Tick-Borne Infections Council of North Carolina, Inc.

NEWSLETTER 2021, Volume 2

Quote: - By using commercial insurance claims data, we estimated that Lyme disease was diagnosed and treated in ≈476,000 patients in the United States annually during 2010–2018… A previous analysis of insurance claims data for the years 2005–2010 estimated that Lyme disease was diagnosed in ≈329,000 persons annually in the United States. Kugeler KJ, et al. Emerg Infect Dis. 2021. DOI: 10.3201/eid2702.202731

Highlights…

- **New resource from the CDC**: The National Syndromic Surveillance Program
- **Two Lyme disease prevalence studies from the CDC**
- **Asian longhorned tick in Pennsylvania found with the Lyme disease bacteria**
- **Parental behavior to prevent tick-bites among children**
- **Infected Gulf Coast ticks all the way into Connecticut**
- **Will a Lyme disease vaccine make people less vigilant against ticks and, thus, be at more risk for other tickborne infections?**
- **Spectroscopy for detection of Lyme disease**
- **Lyme Disease on Treeless Islands, Scotland, United Kingdom**
- **Cats: Immunity and persistent lung problems after Covid-19 Infection**
- ***Borrelia miyamotoi*, a relapsing fever spirochete, more on how ticks get infected**

- **Alpha-gal review paper**
- **Tick bite cases increased 40-fold in eight years in the coldest inhabited region in the world due to warming**
- **Asian Longhorned incompetent agent of Human Granulocytic Anaplasmosis**

Special notice:

COVID-19 vs. Tick-Borne Illnesses: How to Tell the Difference

People are getting outside more due to the pandemic, increasing tick exposure.

People can contract a tick-borne infection (TBI) any time of year without knowledge or visible evidence of a tick bite. Symptoms for COVID may be similar to those caused by TBIs and flu, including but not limited to fatigue, fever, muscle aches, cough, sore throat, and occasionally diarrhea. Respiratory symptoms are usually but not always particular to COVID. Overlapping symptoms may cause delayed diagnosis of TBIs, resulting in hard to treat, more severe illness, or even a fatality.

There are now reported cases in medical literature of delayed treatment for TBIs due to this confusion. TIC-NC knows of two local situations where this has occurred. People may have symptoms suggestive of either COVID or a TBI. If they have a history of exposure to ticks, treatment for a possible TBI(s) should be initiated while waiting for COVID testing.

State Vector-borne Disease Working Group

There are no state Vector-borne Disease Working Group meetings planned for 2021 due to the pandemic. They are normally held quarterly at the Office of the Chief Medical Examiner, 4312 District Drive, Raleigh, NC 27607.

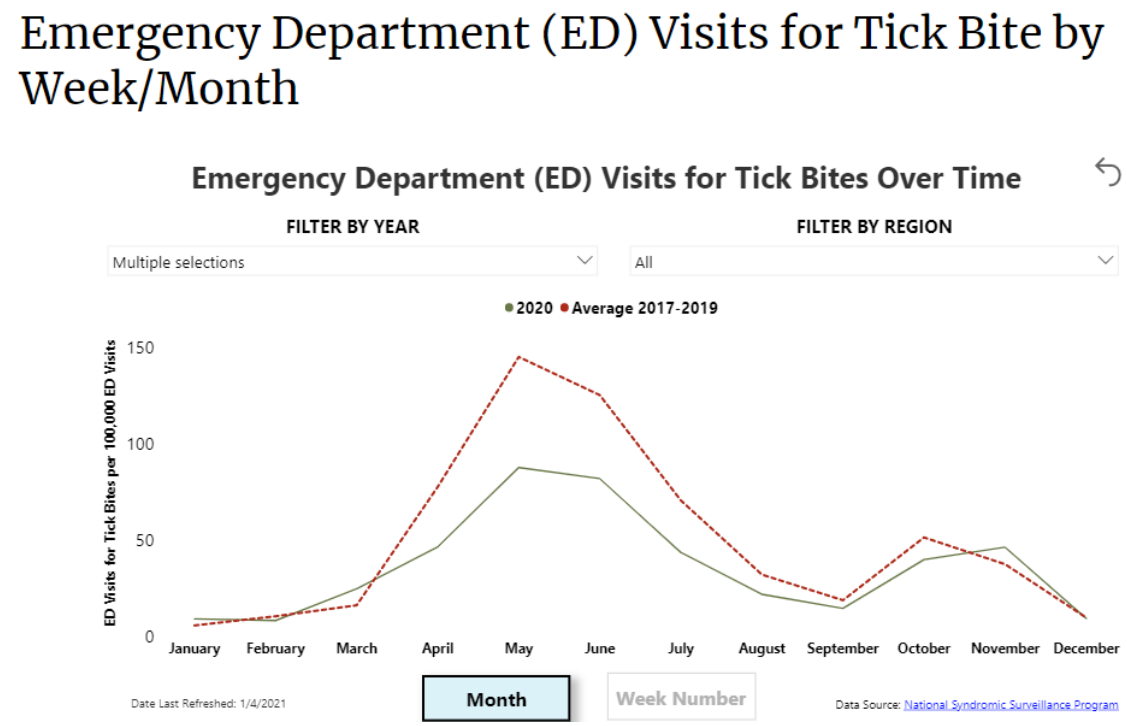
There are no reports.

Link to Notice to Medical Providers from the State Department of Public Health on Lyme Disease and Rickettsial Diseases: "Annual Update on Diagnosis and Surveillance for Tickborne Diseases"

The state has started issuing only one letter. Please see the home page of our website to access. www.tic-nc.org. None was issued for 2020.

From the CDC

New resource: The National Syndromic Surveillance Program (NSSP) is a collaboration between CDC, federal partners, local and state health departments, and academic and private sector partners. Example of data below. DVBD also recently released a data dashboard showing syndromic surveillance of emergency department visits for tick bites by time, region, age, and sex. Unlike some tickborne disease surveillance data, the dashboard is updated weekly rather than annually. These data can show when people in different parts of the country maybe at highest risk of getting tick bites.



https://www.cdc.gov/ticks/tickedvisits/tick-bite-by-week-month.html

Estimating the Frequency of Lyme Disease Diagnoses, United States, 2010–2018: ~ 476,000 cases per year!

By using commercial insurance claims data, we estimated that Lyme disease was diagnosed and treated in ≈476,000 patients in the United States annually during 2010–2018. Our results underscore the need for accurate diagnosis and improved prevention.

Lyme disease is caused by *Borrelia burgdorferi* spirochetes, which are transmitted to humans by certain *Ixodes* spp. ticks. The infection can involve multiple organ systems and is treatable with antimicrobial drugs; most persons recover fully, especially those who receive early and appropriate treatment. The geographic distribution of Lyme disease in the United States and the

demographic characteristics of persons affected have been well documented through nearly 3 decades of public health surveillance.

However, the frequency of Lyme disease is less well understood. Although 30,000–40,000 cases are reported through surveillance each year, substantial underreporting occurs, as is typical for passively reported surveillance data. A previous analysis of insurance claims data for the years 2005–2010 estimated that Lyme disease was diagnosed in ≈329,000 persons annually in the United States. We use similar methods to develop an estimate for 2010–2018. Kugeler KJ, et al. Emerg Infect Dis. 2021. DOI: 10.3201/eid2702.202731

Use of Commercial Claims Data for Evaluating Trends in Lyme Disease Diagnoses, United States, 2010-2018

We evaluated MarketScan, a large commercial insurance claims database, for its potential use as a stable and consistent source of information on Lyme disease diagnoses in the United States. The age, sex, and geographic composition of the enrolled population during 2010–2018 remained proportionally stable, despite fluctuations in the number of enrollees. Annual incidence of Lyme disease diagnoses per 100,000 enrollees ranged from 49 to 88, ≈6–8 times higher than that observed for cases reported through notifiable disease surveillance. Age and sex distributions among Lyme disease diagnoses in MarketScan were similar to those of cases reported through surveillance, but proportionally more diagnoses occurred outside of peak summer months, among female enrollees, and outside high-incidence states. Misdiagnoses, particularly in low-incidence states, may account for some of the observed epidemiologic differences. Commercial claims provide a stable data source to monitor trends in Lyme disease diagnoses, but certain important characteristics warrant further investigation. Schwartz AM, et al. Emerg Infect Dis. 2021 Feb [*date cited*]. https://doi.org/10.3201/eid2702.202728.

Figure 3

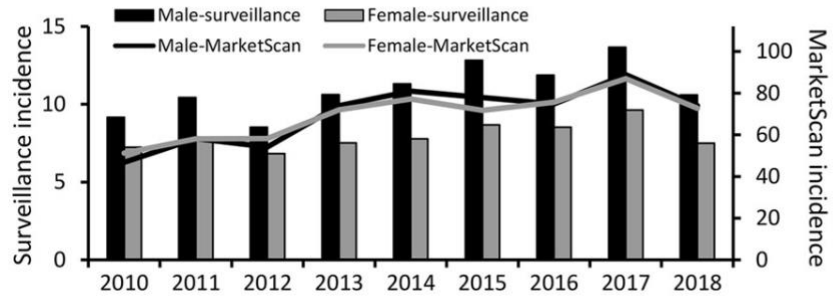


Figure 3. Incidence of patients with Lyme disease diagnoses in MarketScan database versus cases found by surveillance, by sex, United States, 2010–2018. Incidence was calculated as diagnoses/100,000 enrollees in MarketScan or cases/100,000 population among each subcategory. Scales for the primary and secondary y axes differ substantially to underscore sex-related incidence patterns but do not permit direct comparison of the magnitude of Lyme disease incidence between systems.

Where To Find CDC Case Definitions and their Statement that the Surveillance Case Definitions Are "not to be used as the sole criteria for establishing critical diagnosis"

Case Definition and Report Forms

Lyme Disease Surveillance Case Definition (revised Jan 2017)
Lyme Disease Surveillance Case Report FormCdc-pdf PDF – 2 pages] (for public health officials' use)

Note: Surveillance case definitions establish uniform criteria for disease reporting and should not be used as the sole criteria for establishing clinical diagnoses, determining the standard of care necessary for a particular patient, setting guidelines for quality assurance, or providing standards for reimbursement.

Accessed and copied 14 September 2019.

State tick research and/or reports

The 2019 tick-borne disease surveillance summaries are now complete. You can view them at the bottom of the NC DHHS Epi Section Facts & Figures page, under Vector-borne disease.

Note: By the *former* CDC definition, six counties had confirmed cases of Lyme disease in two persons who had not traveled out of the county for 30 days after their tick exposure. **Therefore, these counties were endemic for Lyme disease by the former CDC definition: Wake, Guilford, Haywood, Alleghany, Buncombe, and Wilkes.** Counties with one case of locally acquired Lyme disease were: Cleveland (2008), Wilson (2009), Pitt (2009), Carteret (2009), Gates (2011), Perquimans (2011), Rowan (2013), Union (2013), Caldwell (2013), Franklin (2014), Stanley (2014), Duplin 2014.

NC TBIs 2019 final, 2020 to November probable/confirmed

NC EDSS Event Data – Cases Submitted to CDC

Disease	Probable / Confirmed cases by year of report (2019)	Total preliminary confirmed and probable Events in NC EDSS Created between 1/1/2020 – 11/1/2020*	Total Events Reviewed and closed by NC DPH 1/1/2020 – 11/1/20	Total Events Still Under Investigation by LHD 1/1/19 – 11/1/20	Total Events created in NC EDSS 1/1/20 – 11/1/20
Spotted Fever group rickettsiosis	669P / 16C	151P / 7C	1394	243	1637
Lyme disease	243P / 91C	125P / 83C	473	302	775
Ehrlichiosis	150P / 6C	74P / 10C	310	114	424
Anaplasmosis	7P / 4C	1P / 4C	8	5	13
Total Numbers	1069P /117C (1,186)	351P / 104C (491)	2,185	664	2,849

*Note 2020 data are preliminary

TIC-NC Activities

TIC-NC Talks and Materials Distributed

Brochures/booklets:
PORCH event with Burmese refugees, Orange County
Folletos:
Eno River NC State Park
Jordan Lake NC State Park
Umstead NC State Park
Piedmont Health Services Farmworker Health Outreach
Episcopal Farmworker Ministry, Dunn NC
Community Partners HealthNet Clinic, Dunn NC
Urban Ministries Durham
El Futuro Durham
Durham Community Food Pantry
Great Outdoor Provision Company
Center for Employment & Leadership
Ayr Mount Poets Walk
Ixtapa Mexican Restaurant Hillsborough
REI Raleigh and Durham
Orvis Raleigh
Tick School Cards:
PORCH vaccine event, Orange County Board of Education

Radio: WUNC announcements for tick safety for one week in April.

Presentations: Annual Safety Training 2021, NC Dept of Agriculture and Consumer Services, Structural Pest Control and Pesticides Division. "Staying Safe(r) From Ticks."

Announcements sponsored by TIC-NC on WUNC NPR, Public Radio.

- Tick-Borne Infections Council of North Carolina, Inc. Symptoms of COVID-19 and tick-borne infections, like Lyme disease, can overlap. Learn about the difference on TIC- NC's Facebook page. One tick bite can change a life.
- Tick-borne Infections Council of North Carolina, Inc. Providing information about diseases including Lyme disease, Rocky Mountain Spotted Fever, red meat allergy and more on their Facebook page. One tick bite can change a life.

⁂ North Carolina and South ⁂

Virtual Medicine Grand Rounds at UNC, Ross Boyce, MD, MSc, presented, "Tick-borne Diseases in North Carolina: The Known and Unknown Unknowns."
This hour-long presentation was given on Feb 25 but is available to watch at the link below.
https://www.med.unc.edu/medicine/about/grand-rounds/grand-rounds-video-archives/

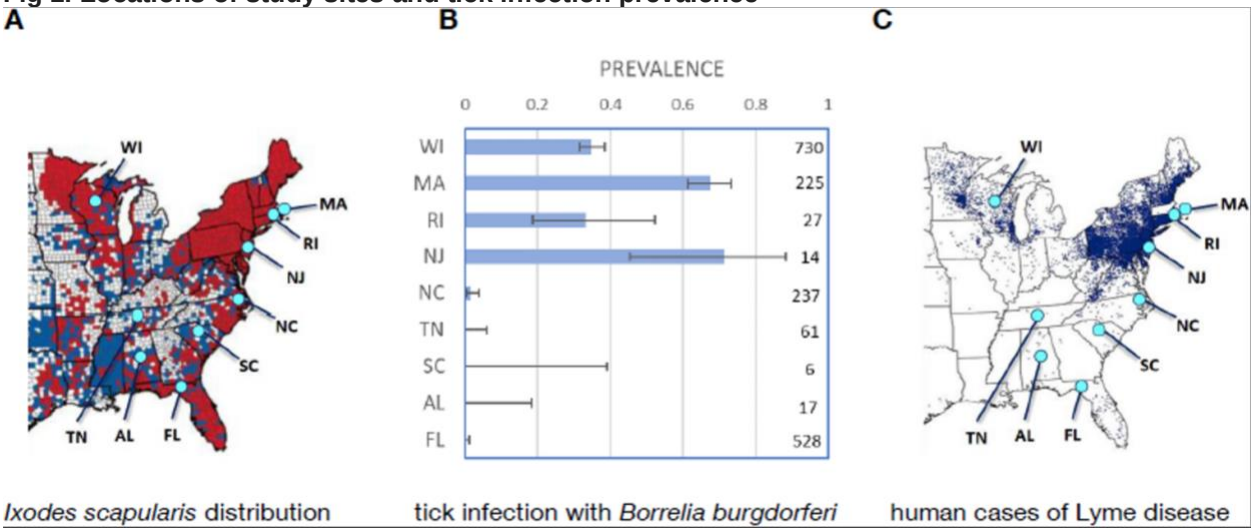
Why Lyme disease is common in the northern US, but rare in the south: The roles of host choice, host-seeking behavior, and tick density.

Lyme disease is common in the northeastern United States, but rare in the southeast, even though the tick vector is found in both regions. Infection prevalence of Lyme spirochetes in host-seeking ticks, an important component to the risk of Lyme disease, is also high in the northeast and northern midwest, but declines sharply in the south. As ticks must acquire Lyme spirochetes from infected vertebrate hosts, the role of wildlife species composition on Lyme disease risk has been a topic of lively academic discussion.

We compared tick–vertebrate host interactions using standardized sampling methods among 8 sites scattered throughout the eastern US. Geographical trends in diversity of tick hosts are gradual and do not match the sharp decline in prevalence at southern sites, but tick–host associations show a clear shift from mammals in the north to reptiles in the south. 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. Ginsberg HS, et al. PLoS Biol 19(1): e3001066. https://doi.org/10.1371/journal.pbio.3001066.

Eds note: It is unfortunate that the word "rare" was used in the title of this paper. Cases are not as common in the south as in the northeast, but they are *not* rare. Unfortunately, the maps from the figure in the paper below are out of date. Prevalence of I scapularis ticks and Lyme disease cases have increased from what is shown on the maps in this paper.

Fig 1. Locations of study sites and tick infection prevalence



(A) Map of distribution of *Ixodes scapularis* ticks; red counties have tick populations that are considered established (at least 6 ticks or at least 2 of the host-seeking life stages had been identified in a single collection period), and blue counties have at least some tick collections, but establishment has not been demonstrated [2]. (**B**) Infection prevalence in host-seeking adult *I*. *scapularis* with binomial 95% confidence intervals (from current study; number to the right of each bar is the number of ticks tested to provide that infection prevalence value). (**C**) Map of human cases of Lyme disease in the eastern and central US in 2018 (CDC map; each dot indicates 1 case of Lyme disease, placed randomly in the patient's county of residence; https://www.cdc.gov/lyme/stats/maps.html). Maps in Fig 1A and 1C are from the CDC, and data in Fig 1B are available in S1 Data. CDC, Centers for Disease Control and Prevention.

Review of papers on alpha-gal (red meat allergy) syndrome

Tick exposures and alpha-gal syndrome: A systematic review of the evidence

- Tick bites can lead to α-Gal syndrome by sensitizing people to the α-Gal molecule.
- α-Gal syndrome primarily occurs after consuming meat or other animal-based foods.
- Reactions are typically delayed 2−6 h but can range from minutes to 12−24 h.
- There is inconsistency about α-Gal-specific IgE levels required for diagnosis.
- More research is needed on risk factors and epidemiology of this syndrome.

Alpha-gal syndrome (AGS) refers to a delayed allergic reaction to galactose-α-1,3-galactose (α-Gal) that occurs following the consumption of mammalian meat or exposure to other animal-based foods and products. Increasing evidence suggests that bites from certain tick species can lead to AGS through sensitization of a person's α-Gal specific IgE levels.

This systematic review aimed to summarize the published evidence on this topic to understand post-tick exposure AGS epidemiology and health outcomes. A structured search for literature in eight bibliographic databases was conducted in January 2020. Grey literature and verification searches were also performed. The exposure of interest was tick bites, and the outcome of interest was AGS. All primary research study designs were eligible for inclusion. References were screened for relevance, and data extraction and risk-of-bias assessment were conducted on relevant studies by two independent reviewers. Data were descriptively and narratively summarized. Of 1390 references screened, 102 relevant articles (103 unique studies) were identified (published from 2009 to 2020).

Most studies (76.7 %) were case report or series. These 79 studies reported on 236 post-tick exposure AGS cases from 20 different countries, mostly the United States (33.5 %), Spain (19.5 %), Sweden (18.6 %), and France (12.7 %). The mean case age was 51.3 (SD = 16.7, range 5–85, n = 229), while 68.1 % were male (n = 226). The most commonly reported symptom was urticaria (71.2 %); 51.7 % of cases reported anaphylaxis. Twenty-one observational studies were reported, mostly (95.2 %) among clinical allergy patients. The proportion of AGS cases that recalled tick bites was highly variable across these studies. Three challenge studies evaluating tick exposures and α-Gal levels in α-Gal deficient mice were identified. The existing evidence suggests tick bites lead to α-Gal-specific IgE sensitization, which can cause AGS, but further research is needed to clarify if AGS is only attributable to certain tick species and whether other vectors may trigger AGS.
Additional research is needed on risk factors for AGS development, evaluation of diagnostic immunoassays, and the epidemiology and distribution of AGS in different populations. Climate change will likely lead to future cases of AGS in new regions worldwide due to the predicted alteration of suitable tick habitats. Young et al. Ticks and Tickborne Diseases, May 2021. https://doi.org/10.1016/j.ttbdis.2021.101674. Open access.

A common bacterium in the lone star tick, Rickettsia amblyommatis, is shown to cause mild illness in guinea pigs

Assessment of the Pathogenicity of *Rickettsia amblyommatis*, *Rickettsia bellii*, and *Rickettsia montanensis* in a Guinea Pig Model

Members of the genus *Rickettsia* range from nonpathogenic endosymbionts to virulent pathogens such as *Rickettsia rickettsii*, the causative agent of Rocky Mountain spotted fever. Many rickettsiae are considered nonpathogenic because they have been isolated from ticks but not vertebrate hosts. We assessed the ability of three presumed endosymbionts: *Rickettsia amblyommatis*, *Rickettsia bellii*, and *Rickettsia montanensis*, to infect a guinea pig animal model. These species were chosen because of their high prevalence in respective tick vectors or published reports suggestive of human or animal pathogenicity.

Following intraperitoneal (IP) inoculation of cell culture suspensions of *R. rickettsii*, *R. amblyommatis*, *R. bellii*, or *R. montanensis* into guinea pigs, animals were monitored for signs of

clinical illness for 13 days. Ear biopsies and blood samples were taken at 2- to 3-day intervals for detection of rickettsial DNA by PCR. Animals were necropsied and internal organ samples were also tested using PCR assays. Among the six guinea pigs inoculated with *R. amblyommatis*, fever, orchitis, and dermatitis were observed in one, one, and three animals respectively.

In *R. bellii*-exposed animals, we noted fever in one of six animals, orchitis in one, and dermatitis in two. No PCR-positive tissues were present in either the *R. amblyommatis*- or *R. bellii*-exposed groups. In the *R. montanensis*-exposed group, two of six animals became febrile, two had orchitis, and three developed dermatitis in ears or footpads. *R. montanensis* DNA was detected in ear skin biopsies collected on multiple days from three animals. Also, a liver specimen from one animal and spleen specimens of two animals were PCR positive. The course and severity of disease in the three experimental groups were significantly milder than that of *R. rickettsii*.

This study suggests that the three rickettsiae considered nonpathogenic can cause either subclinical or mild infections in guinea pigs when introduced via IP inoculation. Snellgrove et al. Vector-borne and Zoonotic Diseases, 2021. https://doi.org/10.1089/vbz.2020.2695.

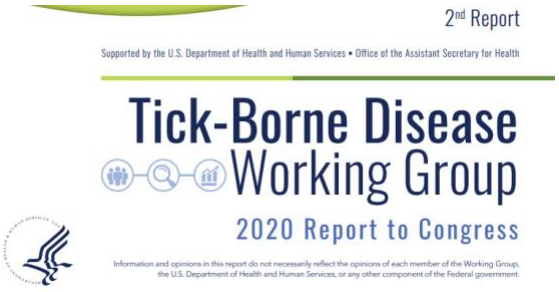
Presence of Rickettsia Species in Ticks Collected from Companion Animals in Northeastern Georgia, United States

Tick-borne diseases are a major threat to both humans and their pets; therefore, it is important to evaluate the prevalence of pathogens carried by ticks on companion animals. In this study, attached and unattached Ixodid ticks were removed from companion animals by a veterinary practice in Hall County, Georgia. DNA was extracted from unengorged adult ticks and each was screened for the presence of Rickettsia spp. by polymerase chain reaction (PCR) and sequenced to determine the species present.

Two hundred and four adult hard-bodied ticks were identified to species and Rickettsia spp. were found in 19.6% (n = 38) of the 194 analyzed DNA extracts. Rickettsia montanensis was found in Dermacentor variablis (14.7%; n = 25), Amblyomma maculatum (33.3%; n = 2), and Rhipicephalus sanguineus s.l. ticks (25%; n = 4). One Amblyomma americanum tick contained Rickettsia amblyommatis, while Rickettsia felis was found in one Dermacentor variablis tick, serving as the first report of Rickettsia felis in a tick in this region and within this tick vector.

This study suggests that there is a risk of companion animals contracting a species of Rickettsia from a tick bite in northeastern Georgia, indicating a need for more investigation and highlighting the importance of tick prevention on pets. Stanley H & Rhodes DVL, Vet. Sci. 2021, 8, 37. https://doi.org/10.3390/vetsci8030037

◘◘ National Section ◘◘



The Tick-Borne Disease Working Group 2020 Report to Congress addresses continuing key gaps in the diagnosis and treatment of Lyme disease and adds additional focus on other tick-borne diseases and conditions in the United States. These include life-threatening Rocky Mountain spotted fever, human monocytotropic ehrlichiosis, human granulocytotropic anaplasmosis, babesiosis, emerging tick-borne viruses and other pathogens, as well as Alpha-gal Syndrome, the serious allergic condition associated with lone star ticks. The entire report is at https://www.hhs.gov/sites/default/files/tbdwg-2020-report_to-congress-final.pdf.

…This report addresses not only tick-borne diseases, but also the biology, ecology, and control of the ticks that transmit disease. Included is a recommendation to adopt a One Health interdisciplinary, collaborative approach in health care for humans, animals, and the environment leading to integrated tick management to prevent transmission of tick-borne diseases. From the Executive Summary.

Will a Lyme disease vaccine make people less vigilant against ticks and, thus, be at more risk for other tickborne infections?

Control of ixodid ticks and prevention of tick-borne diseases in the United States: The prospect of a new Lyme disease vaccine and the continuing problem with tick exposure on residential properties

> In the United States, exposure to human-biting ixodid ticks can occur while spending time on residential properties or in neighborhood green spaces as well as during recreational or occupational activities on public lands. Human-biting tick species collectively transmit >15 species of pathogenic microorganisms and the national burden of tick-borne diseases is increasing. The prospect of a new Lyme disease vaccine for use in humans provides hope

for substantial reduction in the >300,000 estimated annual cases of Lyme disease but this breakthrough would not reduce cases of other tick-borne diseases, such as anaplasmosis, babesiosis, ehrlichiosis, spotted fever group rickettsiosis, and Powassan encephalitis.

One intriguing question is to what extent a new Lyme disease vaccine would impact the use of personal protection measures acting broadly against tick-bites. The main tick vector for Lyme disease spirochetes in the eastern United States, Ixodes scapularis, also transmits causative agents of anaplasmosis, babesiosis, and Powassan encephalitis; and this tick species co-occurs with other human-biting vectors such as Amblyomma americanum and Dermacentor variabilis. It therefore is important that a new Lyme disease vaccine does not result in reduced use of tick-bite prevention measures, such as tick repellents, permethrin-treated clothing, and frequent tick checks.

Another key issue is the continuing problem with tick exposure on residential properties, which represents a heavily used outdoor environment the residents cannot reasonably avoid and where they tend to spend large amounts of time outside. As it may not be realistic to keep up daily vigilance with personal protective measures against tick-bites on residential properties during many months of every year, homeowners may also consider the option to suppress host-seeking ticks by means of deer fencing, landscaping, vegetation management, and use of products to kill host-seeking ticks or ticks infesting rodents.

When considering the full range of options for actions that can be taken to suppress host-seeking ticks on residential properties, it is clear that individual homeowners face a difficult and bewildering task in deciding what to do based on very general guidance from public health agencies (developed without the benefit of a strong evidence base) and often without ready access to local public health professionals experienced in tick control.

This situation is not satisfactory but cannot be corrected without first addressing knowledge gaps regarding the impact of peridomestic tick control measures on host-seeking ticks, human tick-bites, and tick-borne diseases. In parallel with this effort, there also is a need to increase the local public health workforce with knowledge of and experience with tick control to provide better access for homeowners to sound and objective advice regarding tick control on their properties based on key characteristics of the landscaping, habitat composition, and use patterns by wild animal tick hosts as well as the residents. Eisen L. Ticks and Tick-borne Diseases, Jan 2021. https://doi.org/10.1016/j.ttbdis.2021.101649**.**

Ticks that have fed as larvae from short-tailed shrews, red squirrels, and opossums tended to have higher infection prevalence of *Borrelia miyamotoi*. *B. miyamotoi* has been found in a tick in NC, but not identified in a patient

Spatial and temporal patterns of the emerging tick-borne pathogen *Borrelia miyamotoi* in blacklegged ticks (*Ixodes scapularis*) in New York.

Borrelia miyamotoi, a bacterium that causes relapsing fever, is found in ixodid ticks throughout the northern hemisphere. The frst cases of human infection with B. miyamotoi were identifed in 2011. In the eastern USA, blacklegged ticks (Ixodes scapularis) become infected by feeding on an infected vertebrate host, or through transovarial transmission.

We surveyed B. miyamotoi prevalence in ticks within forested habitats in Dutchess County, New York, and identifed possible reservoir hosts. To assess spatial variation in infection, we collected questing nymphal ticks at > 150 sites. To assess temporal variation in infection, we collected questing nymphs for 8 years at a single study site. We collected questing larval ticks from nine plots to estimate the amount of transovarial transmission.

To evaluate potential reservoir hosts, we captured 14 species of mammal and bird hosts naturally infested with larval blacklegged ticks and held these hosts in the laboratory until ticks fed to repletion and molted to nymphs. We determined infection for all ticks using quantitative polymerase chain reaction. The overall infection prevalence of questing nymphal ticks across all sites was ~1%, but prevalence at individual sites was as high as 9.1%. We detected no signifcant increase in infection through time. Only 0.4% of questing larval ticks were infected.

Ticks having fed as larvae from short-tailed shrews, red squirrels, and opossums tended to have higher infection prevalence than did ticks having fed on other hosts. Further studies of the role of hosts in transmission are warranted. The locally high prevalence of B. miyamotoi in the New York/ New England landscape suggests the importance of vigilance by health practitioners and the public. Keesing F *et al.* *Parasites Vectors* 14**,** 51 (2021). https://doi.org/10.1186/s13071-020-04569-2.

Preventing tick-bites among children in Indiana, USA: An analysis of factors associated with parental protective behaviors

> … The objective of this study was to identify the most significant factors associated with parental adoption of tick-bite PPB on behalf of a child or children at risk of tick encounters.
>
> A cross-section of parents in Indiana, USA whose child had spent time outdoors in tick habitat during the summer were recruited from representative online panels maintained by Qualtrics. Binary logistic regression was used to model determinants of five tick-bite PPBs.
>
> Our results revealed that the application of tick repellent (89 %, n = 718) followed by conducting a tick check of the child's body soon after returning from the outdoors (84 %, n = 676) were the PPBs most frequently adopted by parents. Conversely, tucking one's shirt into pants and pants into socks was the least frequently adopted PPB (48 %, n = 386). Compared to other factors evaluated in logistic regression models, parents who reported implementing one or more residential tick control practices were significantly more likely to adopt nearly all five tick-bite PPBs for their children. Additionally, parents who were more

worried about their health due to ticks and reported being more likely to avoid the outdoors because of ticks were more likely to adopt at least three PPBs on behalf of their children.

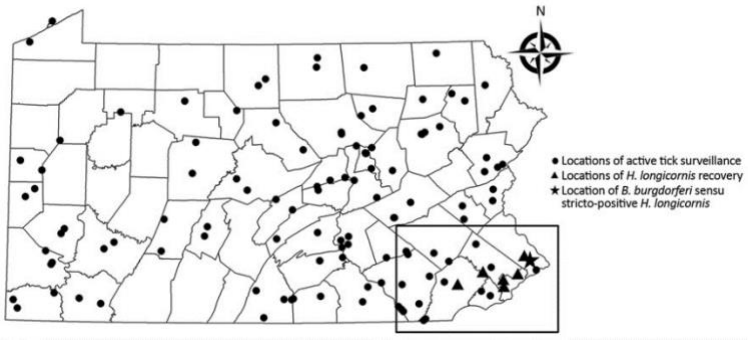
To ensure children can most safely engage in outdoor activity, identifying the factors associated with parental adoption of tick-bite preventive behaviors represents an important mechanism in the prevention of tick-borne diseases. Oghenekaro et al. *Ticks and Tick-borne Diseases*. doi.org/10.1016/j.ttbdis.2020.101647.

Asian longhorned tick in Pennsylvania found with the Lyme disease bacteria

Borrelia burgdorferi Sensu Stricto DNA in Field-Collected *Haemaphysalis longicornis* Ticks, Pennsylvania, United States

We collected questing *Haemaphysalis longicornis* ticks from southeastern counties of Pennsylvania, USA. Of 263 ticks tested by PCR for pathogens, 1 adult female was positive for *Borrelia burgdorferi* sensu stricto, yielding a 0.4% infection rate. Continued monitoring of this invasive tick is essential to determine its public health role.

…Based on microscopy, we estimated that ≈10% of the host-seeking *H. longicornis* ticks that we recovered were partially fed, suggesting the possibility that transmission could occur before the ticks molt. Of note, however, although we detected *B. burgdorferi* sensu stricto DNA in the tick, we have no evidence to suggest the spirochetes were viable. Unique ecologic traits of *H. longicornis* ticks (e.g., cold hardiness, parthenogenetic reproduction, host generality), which may enable the species' rapid establishment and high density (*4*), could confound efforts to determine the extent to which the tick may be involved in maintenance of *B. burgdorferi* sensu stricto in nature.



Continued monitoring to identify infested areas is essential, especially in densely populated regions (e.g., southeastern Pennsylvania). Despite limited documentation of *H. longicornis* ticks biting humans in the United States (*15*), findings presented here support continued use of personal protective measures. *H. longicornis* ticks are a vector of human pathogens in its native range; further investigation is needed to determine its potential public health significance in the United States. Price KJ, et al. Emerg Infect Dis. 2021. https://doi.org/10.3201/eid2702.201552.

Incompetence of the Asian Longhorned Tick (Acari: Ixodidae) in Transmitting the Agent of Human Granulocytic Anaplasmosis in the United States

The Asian longhorned tick, *Haemaphysalis longicornis* Neumann (Acari: Ixodidae), was recently introduced into the United States and is now established in at least 15 states. Considering its ability for parthenogenetic propagation and propensity for creating high-density populations, there is concern that this tick may become involved in transmission cycles of endemic tick-borne human pathogens.

Human granulocytic anaplasmosis (HGA) caused by *Anaplasma phagocytophilum* is one of the more common tick-borne diseases in the United States, especially in the northeastern and midwestern states. There is considerable geographical overlap between HGA cases and the currently known distribution of *H. longicornis*, which creates a potential for this tick to encounter *A. phagocytophilum* while feeding on naturally infected vertebrate hosts. Therefore, we evaluated the ability of *H. longicornis* to acquire and transmit the agent of HGA under laboratory conditions and compared it to the vector competence of *I. scapularis*. *Haemaphysalis longicornis* nymphs acquired the pathogen with the bloodmeal while feeding on infected domestic goats, but transstadial transmission was inefficient and PCR-positive adult ticks were unable to transmit the pathogen to naïve goats.

Results of this study indicate that the Asian longhorned tick is not likely to play a significant role in the epidemiology of HGA in the United States. Levin M et al, 2021. *Journal of Medical Entomology*, tjab015, https://doi.org/10.1093/jme/tjab015.

Infected Gulf Coast ticks found all the way into Connecticut

Established Population of the Gulf Coast Tick, *Amblyomma maculatum* (Acari: Ixodidae), Infected with *Rickettsia parkeri* (Rickettsiales: Rickettsiaceae), in Connecticut

We identified an established population of the Gulf Coast tick (*Amblyomma maculatum* Koch) infected with *Rickettsia parkeri* in Connecticut, representing the northernmost range limit of this medically relevant tick species. Our finding highlights the importance of tick surveillance and public health challenges posed by geographic expansion of tick vectors and their pathogens. Molaei et al. *Journal of Medical Entomology*, tjaa299, https://doi.org/10.1093/jme/tjaa299.

Tick bite cases increased 40-fold in eight years in the coldest inhabited region in the world due to climate change

Quantifying the Northward Spread of Ticks (Ixodida) as Climate Warms in Northern Russia

The Republic of Sakha, also known as Yakutia is considered one of the coldest populated regions of the world, with very low temperatures in winter reaching 60 degrees F and lower. The region is considered one of the coldest populated regions of the world.

The area is inhabited mainly by indigenous communities whose livelihoods are still traditional farming—breeding of reindeer, native cattle, and horses, as well as hunting, fishing, and gathering of berries and herbs.
Climate change is affecting human health worldwide. In particular, changes to local and global climate parameters influence vector and water-borne diseases like malaria, dengue fever, and tick-borne encephalitis. The Republic of Sakha in northern Russia is no exception. Long-term trends of increasing annual temperatures and thawing permafrost have corresponded with the northward range expansion of tick-species in the Republic.

Indigenous communities living in these remote areas may be severely affected by human and livestock diseases introduced by disease vectors like ticks. To better understand the risk of vector-borne diseases in Sakha, we aimed to describe the increase and spatial spread of tick-bite cases in the Republic. Between 2000 and 2018, the frequency of tick bite cases increased 40-fold… Ticks in Siberia may carry Lyme disease and other pathogens. Tick bite case frequency per district was significantly explained by average annual temperature, average temperature in the coldest month of the year, the observation year, as well as Selyaninov's hydrothermal coefficient. These findings contribute to the growing literature that describe the relationship between tick abundance and spread in Northern Latitudes and changes in temperatures and moisture. Future studies might use these and similar results to map and identify areas at risk of infestation by ticks, as climates continue to change in Sakha.
Vladimirov, L.N., et al. *Atmosphere* 2021

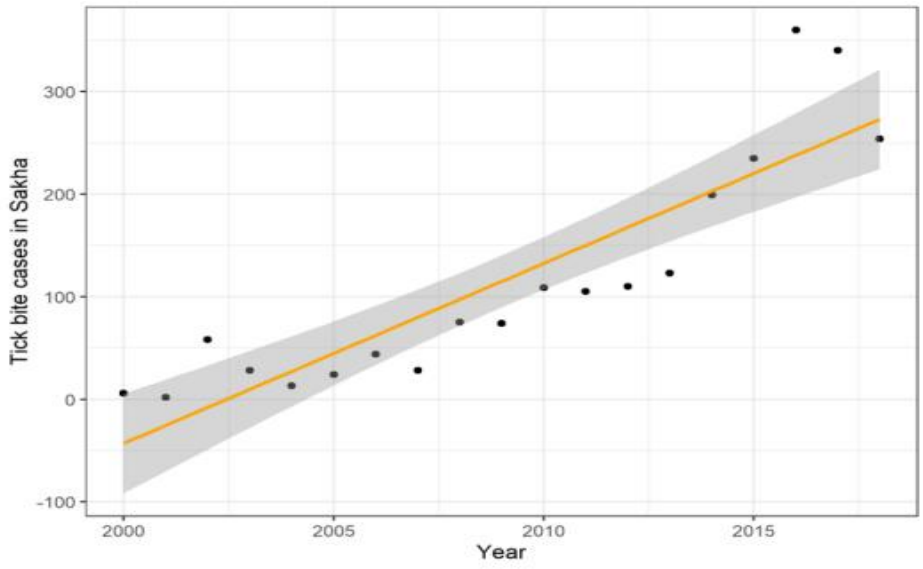


Figure 5. Scatter plot showing the increase in reported tick bite cases between 2000 and 2018 in the Republic of Sakha. The orange line and filled region show a linear regression line and 95% confidence interval. The regression line predicts an increase of 17.5 tick bites per year.

12, 233. https://www.mdpi.com/2073-4433/12/2/233/htm

Protective Immunity and Persistent Lung Sequelae in Domestic Cats after SARS-CoV-2 Infection

Severe acute respiratory syndrome coronavirus 2 readily transmits between domestic cats. We found that domestic cats that recover from an initial infection might be protected from reinfection. However, we found long-term persistence of inflammation and other lung lesions after infection, despite a lack of clinical symptoms and limited viral replication in the lungs.
Chiba, S, et al. *Emerging Infectious Diseases*, *27*(2), 660-663. https://dx.doi.org/10.3201/eid2702.203884

Exploring a possibility of using Raman spectroscopy for detection of Lyme disease

Lyme disease (LD), one of the most prevalent tick-borne diseases in the United States (US), is caused by *Borreliella burgdorferi sensu stricto*. To date, in the US, LD diagnostics is primarily based on a validated two-tiered serological testing, which overall exhibits low sensitivity among other drawbacks.

In the present study, a potential of Raman spectroscopy (RS) to detect *Bb* infection in mice has been explored. For that, C3H mice were infected with wild-type *Bb* strains, 297, B31, or B31-derived mutant, Δ*vlsE*. Blood samples taken prior to and post *Bb* infection were subjected to RS. The data demonstrated that RS did not directly detect *Bb* spirochetes in blood, but rather sensed biochemical changes associated with *Bb* infection. Despite *Bb* infection-associated blood changes detectable by RS were very limited, the partial least square discriminant analysis

showed that the average true positive rates were 86% for 297 and 89% for B31 and Δ*vlsE*. Farber et al. Journal of Biophotonics. January 2021, https://doi.org/10.1002/jbio.202000477.

Some islands in Scotland's Highland region that lack woodland coverage have a Lyme disease incidence ≈40 times the national average

Emergence of Lyme Disease on Treeless Islands, Scotland, United Kingdom

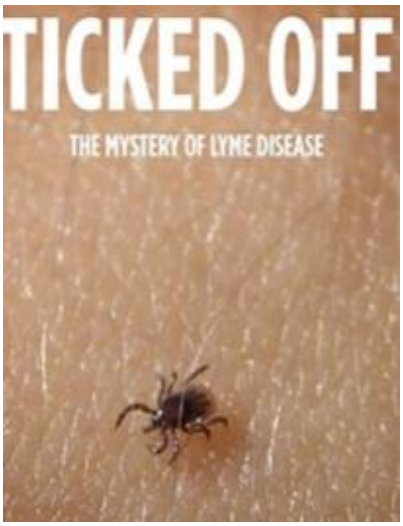
Lyme disease is usually associated with forested habitats but has recently emerged on treeless islands in the Western Isles of Scotland. The environmental and human components of Lyme disease risk in open habitats remain unknown. We quantified the environmental hazard and risk factors for human tick bite exposure among treeless islands with low and high Lyme disease incidence in the Western Isles.

We found a higher prevalence of *Borrelia burgdorferi* sensu lato–infected ticks on high-incidence than on low-incidence islands (6.4% vs. 0.7%); we also found that residents of high-incidence islands reported increased tick bite exposure. Most tick bites (72.7%) occurred ≤1 km from the home, including many in home gardens… This surveillance shows that some islands in the Highland region that lack woodland coverage have a Lyme disease incidence ≈40 times the national average (119 vs. 3.2 cases/100,000 persons per year) (6).

Residents of high Lyme disease incidence islands reported increasing problems with ticks; many suggested changing deer distribution as a potential driver. We highlight the benefits of an integrated approach in understanding the factors that contribute to Lyme disease emergence. Millins, C.,et al. *Emerging Infectious Diseases*, *27*(2), 538-546. https://dx.doi.org/10.3201/eid2702.203862

Canadian Documentary TICKED OFF: The Mystery of Lyme Disease

This documentary follows a few Canadian families who come to the US to get treated because the Canadian system follows the IDSA guidelines.



From the micro world of the tick and its disease-causing bacteria, to the macro world of human suffering and medical science, Ticked ***Off: The Mystery of Lyme Disease*** follows the stories of sufferers of Lyme Disease and investigates the reasons behind the medical and political controversies that continue to surround this mysterious and elusive illness.

Interviews with Dr. Sam Donta and Gary Wormser. 21:00 Discussion of Chronic Lyme begins. 34:00 Discussion of Testing begins. Published on Nov 26, 2020, https://youtu.be/4mgfmXOaX0Q

Advertisement

insect shield®
repellent apparel

About Insect Shield Technology:
Insect Shield's EPA-registered technology converts clothing and gear into effective and convenient insect protection. The repellency is long-lasting and appropriate for use by the entire family with no restrictions for use.

Quick Facts:

- Repellency is in the clothing and gear – not on your skin
- Lasts through 70 launderings
- EPA-registered
- No restrictions for use
- Appropriate for the entire family
- No need to re-apply
- Repels mosquitoes, ticks, ants, flies, chigger and midges including those that can cause Lyme disease, malaria and other dangerous insect-borne diseases

www.insectshield.com

Get your own clothes treated: **Insect Shield Your Own Clothes**
https://www.insectshield.com/IS-Your-Own-Clothes-P338.aspx

☼☼☼

TIC-NC is grateful for the financial contributions of Insect Shield International, LLC.

Tick-Borne Infections Council of North Carolina is a non-profit 501(c)3 organization formed to improve the recognition, treatment, control, and understanding of tick-borne diseases in North Carolina. We are all-volunteer and appreciate donations.

Disclaimer

TIC-NC's newsletter content, including text, graphics, images and information is for general informational purposes only. The contents are not intended to be a substitute for professional medical advice, diagnosis or treatment.

Any contact information is provided for you to learn about tick borne illnesses and related issues. Our organization is not responsible for the content of other material or for actions as a result of opinions or information expressed which may appear from time to time.

It is the responsibility of you as an individual to evaluate the usefulness, completeness or accuracy of any information you read and to seek the services of a competent medical professional of your choosing if you need medical care.

This organization is not a representative, program, affiliate of any other organization, unless specifically stated. Contact us at info@tic-nc.org or 919-542-5573

You have received this newsletter because you are on our membership list. If you want to be taken off at any time, just reply with 'unsubscribe' in the subject box.