



Updates and Review of Tickborne Diseases in Nebraska

Jeff Hamik, MPH
Vectorborne Disease Epidemiologist II
Nebraska Department of Health & Human Services

DISCLOSURES

- I have no financial interests or relationships to disclose
- Names or pictures of any commercial products do not represent endorsement of products by the Nebraska Department of Health and Human Services or myself and are purely for informational use only

LEARNING OBJECTIVES



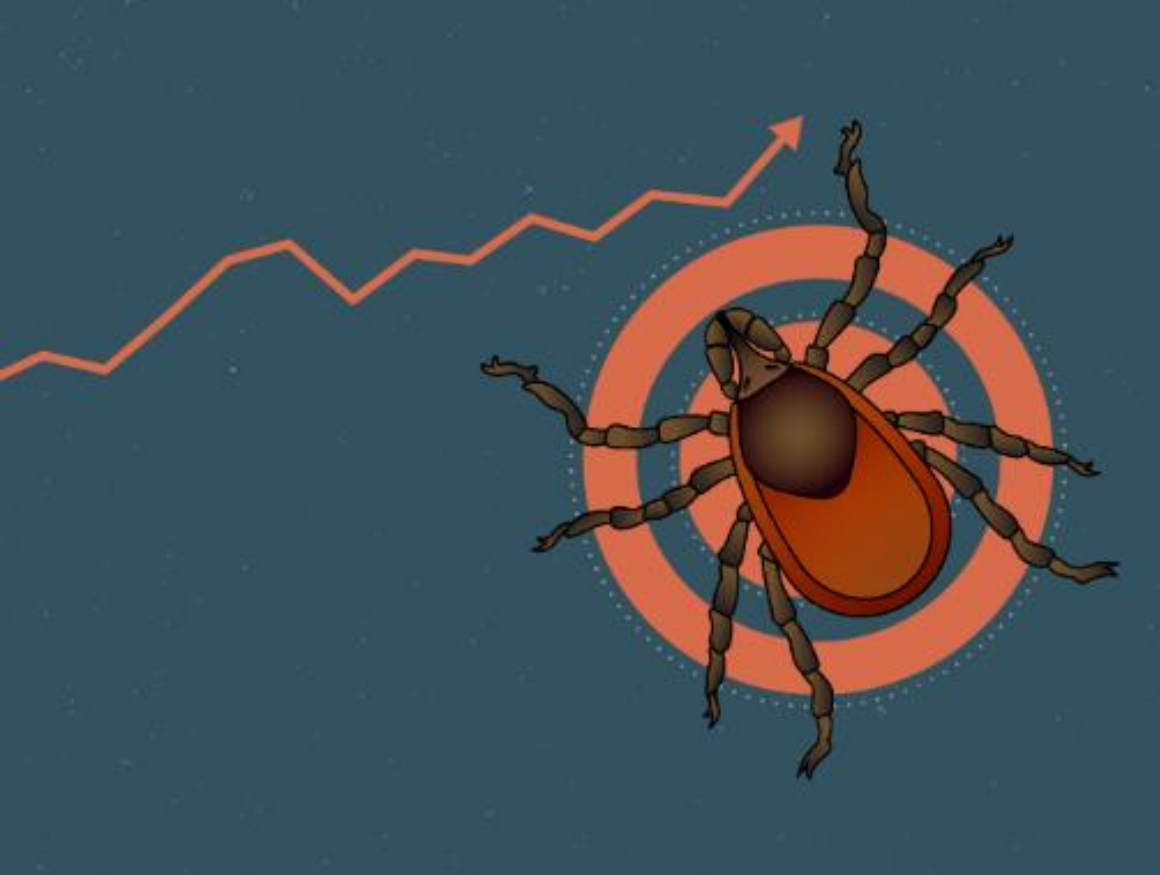
- Identify Tickborne Disease Trends in the United States
- Describe Tick Disease Transmission
- Describe the Epidemiology of Blacklegged Tick-Associated Diseases
- Describe the Epidemiology of Lone Star Tick-Associated Diseases
- Describe the Epidemiology of American Dog Tick-Associated Diseases

Source: Nebraska Department of Health and
Human Services Vector-Borne Disease Program

Why Do We Care?



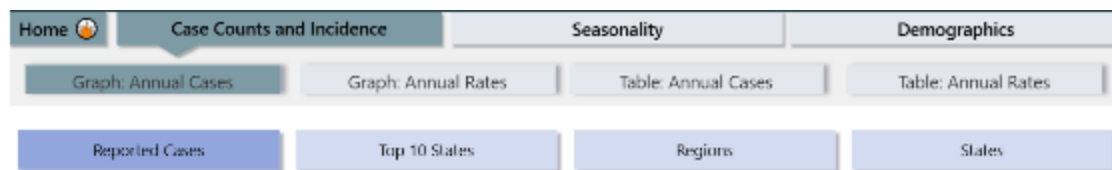
TICKBORNE DISEASES IN THE U.S.



Source: [CDC Train](#)

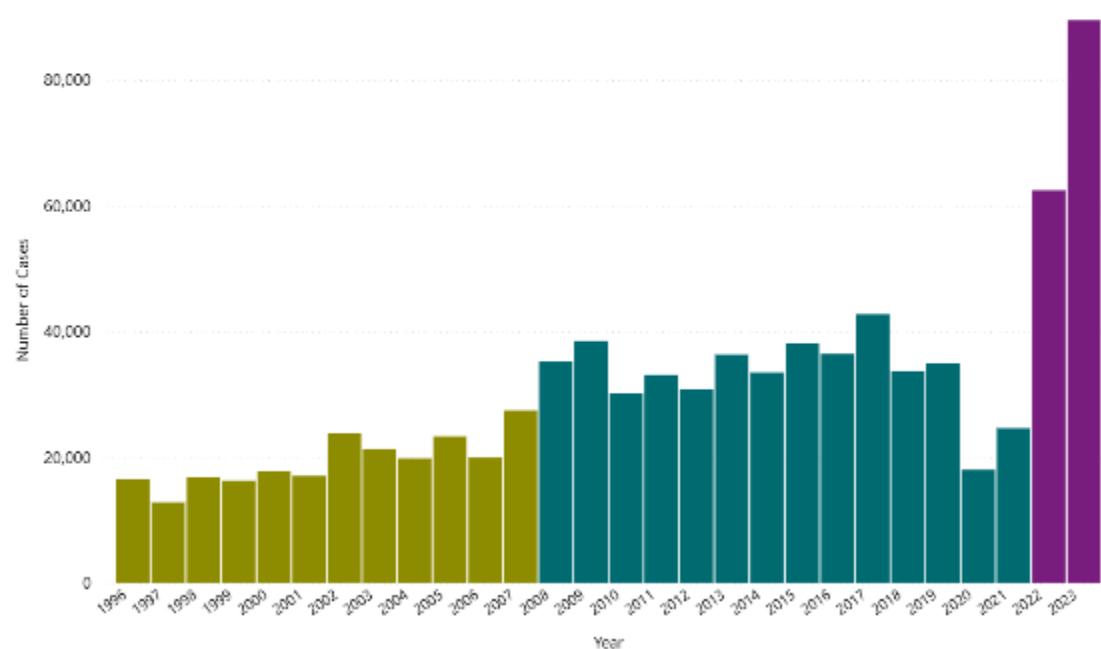
- Tickborne disease cause significant morbidity and mortality in the U.S.
- Ticks transmit **3 out of 4** vector-borne diseases in the United States
- TBD cases have continued to steadily rise

TICKBORNE DISEASES IN THE U.S.



Lyme Disease – Total Reported Cases by Year, United States

● 1996 Case Definition ● 2008 Case Definition ● 2022 Case Definition



* These data were reported according to different Lyme disease case definitions. Only major case definition changes are denoted.

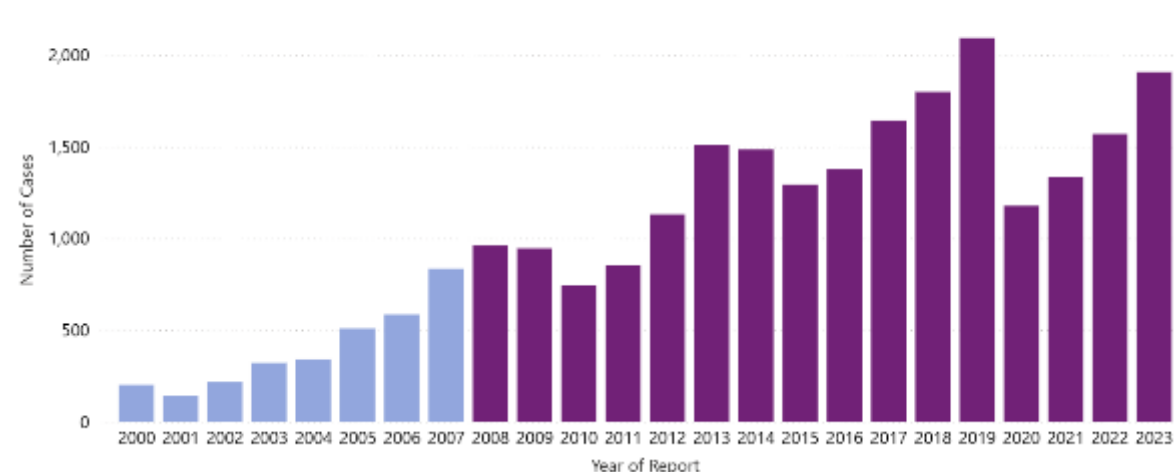


At a Glance

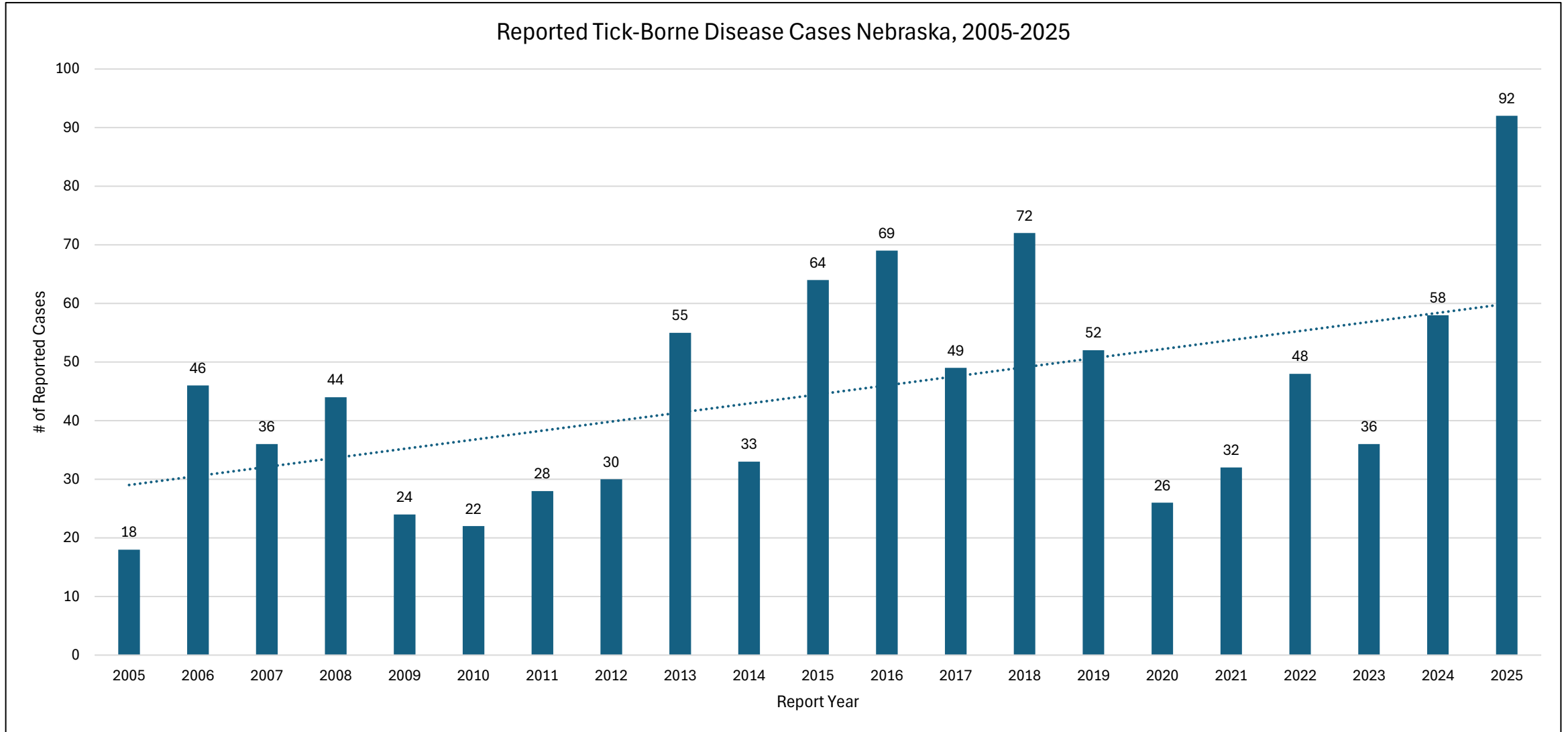
- The number of ehrlichiosis cases due to *E. chaffeensis* reported to CDC has increased steadily since 2000.
- In the year 2000, only 200 cases of ehrlichiosis were reported. In 2019, the number of reported cases rose to 2,093 cases.
- A substantial decrease was seen in 2020. However, due to the coronavirus disease 2019 (COVID-19) pandemic, 2019 and 2020 data may be incomplete. While increasing slightly, reported cases in 2023 remained lower than pre-pandemic levels at 1,907 cases.

Number of reported cases of *Ehrlichia chaffeensis* ehrlichiosis –United States, 2000–2023

● Before 2008 ● After 2008



TICKBORNE DISEASES IN NEBRASKA

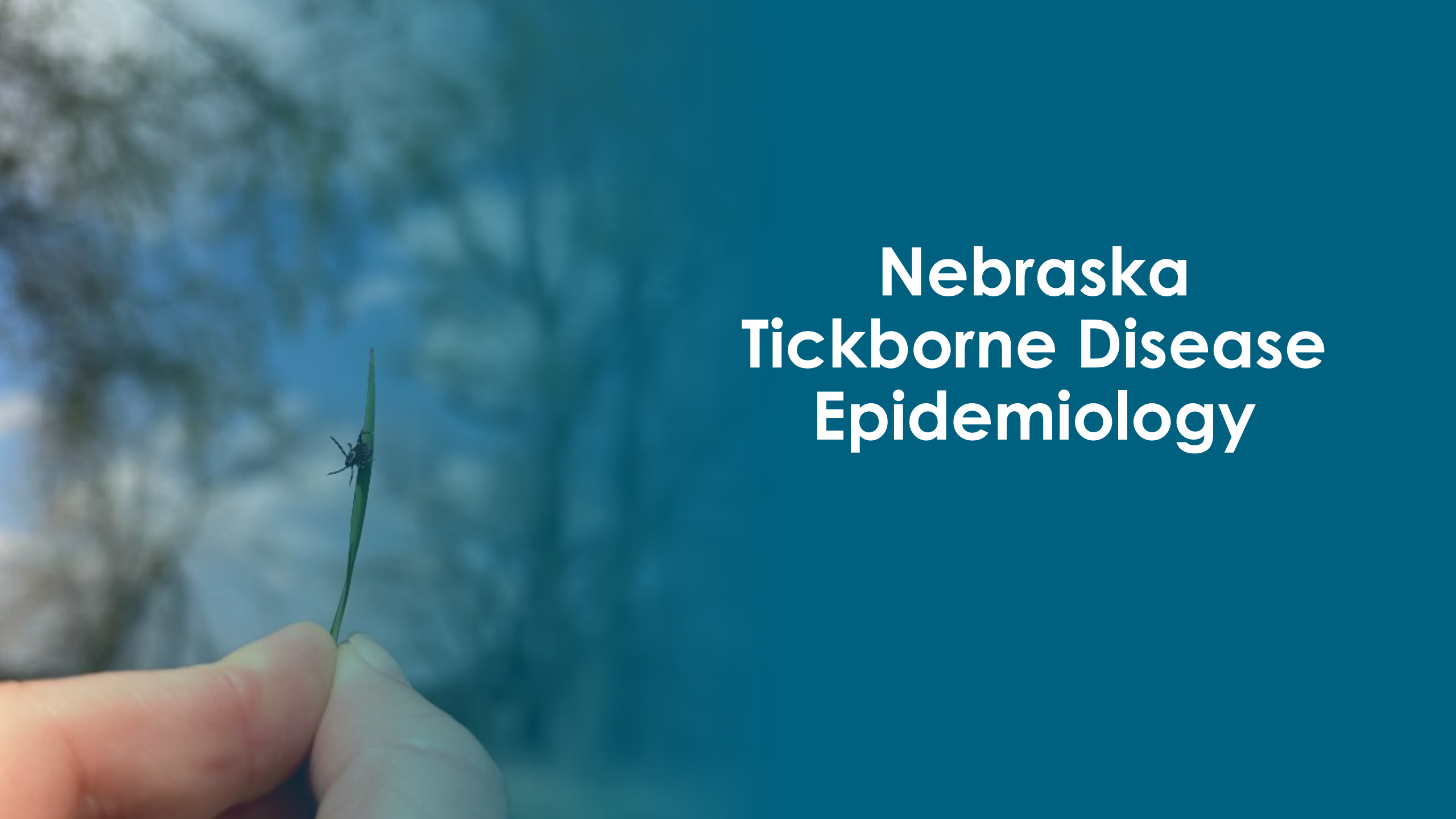


Source: Nebraska Electronic Disease Surveillance System

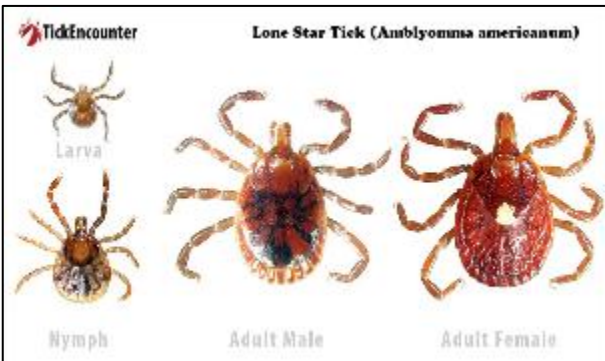
CHECK IN QUESTION

- Tickborne diseases account for what percentage of reported vector-borne disease cases in the United States?
 - 10%
 - 50%
 - 75%
 - 90%

Nebraska Tickborne Disease Epidemiology



MEDICALLY IMPORTANT TICKS



- Ehrlichiosis (*E. chaffeensis* or *E. ewingii*)
- Tularemia (*F. tularensis*)
- Spotted Fever Group Rickettsioses?
- Heartland and Bourbon viruses
- Alpha-gal Syndrome*



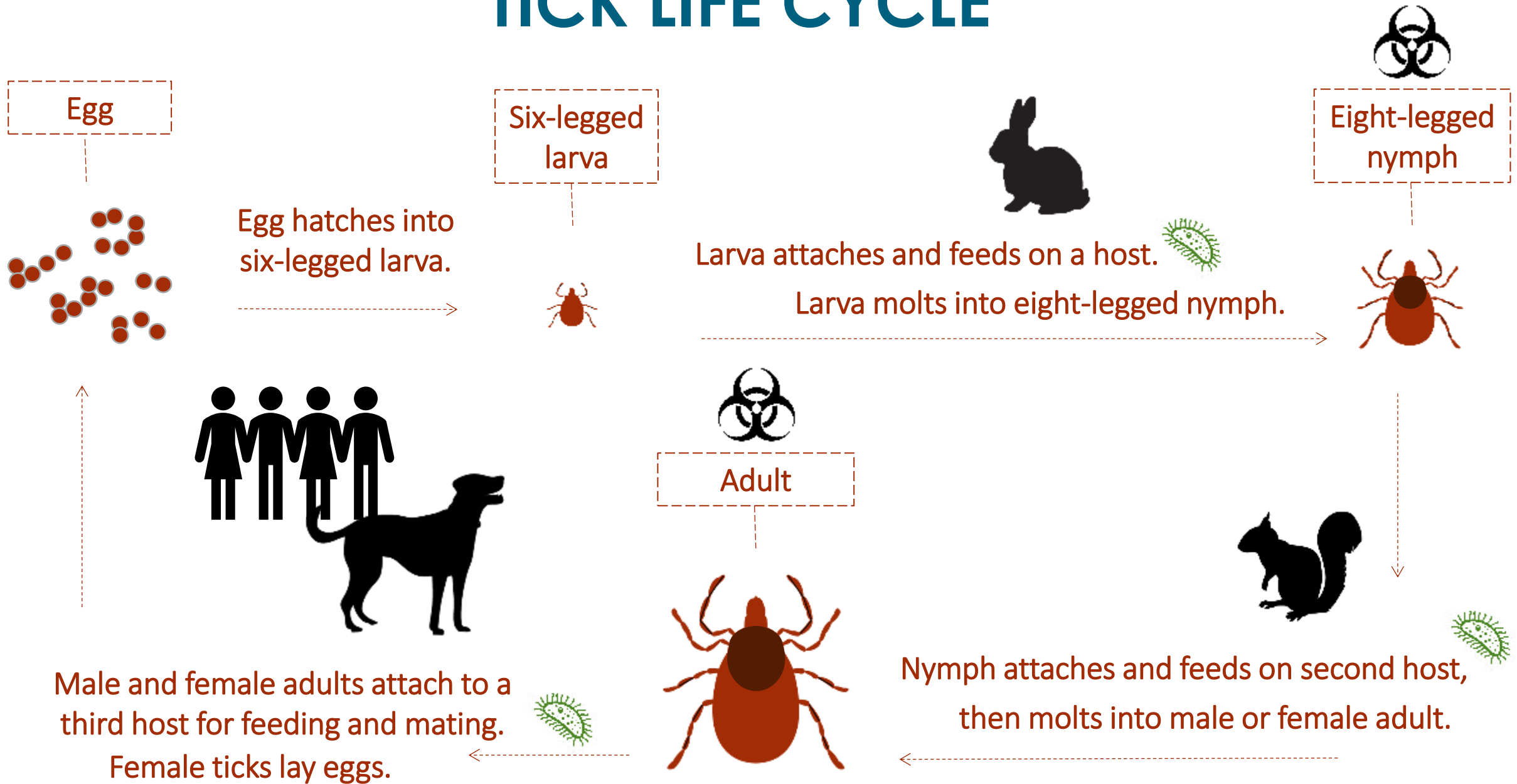
- Ehrlichiosis? (*E. chaffeensis* or *E. ewingii*)
- Anaplasmosis (*A. bovis-like agent*)
- Rocky Mtn Spotted Fever (*R. rickettsii*)
- Spotted Fever Group Rickettsioses?
- Tularemia (*F. tularensis*)



- Anaplasmosis (*A. phagocytophilum*)
- Babesiosis (*B. microti*)
- Ehrlichiosis (*E. muris eauclairensis*)
- Lyme disease (*B. burgdorferi* or *B. mayonii*)
- Tick-borne relapsing fever (*B. miyamotoi*)
- Powassan virus
- Alpha-gal Syndrome*

Source: [Tick Encounter](#)

TICK LIFE CYCLE



TICK QUESTING



- How do ticks find a blood meal?
 - Sense changes in light, temperature, vibrations, and certain chemicals
 - CO2 and heat
 - They “smell” using sensory organs on the front legs
 - Questing behavior
 - DO NOT fall from trees

DISEASE TRANSMISSION



Source: [CDC Train](#)

- Disease transmitted by the bite of an infected tick
- Transmission depends on how long tick has been attached:
 - Lyme disease: 24 – 48 hours
 - Ehrlichiosis: 24 – 48 hours
 - Rocky Mtn Spotted Fever: 6 – 12 hours
 - Tularemia: 48 – 54 hours
 - Viral pathogens: 15 – 30 minutes
 - The longer an infected tick is attached the higher the likelihood it will transmit the pathogen

BLACKLEGGED TICK TRANSMITTED DISEASES



Source: [Tick Encounter](#)

LYME DISEASE: CLINICAL



Source: Dr. Travis Bourret, Creighton University

- Caused by two bacteria
 - *Borrelia burgdorferi* and *Borrelia mayonii*
 - Gram-negative motile spirochete
- Infects tissue
 - Skin
 - Heart
 - Joints
 - CNS
- Onset of symptoms $\approx$ 7 days after tick bite
 - Range 3 – 30 days
- Hospitalization and severe disease more rare
 - Out of every 100 reported cases, 13 with neurologic involvement
 - From 1985 – 2019, 11 fatal Lyme carditis cases reported worldwide.
- Post-Treatment Lyme Disease Syndrome (PTLDS)

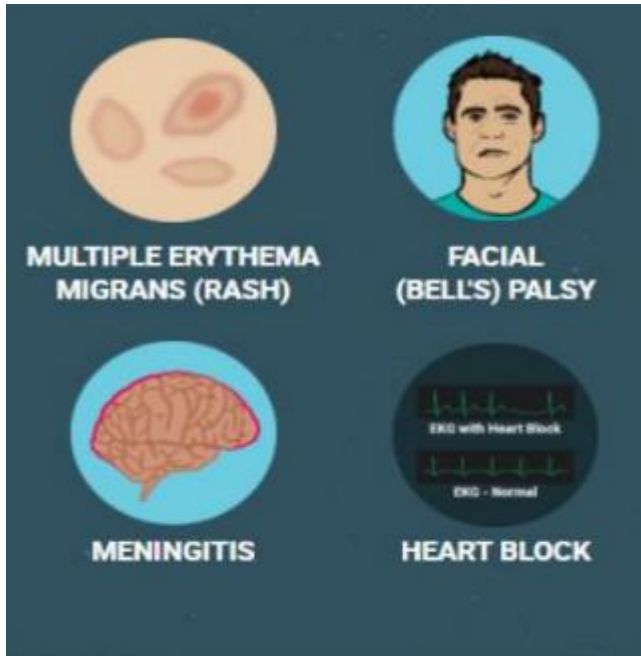
LYME DISEASE SIGNS & SYMPTOMS



Source: Nebraska Department of Health and Human Services Vector-Borne Disease Program

- Multiphase and multisystem
- Early localized ➡ Early disseminated ➡ Late disseminated
- Early localized (within 1 month)
 - Fever, chills, headache, fatigue, myalgias and arthralgias
 - Erythema migrans (EM) rash
 - 70 – 80% of reported infections
 - Begins at tick bite and gradually expands over several days
 - Does not always appear as a “classic” EM rash (bullseye shape)

LYME DISEASE SIGNS & SYMPTOMS



- Early disseminated (1 – 3 months)
 - Severe headache and neck stiffness
 - Additional EM rashes on other areas of the body
 - Facial palsy
 - Meningitis (Neurologic Lyme disease)
 - Heart palpitations or irregular heartbeat (Lyme carditis)
- Late disseminated (3 months or more)
 - Arthritis



Source: [CDC Train](#)

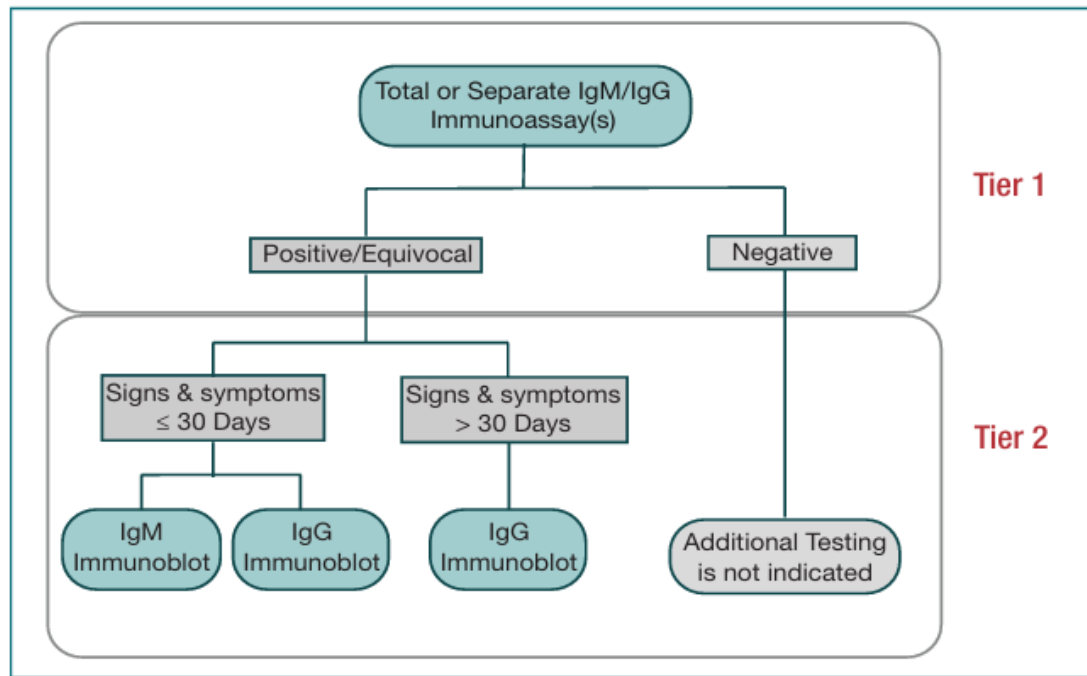
LYME DISEASE: TESTING



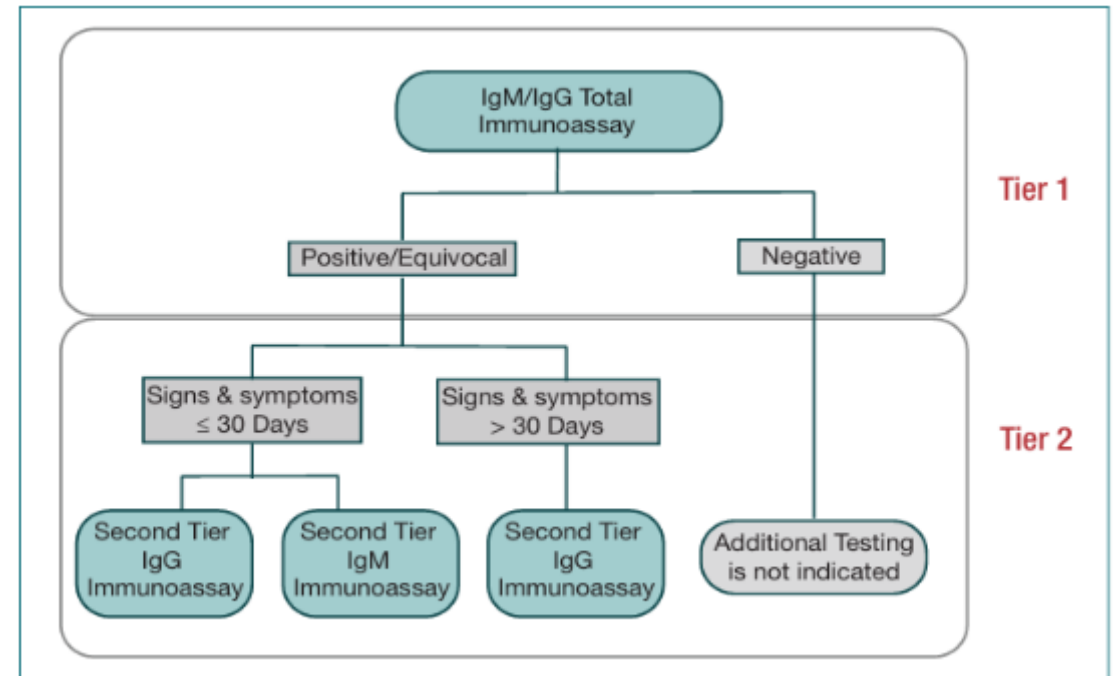
- Two-step testing process is the current recommended testing for Lyme disease
 - Standard two-tier test
 - Modified two-tier test
 - Designed to detect antibodies
 - May take several weeks for antibodies to develop, so patients may test negative if infected recently
 - Antibodies may persist for months to years; tests cannot be used to determine cure
 - Infection with other diseases (including some tickborne) or autoimmune diseases can result in false positives
- Detection of DNA by PCR?
 - Low sensitivity
 - May be useful in detecting *B. burgdorferi* in skin biopsy or synovial fluid specimens

LYME DISEASE: TESTING

- FDA cleared antibody testing
 - Standard two-tier testing
 - Modified two-tier testing



Standard two-tier test



Modified two-tier test

LYME DISEASE: TREATMENT

Age Category	Drug	Dosage	Maximum	Duration, Days*	References
Adults	Doxycycline OR	100 mg, twice per day orally	N/A	10-14	1-6
	Amoxicillin OR	500 mg, three times per day orally	N/A	14	1, 3, 6
	Cefuroxime	500 mg, twice per day orally	N/A		
Children	Doxycycline OR	4.4 mg/kg per day orally, divided into 2 doses	100 mg per dose		
	Amoxicillin OR	50 mg/kg per day orally, divided into 3 doses	500 mg per dose		
	Cefuroxime	30 mg/kg per day orally, divided into 2 doses	500 mg per dose		

Treatment regimens for localized (early) Lyme disease.

Age Category	Drug	Dosage	Maximum	Duration (Days)	References
Adults	Doxycycline	100 mg, twice per day orally	N/A	14-21	2,3
Children (any age)	Doxycycline	4.4 mg/kg per day orally, divided into 2 doses	100 mg per dose	14-21	2,3

Table 1. Facial palsy treatment regimen

Age Category	Drug	Dosage	Maximum	Duration (Days)	References
Adults	Doxycycline OR	200 mg per day orally, divided into 1 or 2 doses	N/A	14-21	3,5
	Ceftriaxone*	2 grams intravenously, once a day	N/A	14-21	5
Children (any age)	Doxycycline OR	4.4 mg/kg per day orally, divided into 1 or 2 doses	100 mg per dose	14-21	1,3
	Ceftriaxone*	50-75 mg/kg intravenously once a day	2 g per day	14-21	4

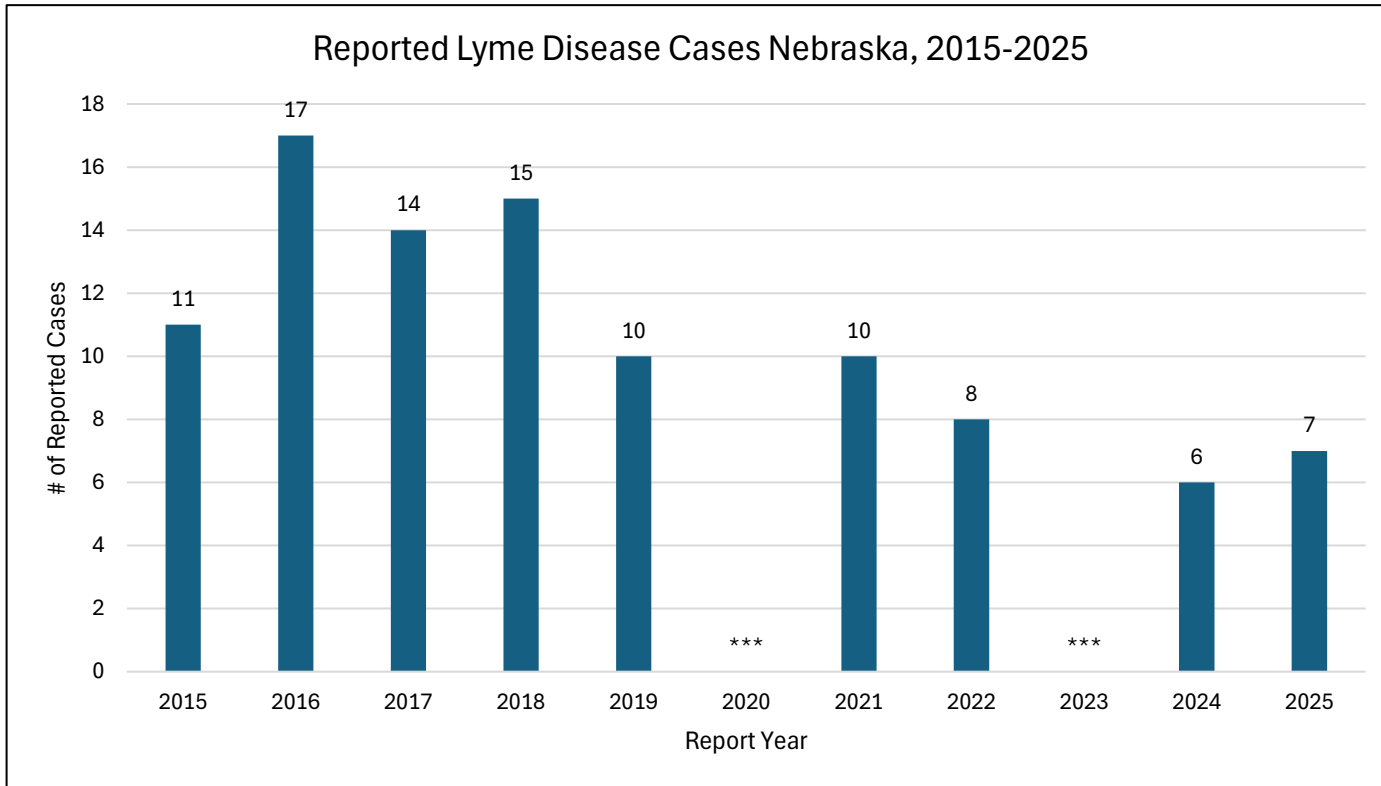
Table 2. Lyme meningitis or radiculoneuritis treatment regimen

* Oral therapy can be substituted when the patient is stabilized or discharged to complete the course.

- Most cases can be treated with 10 – 14 days of antibiotics (e.g., doxycycline, amoxicillin, or cefuroxime axetil)
- Early diagnosis and proper antibiotic treatment help prevent more severe disease

Source: [CDC Lyme Disease Treatment Best Practices](#)

LYME DISEASE: REPORTED CASES

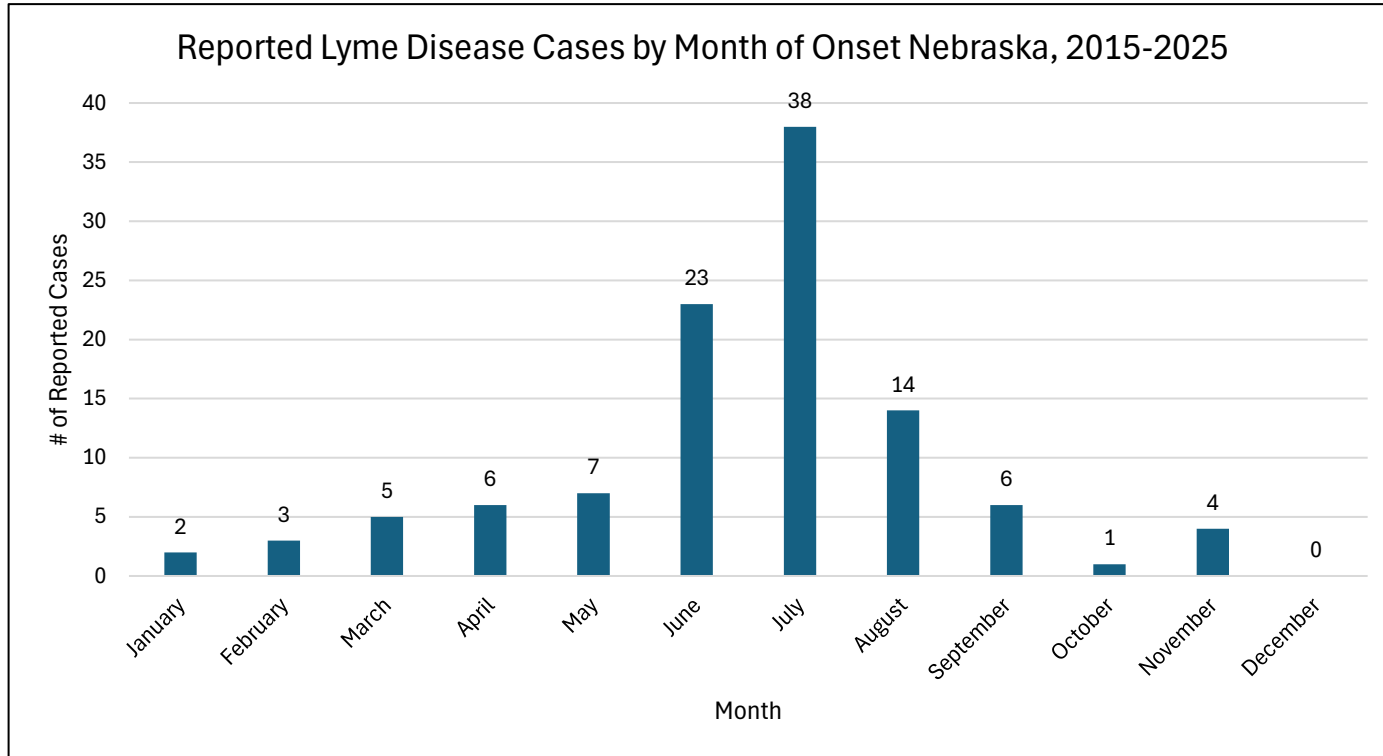


***Unable to report due to small numbers (n = <6)

Source: Nebraska Electronic Disease Surveillance System

- Nebraska reported a median of 10 cases per year during 2015 – 2025
 - 68% of cases travel related
 - 18% unable to determine exposure location
 - 14% local acquired
- 2021 was first time locally acquired Lyme disease cases with definitive evidence were shown to have been acquired in Nebraska
- Significant case definition update in 2022

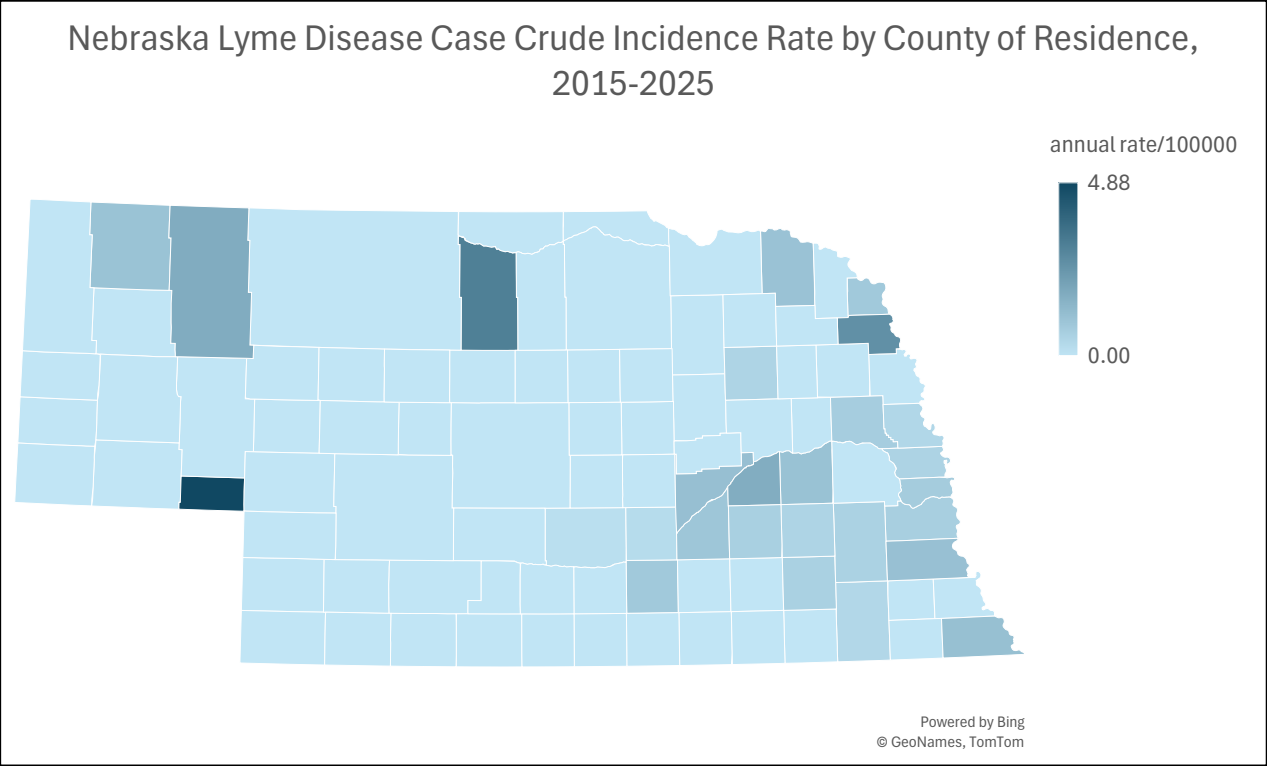
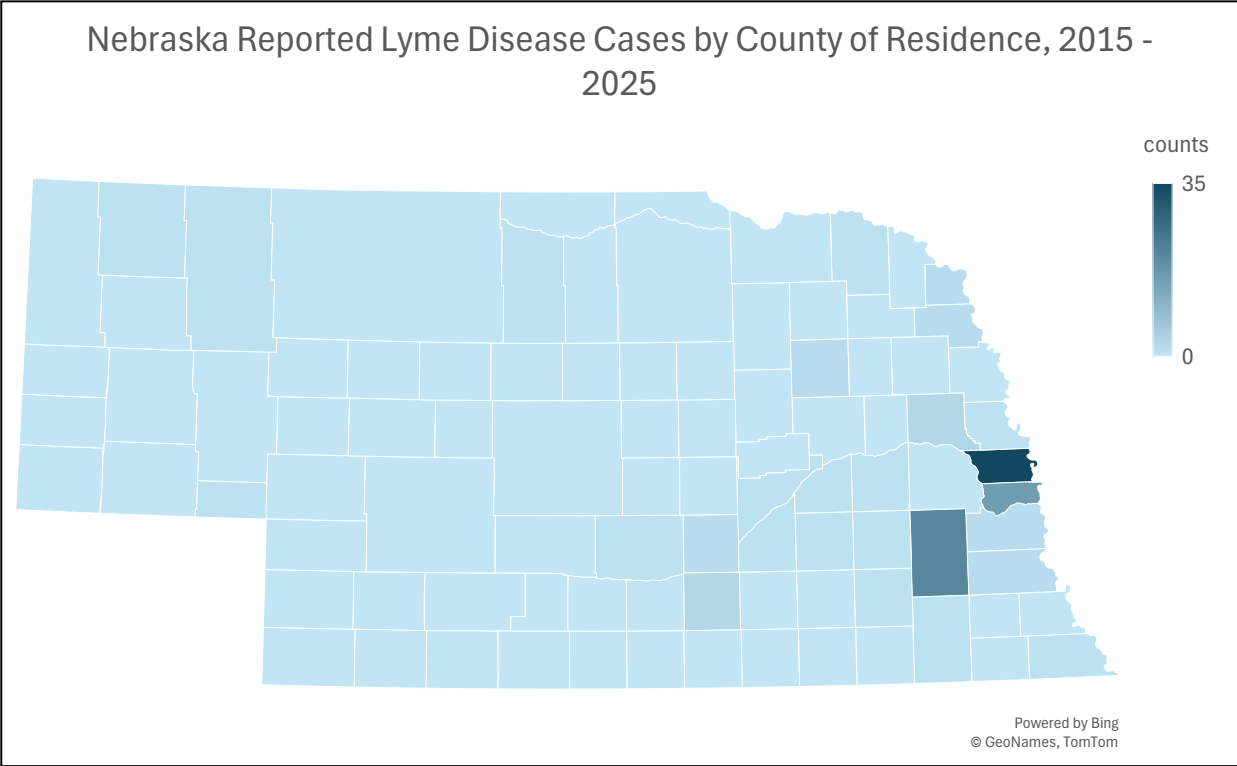
LYME DISEASE: REPORTED CASES



Source: Nebraska Electronic Disease Surveillance System

- 70% of cases are reported during the summer months
- July is usually the month with the most reported cases
 - Due to infections transmitted by the nymphal life stage of tick vector
 - Very small and hard to see if they get onto a person

LYME DISEASE: REPORTED CASES



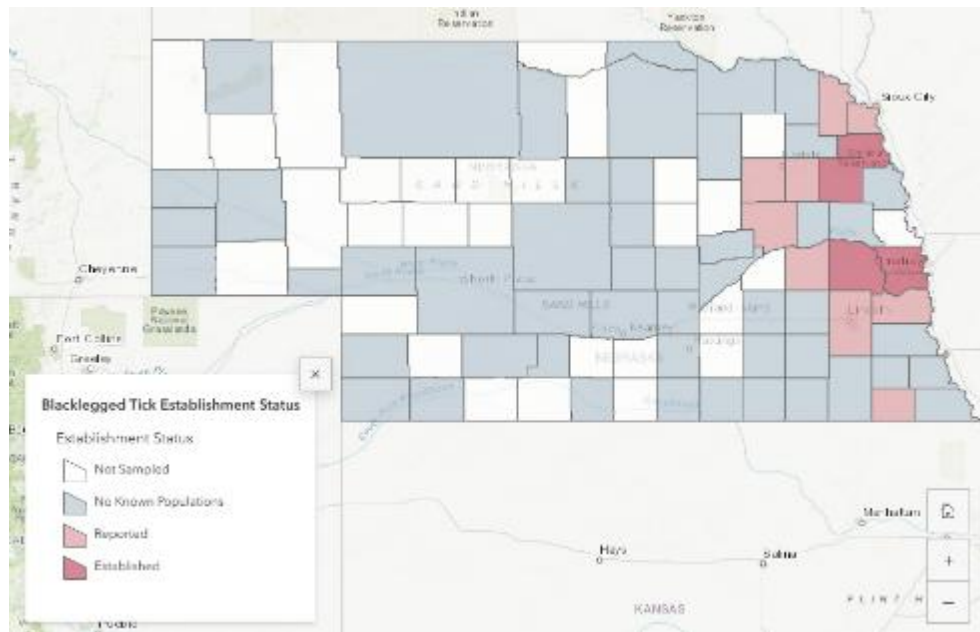
Source: Nebraska Electronic Disease Surveillance System

LYME DISEASE: TICK VECTOR



Source: [Tick Encounter](#)

- Lyme disease vector:
 - *Ixodes scapularis* (blacklegged or deer tick)
 - Found in the eastern part of the U.S.
 - Vector of Lyme disease in Nebraska
 - Responsible for most reported Lyme disease cases in the U.S.
 - *Ixodes pacificus* (western blacklegged tick)
 - Found in the western part of the U.S.
 - Responsible for Lyme disease cases that occur in Pacific coastal states



Source: [Nebraska Department of Health and Human Services Tick Surveillance Maps](#)

LYME DISEASE: TICK VECTOR



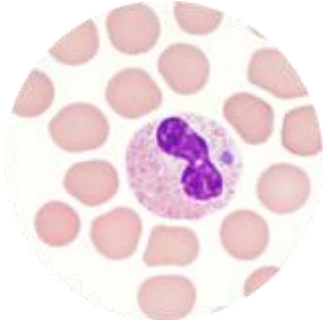
- *B. burgdorferi sensu stricto* prevalence in blacklegged ticks in Nebraska:
 - Statewide: 22.6% (18.8 – 26.9)
 - Thurston County: 56.6% (49.0 – 64.0)

Source: [Nebraska Department of Health and Human Services Tick Surveillance Maps](#)

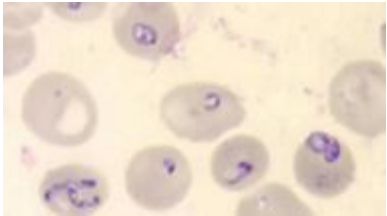
CHECK IN QUESTION

- What blacklegged tick life stage is responsible for most Lyme disease transmission?
 - Eggs
 - Larvae
 - Nymphs
 - Adults

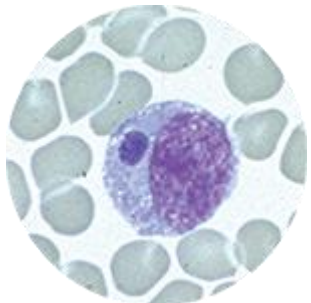
OTHER DISEASES



- Anaplasmosis (Human Granulocytic Anaplasmosis – HGA)
 - Caused by *Anaplasma phagocytophilum* (human active strain – HAS)
 - Very few cases reported in Nebraska residents (<1 per year)
 - No locally transmitted cases
 - *A. phagocytophilum* (non-human active strain variant 1 – V1) detected in blacklegged ticks collected in Nebraska
 - Does not cause human disease

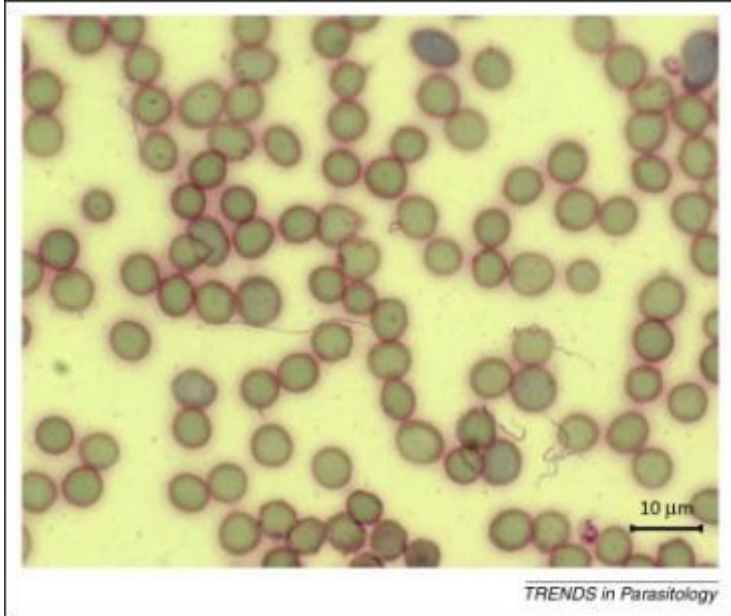


- Babesiosis
 - Caused by *Babesia microti*
 - Rarely reported in Nebraska resident (<1 per year)
 - No locally transmitted cases
 - No detections in blacklegged ticks collected in Nebraska



- Ehrlichiosis
 - Caused *Ehrlichia muris eauclairensis*
 - No cases reported in Nebraska residents
 - No detection in blacklegged ticks collected in Nebraska

BORRELIA MIYAMOTOI: EMERGING PATHOGEN



Source: Wagemakers, A., Staarink, P.J., Sprong, H., & Hovius, J.W.R. *Borrelia miyamotoi*: a widespread tick-borne relapsing fever spirochete. *Trends in Parasitology*: 31(6), 260-269 (2015).

<https://doi.org/10.1016/j.pt.2015.03.008>

- Causative agent of Hard Tick Relapsing Fever (HTRF)
- First identified in 1995 in ticks from Japan
- In the United States it occurs in upper Midwest, Northeast, and mid-Atlantic states.
- Appears less common than Lyme disease
 - True burden still being evaluated
 - Not nationally notifiable (not reportable in Nebraska)
- Incubation period of 3 days to 2 weeks
 - Potentially up to 6 weeks

HTRF SIGNS & SYMPTOMS



- Common signs and symptoms
 - Fever
 - Most cases involve single episode of fever
 - ~10% of cases documented with relapsing fever
 - Chills/Shakes
 - Nausea/Vomiting
 - Headache
 - Myalgia/Arthralgia

HTRF LAB FINDINGS



- Molecular lab diagnosis
 - Detection of DNA by PCR
 - Available at some commercial laboratories
 - Specimens should be collected while patient is symptomatic
 - Most sensitive if specimen is collected before or within 48 hours of antibiotic therapy
 - A positive result is confirmatory, but a negative result does not rule out the possibility of infection
- Serological lab diagnosis
 - Immunoassay
 - Available at some commercial laboratories
 - Results are most sensitive when specimens collected ≥ 14 days after symptom onset
 - May cross-react with other *Borrelia* species

HTRF: TREATMENT



Source: [CDC Lyme Disease Treatment and Intervention Webpage](#)

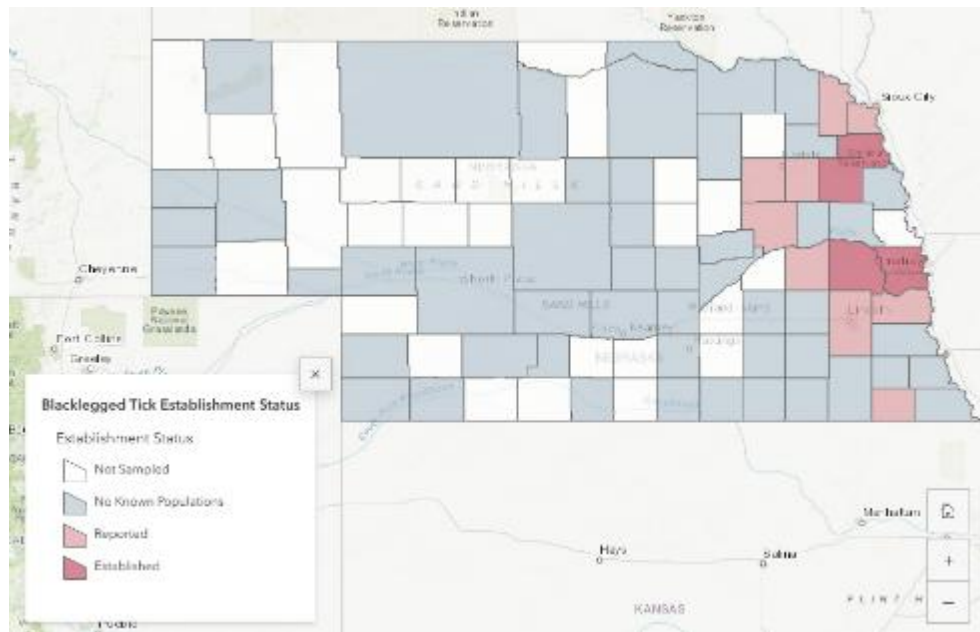
- No randomized controlled trials to evaluate treatment regimens
- In published case series, success with antibiotics effective for Lyme disease
 - 2-week course of oral doxycycline or amoxicillin seems effective for most patients (including young children)
 - Severe illness (e.g., meningoencephalitis) IV antibiotics (i.e., ceftriaxone) are appropriate initial therapy
- Symptoms improve 24 – 72 hours following treatment with antibiotics

HTRF: TICK VECTOR



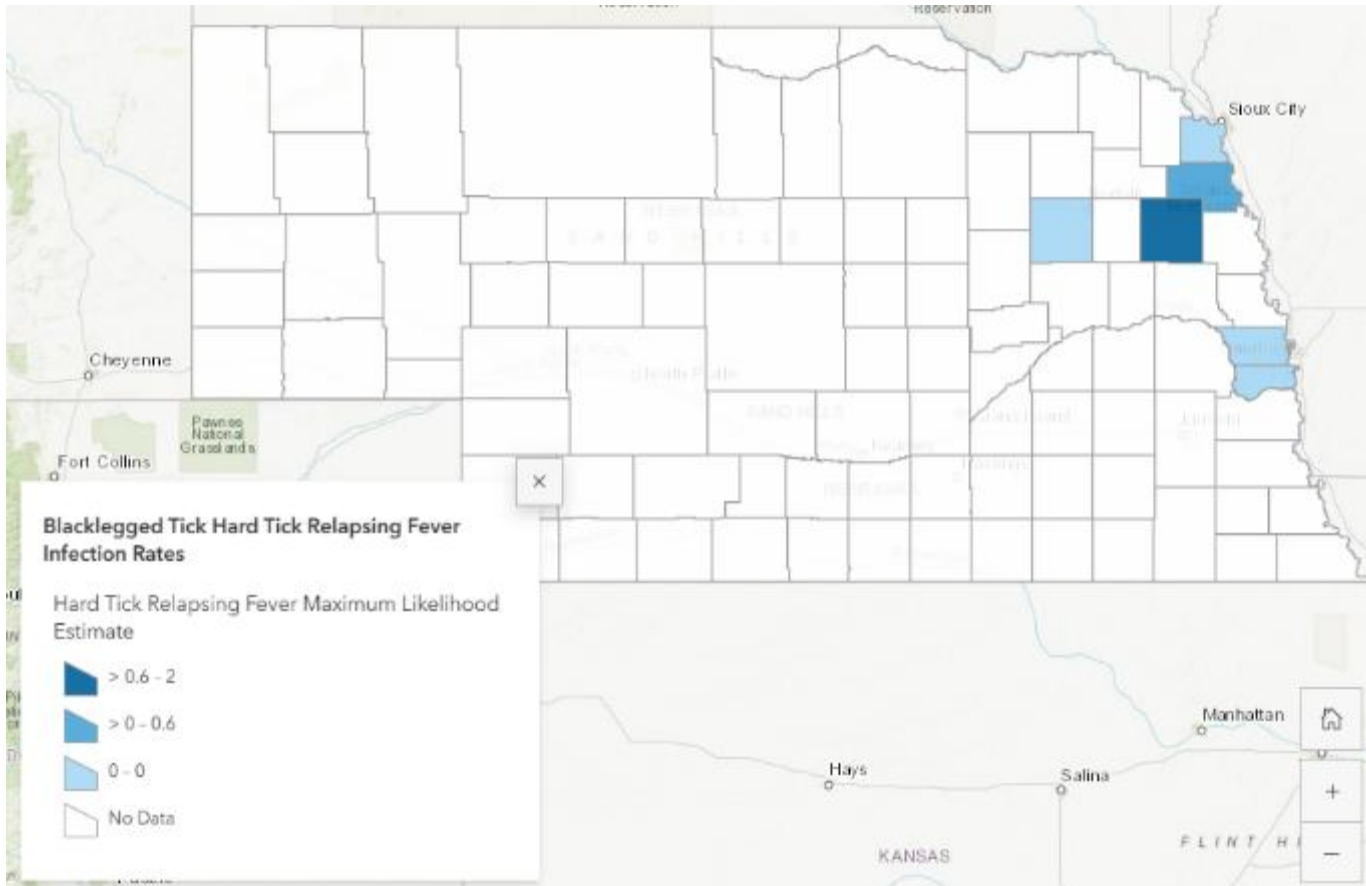
Source: [Tick Encounter](#)

- Lyme disease vector:
 - *Ixodes scapularis* (blacklegged or deer tick)
 - Found in the eastern part of the U.S.
 - Vector of Lyme disease in Nebraska
 - Responsible for most reported Lyme disease cases in the U.S.



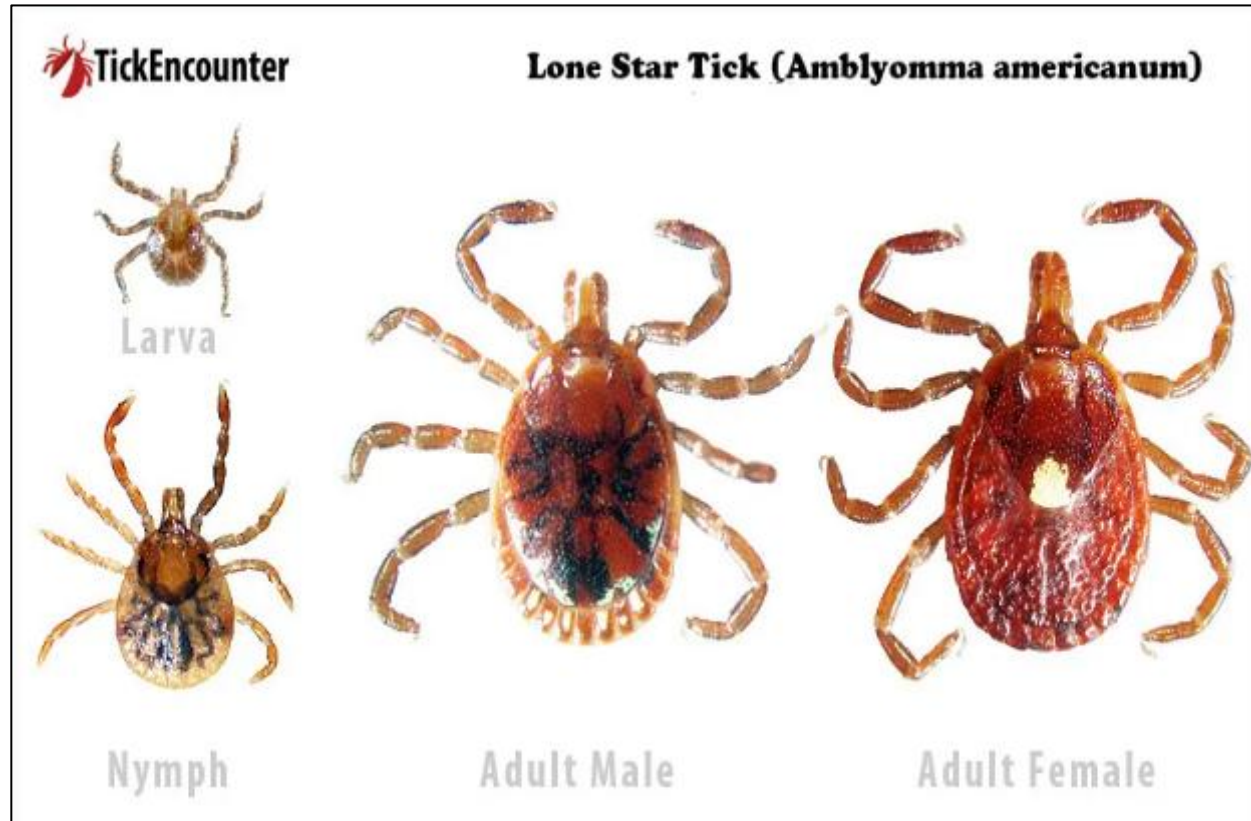
Source: [Nebraska Department of Health and Human Services Tick Surveillance Maps](#)

HRTF: TICK VECTOR



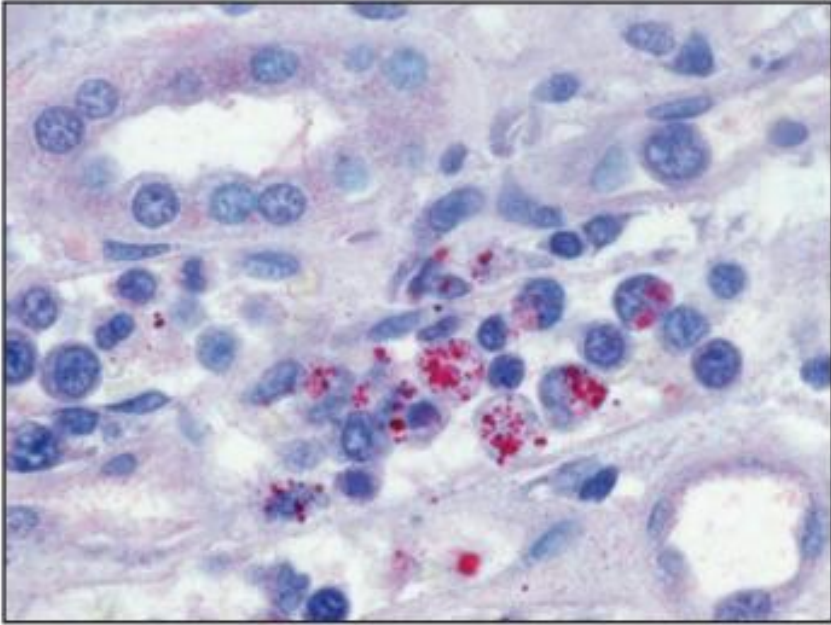
- *B. miyamotoi* prevalence in blacklegged ticks in Nebraska:
 - Statewide (n = 415): 0.5% (0.1 – 1.6)
 - Cuming County (n = 49): 2.0% (0.1 – 9.4)
 - Thurston County (n = 166): 0.6% (0.6 – 2.9)

LONESTAR TICK TRANSMITTED DISEASES



Source: [Tick Encounter](#)

EHRlichiosis: CLINICAL



Source: [CDC Diagnosis and Management of Tickborne Rickettsial Disease – A practical Guide for Health Care and Public Health Professionals](#)

- Caused by two bacteria
 - *Ehrlichia chaffeensis* and *Ehrlichia ewingii*
 - Gram-negative obligate intracellular bacteria
- Infects peripheral blood leukocytes
- Unlike RMSF, direct vasculitis and endothelial injury are rare
- Symptoms appear ≈9 days after a tick bite
 - Range of 5 – 14 days
- Can cause severe disease or death
 - Lower rates than RMSF
 - 3% case fatality rate in hospitalized patients
- Disease severity
 - In part depends on age and immune status
- [CDC Diagnosis and Management of Tickborne Rickettsial Diseases- A Practical Guide for Health Care and Public Health Professionals](#)

Credit: CDC

EHRlichiosis Signs & Symptoms



- Common signs and symptoms
 - Fever (96%), Headache (72%), Malaise (77%), Myalgia (68%)
- Gastrointestinal manifestations can be prominent
 - Nausea (57%), Vomiting (47%), Diarrhea (25%)
- Rash
 - Reported in 33% of patients
 - More common in children
 - Petechial and maculopapular to diffuse erythema
 - Typically occur a median of 5 days after illness onset
 - Involves extremities and trunk but may also affect palms, soles, or face
- Respiratory
 - Reported in 28% of patients
 - More common in adults
- Neurological
 - Meningitis or meningoencephalitis in 20% of patients

EHRLICHIOSIS LAB FINDINGS



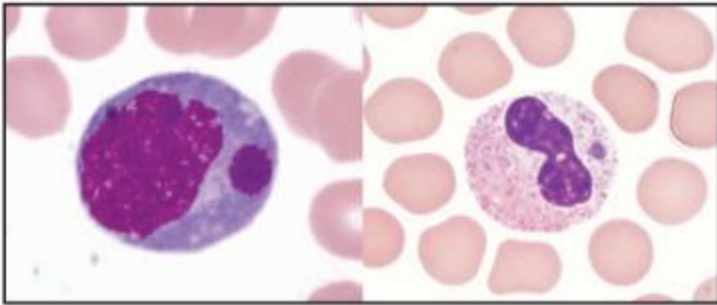
- General lab findings:
 - Thrombocytopenia
 - Leukopenia (absolute)
 - Anemia (later in illness)
 - Elevated hepatic transaminases (mild to moderate)
- Molecular lab diagnosis
 - Detection of DNA by PCR great option for early-stage disease (≤ 7 days post onset)
 - Specimens should be collected while patient is symptomatic
 - Most sensitive if specimen is collected before or within 48 hours of antibiotic therapy
 - A positive result is confirmatory, but a negative result does not rule out the possibility of infection
 - [Rickettsial Disease Diagnostic Testing and Interpretation](#)

EHRlichiosis LAB FINDINGS



Source: [CDC Ehrlichiosis Testing and Diagnosis Website](#)

- Serological lab diagnosis
 - Indirect immunofluorescence antibody (IFA)
 - IgG IFA are the recommended method
 - IgM assays are less specific (more false positives)
 - IFAs are less sensitive during the first week of illness
 - Many will be negative in the first week of illness
 - Recommend paired acute (collected in first week) and convalescent (collected 2 – 4 weeks later) specimens



- Blood-smear microscopy
 - Might reveal presence of morulae in infected leukocytes is highly supportive evidence of infection
 - Insensitive and inconsistent
 - Cannot identify an *Ehrlichia* species

Source: [CDC Diagnosis and Management of Tickborne Rickettsial Disease – A practical Guide for Health Care and Public Health Professionals](#)

EHRlichiosis: TREATMENT



Source: [CDC Treatment of Ehrlichiosis Page](#)

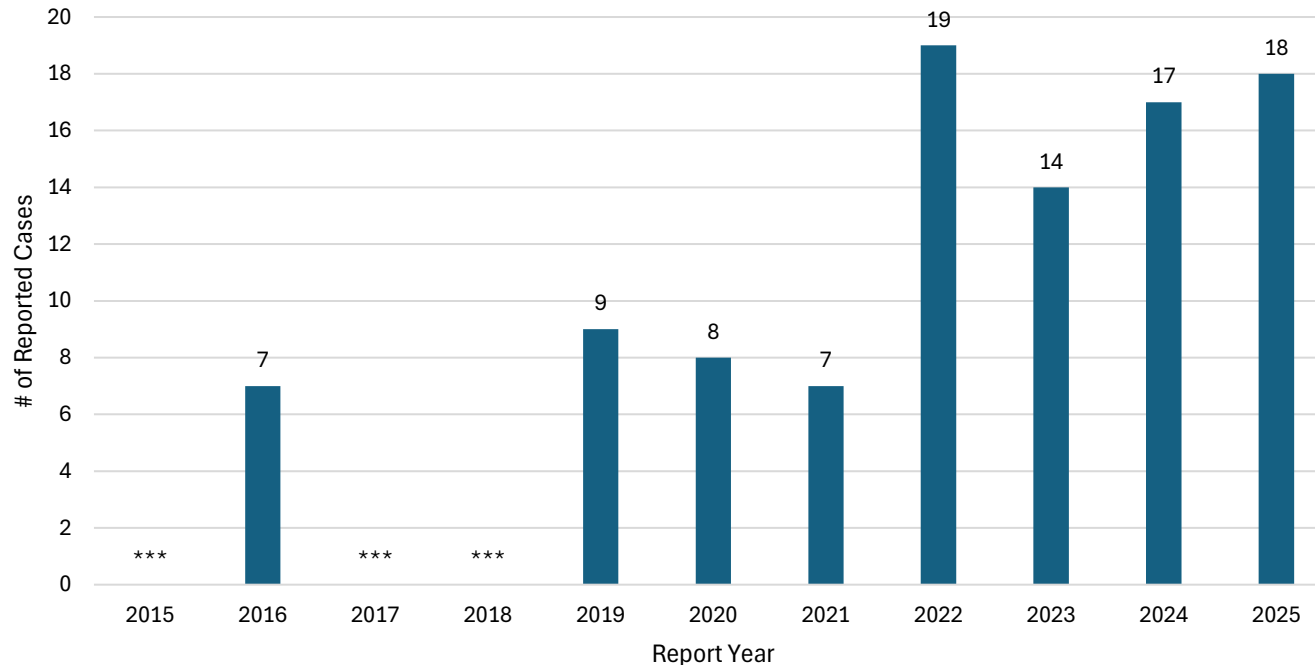
- Most cases can be treated with minimum of 5 – 7 days of doxycycline
- Early diagnosis and proper antibiotic treatment help prevent more severe disease or death
- **Doxycycline** is the **only antibacterial agent recommended** treatment for suspected infection in both adults and children
 - Concern about tooth staining in children
 - American Academy of Pediatrics and CDC recommend treatment with doxycycline
 - Research has shown no evidence that doxycycline cause tooth staining in children
- [Research: Doxycycline and Tooth Staining](#)

CHECK IN QUESTION

- What lab diagnostic option can be used to detect and diagnosing ehrlichiosis ≤ 7 days post onset?
 - Culture
 - IgG IFA Serology
 - IgM IFA Serology
 - PCR

EHRlichiosis: REPORTED CASES

Reported Ehrlichiosis Cases Nebraska, 2015-2025

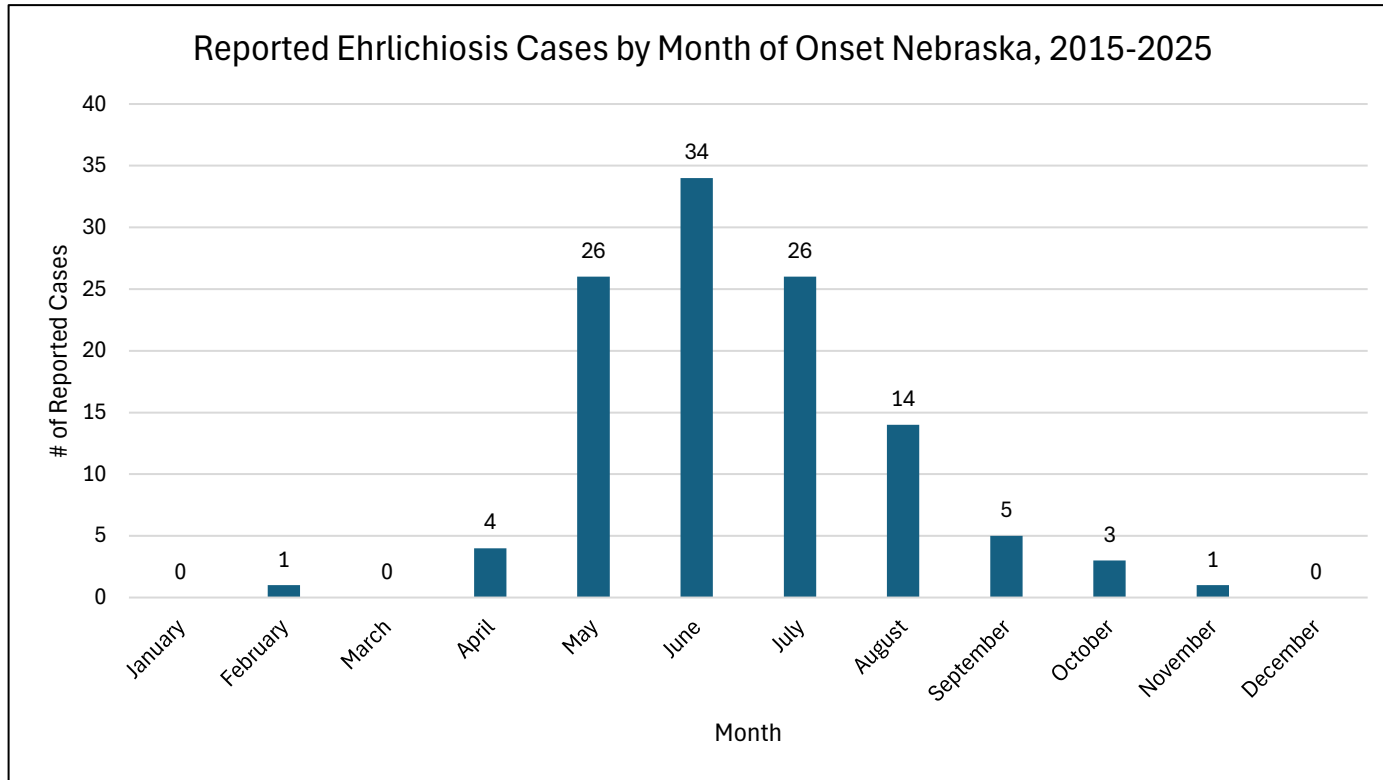


***Unable to report due to small numbers (n = <6)

Source: Nebraska Electronic Disease Surveillance System

- Nebraska reported a median of 8 cases per year during 2015 – 2025
 - 11% of cases travel related
 - 37% unable to determine exposure location
 - 52% local acquired
- 59% hospitalized
- 4 associated deaths (2019, 2022, 2023, 2024)

EHRlichiosis: REPORTED CASES

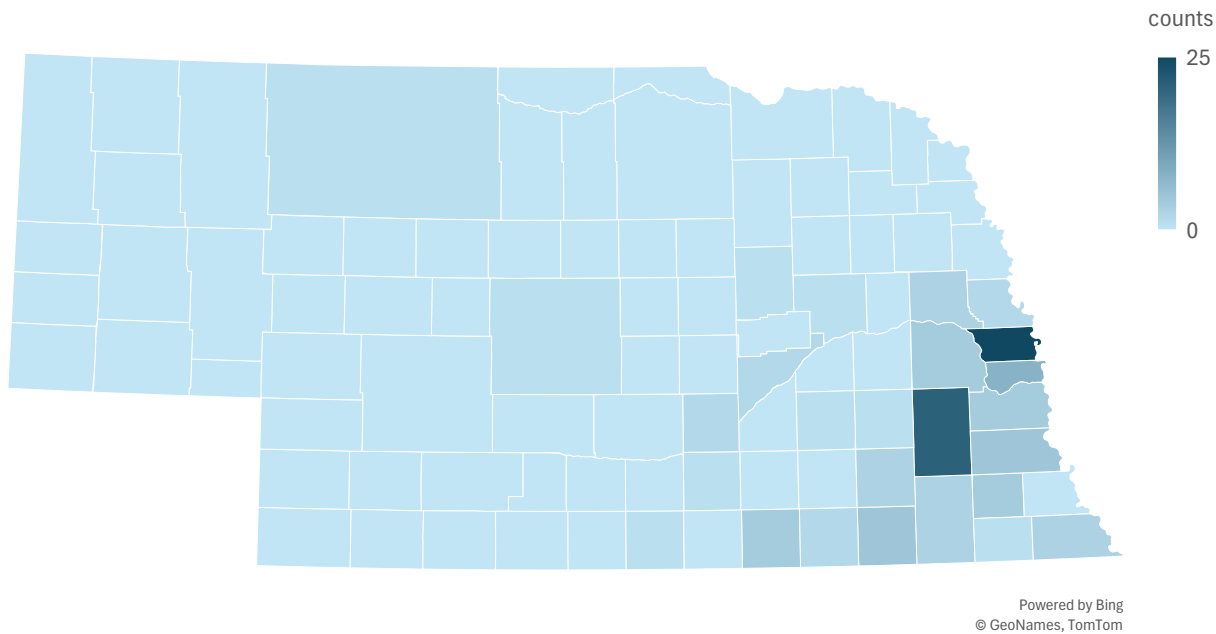


Source: Nebraska Electronic Disease Surveillance System

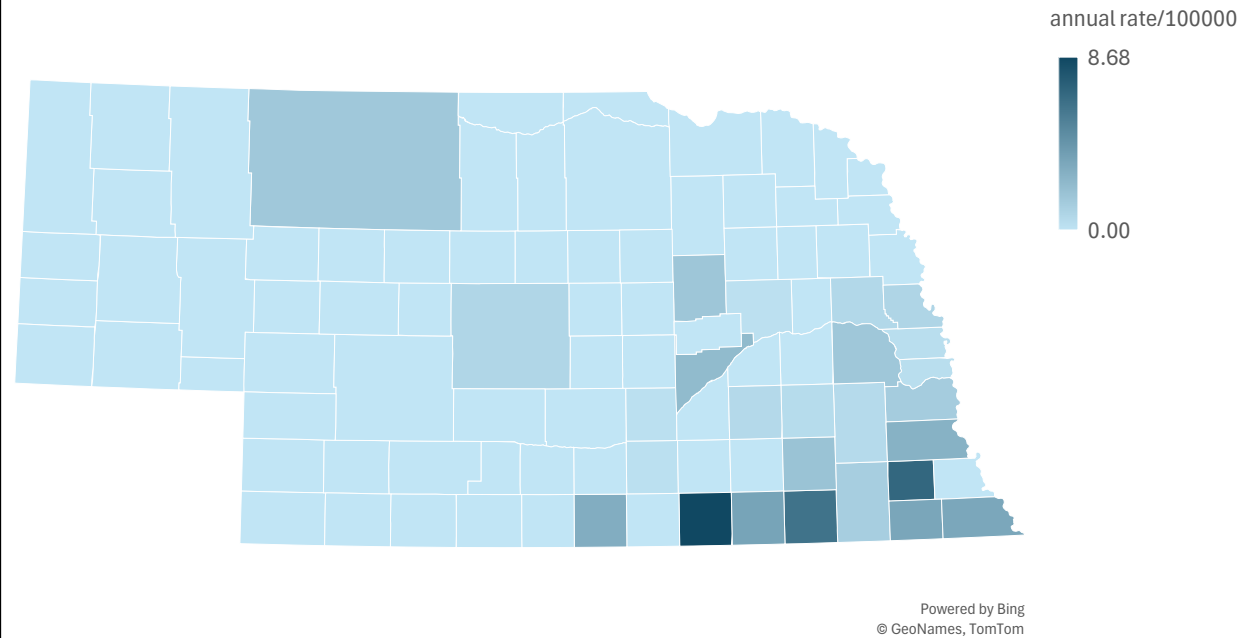
- 75% of cases are reported during May – July
- Coincides with adult and nymph Lonestar tick life stages

EHRlichiosis: REPORTED CASES

Nebraska Reported Ehrlichiosis Disease Cases by County of Residence, 2015 - 2025



Nebraska Ehrlichiosis Case Crude Incidence Rate by County of Residence, 2015-2025



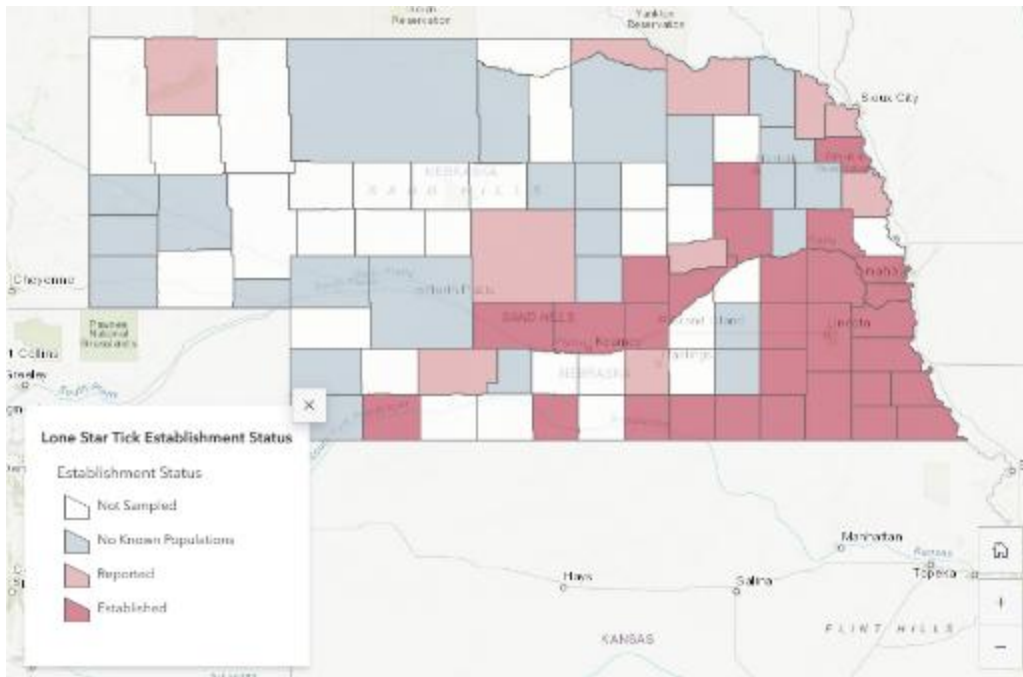
Source: Nebraska Electronic Disease Surveillance System

EHRlichiosis: TICK VECTORS



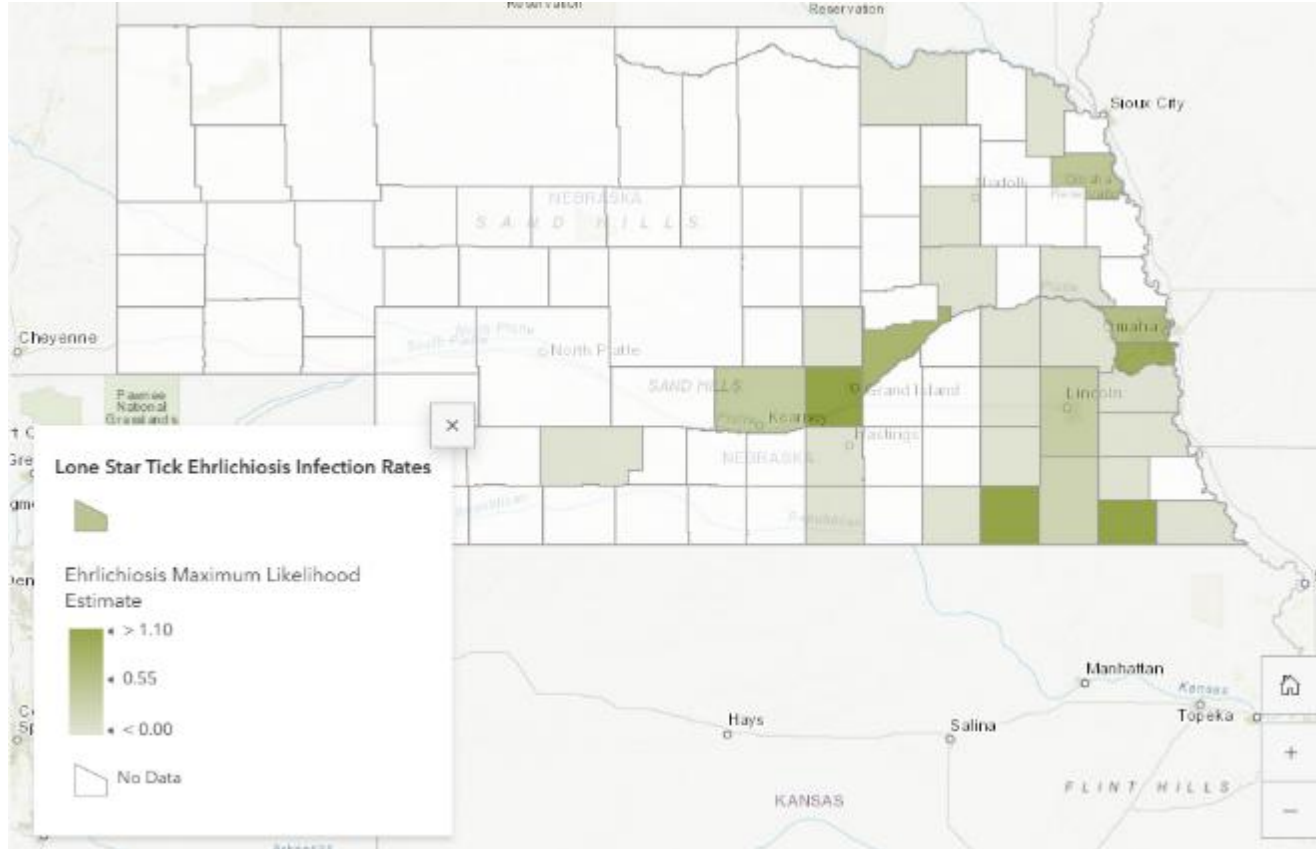
Source: [Tick Encounter](#)

- Ehrlichiosis vector:
 - *Amblyomma americanum* (Lone star tick)
 - Found in the eastern part of the U.S.
 - Expanding further north and west in Nebraska
 - Highest densities in east-central and southeast Nebraska
 - Primary vector of both *Ehrlichia chaffeensis* and *Ehrlichia ewingii*



Source: [Nebraska Department of Health and Human Services Tick Surveillance Maps](#)

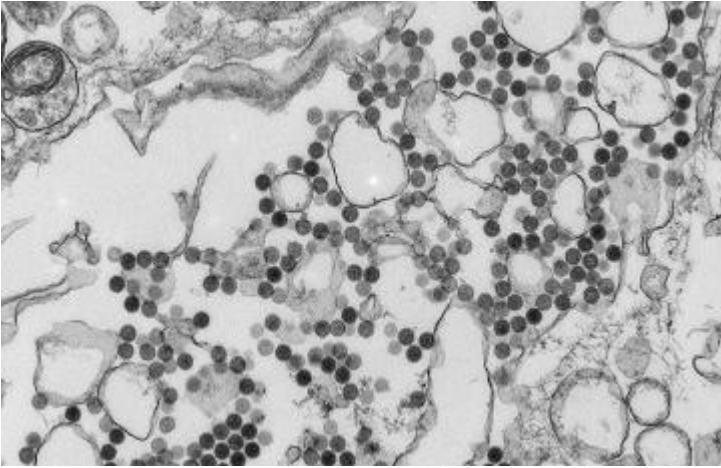
EHRlichiosis: TICK VECTORS



Source: [Nebraska Department of Health and Human Services Tick Surveillance Maps](#)

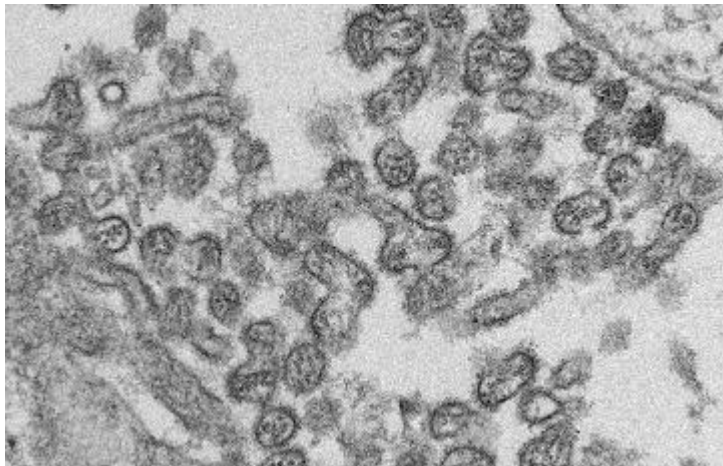
- *Ehrlichia* prevalence in Lone star ticks in Nebraska:
 - Statewide: 1.1% (0.8 – 1.5)
 - Highest prevalence rates in ticks collected from central, eastern and southeastern NE

HEARTLAND AND BOURBON VIRUSES: EMERGING PATHOGENS



Source: [CDC Heartland Virus Website](#)

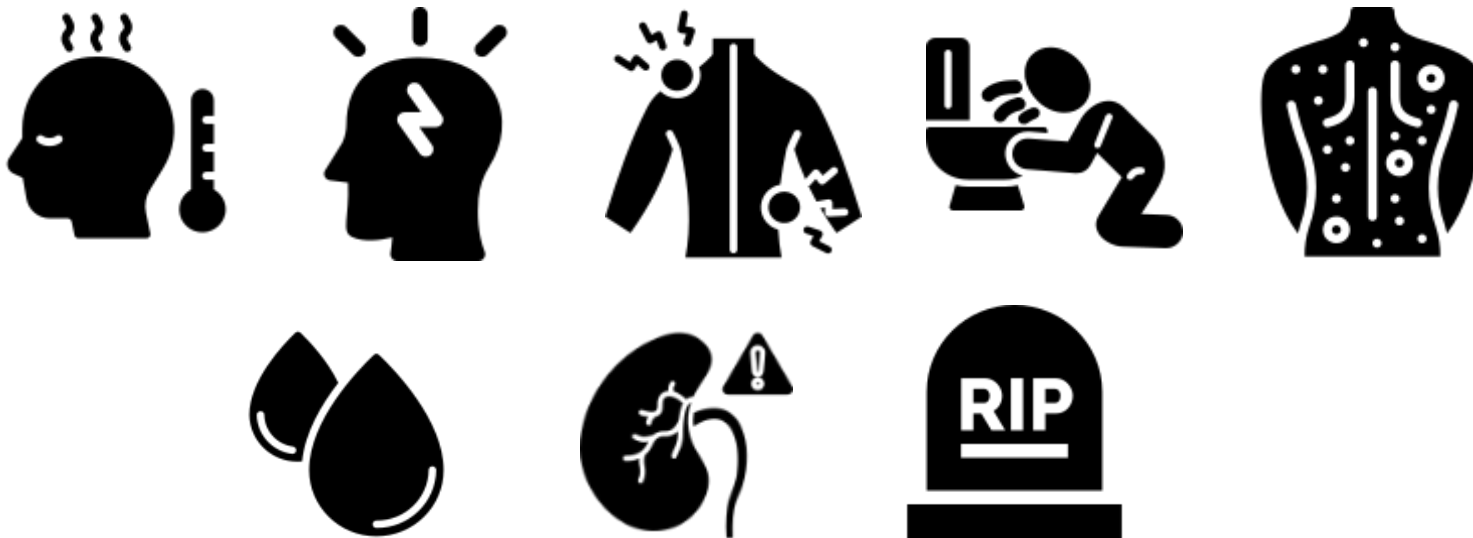
- Heartland virus (HRTV)
 - RNA virus (Family: Phenuiviridae)
 - Missouri 2009
- Bourbon virus (BRBV)
 - RNA virus (Family: Orthomyxoviridae)
 - Kansas 2014



Source: [CDC Public Health Image Library \(PHIL\)](#)

HEARTLAND AND BOURBON VIRUSES: SIGNS AND SYMPTOMS

- Incubation period
 - HRTV: 2 – 14 days
 - BRBV: unknown
- Signs & symptoms similar to ehrlichiosis



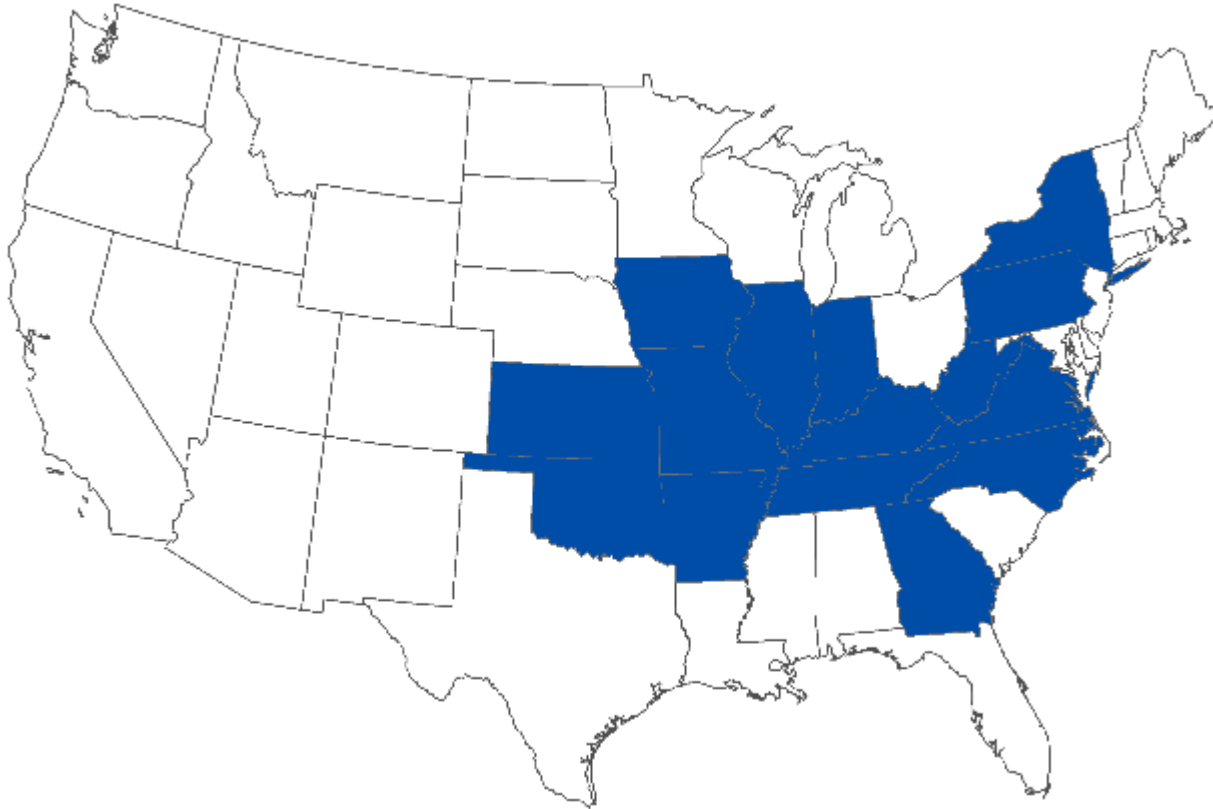
HEARTLAND AND BOURBON VIRUS: TESTING



Source: [CDC Heartland Virus Website](#)

- Very limited testing for Heartland virus
 - Commercially at Mayo Clinic Laboratories
 - PCR only available, no serological testing
 - CDC/Wadsworth Center (NY)
 - PCR and PRNT available
- No commercial testing for Bourbon virus
 - Testing via CDC/Wadsworth Center (NY)
 - PCR and PRNT available

HEARTLAND AND BOURBON VIRUS : REPORTED CASES



- Nebraska has not reported any Heartland or Bourbon virus cases
 - At least one non-resident Heartland virus case hospitalized in Nebraska
- In the United States
 - Heartland virus: >80 cases
 - Bourbon virus: 6 cases

Source: [States Reporting Heartland Virus Disease Cases per CDC \(as of July 2026\)](#)

HEARTLAND AND BOURBON VIRUS : TREATMENT



Source: [CDC Heartland Virus Website](#)

- No specific treatment for Heartland or Bourbon virus
- Clinical management is supportive
- Many of the patients diagnosed with Heartland and Bourbon virus have required hospitalization
 - Most patients fully recovered
 - Older individuals with medical comorbidities have developed severe disease
 - HLH
 - Death
- [CDC Treatment of Heartland Virus Page](#)
- [CDC Treatment of Bourbon Virus Page](#)

HEARTLAND AND BOURBON VIRUS: TICK VECTORS

- Heartland virus
 - 2 detections in tick samples
 - Sarpy County (n = 1)
 - Richardson County (n = 1)
 - Statewide prevalence (N = 2,826): <0.5%
- Bourbon virus
 - 1 detection in tick samples
 - Sarpy County
 - Statewide prevalence (n = 2,826): <0.5%

Source: [Nebraska Department of Health and Human Services Tick Surveillance Maps](#)

ALPHA-GAL SYNDROME (AGS): EMERGING DISEASE



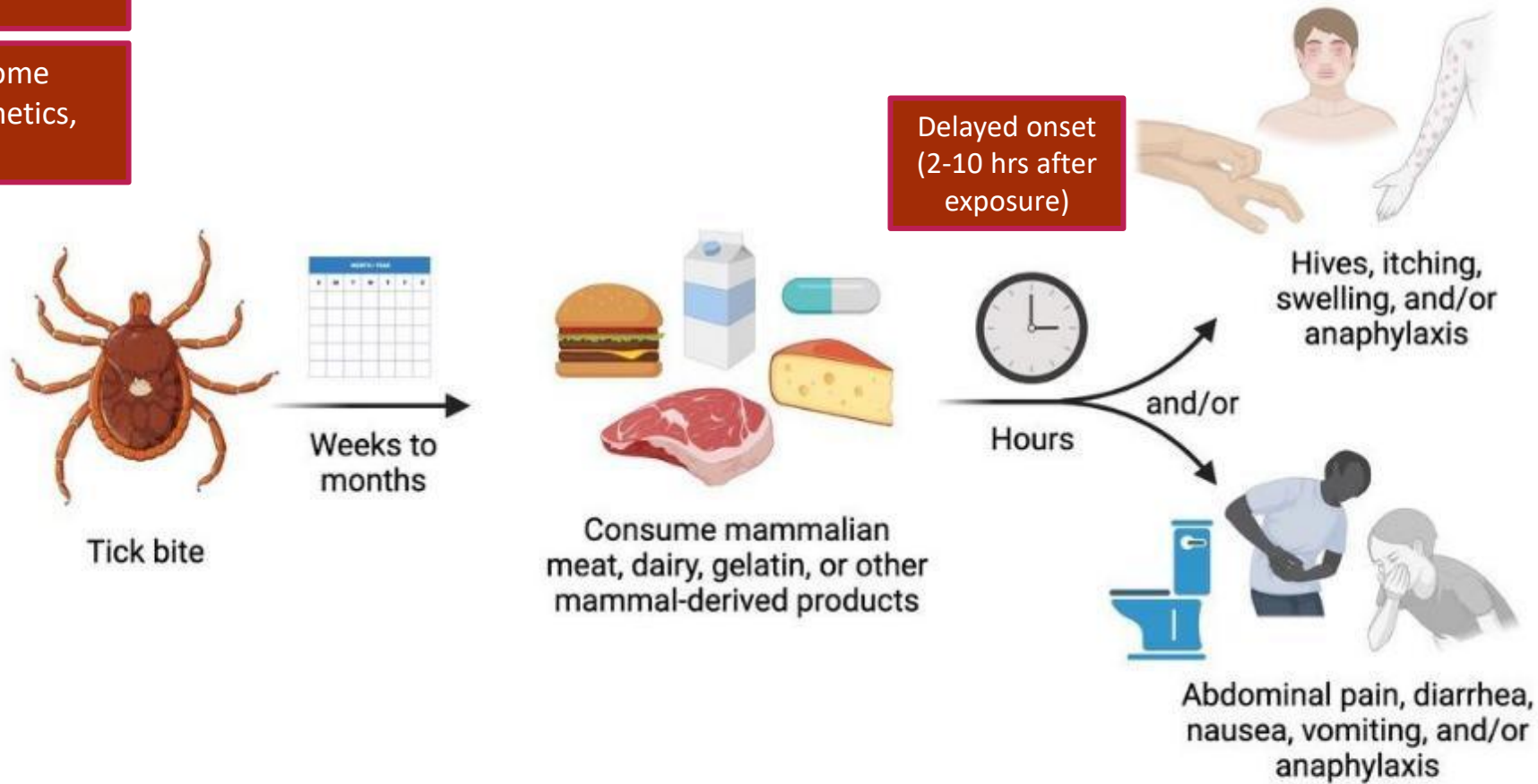
- Delayed allergic reaction to mammalian meat/products (reactions typically 2-10 hours after exposure)
- Immune response to galactose-alpha-1,3-galactose, a sugar molecule found in all non-primate mammals
 - Found in meat (pork, beef, rabbit) & products made from mammals (gelatin, milk, cheese)
- Typically follows Lone star tick exposure
- No treatment or medication for AGS – avoid mammalian products

Source: Nebraska Department of Health and
Human Services Vector-Borne Disease Program

WHAT IS ALPHA-GAL SYNDROME?

Not JUST a red meat allergy!

Dairy, gelatin, some medications, cosmetics, vaccines



Wide range of potential symptoms:

- Abdominal pain
- Diarrhea
- Vomiting
- Heartburn
- Hives
- Swelling
- Itching
- Shortness of breath
- Cough
- Wheezing
- Hypotension
- Anaphylaxis

Adapted from McGill SK, Hashash JG, Platts-Mills TA. AGA Clinical Practice Update on Alpha-Gal Syndrome for the GI Clinician: Commentary. *Clin Gastroenterol Hepatol*.

Created with BioRender.com

ALPHA-GAL SYNDROME: TESTING



Source: [CDC Alpha-Gal Website](https://www.cdc.gov/alpha-gal/)

- Galactose- α -1,3-galactose (alpha-gal) IgE antibody test
- Widely available at commercial labs
- IgE levels ≥ 0.1 kU/l confirm sensitivity to alpha-gal
- Positive result does not mean a person has AGS

2026 VS 2025 AGS CASES



The lone star tick may have infected nearly 500,000 Americans, experts estimate. The tick, which has made its way to Nebraska in part due to climate change and development, is now sickening some Nebraskans – and making some allergic to red meat. Photo courtesy of Joshua Allen

Nebraska nightmare: New tick biting us, making us allergic to ... red meat.

By Michael Wunder

Sept. 1, 2023

Share ↗

Year	# of Cases	IgE Labs Reported	Positive IgE Labs Reported (% Positive)
2025	33	330	50 (15%)
2026	44	391	82 (21%)

Source: Nebraska Electronic Disease Surveillance System

Source: [Michael Wunder, Flatwater Press](#)

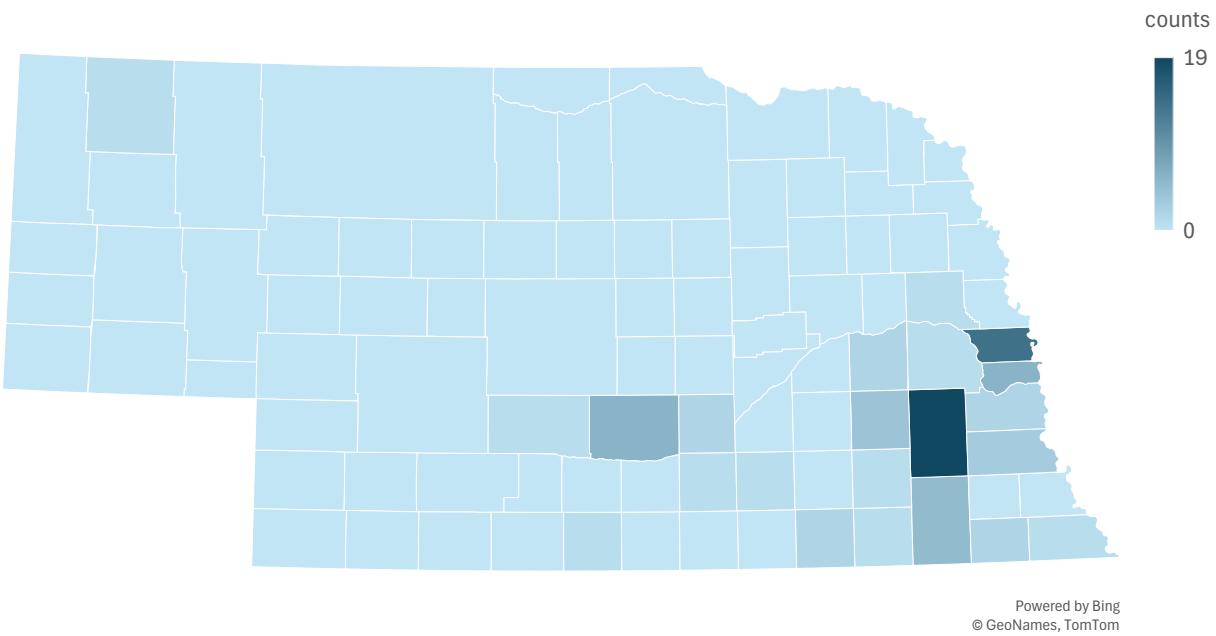
2025 – 2026 AGS Case Data (n = 77)

Age Range		%
0 – 13		2.6
14 – 25		6.5
26 – 50		29.9
50+		61.0
Sex		%
Male		50.6
Female		49.4
Symptoms		%
GI		70.1
Cutaneous		76.6
Respiratory		35.0
Anaphylaxis		35.0
Outcomes		%
Hospitalized		10.4
Death		0.0
Tick Bite Reported		%
Yes		80.5
No		10.4
Unk		9.1

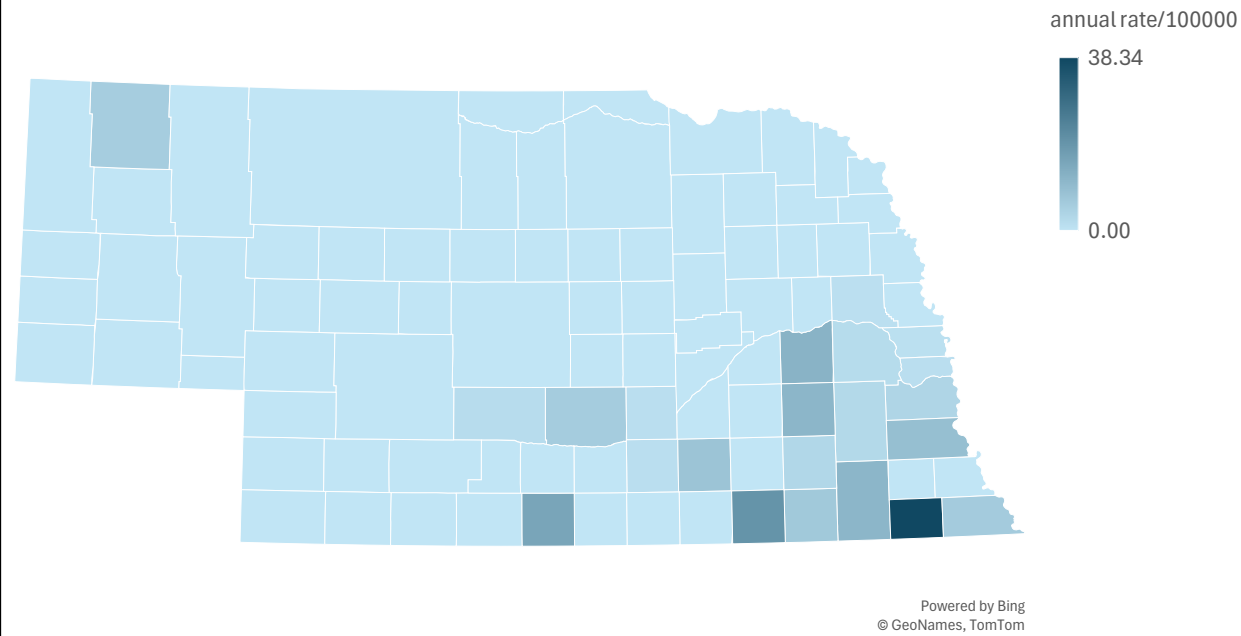
Source: Nebraska
Electronic Disease
Surveillance System

ALPHA-GAL SYNDROME: REPORTED CASES

Nebraska Reported Alpha-Gal Syndrome Disease Cases by County of Residence, 2025 - 2026

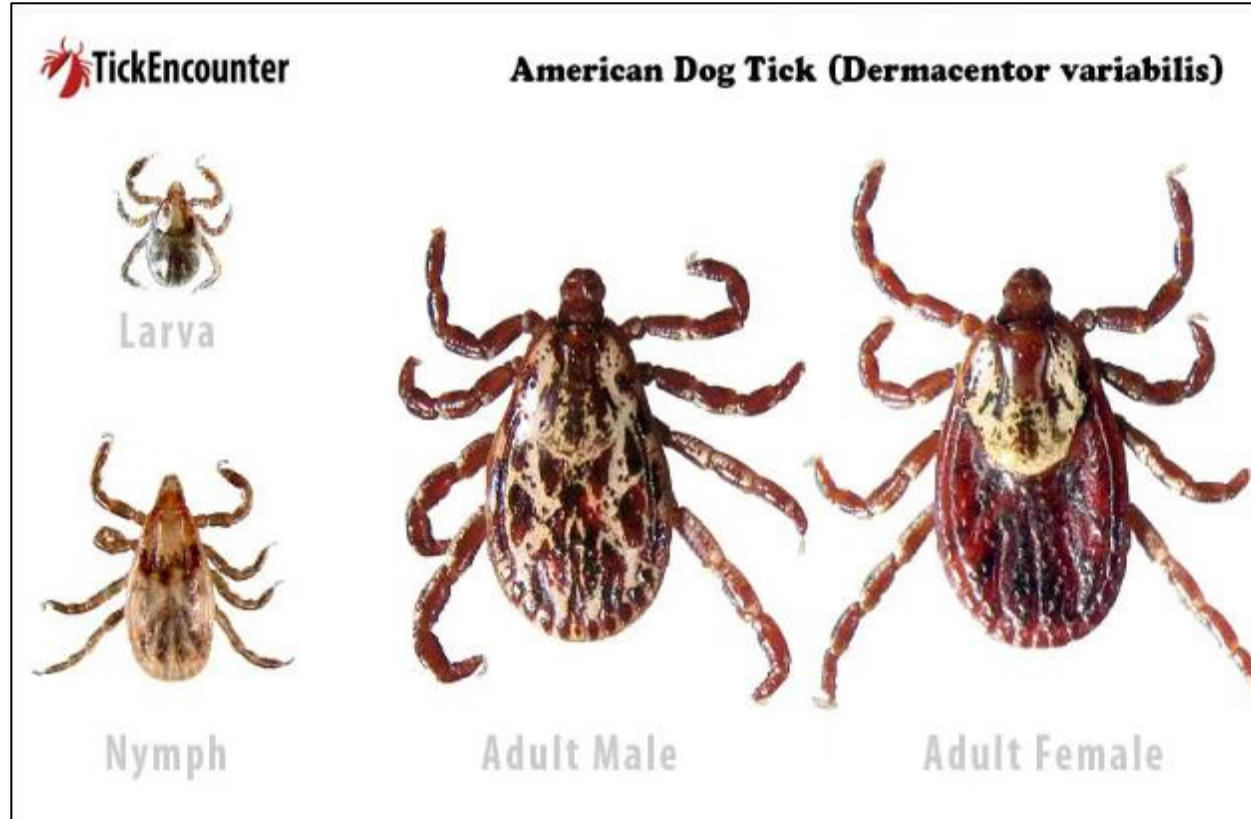


Nebraska Alpha-Gal Syndrome Case Crude Incidence Rate by County of Residence, 2025-2026



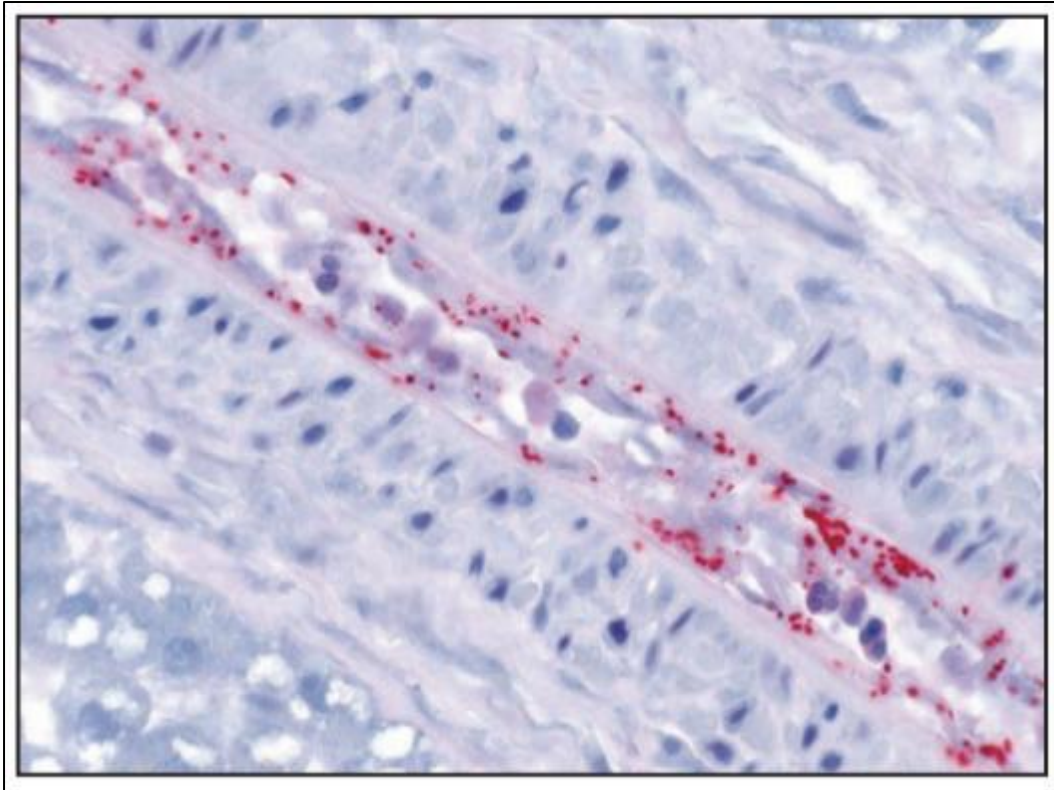
Source: Nebraska Electronic Disease Surveillance System

AMERICAN DOG TICK TRANSMITTED DISEASES



Source: [Tick Encounter](#)

ROCKY MOUNTAIN SPOTTED FEVER (RMSF): CLINICAL



- RMSF caused by *Rickettsia rickettsii*
- Belong to the Rickettsiales Order
 - Related to *Ehrlichia* spp.
- Gram-negative obligate intracellular bacteria
 - Infect vascular endothelia cells
- Leads to advancing vascular damage
- Infection typically causes severe disease

Source: [CDC Diagnosis and Management of Tickborne Rickettsial Disease – A practical Guide for Health Care and Public Health Professionals](#)

RMSF SIGNS & SYMPTOMS



- Fever (99%), Headache (79 – 81%), Myalgia (72 – 83%)
- Gastrointestinal manifestations
 - Nausea/Vomiting (56 – 60%), Diarrhea (20%)
- Rash
 - Reported in 90% of cases
 - 2 – 4 days after onset of fever
 - Maculopapular
 - ankles, wrists, or forearms ➡ palms, soles, arms, legs, and trunk
- Severe, late-stage manifestations
 - Meningoencephalitis
 - ARDS
 - Cutaneous necrosis
- High case fatality rate
 - 5 – 10%



Source: [CDC Diagnosis and Management of Tickborne Rickettsial Disease – A practical Guide for Health Care and Public Health Professionals](#)

RMSF LAB FINDINGS



- RMSF general lab findings:
 - Thrombocytopenia
 - Hyponatremia
 - Elevated hepatic transaminases
- Molecular lab diagnosis
 - Detection of DNA by PCR is available at some commercial labs
 - Specimens should be collected while patient is symptomatic
 - Most sensitive if specimen is collected before or within 48 hours of antibiotic therapy
 - A positive result is confirmatory, but a negative result does not rule out the possibility of infection
 - [Rickettsial Disease Diagnostic Testing and Interpretation](#)

RMSF LAB FINDINGS



Source: [CDC Rocky Mountain Spotted Fever Website](https://www.cdc.gov/rmsf/)

- Serological lab diagnosis
 - Indirect immunofluorescence antibody (IFA)
 - IgG IFA are the recommended method
 - IgM assays are less specific (more false positives)
 - IFAs are less sensitive during the first week of illness
 - Many will be negative in the first week of illness
 - Recommend paired acute (collected in first week) and convalescent (collected 2 – 4 weeks later) specimens

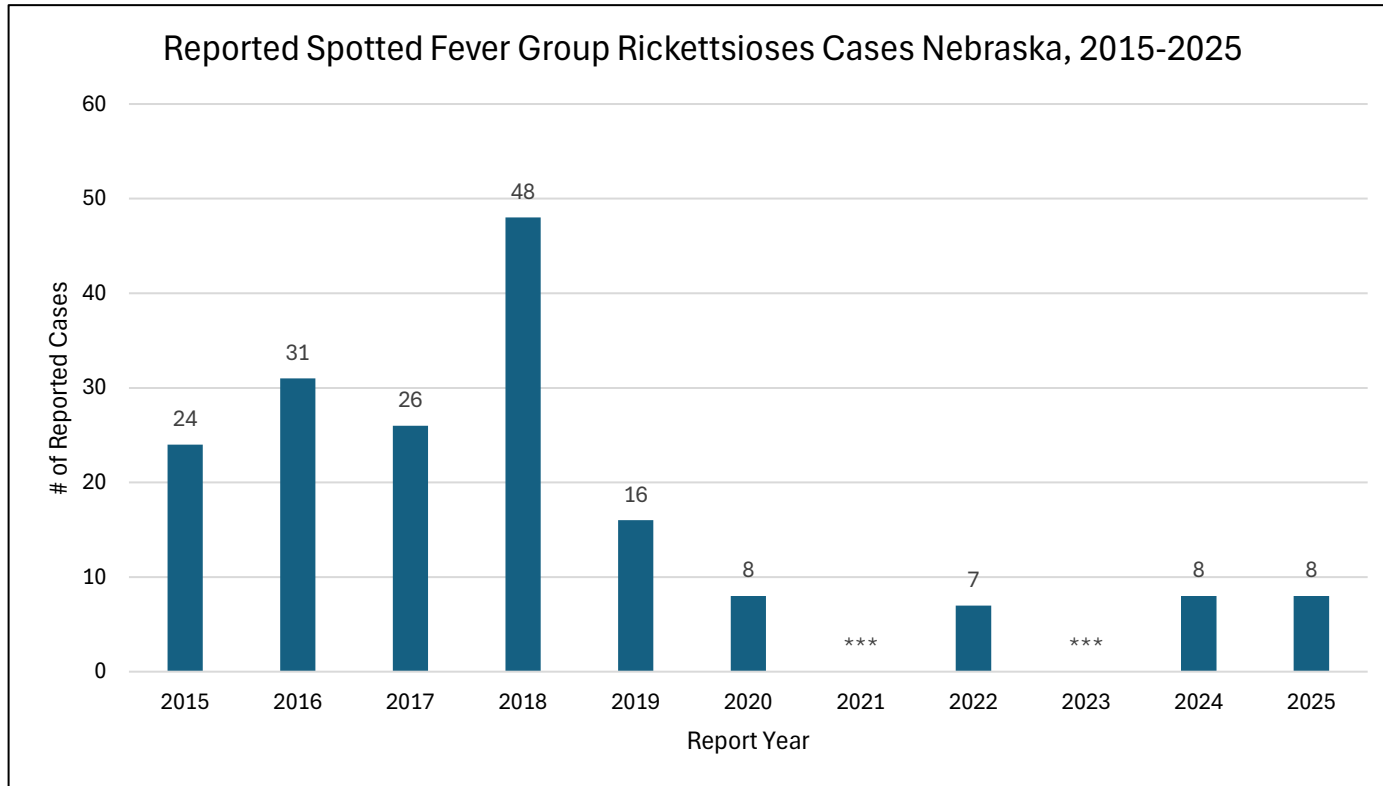
RMSF: TREATMENT



Source: [CDC Treatment of RMSF Page](#)

- Doxycycline is the treatment of choice for RMSF
- Doxycycline most effective at preventing severe complications from developing if started within 5 days of illness
- **Doxycycline** is the **only antibacterial agent recommended treatment** for suspected infection in both adults and children
 - Using antibiotics other than doxycycline is associated with higher risk of fatal outcomes
 - Concern about tooth staining in children
 - American Academy of Pediatrics and CDC recommend treatment with doxycycline
 - Research has shown no evidence that doxycycline cause tooth staining in children
- [Research: Doxycycline and Tooth Staining](#)

RMSF: REPORTED CASES

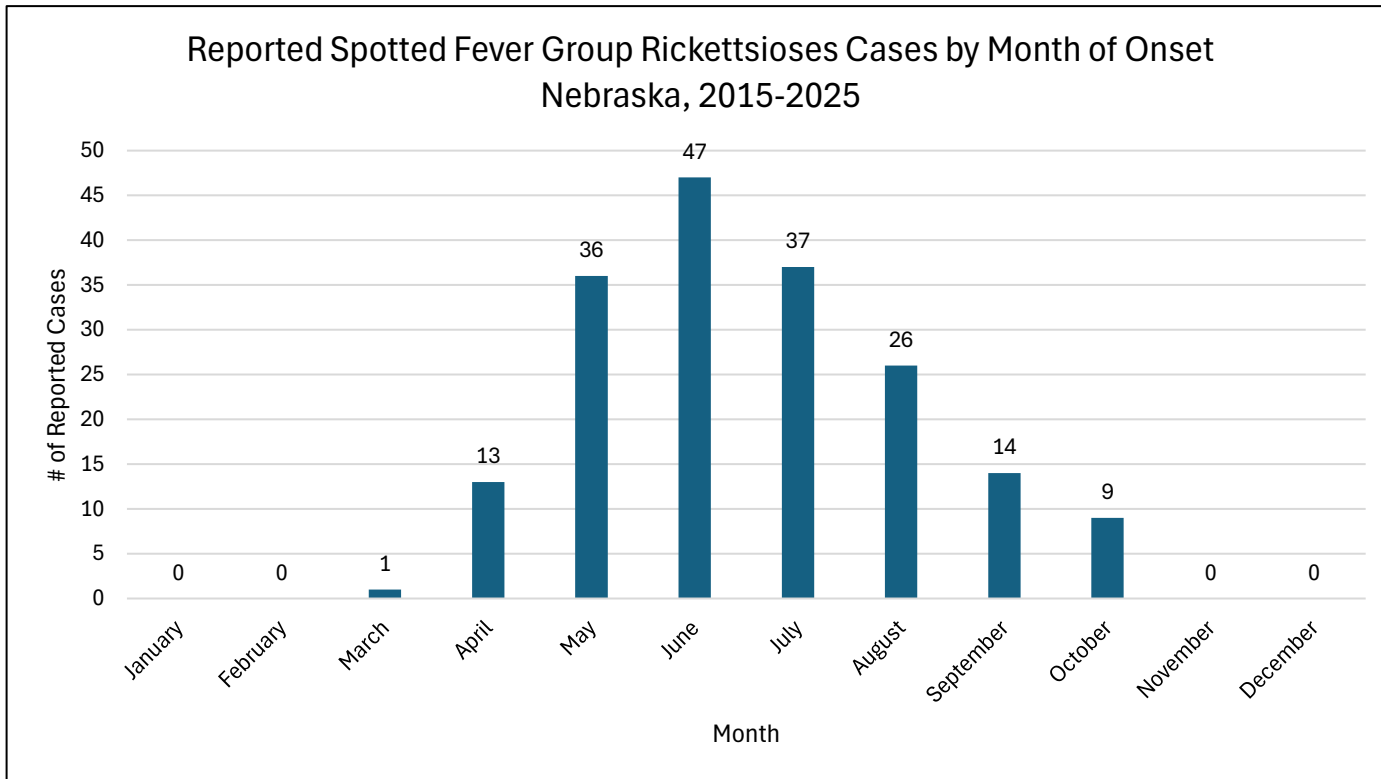


***Unable to report due to small numbers (n = <6)

Source: Nebraska Electronic Disease Surveillance System

- Nebraska reported a median of 8 cases per year during 2015 – 2025
- 40% hospitalized
- 6 associated deaths (2015, 2017, 2018, 2020, 2021)
- Significant case definition update in 2020

RMSF: REPORTED CASES

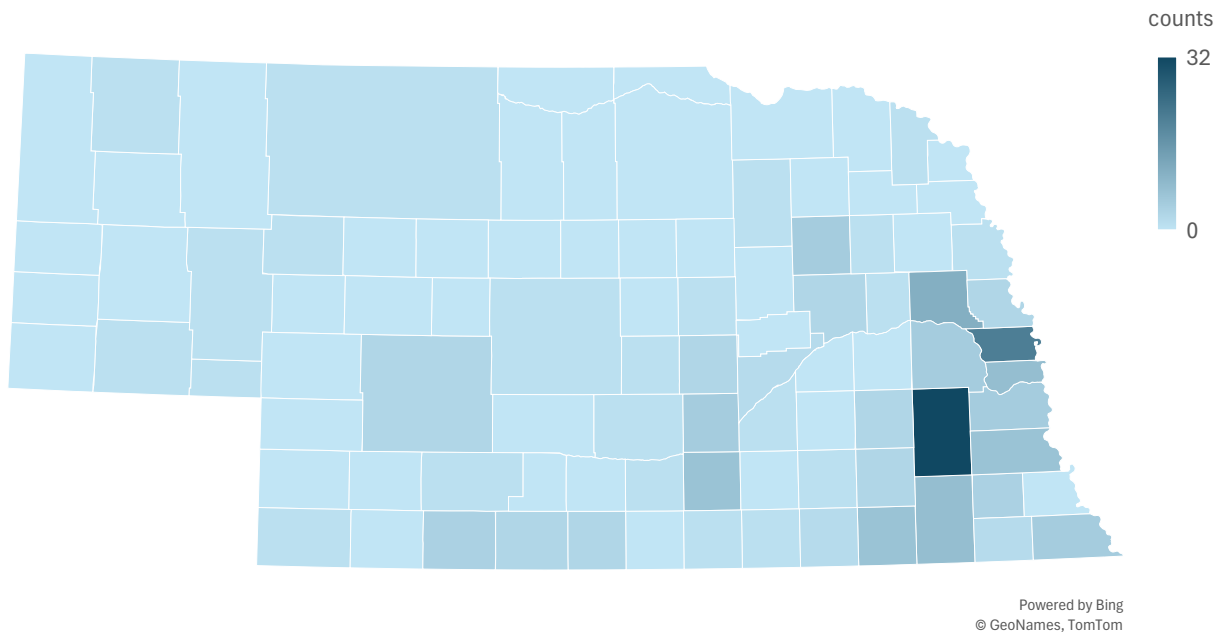


Source: Nebraska Electronic Disease Surveillance System

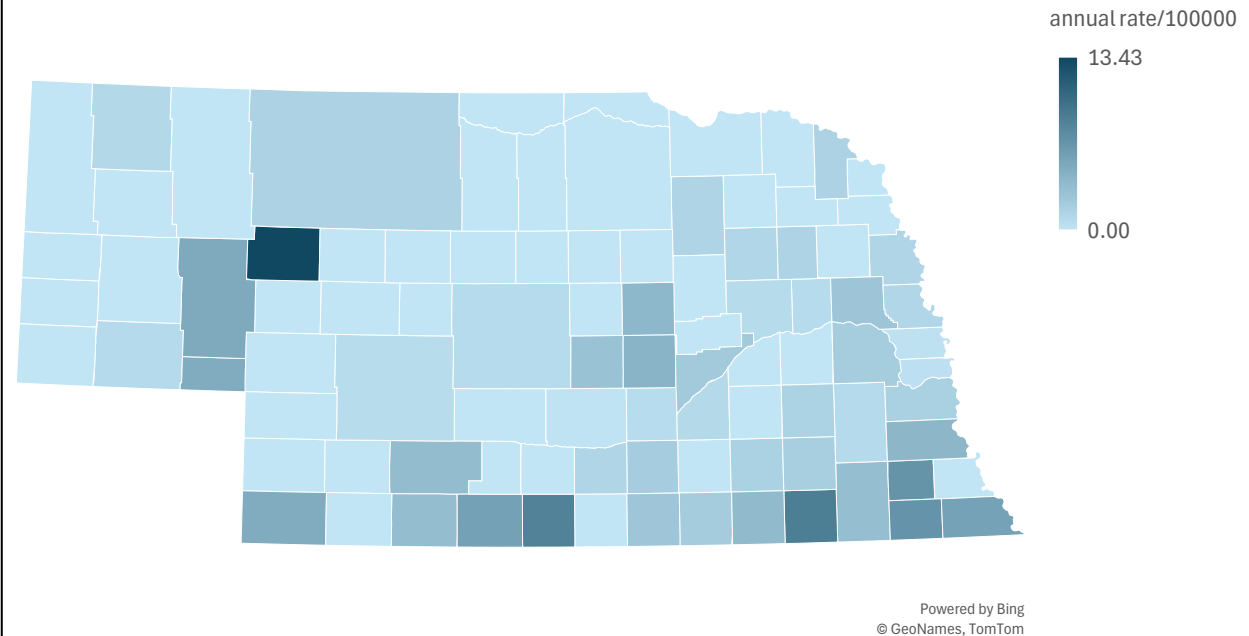
- 80% of cases are reported during May – August
- Coincides with adult American dog tick life stage

RMSF: REPORTED CASES

Nebraska Reported Rocky Mountain Spotted Fever Cases by County of Residence, 2015 - 2025



Nebraska Rocky Mountain Spotted Fever Case Crude Incidence Rate by County of Residence, 2015-2025

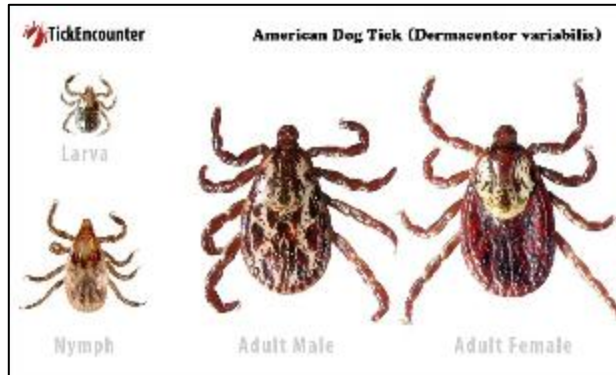


Source: Nebraska Electronic Disease Surveillance System

CHECK IN QUESTION

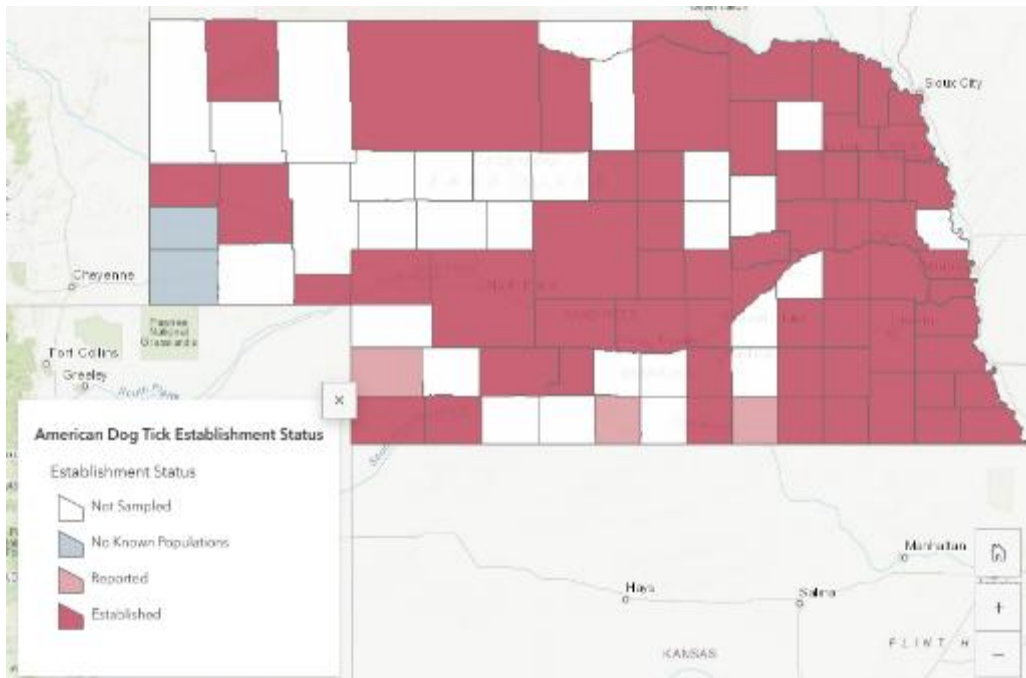
- What antibiotic is the only recommended treatment for RMSF in both adults and children?
 - Amoxicillin
 - Ciprofloxacin
 - Doxycycline
 - Gentamicin

RMSF: TICK VECTORS



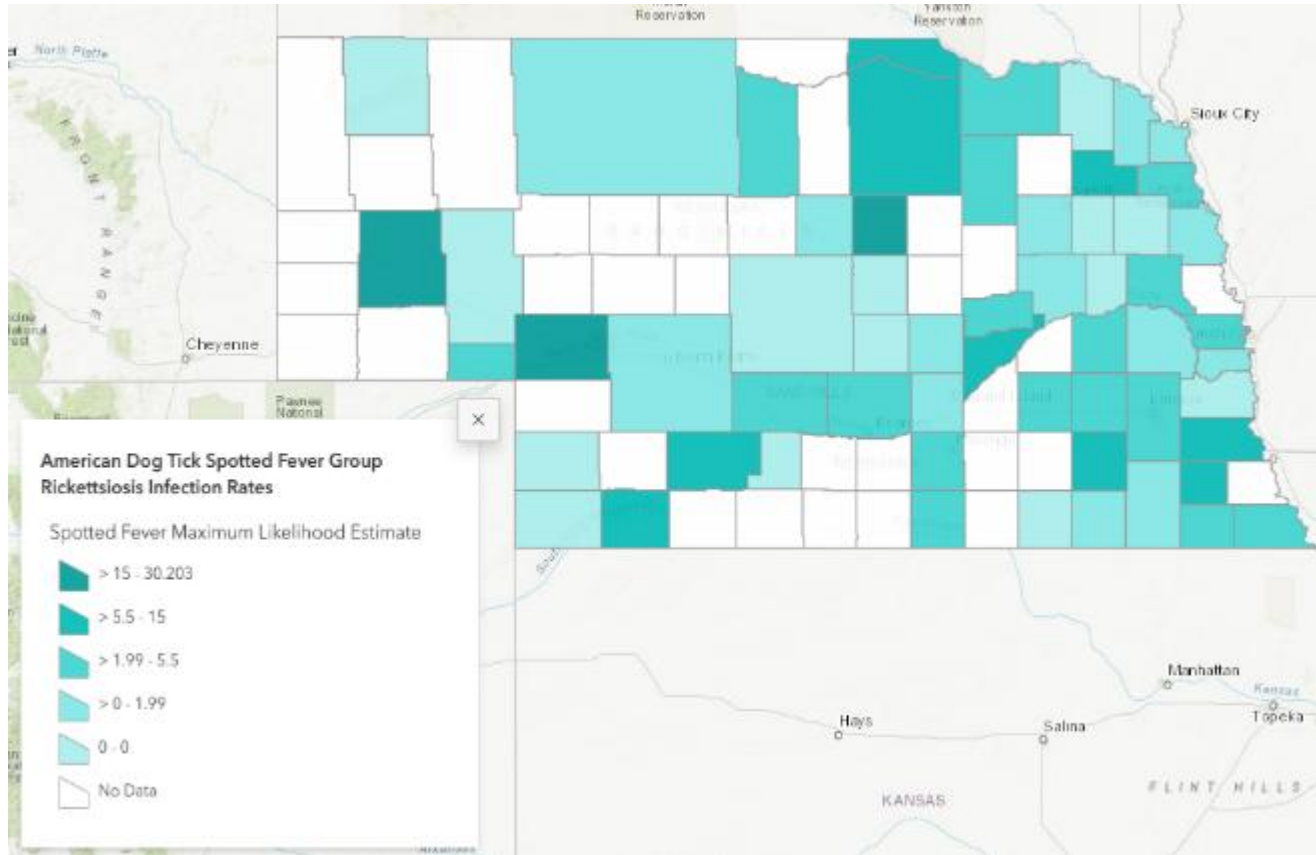
Source: [Tick Encounter](#)

- RMSF vector:
 - *Dermacentor variabilis* (American dog tick)
 - Found in the eastern part of the U.S.
 - Expanding further west in the U.S.
 - Found throughout Nebraska
 - Primary vector of *Rickettsia rickettsii*



Source: [Nebraska Department of Health and Human Services Tick Surveillance Maps](#)

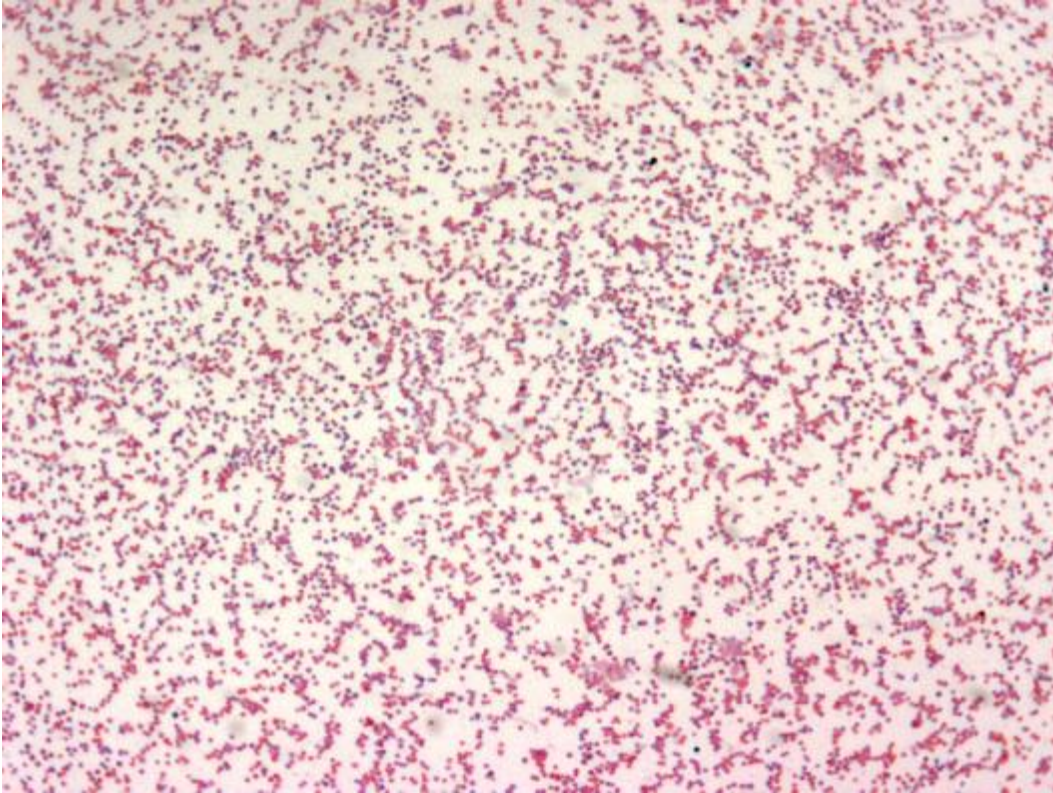
RMSF: TICK VECTORS



Source: [Nebraska Department of Health and Human Services Tick Surveillance Maps](#)

- Spotted fever group *Rickettsia* prevalence in American dog ticks in Nebraska:
 - Statewide (n = 3,615): 6.2% (5.4 – 7.1)
 - Most positive samples are due to other species of spotted fever group *Rickettsia* and not *Rickettsia rickettsii* (<1.0%)

TULAREMIA: CLINICAL



Source: [CDC Public Health Image Library \(PHIL\)](#)

- Tularemia caused by *Francisella tularensis*
- Gram-negative coccobacillus bacteria
 - Infect vascular endothelial cells
- Two primary subtypes
 - *F. tularensis tularensis* (Type A)
 - *F. tularensis holarctica* (Type B)
- Highly virulent and infectious
- Potential bioterrorism agent

TULAREMIA SIGNS & SYMPTOMS

- Generalized signs and symptoms
 - Fever/chills
 - Headache
 - Malaise
 - Myalgia
 - Anorexia
 - Sore throat
 - Nausea/vomiting/diarrhea
- More specific presentations
 - Glandular/Ulceroglandular
 - Oculoglandular
 - Oropharyngeal
 - Pneumonic
 - Typhoidal

Ulceroglandular 	• Localized lymphadenopathy • Cutaneous ulcer at infection site (not always present)
Oculoglandular 	• Photophobia • Vision impairment/loss • Conjunctivitis • Regional lymphadenopathy
Oropharyngeal 	• Severe sore throat • 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 	• Combination of the general symptoms without localization • May have infiltrates in chest radiograph in the absence of respiratory symptoms

Source: Watson, J.R., Syed, R.R., Salazar, V.M., Dahdouh, G., Bursalyan, J., English, A., Ponce-Sanchez, H., Urrutia, F., Chan, F., Dhamotharan, M., Gonzalez, N., Messele, B., Mohta, S., and Sah, J. Decoding the unexpected: How cell-free DNA sequencing unveiled an elusive tularemia case. The Permanente Journal: 29(4), 165-172 (2025)
<https://doi.org/10.7812/TPP/25.070>

TULAREMIA LAB FINDINGS



- Tularemia general lab findings:
 - Elevated inflammatory markers (e.g., CRP and ESR)
 - Mildly elevated hepatic transaminases
- Molecular lab diagnosis
 - Detection of DNA by PCR not readily available commercially
- Isolation from clinical specimen diagnosis
 - Scraping of ulcers
 - Conjunctival swabs, lymph node aspirates, biopsies, blood, or respiratory specimens (e.g., pleural fluid)
- Serological lab diagnosis
 - Antibodies are often not detectable until 2 – 3 weeks after symptom onset
 - Negative result soon after illness onset does not exclude a tularemia diagnosis

TULAREMIA: TREATMENT

Treatment recommendations

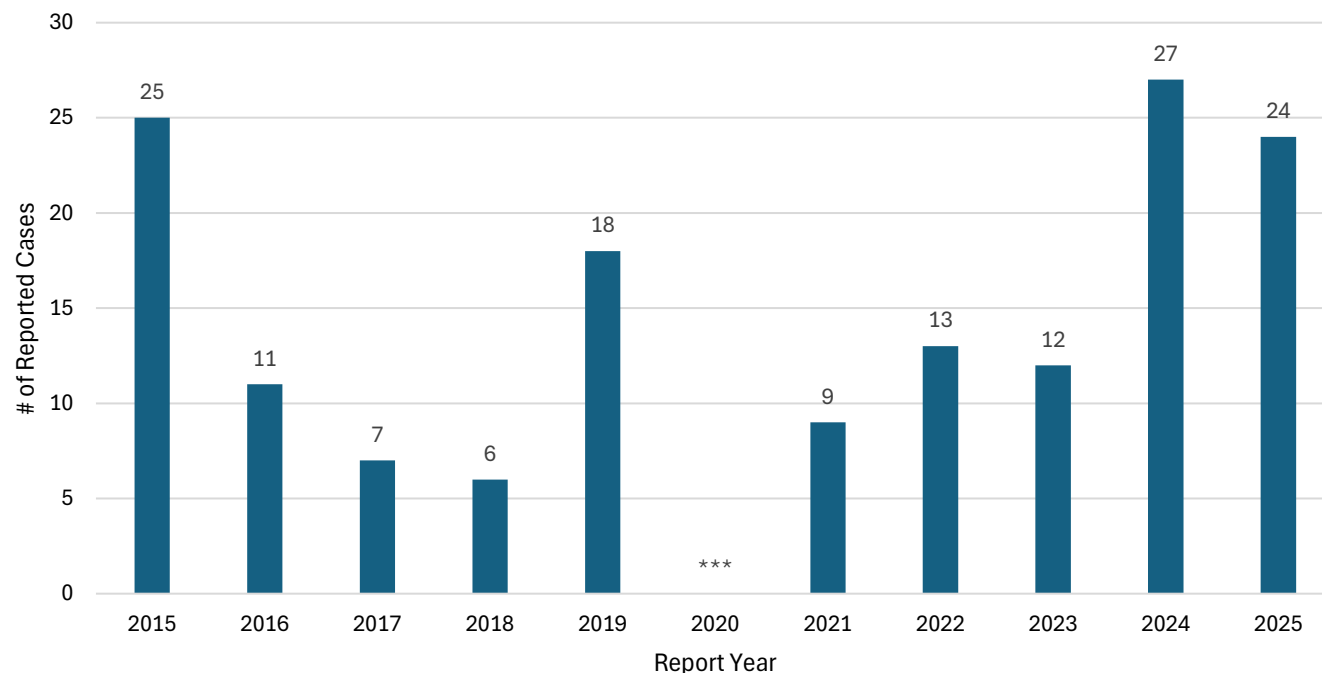
- Treatment regimens may need to be adjusted
 - Age
 - Medical history
 - Underlying conditions
 - Pregnancy status
 - Allergies

Population	Antimicrobial Class	Antimicrobial	Dosage	Duration (Days)
Adults aged ≥18 yrs	Fluoroquinolone	Ciprofloxacin*	400 mg every 8 hrs IV or 750 mg every 12 hrs PO	10
		Levofloxacin*	750 mg every 24 hrs IV or PO	10
	Aminoglycoside	Gentamicin*	6 mg/kg every 24 hrs IV or IM [†]	10
	Tetracycline	Doxycycline	200 mg loading dose, then 100 mg every 12 hrs IV or PO	14–21
Children aged ≥1 mo. to ≤17 yrs	Fluoroquinolone	Ciprofloxacin*	10 mg/kg every 8–12 hrs IV (maximum 400 mg/dose) or 15 mg/kg every 8–12 hrs PO (maximum 500 mg/dose every 8 hrs or 750 mg/dose every 12 hrs)	10
		Levofloxacin*	Infants and children aged <5 yrs: 10 mg/kg every 12 hours IV or PO (maximum 375 mg/dose) Children aged ≥5 yrs and adolescents: 10 mg/kg every 24 hours IV or PO (maximum 750 mg/dose)	10
	Aminoglycoside	Gentamicin*	5–7.5 mg/kg every 24 hrs IV or IM [†] (mg/kg dose determined by age;** upper range can be increased to 9.5 mg/kg based on age and AUC monitoring)	10
	Tetracycline	Doxycycline	4.4 mg/kg loading dose (maximum 200 mg), then 2.2 mg/kg every 12 hrs IV or PO (maximum 100 mg/dose)	14–21

Source: [CDC Tularemia Treatment Webpage](#)

TULAREMIA: REPORTED CASES

Reported Tularemia Cases Nebraska, 2015-2025

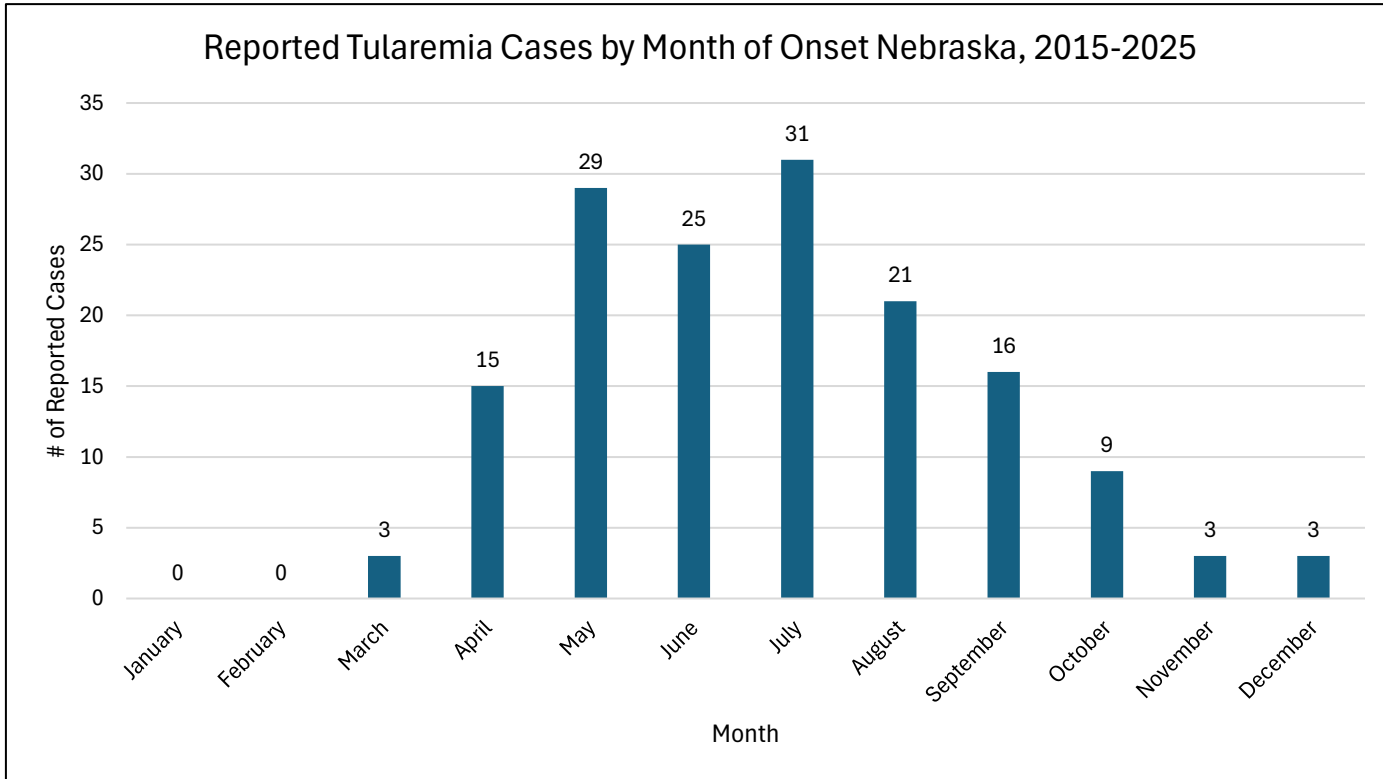


***Unable to report due to small numbers (n = <6)

Source: Nebraska Electronic Disease Surveillance System

- Nebraska reported a median of 12 cases per year during 2015 – 2025
- 48% hospitalized
- Three significant outbreaks in 2015, 2024, and 2025

TULAREMIA: REPORTED CASES

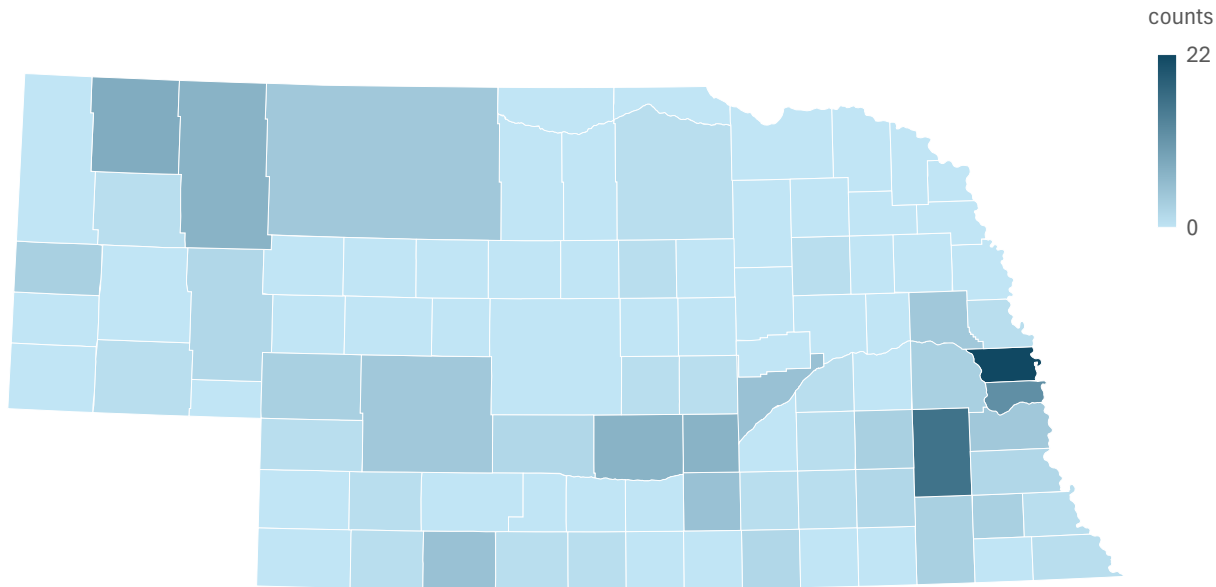


Source: Nebraska Electronic Disease Surveillance System

- 68% of cases are reported during May – August
- 29% of cases due to tick bite
- 10% due to contact with animals
- 5% due to inhalation
- 56% have multiple exposures and cannot definitively assign exposure route

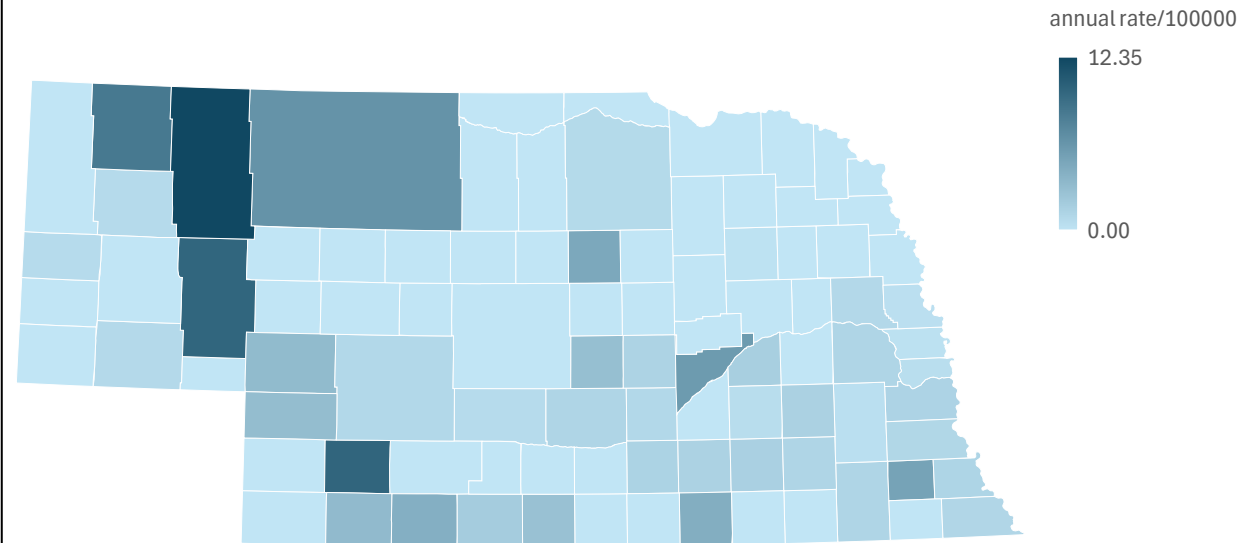
TULAREMIA: REPORTED CASES

Nebraska Reported Tularemia Cases by County of Residence, 2015 - 2025



Powered by Bing
© GeoNames, TomTom

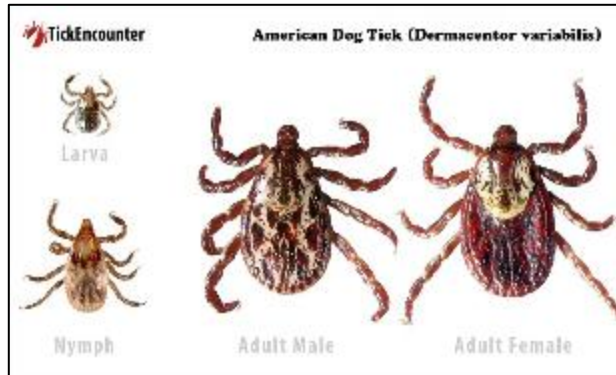
Nebraska Tularemia Case Crude Incidence Rate by County of Residence, 2015-2025



Powered by Bing
© GeoNames, TomTom

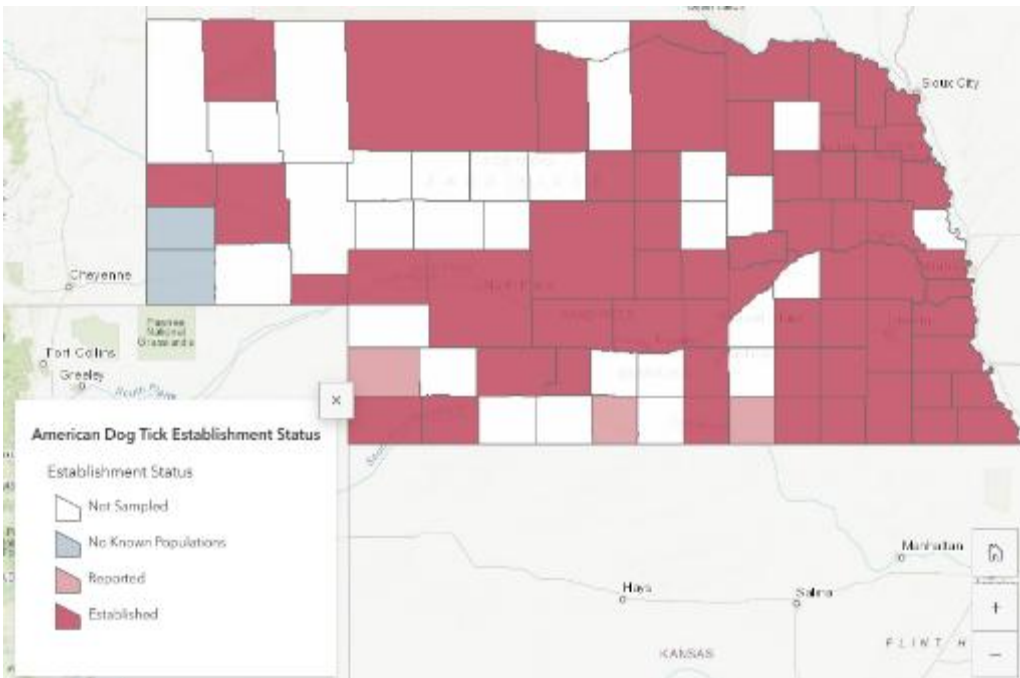
Source: Nebraska Electronic Disease Surveillance System

TULAREMIA: TICK VECTORS



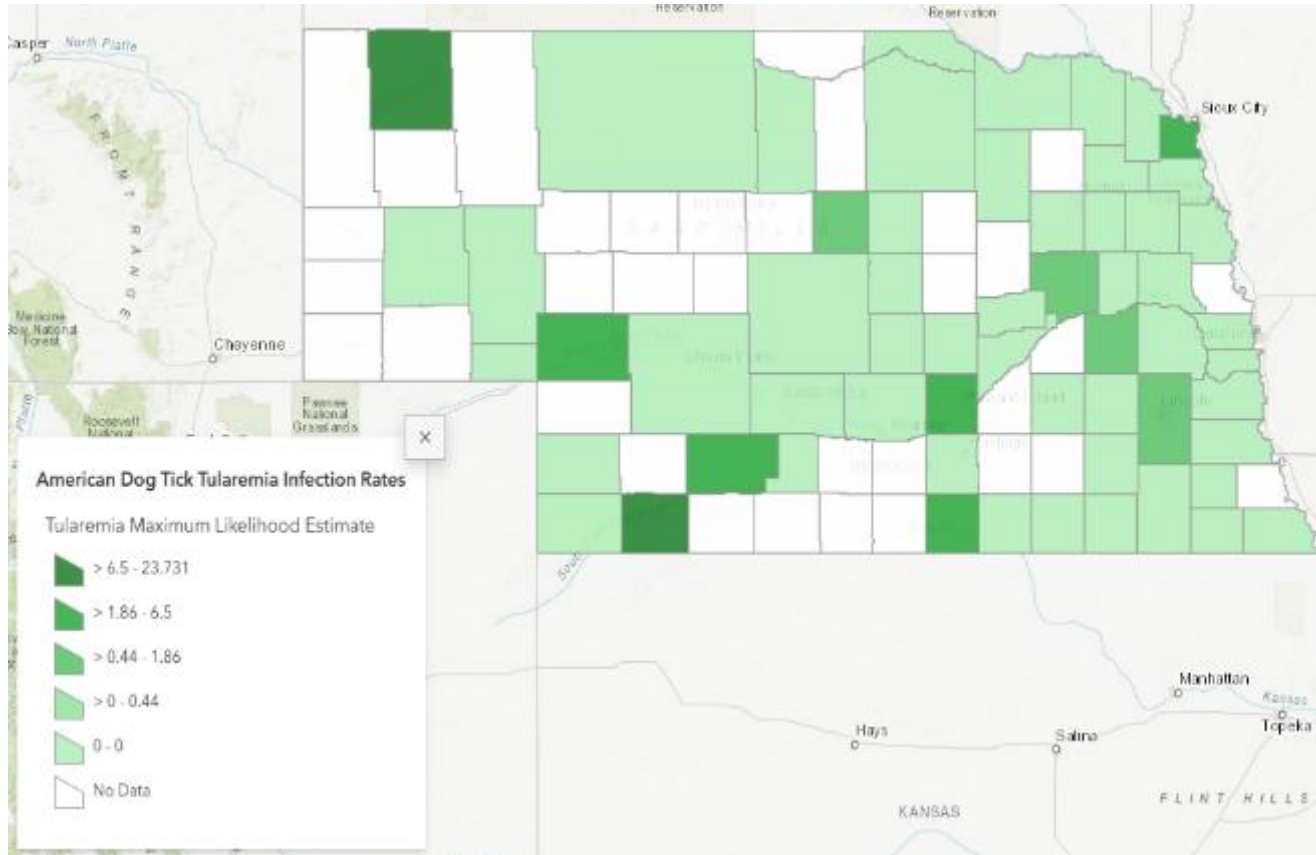
Source: [Tick Encounter](#)

- Tularemia vector:
 - *Dermacentor variabilis* (American dog tick)
 - Found in the eastern part of the U.S.
 - Expanding further west in the U.S.
 - Found throughout Nebraska
 - Primary vector of *F. tularensis*



Source: [Nebraska Department of Health and Human Services Tick Surveillance Maps](#)

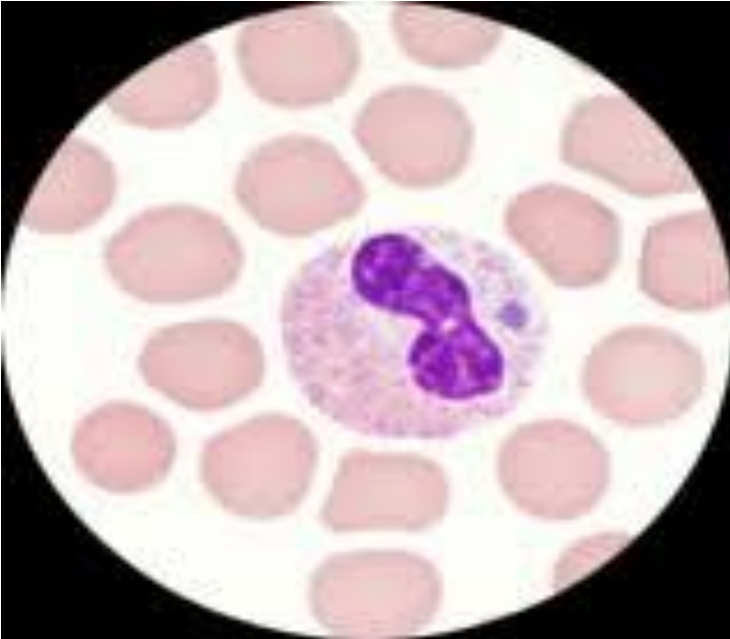
TULAREMIA: TICK VECTORS



Source: [Nebraska Department of Health and Human Services Tick Surveillance Maps](#)

- *F. tularensis* prevalence in American dog ticks in Nebraska:
 - Statewide (n = 3615): 1.3% (0.9 – 1.7)

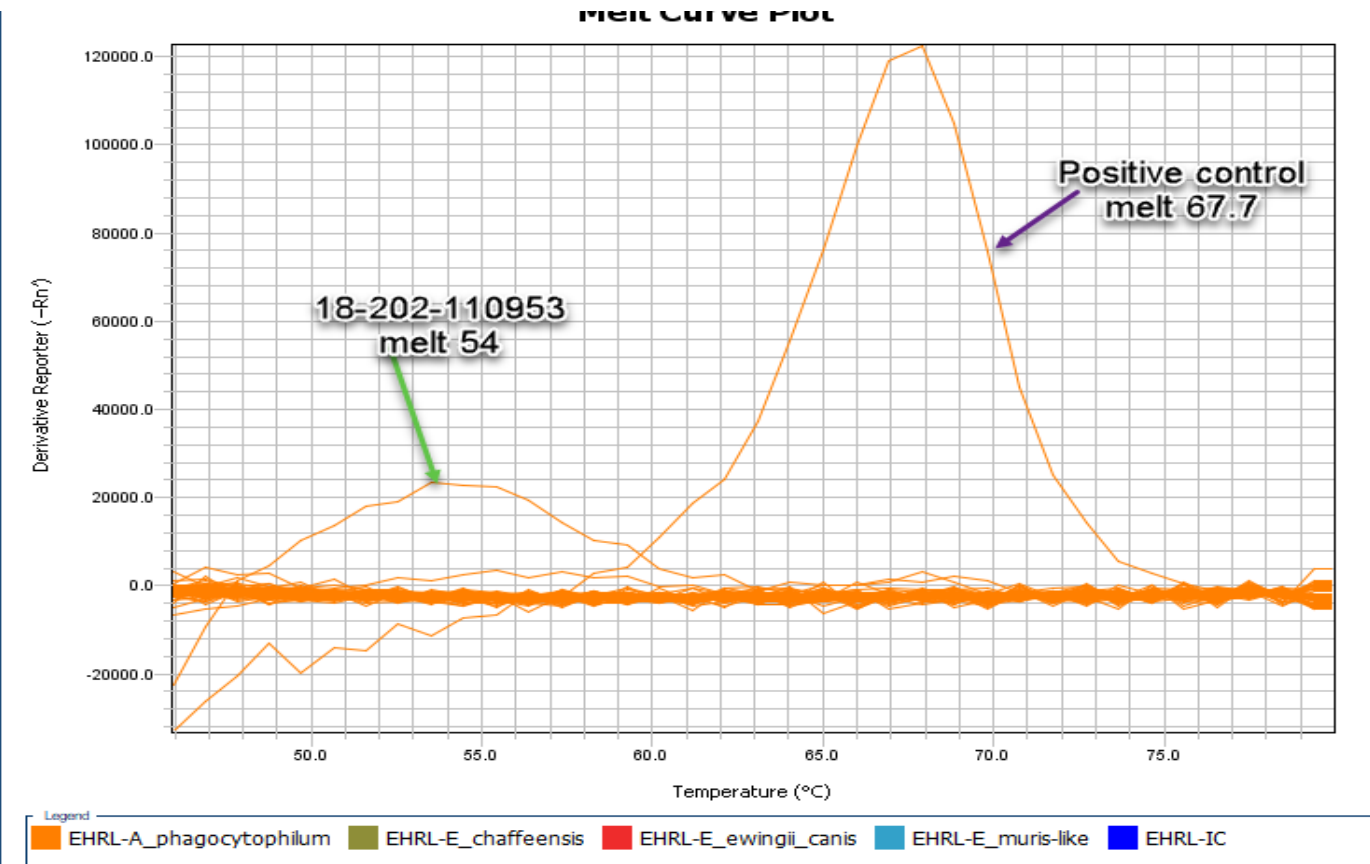
ANAPLASMA BOVIS-LIKE AGENT: EMERGING PATHOGEN



Source: [CDC Public Health Image Library \(PHIL\)](#)

- Family: Anaplasmataceae Family
- Obligate intracellular, gram-negative bacteria
- *Anaplasma phagocytophilum*
 - >5,000 cases annually (primarily upper Midwest and Northeast)
 - Blacklegged tick is the primary vector
- Other *Anaplasma* spp. infect animal hosts almost exclusively
 - Rarely infect humans

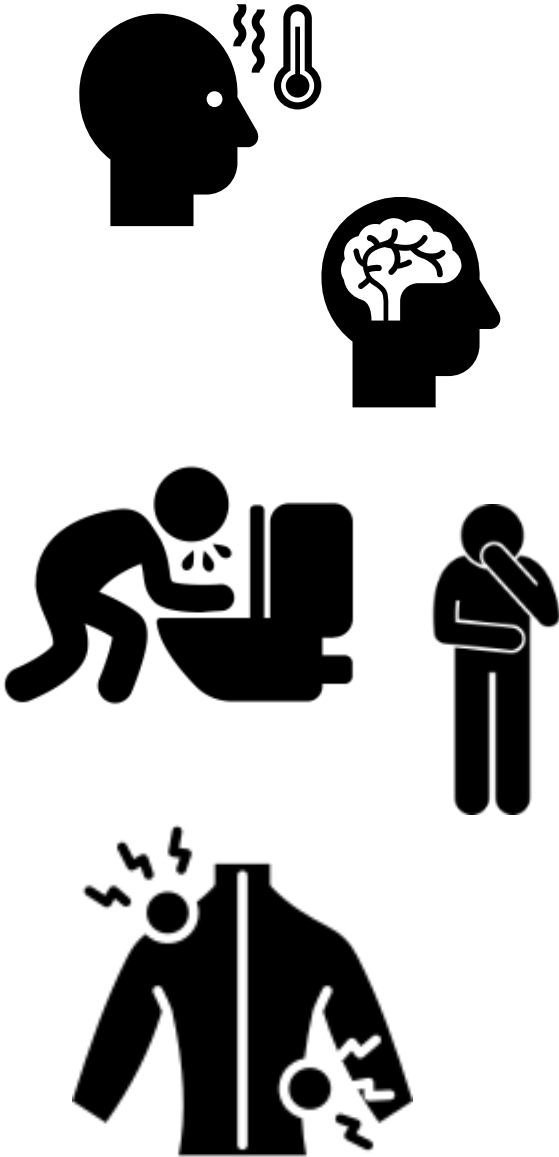
ANAPLASMA BOVIS-LIKE AGENT: EMERGING PATHOGEN



- *Anaplasma bovis*-like agent
 - Closely related to *A. bovis*
- Human infections have appeared to be rare
 - 4 cases previously reported in the U.S. (MN, MO, and OK)
 - No clinical information from these cases
- Nebraska reported first case in 2025
- Subsequent case from 2018 was then identified

Source: [CDC Public Health Image Library \(PHIL\)](#)

ANAPLASMA BOVIS-LIKE AGENT: SIGNS & SYMPTOMS



- Fever/Chills
- Malaise
- Weakness
- Headache
- Myalgia/Arthralgia

ANAPLASMA BOVIS-LIKE AGENT LAB FINDINGS



- General lab findings:
 - Thrombocytopenia
 - Elevated hepatic transaminases
- Molecular lab diagnosis
 - Detection of DNA by PCR for *A. phagocytophilum*
 - Atypical melt curve
 - Further testing by CDC determined *A. bovis*-like agent via sequencing analysis

ANAPLASMA BOVIS-LIKE AGENT: TREATMENT



Source: [CDC Treatment of Ehrlichiosis Page](#)

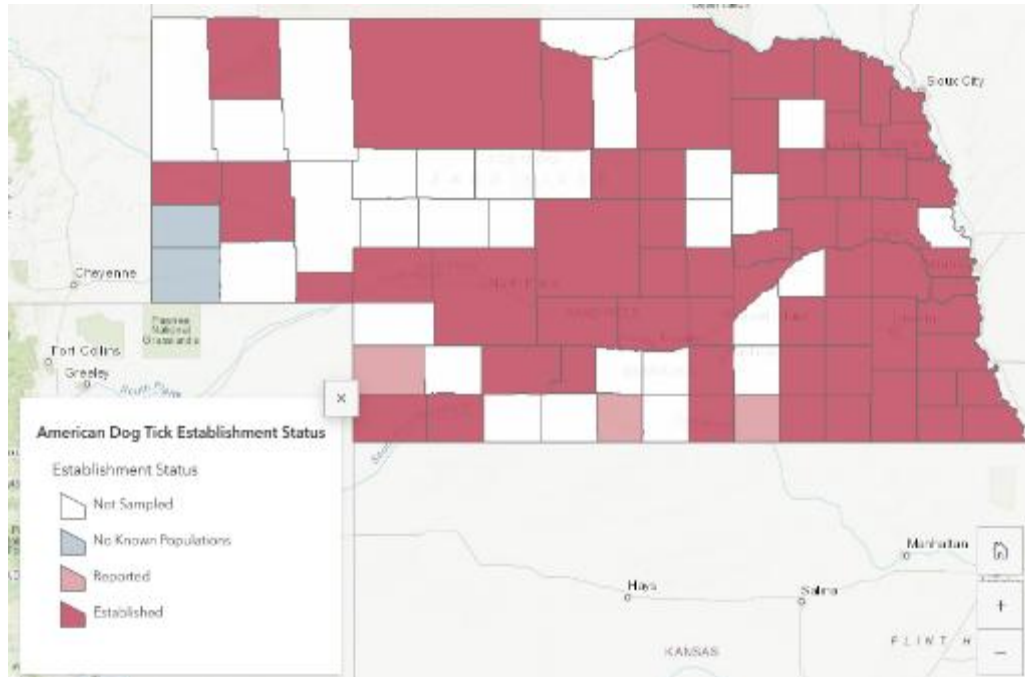
- Both patients treated with doxycycline and recovered
- Appears doxycycline would be first treatment choice
 - Currently unknown efficacy
- Unknown if other antibiotics would be efficacious

ANAPLASMA BOVIS-LIKE AGENT: TICK VECTORS



Source: [Tick Encounter](#)

- *A. bovis-like agent* vector:
 - *Dermacentor variabilis* (American dog tick)
 - Found in the eastern part of the U.S.
 - Expanding further west in the U.S.
 - Found throughout NE
 - 4 of 30 (13%) ticks submitted to CDC were positive for the pathogen
 - 300+ additional ticks submitted to CDC for testing



Source: [Nebraska Department of Health and Human Services Tick Surveillance Maps](#)



Thank You
Jeff Hamik, MS
jeff.hamik@nebraska.gov