Tick-Borne Infections Council of North Carolina, Inc.

# NEWSLETTER 2025, Volume 3

**Quotes:** "While outbreaks of VBDs such as malaria frequently attract attention, the vast majority - approximately 75% - of VBDs reported in the US are tick-borne diseases (TBDs) such as Lyme disease (LD), spotted fever rickettsiosis (SFR), anaplasmosis, babesiosis, and ehrlichiosis." *Ursery, L, et al.; PLOS One (2025);* https://doi.org/10.1371/journal.pone.0320361

**New features:**
We have created an "Alpha-Gal" section for research updates related to the unique and rising tick-borne threat of alpha-gal syndrome.

## Highlights:

- **North Carolina tick-borne illness clinician memo**
- **Enhanced surveillance program for tick-borne illnesses in North Carolina**
- **New Rickettsia isolated in Oklahoma**
- **Catalogue of ticks in Delaware**
- **Emerging babesiosis in the mid-Atlantic**
- **Rickettsia and Ehrlichia in birds in the Great Plains**
- **Lyme disease and Ixodes ricinus in Iceland**
- **Lyme disease in Asia**
- **Borrelia burgdorferi as a rare cause of stroke**
- **Alpha-gal and reactions to oral care products**

# State Updates

## Tick-borne Illness Surveillance Dashboard

In North Carolina, Public Health surveillance is conducted for the following tick-borne illnesses: anaplasmosis, ehrlichiosis, Lyme disease, and spotted fever illnesses including Rocky Mountain spotted fever.

The surveillance summary reports can be found here.

## North Carolina tickborne illness clinician memo

In May 2025, the North Carolina Department of Health and Human Services distributed the following memo regarding tick-borne illnesses to state clinicians.

**Introduction**

Lyme disease, spotted fever rickettsiosis, and ehrlichiosis are the three most common tickborne diseases reported in North Carolina. In 2024, over 700 cases of these three conditions were reported in NC.

**Surveillance for tickborne illnesses**

Per North Carolina law (10A NCAC 41A .0101), clinicians are required to report confirmed or suspected tickborne illness cases to their local health department. Laboratory diagnostic tests demonstrating isolation or identification of the pathogens are also reportable by laboratories to the Division of Public Health. North Carolina adheres to CDC case definitions for each of the tickborne infections, which establish uniform criteria for disease reporting to accurately monitor trends, take action to reduce disease, and protect public health. Surveillance case definitions are not intended to be used by healthcare providers for making a clinical diagnosis or determining how to meet an individual's health needs.

**Actions for North Carolina clinicians**

- Report cases of tickborne infections to your local health department within 7 days of when the condition is reasonably suspected to exist.
- Remind patients to take preventive measures including:
    - Recognizing and avoiding tick habitats;
    - Using CDC-recommended and EPA-registered insect repellents when outdoors;
    - Showering immediately after returning indoors;
    - Removing attached ticks promptly;
    - Using permethrin-treated clothing;
    - Creating tick-safe zones in their yard.

## Lyme disease (LD)

LD is now considered endemic to Northwest NC. Public health surveillance has indicated a substantial increase in the reported cases of LD in this region over the last decade. Testing of *Ixodes* ticks demonstrates an infection rate with *Borrelia burgdorferi* of over 20% in several counties. As such the NC DPH recommends post-exposure prophylaxis for LD in accordance with CDC recommendations for persons residing or traveling in counties that have had a high incidence of LD (16 cases per 100,000 residents) within the previous 5 years or are geographically positioned between two high-incidence counties. These counties include: Buncombe, Madison, Yancey, Mitchell, Avery, Watauga, Ashe, Alleghany, Surry and Stokes (**Figure 1**).

Most cases of LD reported in NC are now confirmed due to the widespread adoption of modified Two Tier Testing (mTTT). The NC DPH recommends the use of mTTT when there is a clinical and epidemiologic suspicion of infection. Standard Two-Tier Testing using western blotting is still available but is more difficult to interpret. In either case, remember to utilize testing in which there is an automatic reflex to the second-tier test if the first is equivocal or positive. Diagnostic testing is commercially available. Comprehensive information on the clinical care, testing and diagnosis of LD is available from the CDC.

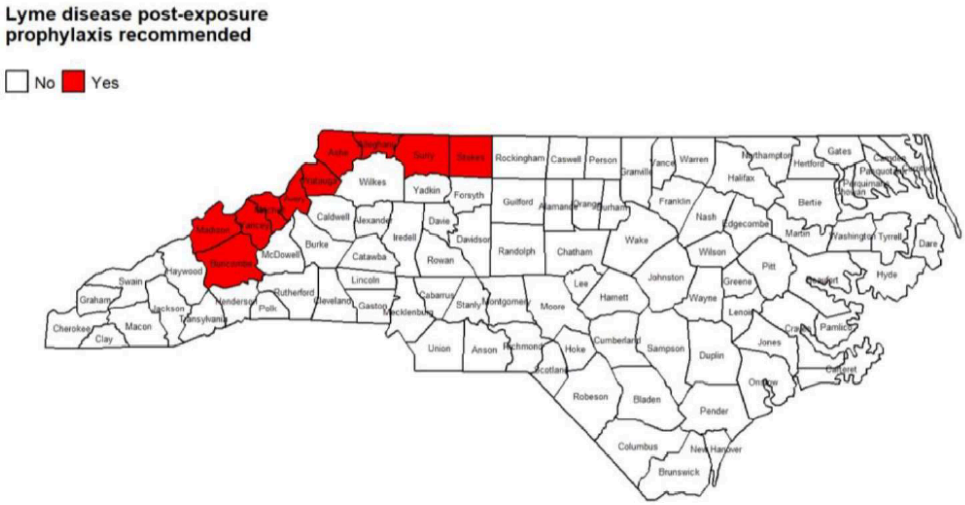



**Figure 1**. Map of NC counties where Lyme disease post-exposure prophylaxis is recommended

## Ehrlichiosis and Spotted Fever Rickettsiosis (SFR)

Ehrlichiosis is now the most reported tickborne illness in NC. However, most cases are not confirmed due to the lack of convalescent serology or the failure to utilize PCR testing. Ehrlichiosis is transmitted statewide by infected Lone Star ticks (*Amblyomma americanum*). Diagnostic testing is commercially available and should be considered when there is a clinical and epidemiologic suspicion of infection. PCR testing can provide confirmatory results and is preferred, if available.

SFR comprises illness caused by several related pathogens in the Genus *Rickettsia*. This includes the causative agent of Rocky Mountain Spotted Fever (*Rickettsia rickettsii*) as well as other rickettsial pathogens that may cause a milder illness such as *R. parkeri* and *R. amblyommii*. Reported cases of SFR, like ehrlichiosis, have statewide distribution. Also similar to ehrlichiosis, most cases are not confirmed due to the lack of convalescent serology. Diagnostic testing is commercially available and should be considered when there is a clinical and epidemiologic suspicion of infection.

Prompt treatment (in the first five days of illness) with an appropriate antibiotic (doxycycline) will minimize the chances of severe illness development and usually results in a rapidly effective cure. Ehrlichiosis and SFR can be severe or fatal illnesses, so treatment should be given based on suspicion of illness and not be delayed until laboratory results are complete. Short courses of doxycycline (such as those used to treat rickettsial diseases) do not cause dental staining when given to children under 8 years old and should be used.

**Other tickborne illnesses**

In NC cases of **Anaplasmosis**, **Babesiosis**, and **Powassan virus** have been reported, but are generally travel-associated. In contrast, while rare, **Heartland** and **Bourbon** viruses may be transmitted to people in NC. While not infectious, **Alpha-gal syndrome** is an allergic reaction which may occur following the bite of a Lone Star tick.

**For more information**

Please contact the NC Communicable Disease Branch epidemiologist on call at 919-733-3419 for any additional questions.

# North Carolina and the South

## First identification of *Candidatus* Rickettsia andeanae in host-attached *Dermacentor variabilis* and across a large geographic sampling region, South Carolina, U.S.A.

Studying the speciation of *Rickettsia* spp. provides a unique insight into pathogen evolutionary patterns, vector symbiosis, and pathogen transmission dynamics. The *Ca.* R. andeanae-positive ticks from our study were not found to be coinfected with *R. parkeri* or *R. rickettsii*, although *Ca.* R. andeanae testing was not systematically performed for all *R. parkeri* ticks (a study limitation). These results suggest that the presence of *Ca*. R. andeanae may reduce infection from other pathogenic species, although this hypothesis has not been recently analyzed (Paddock et al. 2015). This scenario has been hypothesized with other *Rickettsia* spp. among other tick vectors,

such as *R. amblyommatis* in *Am. americanum* (Gual-Gonzalez et al. 2024) and by other researchers. Vertical, horizontal, and mixed transmission of rickettsial pathogens may be affected through selective pressure from highly virulent rickettsial species. For example, highly virulent species may be excluded in favor of less virulent ones during vertical transmission, while highly virulent species are maintained through horizontal transmission (Lipsitch et al. 1996, Perlman et al. 2006). This scenario may allow for less virulent strains to successfully compete with their more virulent counterparts in preservation of the tick host, while horizontal transmission ensures highly virulent species survival in animals.

Pickle, E.O., et al.; *Journal of Vector Ecology* (2025); https://doi.org/10.52707/1081-1710-50.1-S4

***Summary:*** This study explored rickettsial disease distribution in South Carolina based on surveillance system results.

## Enhanced surveillance for tick-borne rickettsiosis and ehrlichiosis in North Carolina: Protocol and preliminary results

North Carolina (NC) experiences some of the highest incidence rates of spotted fever rickettsiosis (SFR) and ehrlichiosis in the United States (US). Due to the non-specific nature of clinical symptoms, minimal utilization of molecular methods when appropriate, and limitations of sero-diagnostic methods, accurate case identification and subsequent public health reporting is challenging. Herein we detail the protocol and early enrollment results for an enhanced surveillance project aiming to generate more accurate estimates of tick-borne disease incidence in NC. Secondary outcomes of interest include: (i) increasing the obtainment rate of convalescent samples (ii) defining demographic and socioeconomic, behavioral/knowledge, entomologic, and environmental risk factors for disease, and (iii) describing the spectrum and clinical course of disease among cases of SFR and ehrlichiosis up to 90 days after symptom onset. In addition, we will collect remnant serum to establish a biorepository of well characterized samples that we intend to make available to researchers. Of the 150 participants enrolled, highlighted results include 49.5% of participants reported being exposed in their own home compared to 43.2% being exposed due to work or travel showing the importance of tick control and education. We also reported more confirmed cases of SFR and ehrlichiosis (15 and 20 respectively) where the North Carolina State Health Department only reported 14 and 11 confirmed cases in the entire state in 2022. Findings from the project will be reported in subsequent publications.

Ursery, L., et al.; *PLOS One* (2025); https://doi.org/10.1371/journal.pone.0320361

***Summary:*** A proposal, description, and early enrollment results of an enhanced surveillance project aiming to get more accurate estimates of tick-borne disease in North Carolina.

# TIC-NC Activities

On March 19, 2025, our scientific advisor, Dr. Marcia Herman-Giddens, gave a one-hour presentation on Zoom to the Durham Garden Forum. The Forum is an independent, informal group in partnership with NC Cooperative Extension since 2009. Many of the current 170-plus members are Extension Master Gardeners. The questions from the participants were excellent.


# National Section

### Isolation, culture, and genome analysis of *Rickettsia oklahomensis* sp. nov. (Rickettsiales: Rickettsiaceae) from *Amblyomma americanum* (Acari: Ixodidae)

An uncharacterized *Rickettsia* species was previously identified by molecular detection in *Amblyomma americanum* ticks from Oklahoma, a state reported to have high *Rickettsia* seroprevalence. *Amblyomma americanum* ticks are aggressive feeders capable of transmitting viral, protozoal and bacterial species that cause diseases in humans and animals. Discovering and characterizing novel microorganisms in this tick species is crucial for identifying potential new pathogens. Using *A. americanum* ticks collected from Oklahoma, we isolated, cultured and sequenced the entire genome of a previously detected, but uncharacterized, novel *Rickettsia*

species. Triturated *A. americanum* ticks were used as inoculum to culture the novel *Rickettsia* species in Vero E6 cells, and qPCR testing confirmed the presence of the new *Rickettsia* species while ruling out the presence of other tick-borne organisms. The total genome size was 1.17 Mbp consisting of a complete chromosome with a 30.7 % G+C content (GenBank accession CP157197). We predicted 1037 genes, 997 coding gene open reading frames, along with 33 tRNAs, 4 ncRNAs and 3 rRNAs. This genome was most similar to *Rickettsia canadensis* strain CA410 at 91.1 % identity, based on average nucleotide identity analysis. A maximum-likelihood phylogeny tree, constructed using 636 concatenated core proteins, placed the novel *Rickettsia* species in a clade with *Rickettsia canadensis.* We propose the name *Rickettsia oklahomensis* sp. nov., strain Oklahoma 10, which is available from the Centers for Disease Control and Prevention Rickettsial Isolate Reference Collection (WDCM 1093), Atlanta, GA, USA (CRIRC accession number ROK001).

Karounos, M., et al.; *Ticks and Tick-borne Diseases* (2025); https://doi.org/10.1016/j.ttbdis.2025.102482

***Summary:*** This paper describes a new *Rickettsia* species isolated and cultured from *Amblyomma americanum* ticks from Oklahoma.

## Ticks of Delaware revisited: an updated checklist of hard ticks (Ixodidae) and first records of soft ticks (Argasidae) in the First State

It has been more than three-quarters of a century since the inaugural report of Delaware's ticks was published. To provide an updated checklist of tick species currently known to occur in Delaware, we reviewed the scientific literature, examined tick collections, accessed archived tick specimen data, and analyzed findings from the state's ongoing tick surveillance program, initiated in 2019. We report here a total of 15 established hard tick species (Ixodidae), as well as additional Ixodidae and 2 soft tick species (Argasidae) that are not yet confirmed as established. We summarize the phenology of each species and its known distribution in Delaware and public health importance. We also provide a table of known tick-host associations for Delaware.

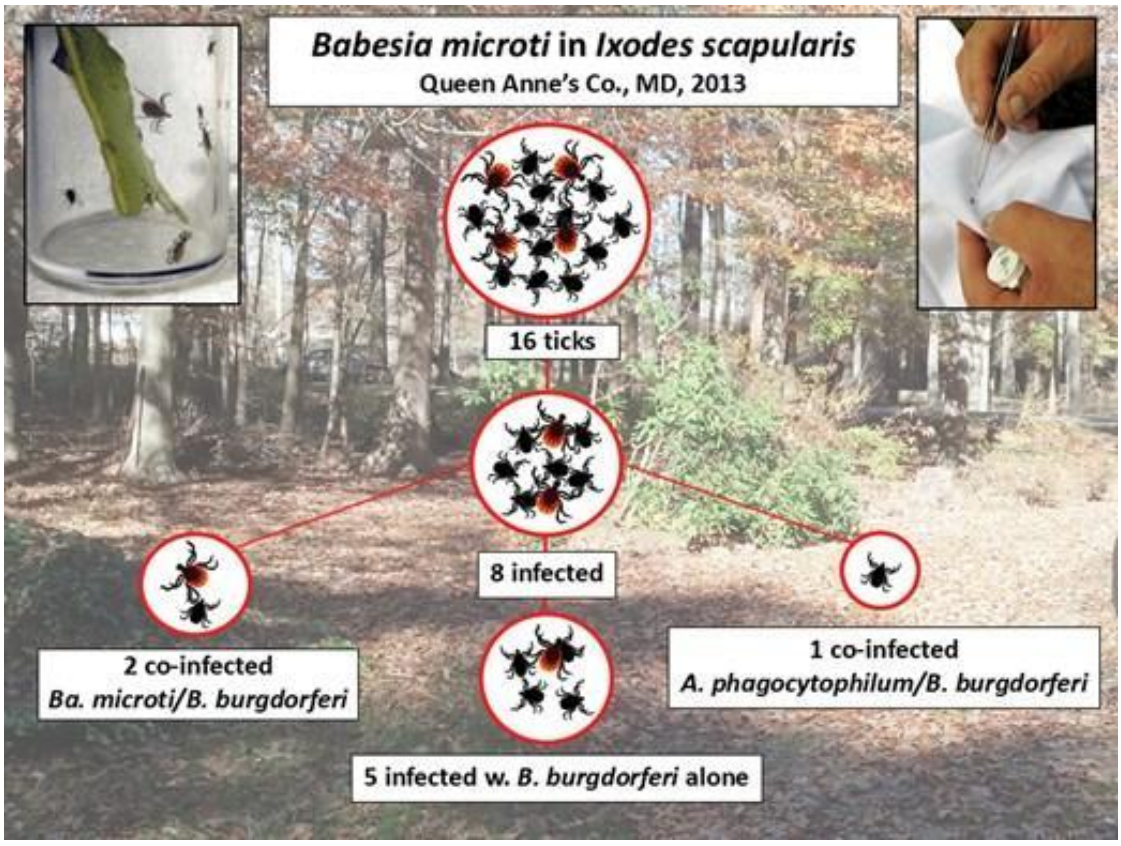
Kennedy, A.C., et al.; *Journal of Medical Entomology* (2025); https://doi.org/10.1093/jme/tjaf029

***Summary:*** An update of all known ticks that can be found in Delaware. The paper provides a list of all the ticks and their sources.

## Emerging babesiosis in the mid-Atlantic: autochthonous human babesiosis cases and *Babesia microti* (Piroplasmida: Babesiidae) in *Ixodes scapularis* (Acari: Ixodidae) and *Ixodes keiransi* (Acari: Ixodidae) ticks from Delaware, Maryland, Virginia, West Virginia, and the District of Columbia, 2009 to 2024

The range of *Babesia microti* (Franca, 1910)-infected ticks is expanding, resulting in locally acquired human babesiosis cases occurring in new areas: Maryland (2009), the District of Columbia (2013), Virginia (2016), and West Virginia (2017). We collected host-seeking ticks

from old fields, ecotones, forested habitats and animal hosts in Delaware, Maryland, and Virginia, 2010 to 2024. *Ixodes scapularis* Say, the tick vector of babesiosis, was captured in all 3 states. PCR revealed *B. microti* in 2.7% (36/1310) of *I. scapularis*, with site prevalence ranging from <1% to 12.5% infected. The first *B. microti*-positive *I. scapularis* was collected in Northampton County, Virginia, 2012. Of the *B. microti*-infected ticks, 50% (18/36) were coinfected with *Borrelia burgdorferi* and one was triple-infected with *B. microti*, *B. burgdorferi*, and *Anaplasma phagocytophilum*. We collected *Ixodes keiransi* Beati, Nava, Venzal, and Guglielmone ticks from Delaware and Virginia. We found *B. microti* and *B. burgdorferi* in those from Virginia, and *B. burgdorferi* in ticks from a shrew in Delaware. To our knowledge, this is the first report of *B. microti* and *B. burgdorferi*-positive *I. keiransi* from Virginia, and the first report of *B. burgdorferi*-positive *I. keiransi* from Delaware. *Ixodes keiransi* ticks rarely bite humans but are involved in the maintenance and spread of pathogens when sympatric with *I. scapularis*. We tested a subset of both tick species for *Babesia duncani*; none were positive. Jurisdictions in the southern mid-Atlantic region should expect babesiosis cases, and Lyme disease and anaplasmosis coinfections, and healthcare providers should consider these tick-borne infections as part of the differential diagnosis.




Stromdahl, E.Y., et al.; *Journal of Medical Entomology* (2025); https://doi.org/10.1093/jme/tjaf054

***Summary:*** This paper describes a large study in which *Ixodes scapularis* ticks were collected across states in the southern mid-Atlantic region of the US and shown to carry *Babesia* and *B. burgdorferi*.

## *Rickettsia* and *Ehrlichia* of Veterinary and Public Health Importance in Ticks Collected from Birds in the Great Plains of the United States

As the incidence of tick-borne disease expands globally, comprehensive understanding of pathogen reservoir hosts is crucial to protect humans and wildlife. While many components are understood, there are gaps in our knowledge regarding the role of alternative, non-mammalian hosts such as birds. Within the United States, birds have been identified as reservoirs for *Borrelia* and *Rickettsia*; however, local studies rarely examine the potential of birds as reservoirs and transporters of *Ehrlichia*-infected ticks, unlike studies in Europe and South America. To address this research gap, we extracted and sequenced important microorganisms within 90 larval and nymphal ticks which were removed from passerine and near-passerine birds in the Great Plains region of the United States between May and October 2023. We found that 11% of birds hosted ticks infected with one or more *Rickettsia* or *Ehrlichia* species. Additionally, we collected a larval *Haemaphysalis leporispalustris* infected with *Ehrlichia chaffeensis* from a Northern Cardinal, the first North American songbird implicated in the *Ehrlichia* transmission cycle. Our research intertwines multiple bird and tick species in the North American pathogen system, highlighting the need for continued research focusing on birds as tick hosts and pathogen reservoirs in understudied parts of the United States.

Taylor, T., et al.; *Pathogens* (2025); https://doi.org/10.3390/pathogens14050461

***Summary:*** Birds are known to be reservoirs for *Borrelia* and *Rickettsia* but have not historically been included in tick-borne illness studies. This study confirms that birds play an important role in tick-borne illness transmission in the Great Plains.

## *Ehrlichia chaffeensis* DNA in *Haemaphysalis longicornis* Ticks, Connecticut, USA

Informed by passive tick surveillance, we collected questing *Haemaphysalis longicornis* ticks from southwestern Connecticut, USA. Of 445 ticks tested by PCR, 3 nymphs were positive: 1 for *Ehrlichia chaffeensis* and 2 for *Borrelia burgdorferi*. This finding highlights the enduring public health challenges of invasive ticks and associated pathogens.

Molaei, G., et al.; *Emerging Infectious Diseases* (2025); 10.3201/eid3106.250034

***Summary:*** This research letter describes findings of ehrlichiosis in ticks in Connecticut.

## Investigating the prevalence of three medically important pathogens in Ixodes pacificus from southern Oregon

In the far western United States of America, Ixodes pacificus is the primary vector of several pathogens of public health and veterinary importance including the Lyme disease spirochete Borrelia burgdorferi sensu lato (s.l.), as well as Borrelia miyamotoi and Anaplasma phagocytophilum. Ixodes pacificus is common in southern Oregon yet there are few published

studies on the distribution of tick-borne pathogens in this region. Using real-time quantitative PCR, we assessed the prevalence of B. burgdorferi s.l., B. miyamotoi, and A. phagocytophilum among 2,463 unfed I. pacificus adults and nymphs combined into 260 pools (131 nymph, 129 adult) with nearly equal numbers of each life stage from 12 locations in Jackson County, Oregon.In our study, 27.9% (36/129) and 29.8% (39/131) of adult and nymph pools, respectively, tested positive for at least a single pathogen. Nymph pools had a higher pool positivity rate (PPR) for B. burgdorferi s.l. with 15.3% (20/131) testing positive compared to 3.1% (4/129) of adult pools.Nymph pools also had a higher minimum infection rate (MIR) and maximum-likelihood estimate of pooled prevalence (EPP) for B. burgdorferi s.l. than adults. Interestingly, the prevalence of B. burgdorferi s.l. varied greatly in nymph pools across collection sites (0-70%). PPR of B. miyamotoi was 21.7% (28/129) for adults and 12.2% (16/131) for nymphs, making it the most frequently detected pathogen in adult pools and most detected pathogen overall. Anaplasma phagocytophilum was the least frequently detected pathogen overall with a PPR of 3.1% (4/129) and 2.3% (3/131) for adults and nymphs, respectively. These findings underscore the importance of continued surveillance, pathogen testing, and public education regarding ticks in areas such as southern Oregon where I. pacificus is common but little research has been done.

Partin, A., et al.; *Frontiers in Parasitology* (2025); 10.3389/fpara.2025.1599377

***Summary:*** This study surveys the prevalence of various clinically relevant tick-borne pathogens in Oregon and calls for improved surveillance in this region.

## Short communication: Timber harvesting impacts small mammal foraging behavior and larval tick infestation

Small mammals are important blood-meal hosts for the blacklegged tick, *Ixodes scapularis*, and reservoirs for the pathogens it transmits. Timber harvesting, a widespread forest management practice within *I. scapularis*'s endemic range, may impact tick densities and infection prevalence via effects on rodent communities. We compared rodent population size, activity patterns, tick burdens, and tick-borne pathogen infection rates in forests under different timber harvesting regimes. We found that harvest intensity correlates negatively with rodent foraging intensity and positively with tick burdens. Thus, host behavior may mechanistically link forest structure to tick densities in managed forests.

Hurd, S. and A.M. Gardner; *PLOS One* (2025); https://doi.org/10.1371/journal.pone.0325495

***Summary:*** This short paper describes how timber harvesting impacts small mammal habitats and behaviors, which further impact blacklegged tick dynamics.

# International Section

## Ticks and tick-borne pathogens in urban areas in Lithuania

Recent studies in Europe highlight the growing risk of tick-borne diseases (TBDs) due to urbanization and ecological changes. Lithuania is a highly endemic area for tick-borne encephalitis and Lyme borreliosis (LB), with Ixodes ricinus known to carry various tick-borne pathogens (TBPs). In addition to the agents of these notifiable diseases, various other TBPs, such as Anaplasma phagocytophilum, Rickettsia helvetica, and several Babesia species, have been detected in questing I. ricinus in their natural habitats. However, the prevalence of these pathogens in urban and suburban areas remains largely unexplored. This study investigated the distribution of I. ricinus ticks and their infection rates with Borrelia spp., A. phagocytophilum, and Neoehrlichia mikurensis in urban green spaces in Lithuania. Ticks were collected from 34 urban and 17 peri-urban locations, including public parks, city forests, botanical gardens, and regional parks, during 2021–2023. Pathogens were screened using triplex real-time PCR, followed by PCR and sequencing for positive samples. A total of 3,599 ticks were collected from 83% of the surveyed sites, which included all peri-urban and 25 urban sites, with the highest abundance found in forest parks. Borrelia DNA was detected in 24.06% of the ticks, while A. phagocytophilum and N. mikurensis were found in 4.85% and 4.88% of the ticks, respectively. Six Borrelia species were identified: B. afzelii, B. garinii, B. burgdorferi s.s., B. valaisiana, B. lusitaniae, and B. miyamotoi. The prevalence of TBPs varied among urban and peri-urban locations and was higher in adult ticks compared to nymphs. This study emphasizes the importance of monitoring tick populations in urban green spaces, which pose a significant risk for TBD transmission, particularly LB, anaplasmosis, and neoehrlichiosis. Notably, N. mikurensis and B. lusitaniae were detected in Lithuania for the first time.

Radzijevskaja, J., et al.; *16th International Symposium on Ticks and Tick-Borne Diseases* (2025); https://hdl.handle.net/20.500.12259/276312

***Summary:*** This study describes tick and tick-borne disease prevalence in urban green spaces across Lithuania and reveals clinically relevant diseases, as well as first-time detections of two tick species.

## Detection of *Borrelia burgdorferi* (s.l.) in *Ixodes ricinus* ticks collected in Iceland

**Background:** *Ixodes ricinus* is the most common tick species throughout Europe; it can transmit various pathogens that can cause diseases in humans and animals. It is the principal vector of *Borrelia burgdorferi* sensu lato (s.l.) and tick-borne encephalitis virus (TBEV), and there is increasing concern about *I. ricinus*'s potential to transmit pathogens to humans and animals in Iceland. The aim of this research is to determine whether *I. ricinus* ticks collected in Iceland carry *B. burgdorferi* (s.l) and, in a limited number of samples, other pathogens to better

understand the potential health risks that *I. ricinus* bites may pose to both humans and animals in Iceland.

**Methods:** Birds were captured and examined for ticks at the South East Iceland Bird Observatory from 2018 to 2019. All ticks were screened for infection with *B. burgdorferi* (s.l.). Additionally, 133 ticks collected in Iceland prior to 2018, stored in the collection at the Natural Science Institute of Iceland, were screened for the presence of *B. burgdorferi* (s.l.), TBEV, *Coxiella burnetii*, *Francisella tularensis* and *Rickettsia* spp. Samples positive for *Borrelia* were sequenced by Genewiz Azenta, Germany, and BLAST (NCBI) analysis was performed on the obtained sequences.

**Results:** A total of 1209 *I. ricinus* ticks collected in Iceland were screened for the presence of *B. burgdorferi* (s.l.); 133 ticks from a museum collection were additionally screened for other pathogens. *Borrelia burgdorferi* (s.l.) was detected in 9.9% of the tick samples (86/866). DNA sequencing from 28 positive samples revealed three genospecies. The most frequently detected was *Borrelia garinii* (82.1%), followed by *B. valaisiana* (14.3%) and *B. afzelii* (3.6%). TBEV, *C. burnetii*, *F. tularensis* and *Rickettsia* spp. were not detected in ticks from the collection.

**Conclusions:** This research confirms the presence of *B. burgdorferi* (s.l.) in *I. ricinus* ticks collected in Iceland. Even though Lyme disease is not endemic and *I. ricinus* ticks are not considered established, the risk of exposure remains. Further research on *B. burgdorferi* (s.l.) and other pathogens these ticks may carry is essential along with raising public awareness and fostering collaboration between experts to reduce the risk of tick-borne diseases in Iceland.

Alfredsson, M., et al.; *Parasites & Vectors* (2025); https://doi.org/10.1186/s13071-025-06809-9

***Summary:*** This study confirms the presence of Lyme disease in Iceland despite Lyme disease not being endemic and *Ixodes Ricinus* ticks not being considered established.

## Seroprevalence of Lyme Disease in Asian Human Populations: A Systematic Review and Meta-Analysis

The meta-analysis reveals a high seroprevalence of LD in Asia, indicating that it has become a significant public health concern in the region. Relevant government departments and health organizations in Asia should enhance their surveillance and education efforts regarding LD. This study highlights the importance of a reliable and accurate standard serological diagnostic procedure for confirming a diagnosis of LD. The strict implementation of two-tier testing is especially crucial in diagnosing LD. If only ELISA/IFA is used, it may cause false positive results. Its findings on the prevalence of LD can serve as a foundation for future research on surveillance and the prevalence of LD in the region. In addition, these findings may be useful for clinicians in their work.

Song, J., et al.; *Vector-Borne and Zoonotic Diseases* (2025); https://doi.org/10.1089/vbz.2024.0092

***Summary:*** The authors show a high level of Lyme Disease in Asia and that it has become a significant public health concern.

## Borrelia burgdorferi: A rare cause of stroke

Lyme disease is the most common tick-borne zoonosis in Europe. It is a multisystemic infectious disease that can produce cerebrovascular events on rare occasions. Here, the authors describe a case of a 58-yearold female patient living in a rural area who presented to the hospital with dysarthria, right central facial paralysis, right hypoesthesia, and severe right hemiparesis. Imaging revealed an infarct in the left corona radiata, posterior limb of the internal capsule, posterior parietal region, and multiple microhemorrhages scattered throughout the cerebral hemispheres. She was hospitalized with the diagnosis of ischemic stroke. Given the absence of known risk factors, the diagnostic workup included a lumbar puncture, which showed cerebrospinal fluid serology positive for immunoglobulin M against Borrelia burgdorferi. The patient was treated with doxycycline for 21 days, leading to clinical improvement.

Vieira Afonso, J.F.F., et al.; *Cureus* (2025); 10.7759/cureus.77061

***Summary:*** A case study describing an unusual instance of *Borrelia burgdorferi* being the possible cause of stroke.

## Three Cases of human Babesiosis, Italy, 2017-2020

We report 3 cases of babesiosis in Italy caused by *Babesia* species that are rarely reported in humans. The circulation of *Babesia* spp. among vectors, animals, and humans might be more common than previously thought, and babesiosis might be an underdiagnosed and emerging disease in Italy and Europe.

Sepulcri, C., et al.; *Emerging Infectious Diseases* (2025); 10.3201/eid3106.241776

***Summary:*** A dispatch describing three unusual cases of babesiosis.

## Abundance of ticks and tick-borne pathogens in domestic gardens in Belgium, 2020-2022: a citizen science approach

**Background:** Ticks, particularly *Ixodes ricinus*, are primary vectors for tick-borne diseases in Europe, with private gardens representing an understudied but potentially significant risk habitat. Through a citizen science initiative, we aimed to investigate tick density and pathogen prevalence in domestic gardens across Flanders, Belgium.

**Methods:** A total of 185 citizen scientists participated in standardized tick dragging and collecting garden data over multiple occasions from 2020 to 2022. Generalized linear mixed effects models were used to analyze tick density and pathogen prevalence.

**Results:** Ticks were detected in 44.3% of 185 gardens. They were most frequently found in rural gardens (60.2% of rural gardens, 50/83), but also in suburban (28.9%, 11/38) and urban gardens (50.0%, 4/8). *Ixodes ricinus* was the dominant species (94.7% out of 1162 ticks), with all life stages present. Additionally, few individuals of *Ixodes frontalis* (5.0%) and *Ixodes hexagonus* (0.3%) were collected. Ticks were found in a variety of vegetation types, however the highest proportions of successful collections were in fallen leaves (47.4%) and fallow land

(46.2%). Nymphal density was positively associated with the number of mammal species observed and an association with vegetation type was found: significantly more nymphs were collected on wild vegetation (with fallow land) and fallen leaves, compared to mown grass, tall grass and flower beds (with vegetable gardens). Pathogen screening revealed that 34.1% of ticks carried at least one pathogen, with *Borrelia burgdorferi* s.l. most prevalent (19.6%), followed by Rickettsia spp. (11.7%). Co-infections were observed in 6.6% of ticks. *Borrelia burgdorferi* s.l. prevalence was significantly lower in the presence of dogs and increased with nymphal density. Additionally, a significant interaction was found between life stage and the number of bird species.

**Conclusions:** The presence of *Ixodes ricinus* in gardens, coupled with the detection of pathogens at prevalence levels similar to those in natural habitats, suggests that private gardens may serve as overlooked risk areas for tick exposure. This underscores that raising public awareness, combined with effective garden management strategies, may help mitigate the risk of infection with tick-borne diseases. Future research could focus on evaluating the effectiveness of prevention and garden management measures.

Robert, K., et al.; *BMC Public Health* (2025); https://doi.org/10.1186/s12889-025-23221-1

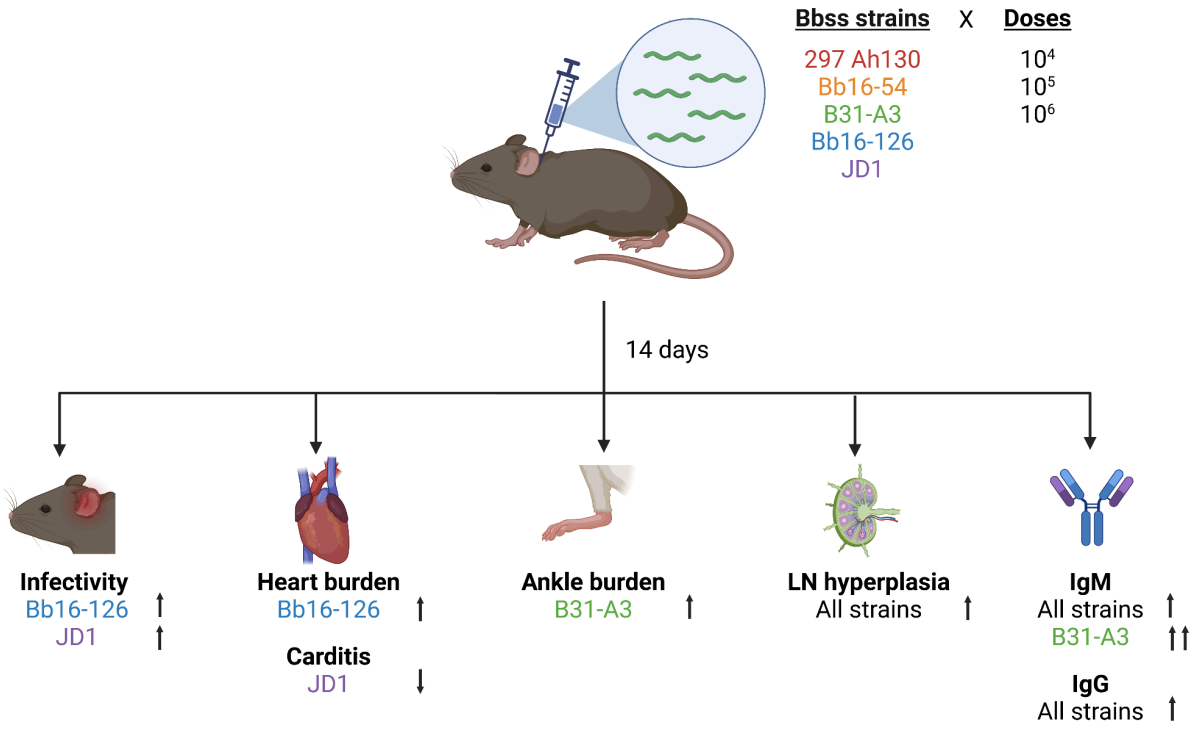
***Summary:*** This study involving citizen scientists characterized the presence of *Ixodes ricinus* and tick-borne pathogens in Belgium, finding similar prevalence levels in private gardens as in natural habitats.

# Molecular Section

## *Borrelia burgdorferi* Strain-Specific Differences in Mouse Infectivity and Pathology

Lyme disease (LD), caused by infection with the tick-borne bacteria, *Borrelia burgdorferi*, is associated with a wide array of symptoms in human patients. Variations in clinical manifestations are thought to be influenced by genetic differences among *B. burgdorferi* strains. In this study, we evaluated the infectivity, tissue bacterial load, pathology, and immunogenicity of five strains of *B. burgdorferi* sensu stricto (297 Ah130, Bb16-54, B31-A3, Bb16-126, JD1) in female C3H/HeN mice at three infectious doses ($10^4$, $10^5$, $10^6$ spirochetes). We found that strains Bb16-126 and JD1 were the most infectious, resulting in 100% infection across all the tested doses. Strain Bb16-126 caused the highest bacterial burden in the heart tissue and significant carditis, whereas JD1 exhibited the lowest spirochete load in the heart and minimal carditis. In comparison, strain B31-A3 demonstrated the highest abundance in the tibiotarsal joint. Infection with all the strains induced severe lymph node hyperplasia, with JD1 producing the greatest increase in cellularity. Using a diagnostic C6 peptide ELISA, all the strains induced significant anti-C6 IgM and IgG antibody titers at 14 days post-infection; however, strain B31-A3 elicited the highest anti-C6 IgM titers. Our findings demonstrate the importance of strain diversity in

shaping *B. burgdorferi* pathogenesis in a mouse model and provide insights for developing strain-specific diagnostic, therapeutic, and vaccine strategies.




Pfeifle, A., et al.; *Pathogens* (2025); https://doi.org/10.3390/pathogens14040352

***Summary:*** Experimentation with *Borrelia burgdorferi* demonstrates that different strains can elicit different clinical symptoms in patients, providing insights for strain-specific diagnostics and therapeutics.

# Alpha-Gal Section

## Environmental risk and Alpha-gal Syndrome (AGS) in the Mid-Atlantic United States

Alpha-gal syndrome (AGS), commonly referred to as the tick bite red meat allergy, has been reported worldwide with the number of suspected cases in the United States increasing from 24 in 2009 to over 34,000 in 2019. Within the US, AGS is associated with the bite of two tick species, *Amblyomma americanum* and *Ixodes scapularis*, and has particularly high incidence rates in the mid-Atlantic region. Because AGS is associated with tick bites, the risk of

developing AGS is affected by the environment individuals visit. Despite this, as well as the numerous studies associating the environment with *Am. americanum*, no work to-date has evaluated AGS risk factors associated with the surrounding landscape. We test the hypothesis that AGS risk is associated with habitat fragmentation typically seen in areas classified as open space and low intensity development that are suitable for human-tick interactions, using a combination of generalized linear modeling (GLM), boosted regression trees (BRT), and Maximum Entropy (MaxEnt). We qualitatively compare results from the models, as well as their predictions within the mid-Atlantic region. We found that models mostly agree when determining important environmental variables, with open space development and population density being highly predictive across all models. BRT and GLM predicted a strong east to west gradient of risk across the mid-Atlantic, which largely mirrors the environmental transition from mountains to coastal plains. MaxEnt predicted a much patchier distribution across the region with no discernable patterns. These results provide evidence that AGS is associated with land uses that are associated with habitat fragmentation, the preferred habitat of *Am. americanum*. This information can be used to inform future education programs aimed at reducing AGS incidence in the region.

Hollingsworth, B.D., et al.; *PLOS Climate* (2025); https://doi.org/10.1371/journal.pclm.0000528

***Summary:*** This modeling study found that alpha-gal syndrome is associated with land use types associated with habitat fragmentation, which is the preferred habitat of *Amblyomma americanum*.

## Alpha-gal syndrome: potential for a hypersensitivity reaction after the use of dental products: Literature review and case report

Alpha-gal syndrome (AGS) is associated with a potentially severe delayed immunoglobulin E–based hypersensitivity reaction produced via transmission of a salivary oligosaccharide (galactose-α-1,3-galactose) predominately from the bite of the lone star tick (*Amblyomma americanum)*. Sensitized people are at an increased risk of experiencing cross-reactivity reactions to numerous foods, pharmaceuticals, and medical and dental products that could result in a spectrum of pathophysiological responses, ranging from gastrointestinal and cutaneous disturbances to anaphylaxis. The authors have summarized the relevant literature and presented a case report describing an alpha-gal (AG) reaction associated with oral health care.

Brooks, J.K., et al.; *The Journal of the American Dental Association* (2025); https://doi.org/10.1016/j.adaj.2025.04.001

***Summary:*** This study summarizes the potential for alpha-gal syndrome reactions associated with oral health care.

## Alpha-gal allergy in a South Asian country

**Background:** Alpha gal syndrome (AGS) is a delayed allergy to red meat, due to IgE to galactose-alpha-1,3-galactose (alpha-gal). Sensitization occurs via tick bites. It has been described in the US, Europe, Australia, Japan and South Korea, but reports from the Indian subcontinent are rare. We report the demographics of alpha-gal allergy for the first time from the Indian subcontinent and possible association with vaccine allergy.

**Methods:** Patients diagnosed with alpha-gal syndrome (AGS) from 2018 to 2024 were selected in this study. AGS was identified by the occurrence of allergic symptoms up to 8 h of ingestion of red meat, with positive serum IgE to alpha-gal > IgE to red meat, and negative IgE to BSA. Allergy to vaccines containing bovine products were also identified in patients with AGS.

**Results:** Fifty-seven patients were identified. Thirty-one (54.3%) were 12 years or younger. There were more females among adults (63.2%) compared to children (50.0%), though statistically not significant. There was no difference between children and adults in relation to clinical features and time of onset of symptoms. However, 5/6 of adults with severe anaphylaxis (grade 5) were females. Six patients with AGS developed allergy, including anaphylaxis, to the measles, mumps, rubella (MMR, $n = 3$), rubella ($n = 1$), varicella ($n = 1$) and anti-rabies ($n = 1$) vaccines.

**Conclusion:** AGS is an important cause of food and vaccine allergy in the Indian subcontinent and is commoner in children unlike in other regions. However, the clinical features are similar to adults.

Dasanayake, D., et al.; *BMC Immunology* (2025); https://doi.org/10.1186/s12865-025-00717-4

***Summary:*** The authors identified risk factors and outcomes for alpha-gal patients in India.

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