dermacentor variabilis*)



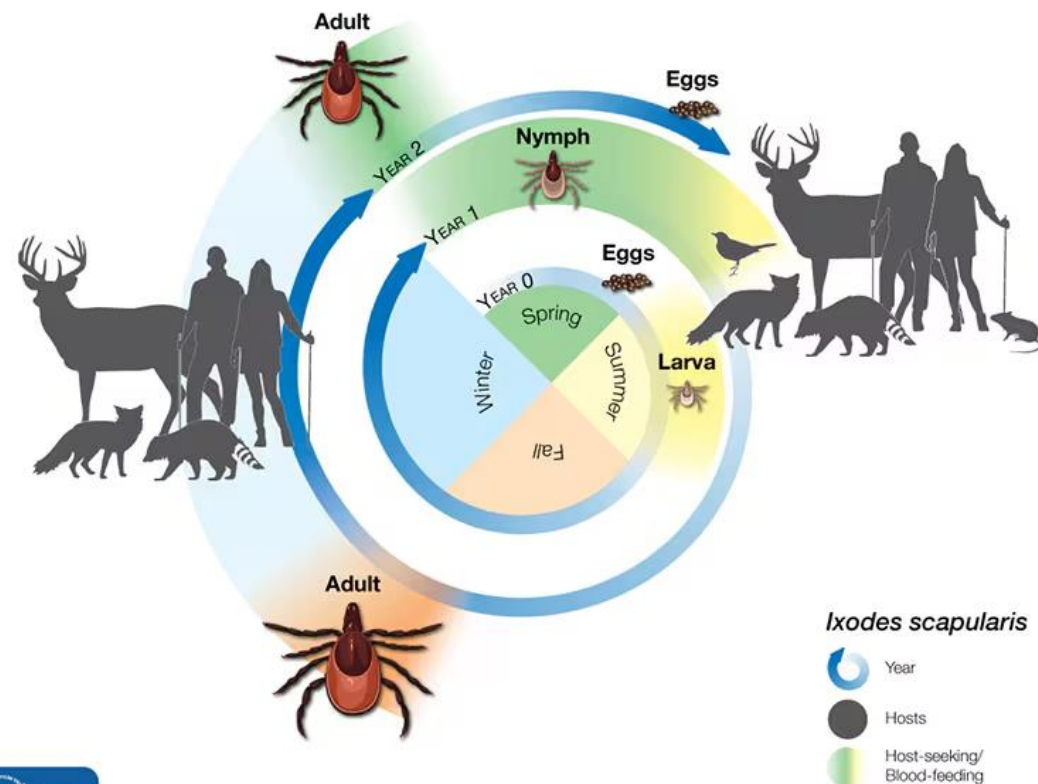
Engorged female *Ixodes scapularis* tick. Color may vary.



Tick Lifecycles

KEY POINTS

- Most ticks go through four life stages: egg, six-legged larva, eight-legged nymph, and adult. After hatching from the eggs, ticks must eat blood at every stage to survive.
- Ticks usually acquire pathogens early in their life (larval or nymphal stages) when they feed on animals. They transmit those pathogens to other animals or to people later in their life (nymphal or adult stages).





TICK ID



BLACKLEGGED TICK *Ixodes scapularis*

WHERE FOUND Widely distributed across the eastern United States.

TRANSMITS *Borrelia burgdorferi* and *B. mayonii* (which cause Lyme disease), *Anaplasma phagocytophilum* (anaplasmosis), *B. miyamotoi* disease (a form of relapsing fever), *Ehrlichia muris eauclairensis* (ehrlichiosis), *Babesia microti* (babesiosis), and Powassan virus (Powassan virus disease).

COMMENTS The greatest risk of being bitten exists in the spring, summer, and fall in the Northeast, Upper Midwest, and mid-Atlantic. However, adult ticks may be out searching for a host any time winter temperatures are above freezing. All life stages bite humans, but nymphs and adult females are most commonly found on people.

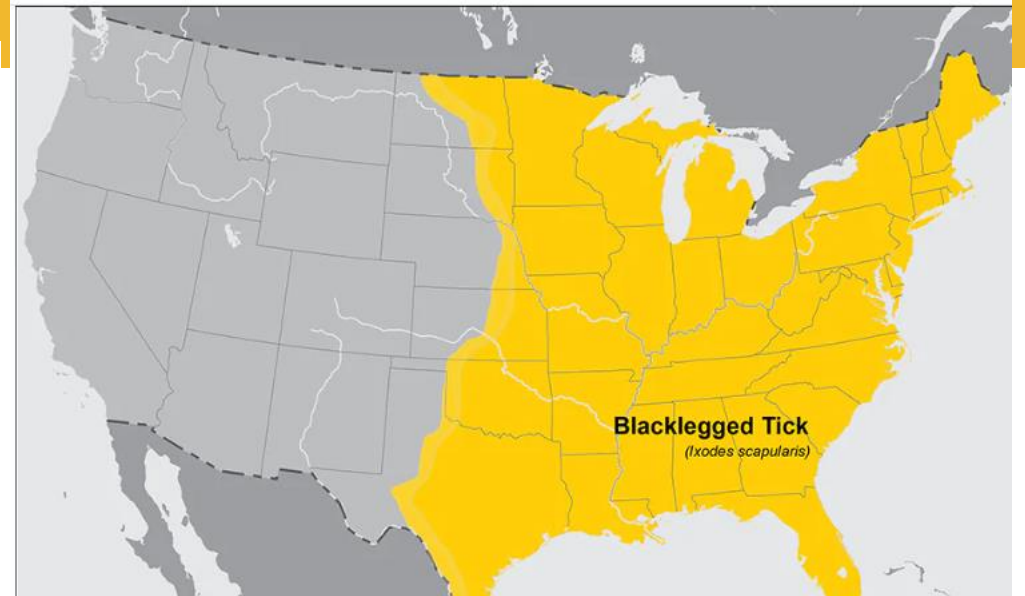


LONE STAR TICK *Amblyomma americanum*

WHERE FOUND Widely distributed in the eastern United States, but more common in the South.

TRANSMITS *Ehrlichia chaffeensis* and *E. ewingii* (which cause human ehrlichiosis), *Francisella tularensis* (tularemia), Heartland virus (Heartland virus disease), Bourbon virus (Bourbon virus disease), and Southern tick-associated rash illness (STARI).

COMMENTS The greatest risk of being bitten exists in early spring through late fall. A very aggressive tick that bites humans. The adult female is distinguished by a white dot or "lone star" on her back. The nymph and adult females most frequently bite humans. Growing evidence suggests that alpha-gal syndrome (AGS) may be triggered by the bite of lone star ticks; however, other tick species have not been ruled out.





AMERICAN DOG TICK *Dermacentor variabilis*, *D. similis*

WHERE FOUND *D. variabilis* is widely distributed east of the Rocky Mountains. Newly described *D. similis* is found west of the Rocky Mountains. More research is needed to understand the role of these species in disease transmission.

TRANSMITS *Francisella tularensis* (tularemia) and *Rickettsia rickettsii* (Rocky Mountain spotted fever).

COMMENTS The greatest risk of being bitten occurs during spring and summer. Adult females are most likely to bite humans.



BROWN DOG TICK *Rhipicephalus sanguineus*

WHERE FOUND Worldwide.

TRANSMITS *Rickettsia rickettsii* (Rocky Mountain spotted fever). Primary vector for *R. rickettsii* transmission in the southwestern United States and along the U.S.-Mexico border.

COMMENTS Dogs are the primary host for the brown dog tick in each of its life stages, but the tick may also bite humans or other mammals.

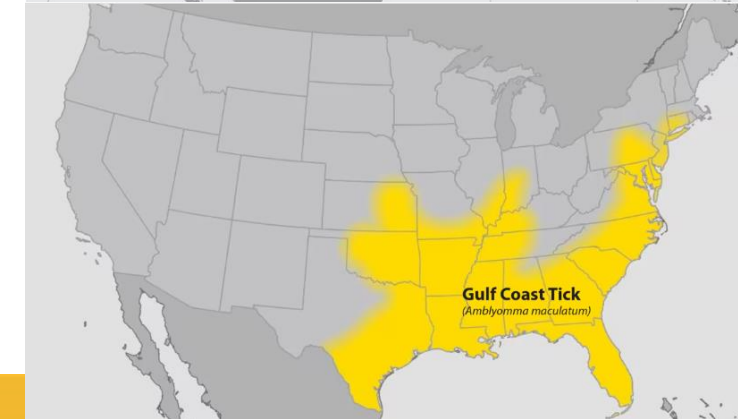


GULF COAST TICK *Amblyomma maculatum*

WHERE FOUND Distributed primarily in the southeastern United States, with focal populations in the northeastern, midwestern, and southwestern United States.

TRANSMITS *R. parkeri* (*R. parkeri* rickettsiosis), a form of spotted fever.

COMMENTS Larvae and nymphs feed on birds and small rodents, while adult ticks feed on deer and other wildlife. Adult ticks have been associated with transmission of *R. parkeri* to humans.



OVERVIEW OF TICKBORNE DISEASES

SELECTED TICKBORNE DISEASES REPORTED TO CDC, U.S., 2018



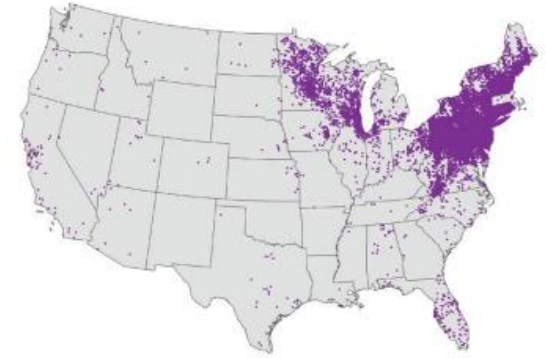
ANAPLASMOSIS



BABESIOSIS



EHRlichiosis



LYME DISEASE



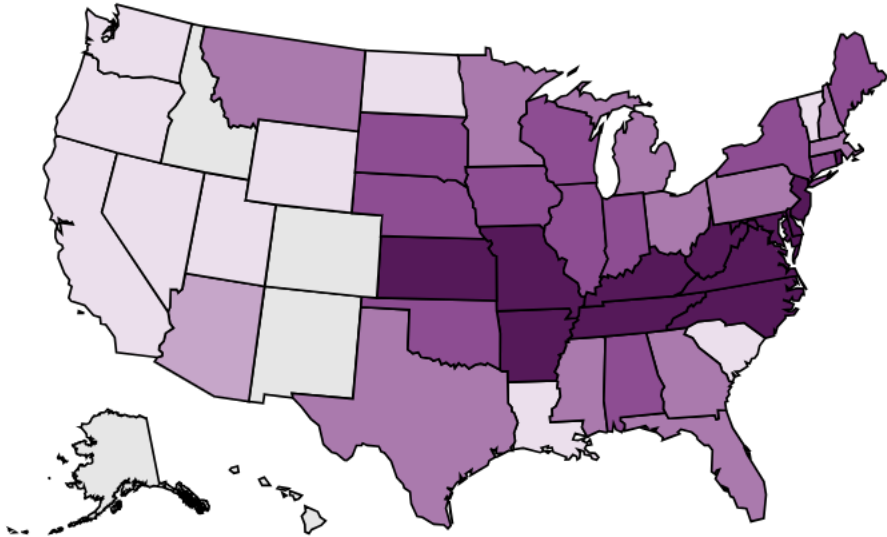
**SPOTTED FEVER RICKETTSIOSIS
(INCLUDING ROCKY MOUNTAIN SPOTTED FEVER)**



TULAREMIA

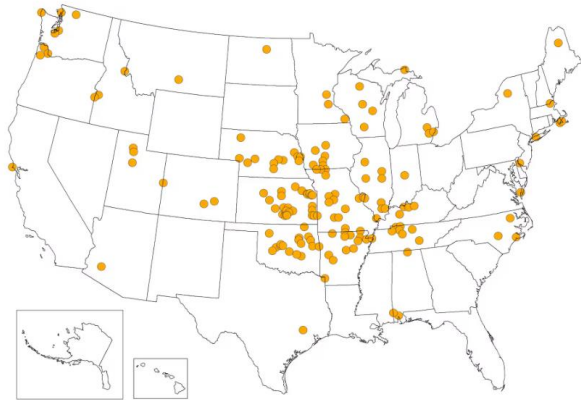
Annual incidence (per million population) of reported *Ehrlichia chaffeensis* ehrlichiosis–United States for 2021

0 0 to < 0.2 0.2 to < 2.2 2.2 to < 8.4 8.4+ Not Notifiable



Map of Reported Cases - U.S. 2022

Tularemia has been reported from all states except Hawaii but is most common in the south-central United States, the Pacific Northwest, and parts of Massachusetts, including Martha's Vineyard.

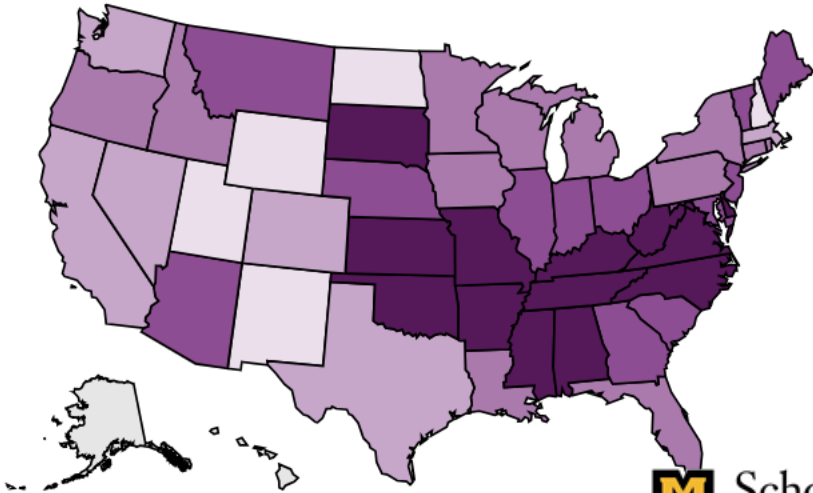


1 dot placed within state of residence for each reported case

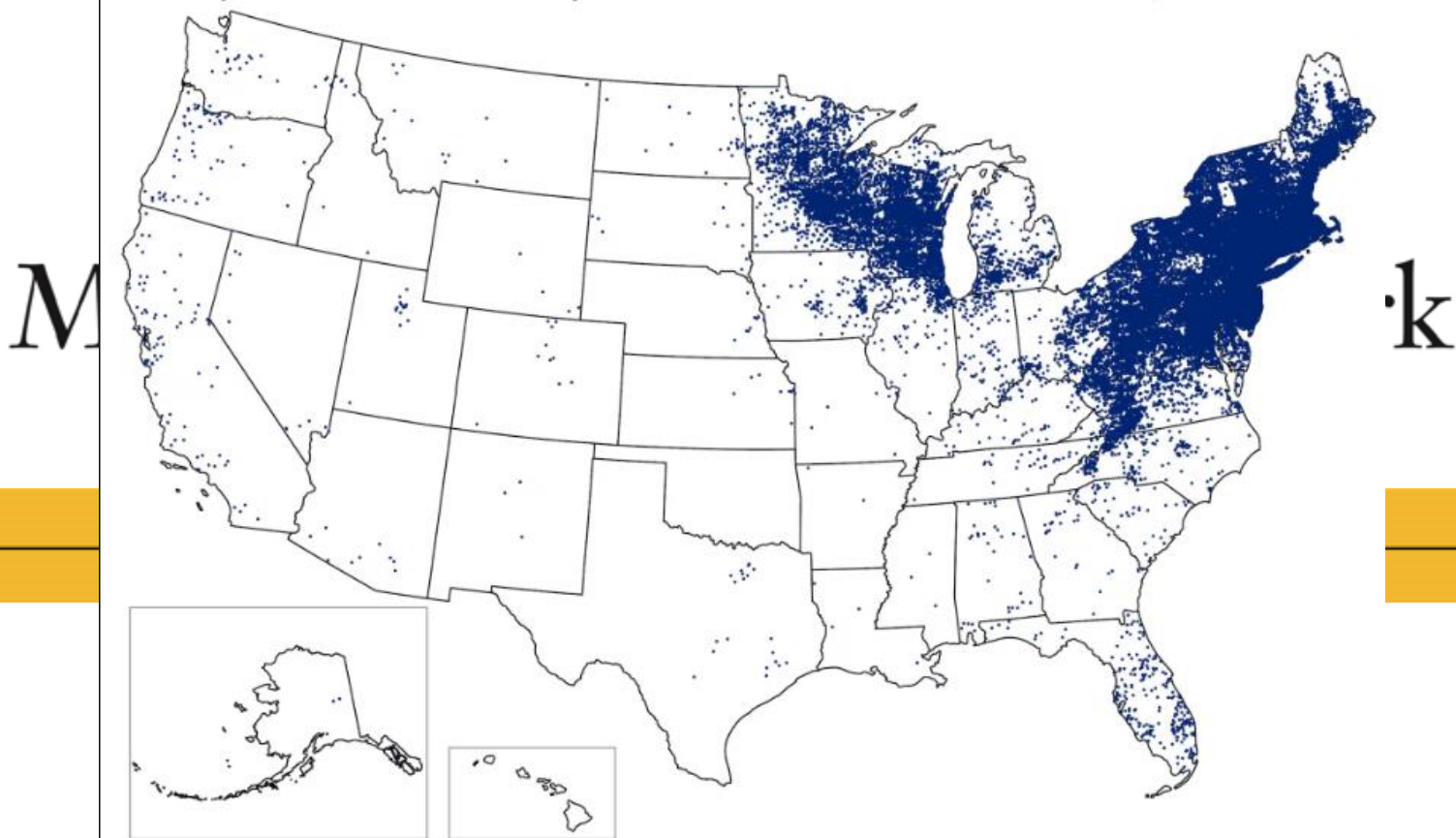
Network

Annual incidence (per million population) of reported spotted fever rickettsiosis–United States for 2021

0 0 to < 0.41 0.41 to < 1.48 1.48 to < 4.77 4.77+ Not Notifiable



Reported Cases of Lyme Disease -- United States, 2022



1 dot placed randomly within county of residence for each case



Why Lyme disease is common in the northern US, but rare in the south: The roles of host choice, host-seeking behavior, and tick density

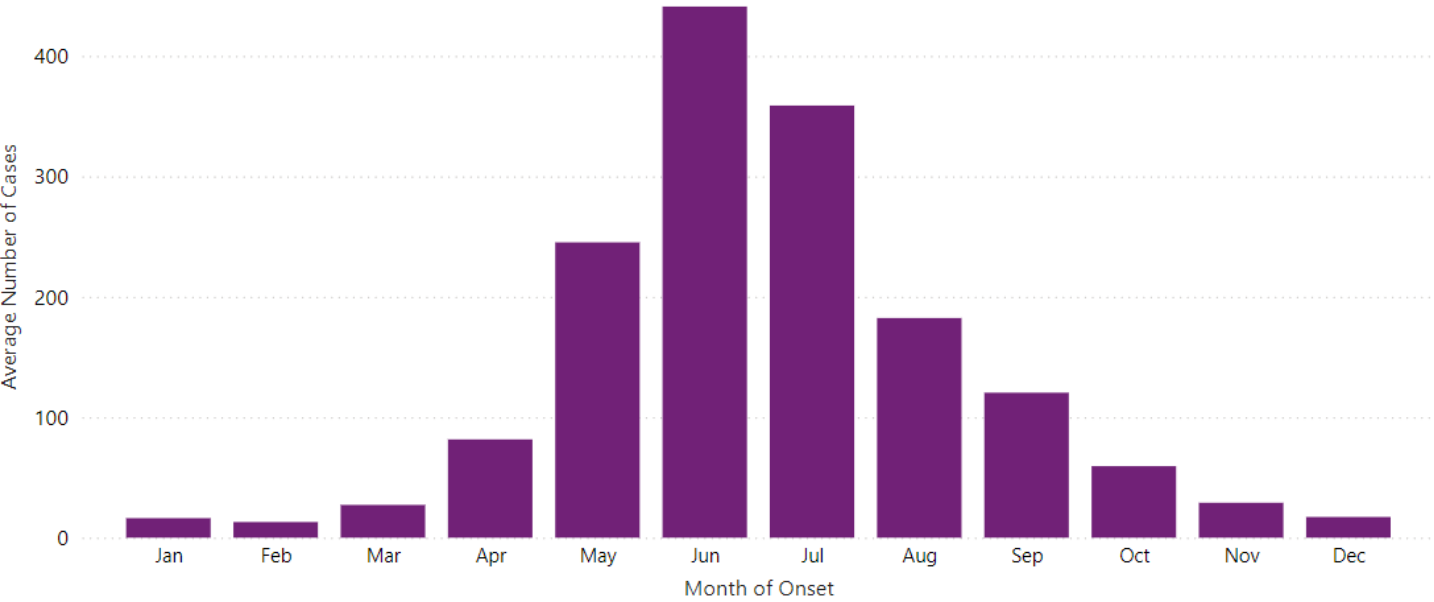
Howard S. Ginsberg , Graham J. Hickling, Russell L. Burke, Nicholas H. Ogden, Lorenza Beati, Roger A. LeBrun, Isis M. Arsnoe, Richard Gerhold, Seungeun Han, Kaetlyn Jackson, Lauren Maestas, Teresa Moody, Genevieve Pang, [...], Jean I. Tsao [view all]

Published: January 28, 2021 • <https://doi.org/10.1371/journal.pbio.3001066>

- Tick infection prevalence declines north to south largely because of high tick infestation of efficient spirochete reservoir hosts (rodents and shrews) in the north but not in the south.
- Minimal infestation of small mammals in the south results from strong selective attachment to lizards such as skinks (which are inefficient reservoirs for Lyme spirochetes) in the southern states.
- Selective host choice, along with latitudinal differences in tick host-seeking behavior and variations in tick densities, explains the geographic pattern of Lyme disease in the eastern US.



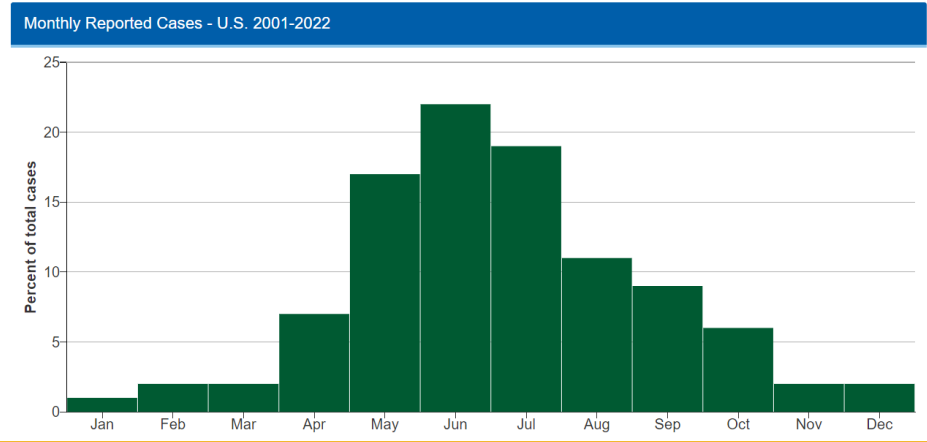
Average number of reported cases of *Ehrlichia chaffeensis* ehrlichiosis, by month of onset–United States, 2017–2021



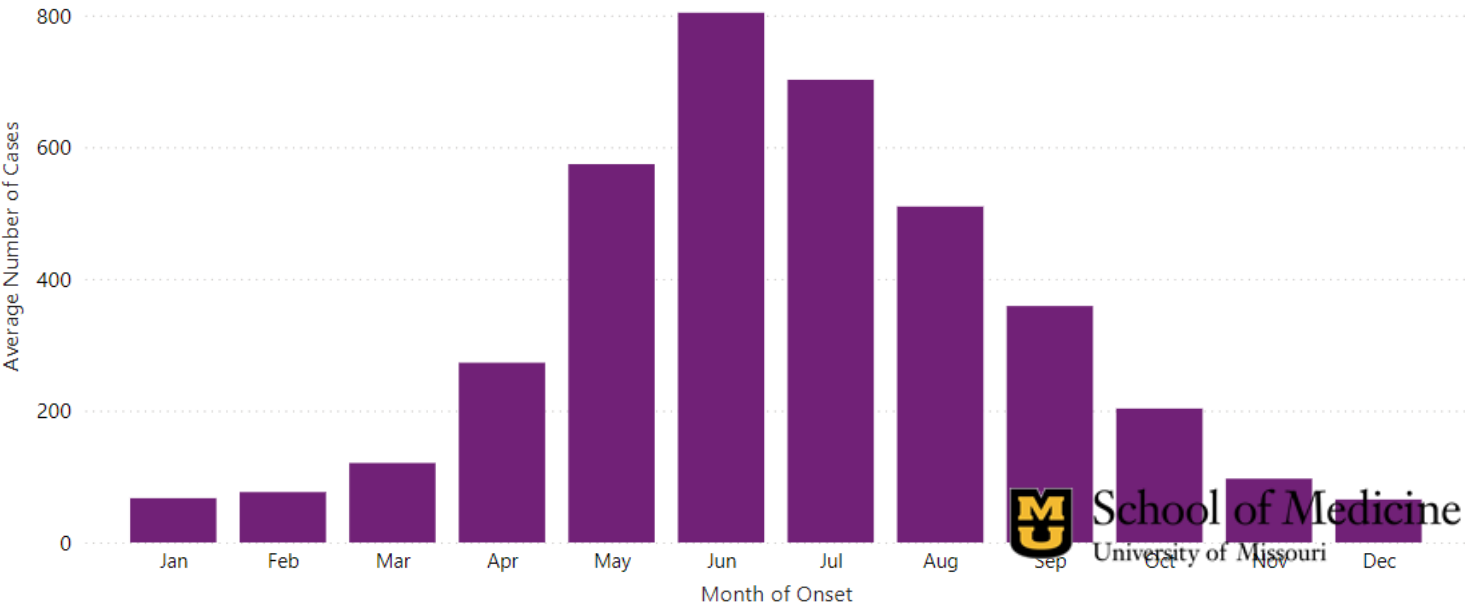
Network

Monthly Reported Cases – U.S. 2001-2022

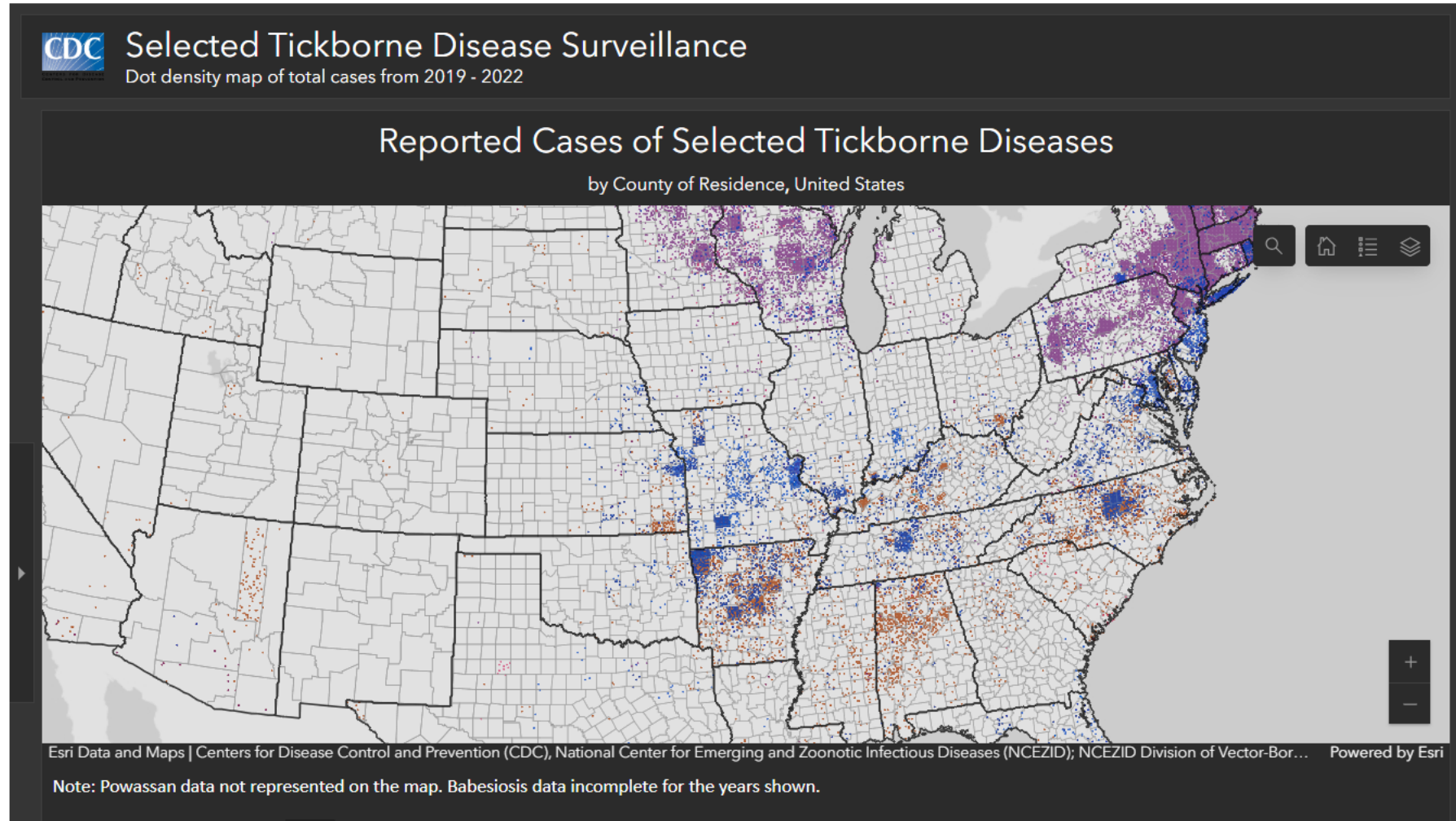
Tularemia is more common in the months of May through September. Bites from infected ticks or deer flies usually occur in the summer months, but illness due to animal handling and hunting can occur at any time of the year.



Average number of reported cases of spotted fever rickettsiosis, by month of onset–United States, 2017–20

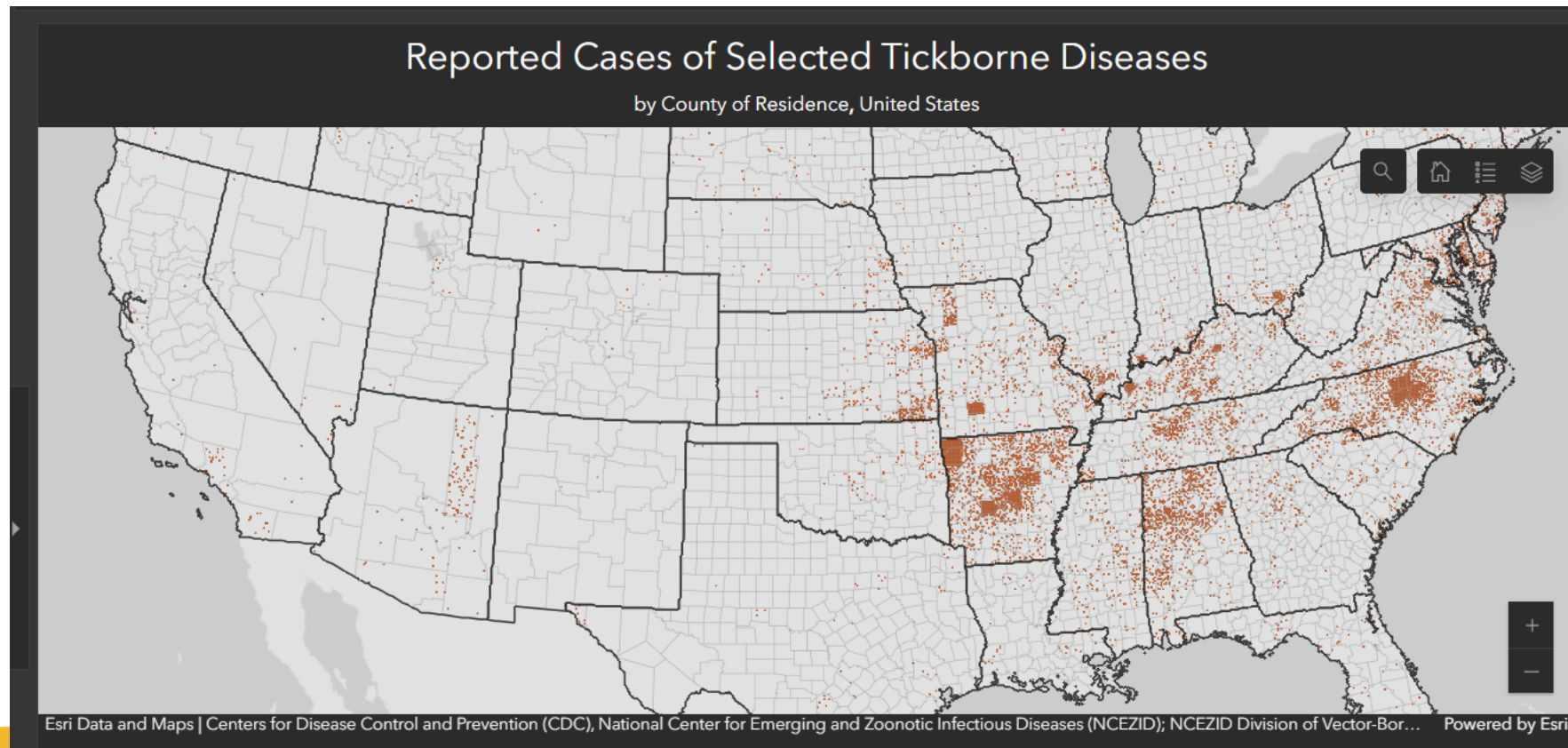


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Blue Ehrlichia chaffensis, brown unspecified, purple Anaplasma phagocytophilum

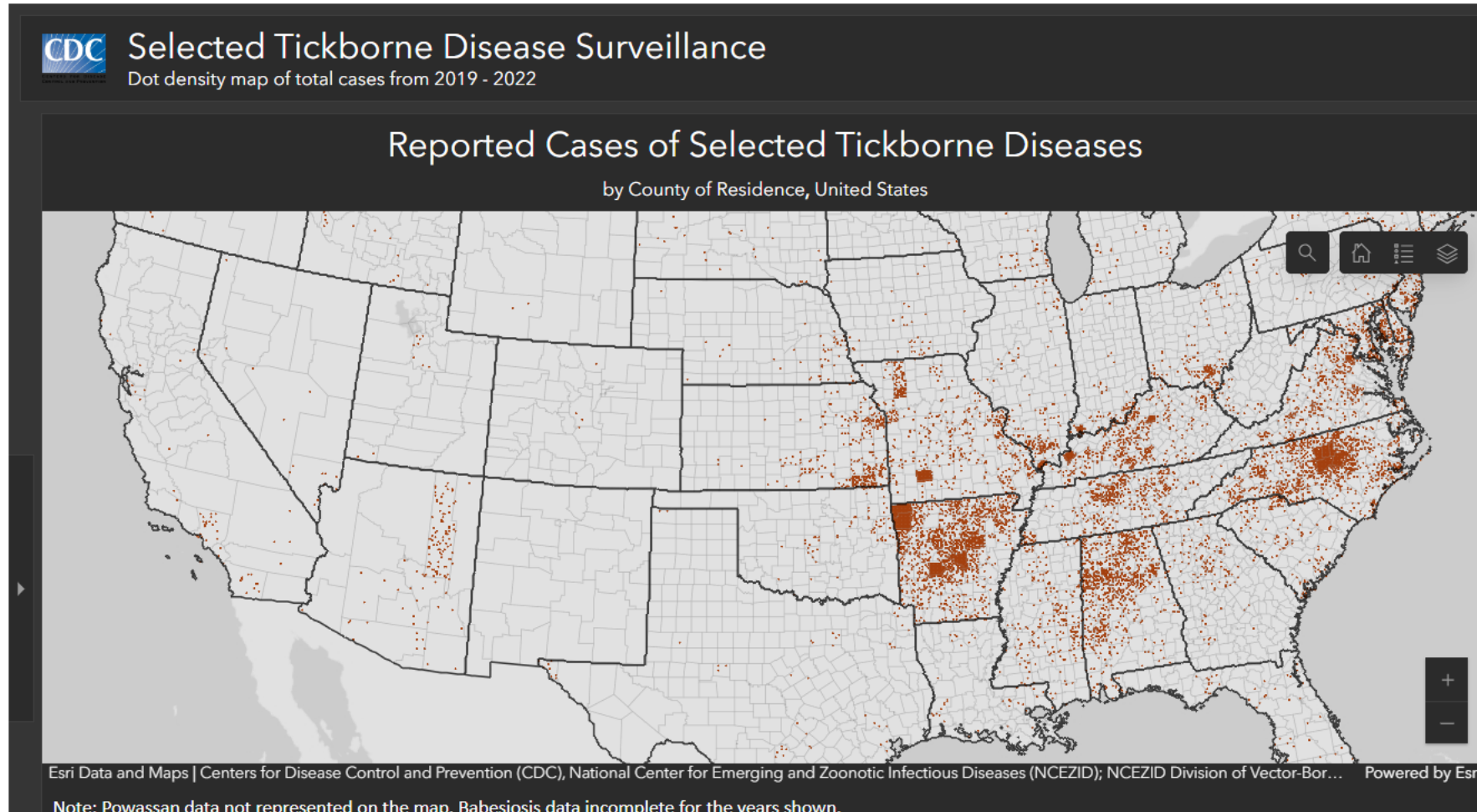
Show Me Echo



Brown: tularemia

Show-Me ECHO

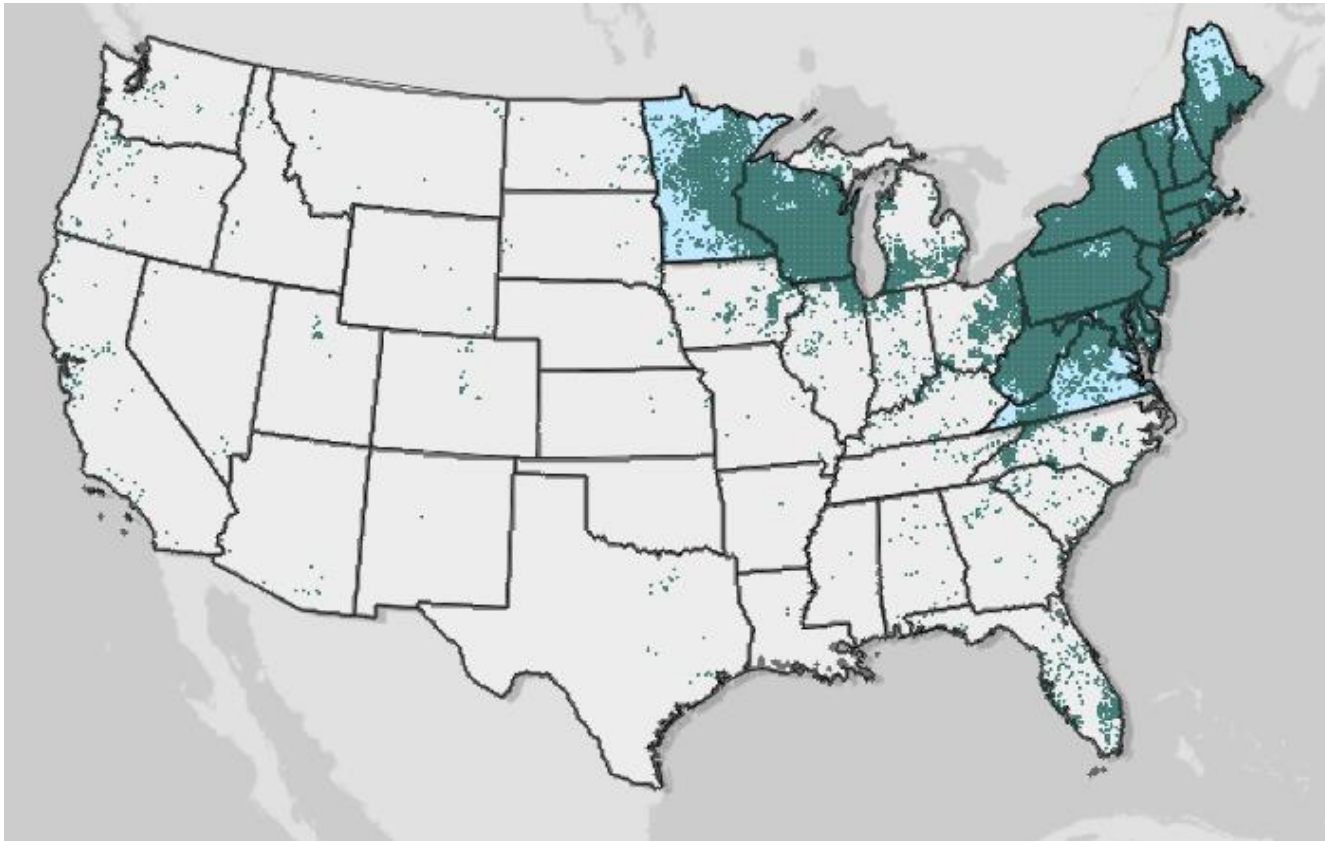




Brown: spotted fever rickettsiosis

Show-Me ECHO





Green: Lyme
disease

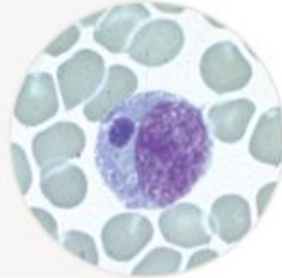
EHRlichiosis

INCUBATION PERIOD
5–14 days

AGENTS: *Ehrlichia chaffeensis*, *Ehrlichia ewingii*, *Ehrlichia muris euclairensis*

E. chaffeensis can cause fatal illness, whereas no deaths have been reported for *E. ewingii* or *E. muris euclairensis* ehrlichiosis.

Incidence of *E. chaffeensis* ehrlichiosis generally increases with age, however, case-fatality rates are highest among children aged <10 years and adults aged ≥70 years.



CONFIRMATION OF THE DIAGNOSIS IS BASED ON LABORATORY TESTING, BUT ANTIBIOTIC THERAPY SHOULD NOT BE DELAYED IN A PATIENT WITH A SUGGESTIVE CLINICAL PRESENTATION.

GENERAL LABORATORY FINDINGS

Typically observed during the first week of clinical disease:

- Thrombocytopenia
- Leukopenia (absolute)
- Anemia (generally occurs later in illness than thrombocytopenia or leukopenia)
- Mild to moderate elevations in hepatic transaminases

During the acute stage of illness, morulae can be detected in about 20% of patients. *E. chaffeensis* most commonly infects monocytes, whereas *E. ewingii* more commonly infects granulocytes. The target cell of *E. muris euclairensis* has not yet been identified. Visualization of morulae during examination of blood smears is highly suggestive of a diagnosis; however, blood smear examination is insensitive and should never be relied upon solely to rule ehrlichiosis in or out.

SIGNS AND SYMPTOMS

- Fever, chills
- Headache
- Malaise
- Muscle pain
- Gastrointestinal symptoms (nausea, vomiting, diarrhea, anorexia)
- Altered mental status
- Rash (more commonly reported among children)

The Signs and Symptoms list presents symptoms commonly seen with ehrlichiosis. However, it is important to note that few people will develop all symptoms, and the number and combination of symptoms varies greatly from person to person.

LABORATORY DIAGNOSIS

- Detection of DNA by PCR of whole blood. This method is most sensitive during the first week of illness and sensitivity can decrease after administration of tetracycline-class antibiotics.
- Demonstration of a four-fold rise in IgG-specific antibody titer by indirect immunofluorescence antibody (IFA) assay in paired serum samples. The first sample should be taken within the first 2 weeks of illness, and the second should be taken 2 to 4 weeks later.
- Immunohistochemical (IHC) staining of organism from skin, tissue, or bone marrow biopsies.

NOTE: Antibody titers are frequently negative in the first 7–10 days of illness. Acute antibody results cannot independently be relied upon for confirmation.

NOTE: IgM antibodies are less specific than IgG antibodies and are more likely to generate false positives. IgM results alone should not be used for laboratory diagnosis.

ROCKY MOUNTAIN SPOTTED FEVER (RMSF)

AGENT: *Rickettsia rickettsii*

RMSF is most often transmitted by the American dog tick in the Eastern, Central, and Western United States; by the Rocky Mountain wood tick in the Rocky Mountain states; and by the brown dog tick in the Southwestern United States, along the U.S.-Mexico border. RMSF can be rapidly fatal if not treated within the first 5 days of symptoms. Before tetracycline antibiotics were available, case fatality rates ranged from 20–80%.



INCUBATION PERIOD

3–12 days

SIGNS AND SYMPTOMS

EARLY (1–4 DAYS)

- High fever
- Severe headache
- Malaise
- Myalgia
- Edema around eyes and on the back of hands
- Gastrointestinal symptoms (nausea, vomiting, anorexia)

LATE (5 DAYS AND BEYOND)

- Altered mental status, coma, cerebral edema
- Respiratory compromise (pulmonary edema, ARDS)
- Necrosis, requiring amputation
- Multiorgan system damage (CNS, renal failure)

RASH

- Typically appears 2–5 days after onset of symptoms; approximately 10% of RMSF patients never develop a rash.
- Decision to treat should not be based on presence of rash.

Early Rash

- Maculopapular: Small, flat, pink, non-itchy spots (macules) initially appear on the wrists, forearms, and ankles then spread to the trunk and sometimes palms and soles.

Late Rash

- Petechial: Red to purple spots (petechiae) are usually not seen until day 6 or later after onset of symptoms.
- Petechial rash is considered a sign of progression to severe disease. Every attempt should be made to begin treatment before petechiae develop.



Confirmation of the diagnosis is based on laboratory testing, but antibiotic therapy should not be delayed in a patient with a suggestive clinical presentation. Antibiotics are more likely to prevent fatal outcome from RMSF if started within the first 5 days of symptoms.

GENERAL LABORATORY FINDINGS

- Thrombocytopenia
- Elevated hepatic transaminases
- Hyponatremia

NOTE: Laboratory values are often within normal limits in early illness.

LABORATORY DIAGNOSIS

- Demonstration of a four-fold rise in IgG-specific antibody titer by indirect immunofluorescence antibody (IFA) assay in paired serum samples. The first sample should be taken within the first 2 weeks of illness and the second should be taken 2 to 4 weeks later.
- Detection of DNA in a skin biopsy specimen of a rash lesion by PCR assay or in an acute phase whole blood specimen. Additionally, new pan-*Rickettsia* and *R. rickettsii*-specific PCR assays are available at some local and state health departments.
- Immunohistochemical (IHC) staining of organism from skin or tissue biopsy specimen.

NOTE: Antibody titers are frequently negative in the first 7–10 days of illness. Acute antibody results cannot be independently relied upon for confirmation

NOTE: IgM antibodies are less specific than IgG antibodies and are more likely to generate false positives. IgM results alone should not be used for laboratory diagnosis.

TREATMENT

Anaplasmosis, ehrlichiosis, and spotted fever group rickettsioses are treated with doxycycline. Clinical suspicion of any of these diseases is sufficient to begin treatment. **Delay in treatment may result in severe illness and death.** The regimens listed below are guidelines only and may need to be adjusted depending on a patient's age, medical history, underlying health conditions, pregnancy status, or allergies. Consult an infectious disease specialist in cases of pregnancy or life-threatening allergy to doxycycline.

AGE CATEGORY	DRUG	DOSAGE	MAXIMUM	DURATION (DAYS)
Adults	Doxycycline	100 mg twice per day, orally or IV	100 mg/dose	Patients should be treated for at least 3 days after the fever subsides and until there is evidence of clinical improvement. Minimum course of treatment is 5–7 days.
Children weighing <100 lbs. (45.4 kg)	Doxycycline	2.2 mg/kg per dose twice per day, orally or IV	100 mg/dose	

Fulminant disease can be seen in setting of initial TMP/SMX use

NOTE: Use doxycycline as first-line treatment for suspected ehrlichiosis in patients of all ages. The use of doxycycline to treat suspected ehrlichiosis in children is recommended by both the CDC and the American Academy of Pediatrics Committee on Infectious Diseases. Use of antibiotics other than doxycycline increases the risk of patient death. At the recommended dose and duration needed to treat ehrlichiosis, no evidence has been shown to cause staining of permanent teeth, even when multiple courses are given before the age of eight.



- Name is misnomer—can occur almost **ANYWHERE**
- Common April-September—can occur **ANYTIME**
- Absence of rash never excludes diagnosis—can be **SPOTLESS**
- However, no such entity as RMSF without **FEVER**
- Signs/symptoms easily confused with viral illness
- **DOXYCYCLINE** is drug of choice for all
- Difficult to distinguish meningococemia clinically
- For Ehrlichiosis: Most children have tick bite history (89%) vs. <50% of all diagnosed RMSF patients



TULAREMIA

AGENT: *Francisella tularensis*

Tularemia is caused by the highly infectious *F. tularensis* bacteria. It is spread through exposure to infected arthropods (including deer flies and several species of ticks), contact with infected carcasses or animals (such as rabbits, hares, and rodents), contaminated food or water, or inhalation of aerosols (such as by mowing over an infected rabbit carcass).

WHERE FOUND

Tularemia has been reported in all states except Hawaii, but it is most common in the south-central United States, the Great Plains region, and parts of Massachusetts.

INCUBATION PERIOD

3–5 days (range 1–21 days)

SIGNS AND SYMPTOMS

The clinical presentation of tularemia depends on many factors, including the route of inoculation and subtype of *F. tularensis*. Tularemia can be serious or fatal without adequate treatment. Unusual and severe clinical manifestations have been described in patients with immunocompromising conditions.

- Fever, chills
- Headache
- Malaise, fatigue
- Anorexia
- Myalgia
- Chest discomfort, cough
- Sore throat
- Vomiting, diarrhea
- Abdominal pain

(*ULCERO*) GLANDULAR

- Localized lymphadenopathy
- Cutaneous ulcer at infection site (not always present)

OCULOGLANDULAR

- Photophobia
- Vision impairment/loss
- Conjunctivitis
- Regional lymphadenopathy

OROPHARYNGEAL

- Severe throat pain
- Exudative pharyngitis or tonsillitis
- Regional lymphadenopathy

PNEUMONIC

- Non-productive cough
- Substernal tightness
- Pleuritic chest pain
- Hilar adenopathy, infiltrate, or pleural effusion may be present on chest X-ray

TYPHOIDAL

- Characterized by any combination of the general symptoms without the localizing symptoms of other syndromes
- May have infiltrates in chest radiograph in the absence of respiratory symptoms



GENERAL LABORATORY FINDINGS

- Hyponatremia
- Leukocytosis
- Thrombocytopenia
- Elevated hepatic transaminases
- Elevated creatine kinase
- Elevated erythrocyte sedimentation rate
- Myoglobinuria
- Sterile pyuria

LABORATORY DIAGNOSIS

Isolation of *F. tularensis* in culture is optimal for diagnosis but can be challenging due to the slow-growing, fastidious nature of the organism. Appropriate specimens for culture include swabs or scrapings of ulcers, lymph node aspirates or biopsies, pharyngeal swabs, or respiratory specimens (e.g., pleural fluid), depending on the form of illness. Blood cultures are often negative.

Seroconversion from negative to positive IgM and/or IgG can also confirm the diagnosis when tularemia is suspected. Ideally, these are performed as paired acute and convalescent specimens, the latter collected 2–3 weeks after initial illness.

When available, other tests can be useful, including:

- Direct immunofluorescence assay (DFA)
- Immunohistochemical staining
- PCR assay

Clinicians who suspect tularemia should alert the laboratory to the possible need for special safety procedures to minimize risk of laboratory transmission.

TREATMENT

These regimens may need to be adjusted depending on a person's age, medical history, underlying health conditions, pregnancy status, or allergies. Consult an infectious disease specialist regarding individual patient treatment decisions.

AGE CATEGORY	DRUG	DOSAGE	MAXIMUM	DURATION (DAYS)
Adults	Gentamicin*	5 mg/kg IM or IV daily (with desired peak serum levels of at least 5 mcg/mL)	Monitor serum drug levels	Minimum 10
	Ciprofloxacin*	400 mg IV or 500 mg PO twice daily	N/A	10-14
	Doxycycline	100 mg IV or PO twice daily	N/A	14-21
Children	Gentamicin*	2.5 mg/kg IM or IV 3 times daily**	Monitor serum drug levels and consult a pediatric infectious disease specialist	Minimum 10
	Ciprofloxacin*	15 mg/kg IV or PO twice daily	800 mg per day	10
	Doxycycline	2.2mg/kg IV or PO twice daily	100mg IV or PO twice daily	14-21

* Not a U.S. FDA-approved use but has been used successfully to treat patients with tularemia.

** Once-daily dosing could be considered in consultation with a pediatric infectious disease specialist and a pharmacist

NOTE: Gentamicin is preferred for treatment of severe tularemia. Dose should be adjusted for renal insufficiency.

NOTE: For tularemic meningitis, combination therapy should be considered in consultation with an infectious disease specialist

LYME DISEASE OR STARI?

An erythema migrans-like rash has also been described in humans following bites of the lone star tick. This condition has been named Southern Tick-Associated Rash Illness (STARI). Although the rash may be accompanied by systemic symptoms, disseminated or severe disease has not been reported. Because the cause of STARI is unknown, diagnostic blood tests are not available. It is not known whether antibiotic treatment is necessary or beneficial for patients with STARI. Nevertheless, because STARI resembles early Lyme disease, physicians often treat patients with the same antibiotics recommended for Lyme disease.

Lone star ticks can be found from central Texas and Oklahoma eastward across the southern states and along the Atlantic Coast as far north as Maine.



STARI rashes take many forms.

- The rash of STARI is a red, expanding lesion that develops around the site of a lone star tick bite. The rash usually appears within 7 days of tick bite and expands to a diameter of 3 inches (8 centimeters) or more, sometimes clearing as it enlarges to produce a target or "bull's-eye" appearance.
- The rash should not be confused with much smaller areas of redness and discomfort that can occur commonly at the site of any tick bite. Patients may also experience fatigue, headache, fever, and muscle pains. The saliva from lone star ticks can be irritating; redness and discomfort at a bite site does not necessarily indicate an infection.



	STARI	Lyme disease
Agent	Unknown	B. burgdorferi
Region	SE US	NE US, upper Midwest
Tick bite	Common	Less likely
Clinical presentation		
Incubation period	< 6 days	7-14 days
EM (frequency)	100%	70%
Number of lesions	One	Variable
Systemic symptoms	Less likely	Common
Chronic manifestations	Less likely	Common

CID 2005. 41(7): 958-965



LYME DISEASE

AGENT: *Borrelia burgdorferi*, *B. mayonii*

INCUBATION PERIOD

3–30 days

SIGNS AND SYMPTOMS

EARLY LOCALIZED (3 to 30 days after a tick bite)

- Erythema migrans (EM)—Red annular or homogeneous rash at the site of tick bite; expands gradually over several days to >5 cm in diameter; central clearing may develop as the rash expands, resulting in a “target” or “bull’s-eye” appearance; may feel warm to the touch but rarely itchy or painful. EM occurs in 70–80% of infected persons. The classic rash is not present in all cases; see examples on the following pages.
- Fever, chills, malaise, fatigue, headache, myalgia, arthralgia
- Lymphadenopathy

DISSEMINATED (days to months after a tick bite)

Untreated or unnoticed early Lyme disease will progress to disseminated disease for about 60% of patients, with diverse clinical manifestations. Most manifestations will appear in the first few weeks to months of infection, though rheumatologic manifestations may be particularly delayed.

Dermatologic Manifestations

- Multiple EM rashes, distant from site of tick bite

Neurologic Manifestations

- Cranial neuritis, most commonly Bell’s palsy (facial paralysis, can be bilateral)
- Lymphocytic meningitis
- Painful radiculoneuritis involving one or multiple dermatomes
- Painful peripheral motor and sensory neuropathy (mononeuritis multiplex)
- Intracranial hypertension (rare)

Cardiac Manifestations

- Lyme carditis resulting in conduction abnormalities (e.g., atrioventricular node block; myopericarditis)
- Rarely, can be fatal

Rheumatologic Manifestations

- Oligoarticular arthritis: transient, migratory arthritis and effusion in one or multiple joints, often large joints; may cause Baker’s cyst
- Migratory pain in tendons, bursae, muscle, and bones

GENERAL LABORATORY FINDINGS

- Elevated erythrocyte sedimentation rate
- Mildly elevated hepatic transaminases
- Microscopic hematuria or proteinuria

LABORATORY DIAGNOSIS

1. For patients who present with an EM rash after being in an area where Lyme disease is common, Lyme disease should be diagnosed clinically (without diagnostic testing), as serologic tests may be negative during the first few weeks of infection before antibodies have developed.
2. Serologic tests are highly sensitive in patients with disseminated Lyme disease, and diagnosis relies on signs and symptoms supported by results of testing.
3. Two-step serologic testing is recommended using validated first- and second-tier tests according to a standard or modified two-test algorithm. IgM Western immunoblot results should only be considered if signs and symptoms have been present for less than 30 days.

NOTE: Coinfection with *Babesia microti* or *Anaplasma phagocytophilum* should be considered in patients who present with initial symptoms that are more severe than are commonly observed with Lyme disease alone, especially in those who have high-grade fever for more than 48 hours despite appropriate antibiotic therapy or who have unexplained leukopenia, thrombocytopenia, or anemia. Coinfection should also be considered in patients whose erythema migrans skin lesion has resolved but who have persistent systemic symptoms.

NOTES ON SEROLOGIC TESTS FOR LYME DISEASE

- For details, refer to the APHL guide for interpretation of serologic test results <https://www.aphl.org/aboutAPHL/publications/Documents/ID-2021-Lyme-Disease-Serologic-Testing-Reporting.pdf>
- While not necessary, acute and convalescent serologies may be useful for diagnosis in some cases, such as for patients with suspected re-infection.
- Serologic tests cannot be used to measure treatment response.
- Other conditions, including some tickborne infections and autoimmune diseases, can result in false positive test results.



Lyme Disease: clinical manifestations

@WuidQ



EARLY INFECTION

Antibiotic halts progression

LATE INFECTION

Overlap

Stage 1. Localized

- EM appears 7-14 days at the site of *Ixodes* bite
- Fatigue, myalgia, arthralgia, headache, **fever (not common)**
- Laboratory abnormalities are rare and mild



Stage 2. Disseminated

- Several days-weeks after EM
- Heralded by **neurologic SSX** (lymphocytic meningitis, CN palsies, radiculopathy, PN)
- **Cardiac SSX** (AV block)



- Months to several years after
- **Arthritis**
 - Large joints (knees), 1-2 joints
 - Remitting, chronic
- **Neurologic**
 - Cognitive impairment
 - Normal CSF
 - CSF + Lyme antibodies

Lyme Disease: treatment @WuidQ



EARLY INFECTION

LATE INFECTION

Overlap

Stage 1. Localized



Doxycycline, amoxicillin,
cefuroxime x 10-14d

Stage 2.
Disseminated



Isolated palsy: doxycycline x 14d
1st degree AVB: doxycycline x 14-21d
Serious CNS/carditis: ceftriaxone x 14-28d



Arthritis: doxycycline/**ceftriaxone x 14-28d**
CNS: ceftriaxone x 14-28d

TREATMENT OF ERYTHEMA MIGRANS RASH

People treated with appropriate antibiotics in the early stages of Lyme disease usually recover rapidly and completely. Early diagnosis and proper antibiotic treatment of Lyme disease can help prevent late Lyme disease. Treatment regimens listed in the following table are for the erythema migrans rash, the most common manifestation of early Lyme disease. These regimens may need to be adjusted depending on a person's age, medical history, underlying health conditions, pregnancy status, or allergies. Consult an infectious disease specialist regarding individual patient treatment decisions. For treating other manifestations, see www.cdc.gov/Lyme/treatment/.



AGE CATEGORY	DRUG	DOSAGE	MAXIMUM	DURATION (DAYS)*
Adults	Doxycycline OR	100 mg, twice per day orally	N/A	10–14
	Amoxicillin OR	500 mg, three times per day orally	N/A	14
	Cefuroxime	500 mg, twice per day orally	N/A	14
Children	Doxycycline OR	4.4 mg/kg per day orally, divided into 2 doses	100 mg per dose	10–14
	Amoxicillin OR	50 mg/kg per day orally, divided into 3 doses	500 mg per dose	14
	Cefuroxime	30 mg/kg per day orally, divided into 2 doses	500 mg per dose	14

* When different durations of antibiotics are shown to be effective for the treatment of Lyme disease, the shorter duration is preferred to minimize adverse effects, including infectious diarrhea and antimicrobial resistance.

NOTE: For people intolerant of amoxicillin, doxycycline, and cefuroxime, the macrolide azithromycin may be used, although it is less effective. People treated with azithromycin should be closely monitored to ensure that symptoms resolve.

LYME DISEASE

ERYTHEMA MIGRANS RASHES

The erythema migrans (EM) rash occurs in 70-80% of patients with Lyme disease. EM rashes may have the classic appearance or may take alternate forms; solid lesions, blue-purple hues, and crusted or blistering lesions have all been documented.



CLASSIC EM—CIRCULAR RED RASH WITH CENTRAL CLEARING THAT SLOWLY EXPANDS

Photo courtesy of Taryn Holman.



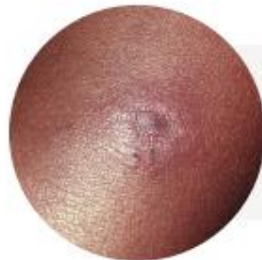
BLUISH HUE WITHOUT CENTRAL CLEARING

Photo courtesy of Yevgeniy Balagula.



EXPANDING LESION WITH CENTRAL CRUST ON CHEST

Photo courtesy of Bernard Cohen.



EARLY, EXPANDING ERYTHEMA MIGRANS WITH NODULE

Reprinted from Bhate C, Schwartz RA. Lyme disease: Part I. Advances and perspective. *J Am Acad Dermatol.* 2011;64:619-36, with permission from Elsevier.



Q.

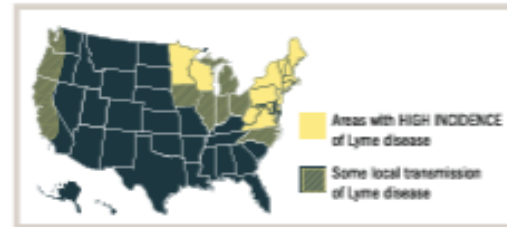
- 5yo girl with h/o tick bite on right scalp in mid June.
- Mother had removed a tick (engorged) from her hair - may have been a dog tick. Fever to 103.5F. She was seen in urgent care same day. She was started on Amoxicillin prophylaxis for the tick bite (amoxicillin prophylaxis is usually recommended in lyme endemic areas; while we are not endemic for lyme).
- Next day later she was seen in ER continuing fever and myalgia. At that time, her work up revealed a normal CBC, CMP, negative blood culture and throat culture, negative Ehrlichia PCR, normal RMSF acute phase titres, urinalysis with 16-20 white cells, negative nitrates; she was started on ceftriaxone for possible febrile uti; however urine culture returned negative; repeat CBC showed lowest platelet count of 94, home with diagnosis of viral illness [amoxicillin not continued]
- Fever resolved in 4 days. 2 weeks later she had drainage/crustiness at tick bite site on Rx with antibiotic ointment and it improved.
- 4 weeks after initial tick bite, she developed swollen lymphnodes in right neck. Labs- normal CBC. Started on 10 days of Amoxicillin-clavulanate for presumed bacterial adenitis. Additional labs also sent for alternate etiology. 10 days later still with swollen nodes and no improvement.
- No contact with cats.

LYME DISEASE PROPHYLAXIS AFTER TICK BITE

In areas that are highly endemic for Lyme disease, a single prophylactic dose of doxycycline (200 mg for adults or 4.4 mg/kg for children of any age weighing less than 45 kg) may be used to reduce the risk of acquiring Lyme disease after a high-risk tick bite.

Benefits of prophylaxis may outweigh risks when **all of the following circumstances are present:**

1. Where the tick bite occurred, are ticks likely to be infected with *Borrelia burgdorferi*?



2. Was the tick removed within the last 72 hours?

3. Was the tick's body engorged with blood (not flat)?



4. Was the tick an *Ixodes* (blacklegged) tick?



5. Is doxycycline safe for the patient? Considerations include allergy to doxycycline, pregnancy, and lactation.

Antibiotic treatment following a tick bite is not recommended as a means to prevent anaplasmosis, babesiosis, ehrlichiosis, Rocky Mountain spotted fever, or other rickettsial diseases. Instead, persons who experience a tick bite should be alert for symptoms suggestive of tickborne illness and consult a physician if fever, rash, or other symptoms of concern develop.

Miss

twork







Q.

- What is the drug of choice for this infection?
- A. Ceftriaxone
- B. Azithromycin
- C. Rifampin
- D. Gentamicin
- E. Amoxicillin



Infectious Causes of Lymphadenitis

- Acute
 - Viral
 - Staphylococcus aureus
 - Streptococcus pyogenes
 - Streptococcus anginosus group
 - Polymicrobial – oropharyngeal flora
- Subacute/chronic
 - EBV – usually generalized
 - CMV – usually generalized
 - HIV – usually generalized
 - Bartonella – usually localized
 - Tularemia – usually localized
 - Atypical mycobacteria – usually localized, toddler age group
 - Toxoplasmosis – localized/generalized



A.

- What is the drug of choice for this tick-borne infection?
- A. Ceftriaxone
- B. Azithromycin
- C. Rifampin
- D. **Gentamicin**
- E. Amoxicillin

- Tularemia titres – 1:1280
- Completed 10 day course of doxycycline while travelling in Pennsylvania when results reported, without any improvement/rather worsening
- Admitted for iv gentamicin and ENT



- I&D by ENT: 1 mL of pus by needle aspiration, 2ml thick necrotic material removed
- Culture – Anerobic, AFB no growth
- Completed 10 days iv gentamicin
- Picture: 5 days s/p ID



Pic 1: Onset

Pic 2: 3 days later

Interim antibiotics:

cephalexin/Bactrim/clindamycin

Tularemia Ab sent 2 weeks after onset, started

Ciprofloxacin 25 days from onset

Last pic – 2 days after starting antibiotic – already regressing



Q.

- 16 yo male with outdoor exposure and h/o MRSA skin lesions and most recently resolved draining skin lesion; presenting with fevers for 4 days, abdominal pain, fatigue, myalgia and headaches.
- One week prior he had swelling in upper right thigh, looked like one of his previous abscess. Took some left over Bactrim and Keflex and wound was nearly healed. Exam with faint macular rash.
- Skin lesion – small ulcer healing, small bilateral femoral lymphnodes. Labs: WCC 2.5, Plt 51, ALT 265.
- Exposures: spends time **outdoors**. Has not travelled outside MO, drives ATV through fields. He **recalls mosquito bites**, had **tick bites in last summer but not this time so far**.





Q.

- In addition to ulceroglandular tularemia, which other arthropod borne infection are you suspecting?
- *A. Rickettsia typhi*
- *B. Ehrlichia*
- *C. Anaplasma*
- *D. Bartonella*
- *E. Yersinia pestis*



A.

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- *A. Rickettsia typhi*
- ***B. Ehrlichia***
- *C. Anaplasma*
- *D. Bartonella*
- *E. Yersinia pestis*



Q.

- In addition to gentamicin, which antibiotic would you definitely add in you empiric regimen?
- A. Ciprofloxacin
- B. continue Bactrim
- C. Doxycycline
- D. Amoxicillin
- E. Azithromycin



A.

- In addition to gentamicin, which antibiotic would you definitely add in you empiric regimen?
- A. Ciprofloxacin
- B. continue Bactrim
- C. **Doxycycline**
- D. Amoxicillin
- E. Azithromycin



Q.

- You are in the urgent care in Missouri and you see a 6 year old. His father had just pull off an engorged tick 3 days ago. He now has this rash on his upper right shoulder area. He does not have any fever. Aside from some local pain at the tick bite site, and some myalgia, he feels ok.





Q.

- What is the cause of this rash?
- A. *Borrelia burdorferi*
- B. *Ehrlichia*
- C. *Borrelia miyamotoi*
- D. *STARI*
- E. *Rickettsia parkerii*



A.

- You are in the urgent care in Missouri and you see a 6 year old. His father had just pull off an engorged tick 3 days ago. He now has this rash on his upper right shoulder area. He does not have any fever. Aside from some local pain at the tick bite site, he feels well. What is the cause of this rash?
- A. *Borrelia burdorferi*
- B. *Ehrlichia*
- C. *Borrelia miyamotoi*
- D. **STARI**
- E. *Rickettsia parkerii*

[@WuidQ](#)

<https://www.cdc.gov/stari/symptoms/index.html>

In the Midwest @WuidQ

1. E hrlichia <i>Ehrlichia</i>	Bacteria		Lone star tick (<i>Amblyomma americanum</i>)
2. R MSF Rocky <i>m</i> ountain spotted <i>f</i> ever	Bacteria		American dog tick (<i>Dermacentor variabilis</i>)
3. S TARI Southern <i>t</i> ick- <i>a</i> ssociated <i>i</i> llness	??		
4. T ularemia <i>Francisella tularensis</i>	Bacteria	 	
5. Heartland	Bunyavirus		
6. Bourbon	Orthomyxovirus	?? 	

The many faces of TULAREMIA @WuidQ



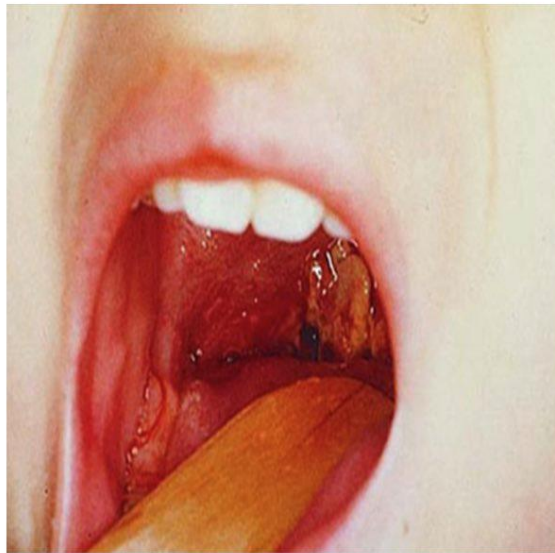
Glandular



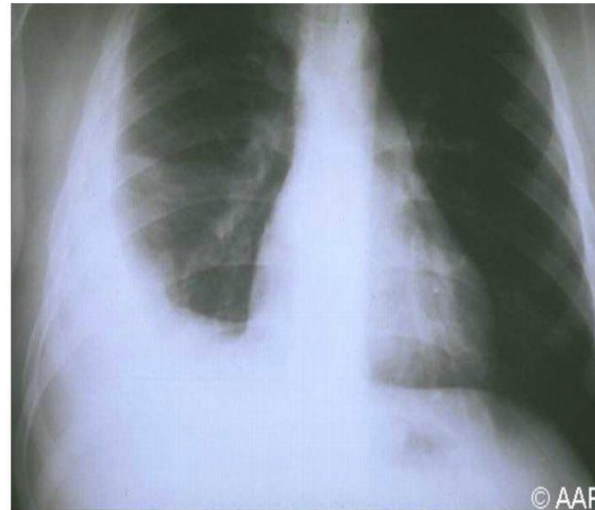
Ulceroglandular



Parinaud's Ulceroglandular



Pharyngeal



Pneumonic



Typhoidal

In the Northeast, upper Midwest @WuidQ

1. <i>Anaplasma</i>	Bacteria		Deer tick (<i>Ixodes scapularis</i>)
2. <i>Lyme disease</i> (<i>Borrelia burgdorferi</i>)	Bacteria		
3. <i>Babesiosis</i> (<i>Babesia microti</i>)	Protozoa		
4. <i>Borrelia miyamotoi</i>	Bacteria		
5. <i>Powassan virus</i>	Virus		

RMSF and tularemia can also be seen



Tick Bite Bot

The Tick Bite Bot is an interactive tool that will assist individuals on removing attached ticks and determining when to seek health care, if appropriate, after a tick bite.

The online mobile-friendly tool asks a series of questions covering topics such as tick attachment time and symptoms. Based on the user's responses, the tool then provides information about recommended actions and resources.



Use the Tick Bite Bot after a tick bite.

A tool to assist people in removing attached ticks and seeking health care, if appropriate, after a tick bite.

[Get Started](#)

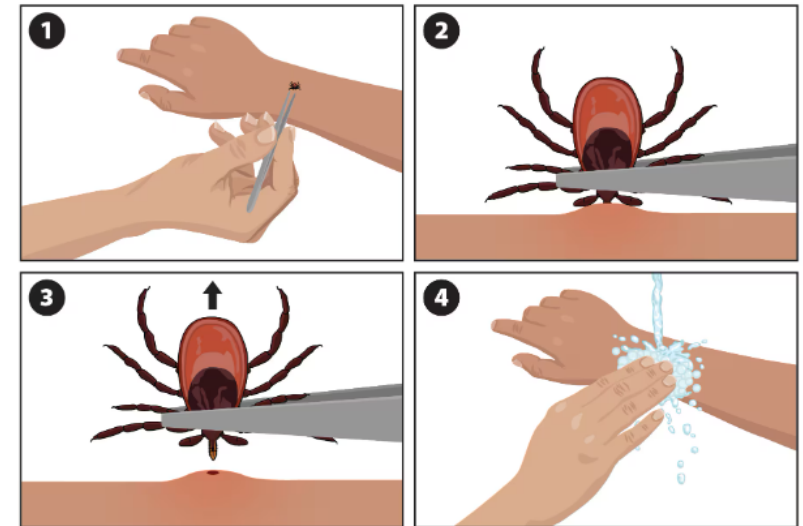
[About the Tool](#)

<https://www.cdc.gov/ticks/after-a-tick-bite/index.html>

How to remove a tick

1. Use clean, fine-tipped tweezers to grasp the tick as close to the skin's surface as possible.
2. 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.
3. After removing the tick, thoroughly clean the bite area and your hands with rubbing alcohol or soap and water.
4. 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, or flushing it down the toilet.

[View Larger](#)





A word of caution

Avoid folklore such as "painting" the tick with nail polish or petroleum jelly, or using heat to make the tick detach from the skin. Your goal is to remove the tick as quickly as possible—not waiting for it to detach.

Avoid: Testing of ticks

People who have removed a tick sometimes wonder if they should have it tested for evidence of infection. Although some commercial groups offer testing, in general this is not recommended, because:

- Laboratories that conduct tick testing are not required to have the high standards of quality control used by clinical diagnostic laboratories. Results of tick testing should not be used for treatment decisions.
- Positive results showing that the tick contains a disease-causing organism do not necessarily mean that you have been infected.
- Negative results can lead to false assurance. You may have been unknowingly bitten by a different tick that was infected.
- If you have been infected, you will probably develop symptoms before results of the tick test are available. If you do become ill, you should not wait for tick testing results before beginning appropriate treatment.

However, you may want to learn to [identify various ticks](#). Different ticks live in different parts of the country and [transmit different diseases](#).



Preventing tick bites on people

Before you go outdoors

- **Know where to expect ticks.** Ticks live in grassy, brushy, or wooded areas, or even on animals. Spending time outside walking your dog, camping, gardening, or hunting could bring you in close contact with ticks. Many people get ticks in their own yard or neighborhood.
- **Treat clothing and gear** with products containing 0.5% permethrin. Permethrin can be used to treat boots, clothing and camping gear and remain protective through several washings. Alternatively, you can buy permethrin-treated clothing and gear.
- **Use [Environmental Protection Agency \(EPA\)-registered insect repellents](#)** [↗](#) containing DEET, picaridin, IR3535, Oil of Lemon Eucalyptus (OLE), para-menthane-diol (PMD), or 2-undecanone. EPA's helpful [search tool](#) [↗](#) can help you find the product that best suits your needs. Always follow product instructions. Do not use products containing OLE or PMD on children under 3 years old.
- **Avoid contact with ticks.** Avoid wooded and brushy areas with high grass and leaf litter. Walk in the center of trails.

TREAT CLOTHING WITH PERMETHRIN



Read label instructions.



Apply in ventilated areas.



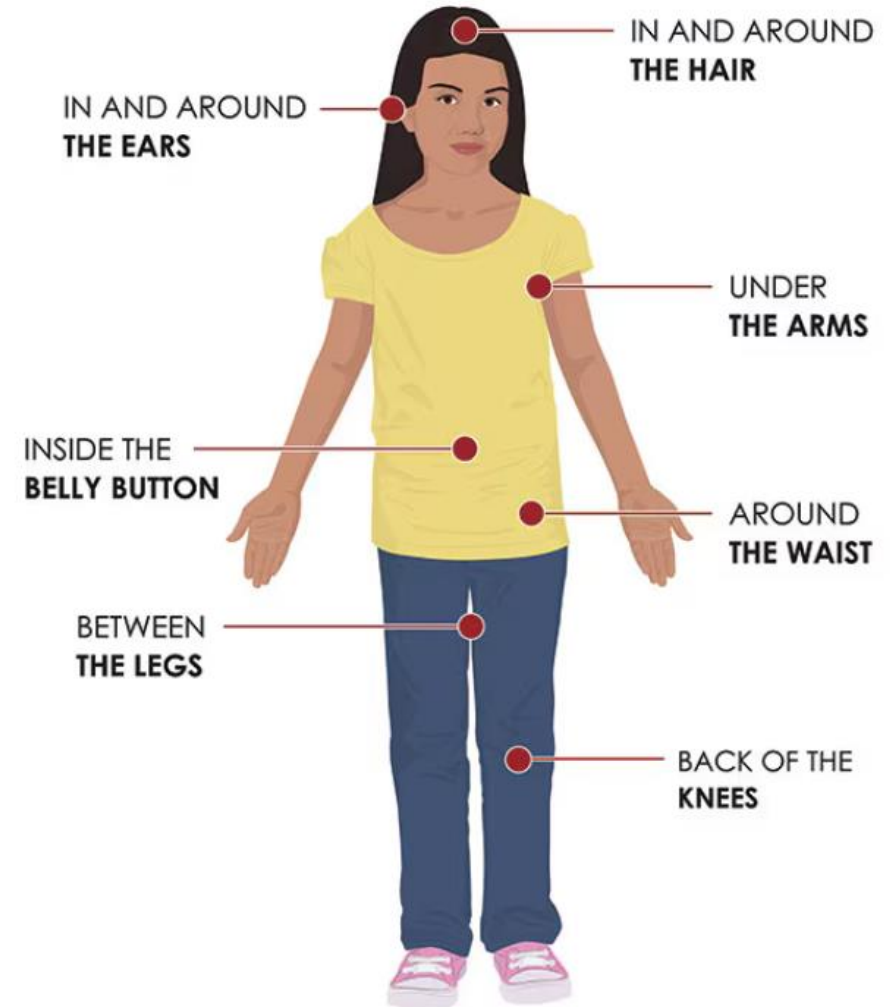
Hang to dry.

Permethrin can be used to treat boots, clothing, and gear and remains protective through several washings. Alternatively, you can buy permethrin-treated clothing and gear.

After you come indoors

Missouri

- **Check your clothing for ticks.** Ticks may be carried into the house on clothing. Any ticks that are found should be removed. Tumble dry clothes in a dryer on high heat for 10 minutes to kill ticks on dry clothing after you come indoors. If the clothes are damp, additional time may be needed. If the clothes require washing first, hot water is recommended. Cold and medium temperature water will not kill ticks.
- **Examine gear and pets.** Ticks can ride into the home on clothing and pets, then attach to a person later, so carefully examine pets, coats, and daypacks.
- **Shower soon after being outdoors.** Showering within two hours of coming indoors has been shown to reduce your risk of getting [Lyme disease](#) and may be effective in reducing the risk of other tickborne diseases. Showering may help wash off unattached ticks and it is a good opportunity to do a tick check.
- **Check your body for ticks after being outdoors.** Conduct a full body check upon return from potentially tick-infested areas, including your own backyard. Use a hand-held or full-length mirror to view **all** parts of your body. Check these parts of your body and your child's body for ticks:
 - Under the arms
 - In and around the ears
 - Inside belly button
 - Back of the knees
 - In and around the hair
 - Between the legs
 - Around the waist



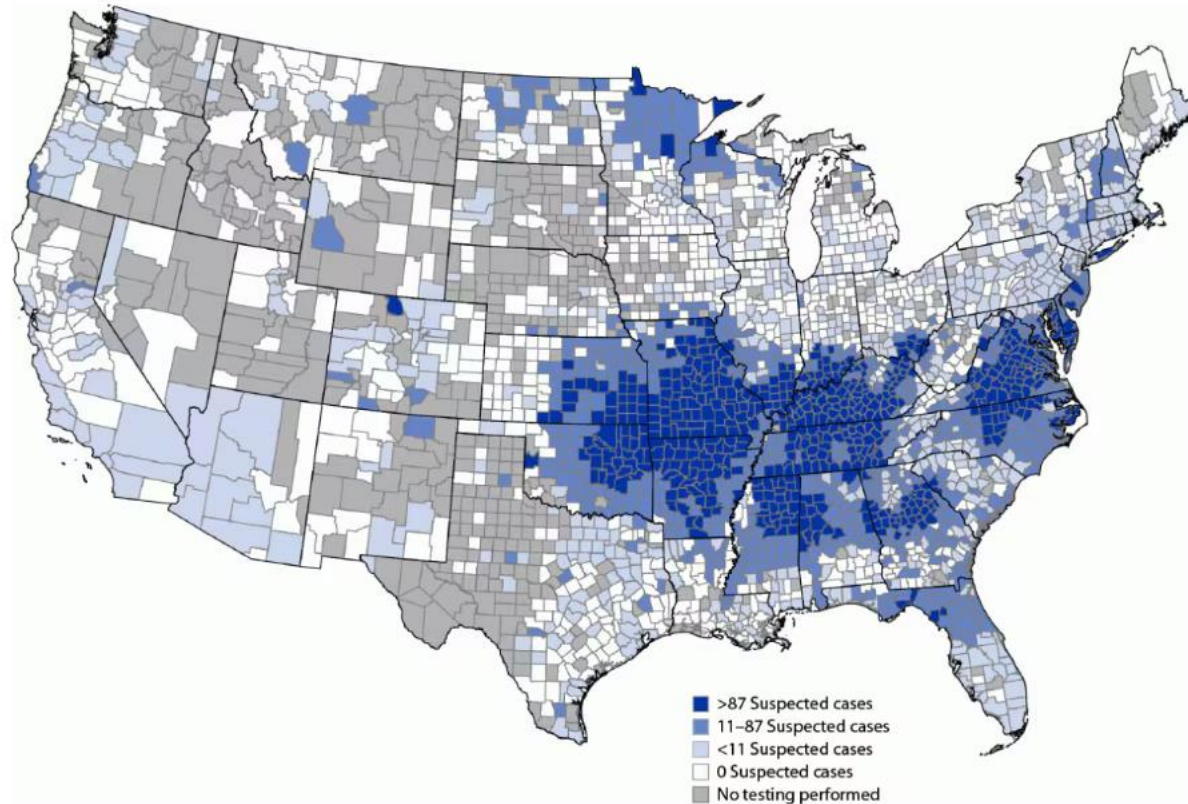


About Alpha-gal Syndrome

KEY POINTS

- Alpha-gal syndrome (AGS) is a serious, potentially life-threatening allergic condition that can occur after a tick bite.
- Alpha-gal is a molecule found in in most mammals.
- Symptoms appear after people eat red meat or are exposed to other products containing alpha-gal.

FIGURE. Geographic distribution of suspected alpha-gal syndrome cases* per 1 million population per year — United States, 2017–2022



Abbreviations: IgE = immunoglobulin E; IU = international unit; kU = kilounit.

* A suspected case of alpha-gal syndrome was defined as being in a person who had confirmatory laboratory evidence (serum or plasma alpha-gal-specific IgE ≥ 0.1 IU/mL or ≥ 0.1 kU/L) with no clinical information available.

What Is Alpha-gal Syndrome?

Alpha-gal syndrome (AGS) is a serious, potentially life-threatening allergic condition that can occur after a tick bite. It's named for a molecule, galactose- α -1,3-galactose, that's found in most mammals.

Symptoms occur after people eat red meat or are exposed to other [products made from mammals](#). Because of this, AGS is also known as red meat allergy or tick bite meat allergy.



The lone star tick is the species mostly associated with AGS, but other kinds of ticks may be involved.

A CDC report showed that between 2010 and 2022, more than 110,000 suspected cases of AGS were identified. However, cases of AGS are not nationally notifiable to CDC, so the actual number of AGS cases in the United States is not known. More data and research are needed to understand how many people are affected by this condition.

Risk factors

AGS is associated with tick bites. In the United States, AGS is primarily associated with the bite of a lone star tick, but other kinds of ticks have not been ruled out.

<https://www.medscape.org/viewarticle/988550>



Regional Aggregate

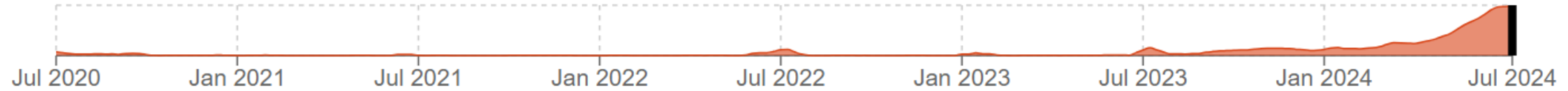
Mycoplasma trends nationwide

RP2.1

United States of America



EpiWeek Ending: July 20, 2024



Mycoplasma pneumoniae



Hashed regions represent insufficient data to display



Regional Aggregate

RP2.1

United States of America

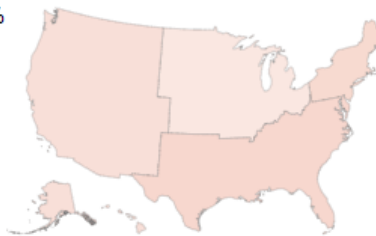
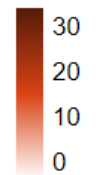


EpiWeek Ending: July 20, 2024



Mycoplasma pneumoniae

Rate %



Northeast 3.0%

Midwest 1.9%

West 2.5%

South 3.2%



Hashed regions represent insufficient data to display

Missouri Telehealth Network

