



Tick-Borne Infections Council  
of North Carolina, Inc.

## NEWSLETTER 2019, Volume 2



**Quote:** - “In recent years, the known distribution of vector-borne diseases in Europe has changed, with much new information also available now on the status of vectors in the United Kingdom.”

Medlock et al. *Int. J. Environ. Res. Public Health* **2018**, 15(10), 2145; <https://doi.org/10.3390/ijerph15102145>

### Highlights...

- **The CDC’s proposal for a national strategy for controlling vector-borne diseases, 2018**
- **The Tick-borne Diseases Working Group 2018 report and the IDSA letter listing their agreements and objections**
- **Lyme disease hospitalizations showed greatest increase in the South**
- **Analysis of 16 million Lyme disease tests on dogs, 2012-2016, increases seen**
- **What you need to know about the Asian longhorned tick**
- **Systematic review on the impact of gestational Lyme disease**
- **Johns Hopkins, Bristol-Myers must face \$1 billion syphilis infections suit**
- **Lone star tick range is expanding further north and west**
- **Many human pathogens found in German ticks**
- **Lone star ticks exhibit preference for human female breath in lab**
- **17 human tick-borne diseases in Australia**

Scroll down to see these features and more!

### State Vector-Borne Disease Working Group 2019 Meeting Schedule

2019 VBWG meeting dates:

- **Date:** Friday, **July 19**, 2019; **Location:** Webinar format, due to height of tick and beginning of mosquito seasons. **Time:** 10 am. All VBDW members on the listserv will receive a link to attend via email.

- **Date:** Friday, November 15, 2019; **Location:** TBD, but likely The State Laboratory of Public Health. **Time:** 10 am.  
(Check with us before going to confirm date as they occasionally change.)

**Location:**

Office of the Chief Medical Examiner      Photo ID required.  
4312 District Drive, Raleigh, NC 27607


**Links to Letters to Medical Providers from the State Department of Public Health on Lyme Disease and Rickettsial Diseases**


Links to the 2018 letters the state Department of Public Health issued to medical providers on Lyme disease and the Rickettsial diseases such as RMSF can be found on our homepage halfway down on the right side: <http://tic-nc.org/>

**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”**

Go to: [www.cdc.gov/lyme/stats/forms.html](http://www.cdc.gov/lyme/stats/forms.html) (The links below in a clip of the website are not active.) Scroll down and find “Case Definition and Report Forms”. See the grey box with “Note” containing the disclaimer.

Case Definition and Report Forms

- [Lyme Disease Surveillance Case Definition](#) (revised Jan 2017)
- [Lyme Disease Surveillance Case Report Form](#)  [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 15 August 2017 and 2 April 2019.

**New CDC paper on the threat of vector-borne disease in the US**

**Combating the Increasing Threat of Vector-Borne Disease in the United States with a National Vector-Borne Disease Prevention and Control System**

Reported cases of vector-borne diseases in the United States have more than tripled since 2004, characterized by steadily increasing incidence of tick-borne diseases and sporadic outbreaks of domestic and invasive mosquito-borne diseases. An effective public health response to these trends relies on public health surveillance and laboratory systems, proven prevention and mitigation measures, scalable capacity to implement these measures, sensitive and specific diagnostics, and effective therapeutics. However, significant obstacles hinder successful implementation of these public health strategies. The recent emergence of *Haemaphysalis longicornis*, the first invasive tick to emerge in the United States in approximately 80 years, serves as the most recent example of the need for a coordinated public health response.

Addressing the dual needs for innovation and discovery and for building state and local capacities may overcome current challenges in vector-borne disease prevention and control, but will require coordination across a national network of collaborators operating under a national strategy. Such an effort should reduce the impact of emerging vectors and could reverse the increasing trend of vector-borne disease incidence and associated morbidity and mortality. Petersen et al. The American Journal of Tropical Medicine and Hygiene, [doi.org/10.4269/ajtmh.18-0841](https://doi.org/10.4269/ajtmh.18-0841). Entire paper is free at charge at the link.

## Case numbers for tick-borne infections from North Carolina public health

NC TBIs 2017 final, 2018 to November probable/confirmed

### NC EDSS Event Data – Cases Submitted to CDC

Disease	Total Cases / Confirmed Cases by year of report 2017	Total preliminary confirmed and probable Events in NC EDSS Created between 1/1/2018 – 11/13/2018*	Total Events Reviewed and closed by NC DPH 1/1/18 – 11/13/18	Total Events Still Under Investigation by LHD 1/1/18 – 11/13/18	Total Events created in NC EDSS 1/1/18 – 11/13/18
Lyme Disease	298/71C	177/51C	736	110	836
RMSF	521/6C	419/10C	2016	346	2362
Ehrlichiosis	72/18C	86/14C	331	54	398
Anaplasmosis	10/4C	4/0C	22	1	23

Remember, not all cases are reported and not all reports are accepted as actual cases. Therefore, reported case numbers are not considered to be representative of the actual number of ‘real’ cases.

**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.

### §§ TIC-NC Activities §§

TIC-NC was invited to give talks to two groups of state park rangers in late winter. These talks were well received. We learned that many park rangers, not surprisingly, have had one or more tickborne infections. We applaud their effort to get tick-warning signs up in parks and at trailheads.

## TIC-NC Talks and Materials Distributed

### Brochures/booklets:

Biltmore YMCA  
Montreat trails  
Asheville Blue Cross  
DuPont State Forest

**Talks:** Umstead Park Ranger Workshop on Ticks and Tick-borne Diseases and Conditions

Ft. Fisher Ranger Workshop on Ticks and Tick-borne Diseases and Conditions  
February 5 and 7, 2019

## §§ North Carolina and South §§

### From Galaxy Labs in Morrisville near Raleigh

Prevention of tick-borne disease in the United States is at a crossroads of peril and opportunity. On the one hand, researchers have identified innovative and achievable methods for reducing the risk of disease in the environment. On the other hand, emerging diseases and species brought to the United States present new challenges.

Their summary of the Tick-borne Diseases Work Group findings: <http://www.galaxydx.com/tbdwg-recommendations-for-improved-prevention-of-tick-borne-disease-transmission/>

**Figure1: Federal Funding for Selected Infectious Diseases**

Disease	Reported <sup>a</sup> Annual Cases in the U.S. (year)	NIH FY 2017 Appropriations <sup>b</sup>	CDC FY 2017 Appropriations <sup>b</sup>
Hepatitis C	2,967 (2016) <sup>1</sup>	\$107 million	\$34 million
HIV/AIDS	38,782 (2016) <sup>2</sup>	\$3 billion (9.5% of total NIH budget)	\$787 million (domestic only)
Seasonal Influenza <sup>c</sup>	9.2-35.6 million <sup>3</sup> (2010-2011 to 2016-2017 seasons)	\$263 million	\$187 million
Vector-Borne Diseases <sup>d</sup>	59,646 (2016) <sup>4</sup>	\$46 million	\$26 million
<b>Lyme Disease</b>	<b>36,429 (2016)<sup>4</sup></b> 291,430 - 437,150 (2016) <sup>e</sup>	<b>\$28 million</b>	<b>\$11 million</b>

## **Almost 1% of a sample of blood donors in MO were positive for Heartland virus antibodies, NC has positive animals**

### **Seroprevalence of Heartland Virus Antibodies in Blood Donors, Northwestern Missouri, USA**

We estimated the seroprevalence of Heartland virus antibodies to be 0.9% (95% CI 0.4%–4.2%) in a convenience sample of blood donors from northwestern Missouri, USA, where human cases and infected ticks have been identified. Although these findings suggest that some past human infections were undetected, the estimated prevalence is low.

In 2012, Heartland virus, a novel virus in the family *Phenuiviridae*, genus *Phlebovirus* was identified in blood specimens obtained from 2 residents (men) of northwestern Missouri, USA...


Wild animals in Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Maine, Missouri, New Hampshire, **North Carolina**, Tennessee, Texas, and Vermont have been found to be seropositive for Heartland virus antibodies. Lindsey NP et al. Seroprevalence of Heartland virus antibodies in blood donors, northwestern Missouri, USA. 2019 Feb. <https://doi.org/10.3201/eid2502.181288>. Entire paper is free of charge at doi link.

## **■ ■ National Section ■ ■**

## **The Tick-borne Diseases Working Group 2018 report and the IDSA letter listing their agreements and objections**

Supported by the U.S. Department of Health and Human Services • Office of the Assistant Secretary for Health

# **Tick-Borne Disease**



# **Working Group**

## **2018 Report to Congress**

Information and opinions in this report do not necessarily reflect the opinions of each member of the Working Group, the U.S. Department of Health and Human Services, or any other component of the Federal Government.

TICK-BORNE DISEASES have rapidly become a serious and growing threat to public health in the United States. Despite many scientific unknowns, experts agree that the incidence and distribution of tick-borne diseases are increasing. Over the past 25 years, reports of Lyme disease have increased

steadily with estimated annual cases approximating 300,000 (Hinckley et al., 2014; Nelson et al., 2015). The number of U.S. counties now considered to be of high incidence for Lyme disease has increased by more than 300% in the Northeastern states and by approximately 250% in the North-Central states. The Centers for Disease Control and Prevention (CDC) currently recognizes 18 tick-borne pathogens in the United States. However, researchers and health care practitioners continue to discover emerging disease agents and new medical conditions associated with tick bites.

Entire report at: [www.hhs.gov/sites/default/files/tbdwg-report-to-congress-2018.pdf](http://www.hhs.gov/sites/default/files/tbdwg-report-to-congress-2018.pdf)

## **Link to the reply to the Tick-borne Diseases Working Group 2018 report**

The first paragraph:



October 22, 2018

The Honorable Alex Azar, II  
Secretary  
U.S. Department of Health and Human Services  
200 Independence Avenue, SW  
Washington, DC 20201

Dear Secretary Azar,

Later this year you will receive a report from the Tick-Borne Diseases Working Group with policy recommendations to address the prevention, surveillance, diagnosis, treatment and research of tick-borne diseases. The Infectious Diseases Society of America (IDSA) is writing to provide you with important contextual information to help inform your consideration of this report. Below we highlight significant concerns with the working group's lack of transparency and minimal opportunities for meaningful public input. While we are pleased to support many of the working group's recommendations, described below, we must also highlight some key recommendations, that if implemented, would cause significant harm to patients and public health. We urge you to ensure that the federal government response to tick-borne diseases is solidly rooted in the best available scientific evidence.

Entire letter at: [www.idsociety.org/globalassets/idsa/policy--advocacy/current\\_topics\\_and\\_issues/emerging\\_infections\\_and\\_biothreats/agency-efforts/102218-idsa-comments-to-hhs-secretary-re-tickborne-diseases-working-group.pdf](http://www.idsociety.org/globalassets/idsa/policy--advocacy/current_topics_and_issues/emerging_infections_and_biothreats/agency-efforts/102218-idsa-comments-to-hhs-secretary-re-tickborne-diseases-working-group.pdf)

## **Lyme disease hospitalizations showed greatest increase in the South**

### **Regional Differences in Trends of Hospitalizations Associated with Tick-Borne Diseases in the United States, 2009–2014**

Tick-borne diseases are increasing in incidence in the United States; however, limited data exist on regional trends of associated hospitalizations. Using a nationally distributed dataset of US hospital-



based medical records, we aimed to assess trends in incidence of hospitalizations from tick-borne disease by geographic region. Data were examined from 156 US hospitals from 2009 to 2014 to identify hospitalizations with tick-borne disease.

Overall, 2,543 hospitalized patients with tick-borne disease were identified (average annual incidence = 28.4 cases/100,000 hospitalized persons), including 1,613 (63%) with Lyme disease, 379 (15%) tick-borne fever, 293 (12%) ehrlichiosis, 93 (4%) babesiosis, 43 (2%) rickettsiosis, and 122 (4%) multiple tick-related diagnoses.

Tick-borne diseases varied significantly by region, with Lyme disease more frequent in those residing in the Northeast (68%) than the South (57%) or West (42%) and tick-borne fever more common in the West (28%) vs. the South (18%), Midwest (14%), and Northeast (13%) ( $P < 0.0001$ )... Lyme disease hospitalizations showed similar trends, with the greatest increase in the South (APC = 53%, 95% CI = 33–76%) and a decrease in the Northeast (APC = 13%; 3%–23%). Hospitalizations with tick-borne fever increased in the Midwest (APC = 49%; 8–206%) and Northeast (APC = 18%; 4–34%); with ehrlichiosis increased in the West (APC = 231%; 75–306%); and with babesiosis increased in the South (APC = 50%; 12–201%) and the Midwest (APC = 21%; 5–39%).

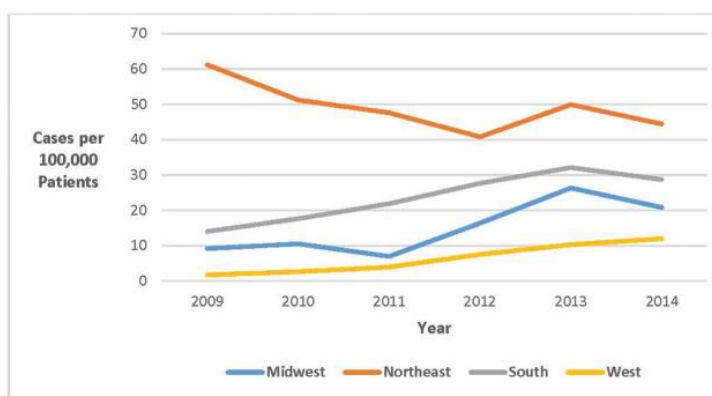
Incidence of hospitalizations from tick-borne disease is increasing throughout much of the nation, except in the Northeast where decreases in Lyme disease were observed. While hospitalizations with tick-borne diseases remain rare, the increases noted are substantial and may reflect rising incidence of these diseases within the represented states. Adjemian, et al.

[Open Forum Infect Dis.](#) 2018 Nov;

5(Suppl 1): S52–

S53. doi: [\[10.1093/ofid/ofy209.126\]](https://doi.org/10.1093/ofid/ofy209.126) Entire abstract at: [www.ncbi.nlm.nih.gov/pmc/articles/PMC6252667/](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC6252667/)

Figure 1. Regional trends in incidence of hospitalizations associated with a tick-borne disease diagnosis in the United States from 2009–2014.



## 2018 Lawsuit against the CDC

### Milford scientist suing CDC over Lyme test By John Burgeson | November 20, 2018

MILFORD — A scientist in Milford who has devised a way to use DNA matching technology to determine if a patient has Lyme Disease has accused the Centers for Disease Control and Prevention of suppressing his test and depriving him of \$57.1 million in profits. Dr. Sin Hang Lee filed suit in federal court in October, saying the CDC, a federal agency, has engaged in an “anti-competitive campaign to stifle” his test and has impugned his reputation and that of his research.

Although the federal government is protected under its sovereign immunity clause, there are cases that are allowed to move forward, such as those involving breach of contract. Lee’s attorney, Mary Alice Moore Leonhardt, contends this is one of those instances. The CDC’s lawyers have filed for dismissal of the case, but so far it’s on track to be heard, Leonhardt said, in the U.S. Court of Federal Claims in Washington, D.C.

“The \$57 million figure is based on the value of his intellectual property for this test that he developed over 20 years,” she said, “as well as the impact of the lost use of this technology — technology that he shared with the CDC.” Attempts to contact Dr. Beth P. Bell, the former CDC director named as a co-defendant in the lawsuit, were not successful. And a spokesperson for the agency did not respond to requests for comment this week.

Twenty years ago, Lee began working on a test for Lyme disease based on DNA sampling and he said his creation was nearly fool-proof. In 2013, he offered it to the CDC. “The serology test that the CDC prefers — it’s also known as the Western Blot Test — is famous for its false positives,” Lee said. “You may have had Lyme disease 10 years ago that didn’t produce symptoms, but with the CDC test, you’d test positive even though you don’t have it now.”

Lee says that the Western blot test also produces false negatives. “The science is very straightforward,” Lee said. “No one can refute DNA sequencing — not even the CDC. Even back in 2012, the CDC realized that the serology test had problems.” Lee’s suit said the CDC had, as early as 2010, held a workshop on tick-borne illnesses in an effort to develop more accurate diagnostic tools and tests for Lyme disease. In 2012, the agency reiterated its need for a better test through what the suit describes as “soliciting submissions and offering business opportunities to members of the public in order to solve a national health problem.”

“The world’s scientific literature agrees that DNA sequencing of bacterial genes in patient specimens is a tool to reach irrefutable diagnosis of bacterial infections, including those due to borrelia, even if antibodies to the bacteria in the patient are not measurable,” Lee said.

Lee is being backed up by the Lyme Action Network, which provides information and builds awareness about Lyme and other tick-borne diseases

“We don’t support anything of this nature that’s not peer-reviewed, and Dr. Lee is entirely on the right track,” LAN President Chris Fisk said in a telephone interview. “The politics at the CDC with regard to Lyme disease is a nasty pit — no other way to describe it.” According to the suit, in 2013, the CDC agreed to provide samples to Lee to test his protocols with “the ultimate goal of the contract (being) to establish the ... test ...that was sought after by the CDC.”

Despite working with CDC physicians through most of 2013 and receiving positive feedback, in January 2014, Lee’s suit says, the representatives of the agency stopped communicating with him. He sent several emails asking for the status of his project and published the findings of the tests in a scientific journal giving credit to CDC’s support.

The suit states the CDC “publicly stated that in the March 2014 article, Lee and (another researcher) reported inconsistent results” and would not answer Lee when he asked what inconsistent results the agency meant. Instead, according to the suit, the CDC referred Lee to its attorney. Since then, the suit states, the CDC has refused to answer Lee’s questions or withdraw its statement on “inconsistent results.”

In response, Lee filed a formal complaint of the CDC and in October, filed the federal suit. Leonhardt said that if Lee prevails in court and is awarded a settlement, “that money will be used to create Lyme disease testing laboratories throughout the U.S., so people can be accurately tested.” The suit charges the CDC “of employing false, pseudo-scientific theories in order to justify its own anti-consumer actions aimed at perpetuating Lyme disease testing by a flawed technology.”

[www.ctpost.com/local/article/Milford-scientist-suing-CDC-over-Lyme-test-13409351.php#photo-16534529](http://www.ctpost.com/local/article/Milford-scientist-suing-CDC-over-Lyme-test-13409351.php#photo-16534529)

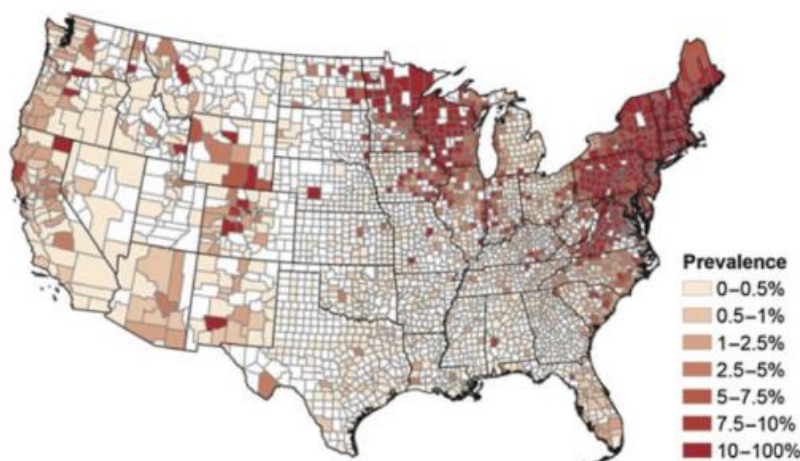


## Analysis of 16 million Lyme disease tests on dogs, 2012-2016, increases seen

### A large-scale spatio-temporal binomial regression model for estimating seroprevalence trends

This paper develops a large-scale Bayesian spatio-temporal binomial regression model to investigate regional trends in antibody prevalence to *Borrelia burgdorferi*, the causative agent of Lyme disease. Our model uses Gaussian predictive processes to estimate the spatially varying trends and a conditional autoregressive scheme to account for spatio-temporal dependence. A novel framework, easily scalable to large spatio-temporal data, is developed. The proposed model is used to analyze about 16 million *B. burgdorferi* antibody Lyme tests performed on canine samples in the conterminous United States over the sixty-month period from January 2012 to December 2016.

This analysis identifies areas of increasing canine Lyme disease risk; prevalence of infection is getting worse in endemic regions and increases are also seen in non-endemic regions. Because Lyme disease is zoonotic, affecting both humans and dogs, the analysis also serves to pinpoint areas of increasing human risk.



**FIGURE 1** Observed seroprevalence of *Borrelia burgdorferi*, aggregated over January 2012 to December 2016. White counties are those that did not report any test results

Self et al. Environmetrics. 2018;29:e2538. [doi.org/10.1002/env.2538](https://doi.org/10.1002/env.2538)

## NY state study on anaplasmosis and ehrlichiosis, only 23% reported tick exposure

### Human Granulocytic Anaplasmosis and Ehrlichiosis Presenting to an Upstate New York Emergency Department

Human granulocytic anaplasmosis (HGA) is an increasingly common tickborne infection in the North-East United States. Statewide incidence of human cases of anaplasmosis in New York (excluding New York City) increased 407% from 2010–2017, with a corresponding increase in *Anaplasma phagocytophilum* prevalence in ticks...

Demographic and clinical data were extracted from electronic records of cases with a positive polymerase chain reaction (PCR) for HGA or the closely related clinical entity ehrlichiosis from 2016 to 2017. HGA and ehrlichiosis PCR tests were performed and basic descriptive analyses were performed.

During the 2-year period, there were 37 cases of PCR-positive HGA and four cases of PCR-positive ehrlichiosis treated in the ED. Electronic data were available for extraction for 40 of these cases. Mean age was 54 years old (range 7–94 years). Thirty-four (85%) patients presented with fever, and 9 (23%) reported a tick bite or tick exposure. Twenty-two (55%) patients had leukopenia; 32 (80%) thrombocytopenia; 26 (65%) hyponatremia; 24 (60%) elevated transaminases; 38 (95%) at least one of these laboratory abnormality; and 13 (33%) all four laboratory abnormalities. Twenty-four patients (60%) were given the empiric diagnosis of a tick-borne illness upon disposition from the ED, with 19 (48%) patients admitted to the hospital.

... Notably, only 23% reported either a tick bite or tick exposure, highlighting the need to consider this for diagnosis in patients presenting to the ED with consistent symptoms and laboratory findings in endemic areas. Further study might explore whether there exists a collection of laboratory findings that could accurately identify HGA in ED patients. Waxman et al. *Open Forum Infectious Diseases*, Volume 5, Issue suppl 1, 2018, Pp. S241. <https://doi.org/10.1093/ofid/ofy210.673>.

## Multistate Infestation with the Exotic Disease–Vector Tick *Haemaphysalis longicornis* — United States, August 2017–September 2018

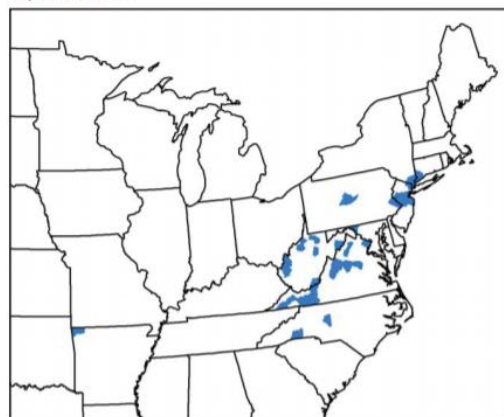
The Centers for Disease Control and Prevention is working with public health, agricultural, and academic experts to understand the possible threat posed by the spread of the Asian longhorned tick (*Haemaphysalis longicornis*) in several U.S. states since its discovery in 2017, according to today's [Morbidity and Mortality Weekly Report](#).

To better understand the full potential impact of this tick discovery in the United States, CDC is working with a network of federal, state, and local experts representing veterinary and agricultural science and public health to:

- Determine the geographic distribution of Asian longhorned tick in the United States.
- Determine the kinds of pathogens carried by Asian longhorned ticks that could infect people in affected states. Pathogens found in these ticks in other parts of the world include *Borrelia*, *Anaplasma*, *Ehrlichia*, *Rickettsia*, and *Babesia*.
- Determine what new laboratory tests are needed to detect pathogens that could be introduced or spread by these ticks in the United States.
- Establish a clean colony (ticks with no pathogens) for studies.
- Determine how frequently the Asian longhorned tick bites people and animals in the United States.
- Determine effective prevention and control strategies.

This network of collaborators will work to limit the spread of tick-borne diseases before they affect people and animals. A concerted, sustained national effort is needed to address the threat posed by the Asian longhorned tick, as well as the threat posed by the ongoing increase in vector-borne diseases in the United States.

FIGURE. Counties and county equivalents\* where *Haemaphysalis longicornis* has been reported (N = 45) — United States, August 2017–September 2018



## For more information:

- [What you need to know about Asian longhorned ticks - A new tick in the United States](#)
- [Preventing tick bites on people](#)
- [Tickborne Diseases of the United States: A Reference Manual for Healthcare Providers](#)
- Petersen L, Beard CB, Visser S. November 2018. [Combatting the Increasing Threat of Vector-Borne Disease in the United States with a National Vector-Borne Disease Prevention and Control System](#). American Journal of Tropical Medicine and Hygiene.

## Co-infection with both Lyme and Powassan virus in 23% of patients, symptoms similar for all tick-borne infections studied

### Clinical Spectrum of Powassan Virus Infection in Patients Presenting with Suspected Acute Tick-Borne Illness from a Lyme-Endemic Focus in the Midwest

Powassan virus (POWV) is the North American member of the tick-borne encephalitis complex of viruses. The potential for concurrent transmission with other tick-borne pathogens, particularly the Lyme disease agent *Borrelia burgdorferi*, is under studied...

One hundred and thirty-five samples selected from patients seen at Gundersen Health System presenting during 2016 with Lyme-like symptoms were tested for Anaplasmosis, Babesiosis, Lyme disease and POWV. PCR testing was performed for Anaplasma and Babesia. Serologic testing for *B. burgdorferi* was performed using two-tier serologic testing. POWV infection was confirmed by POWV-EIA/IFA (Coppe Laboratories). IRB approval was obtained.

Anaplasma infection was seen in 44/88 (50%), Babesia infection in 5/67 (7.5%), Lyme disease in 45/135 (33.3%) and POWV infection in 16/132 (12.1%) patients. Co-infections were seen in 21/135 (15.5%) patients. Patients with Babesia more often presented with anemia, myalgia and decreased appetite.

Patients with Anaplasma presented with fever, chills/sweats, nausea/vomiting, rash, elevated liver function tests, thrombocytopenia, leukopenia, and remembered the tick exposure. Lyme disease patients complained of fatigue, rash, chills/sweats, headache and remembered the tick exposure. Co-infection with both Lyme and Powassan virus was seen in 10/45 (23%) of patients. Patients with Lyme, Powassan virus or co-infection had no other significant difference in symptoms.

POWV infection is more prevalent in the Midwest than previously appreciated. Clinical data suggest that symptoms of POWV infection may be indistinguishable from those of Lyme disease, requiring laboratory testing for proper TBD diagnosis and avoidance of unnecessary antibiotic use. The high rate of POWV co-occurrence with Lyme disease may have relevance for patient outcomes and warrants further investigation. Kehl et al. [Open Forum Infect Dis](#). 2018 Nov; 5(Suppl 1): S241–S242.

doi: [\[10.1093/ofid/ofy210.675\]](https://doi.org/10.1093/ofid/ofy210.675). Entire abstract at: [www.ncbi.nlm.nih.gov/pmc/articles/PMC6255635/](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC6255635/)

## Lone star tick range is expanding further north and west

### Current and Future Distribution of the Lone Star Tick, *Amblyomma americanum* (L.) (Acari: Ixodidae) in North America

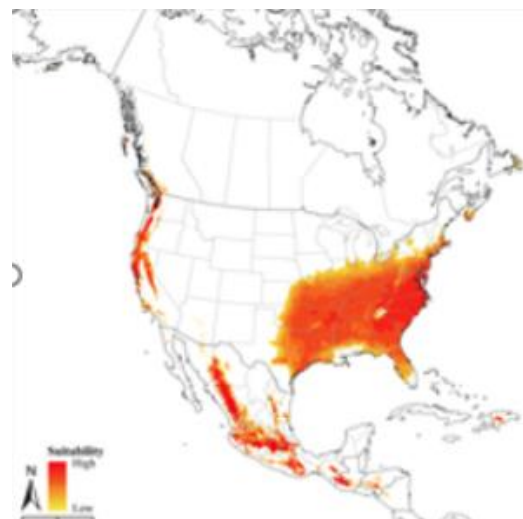
Acarological surveys in areas outside the currently believed leading edge of distribution of lone star ticks (*Amblyomma americanum*), coupled with recent reports of their identification in previously uninvaded areas in the public health literature, suggest that this species is more broadly distributed in North America than currently understood. Therefore, we evaluated the potential geographic extent under present and future conditions using ecological niche modeling approach based on museum records available for this species at the Walter Reed Biosystematics Unit (WRBU).



The median prediction of a best fitting model indicated that lone star ticks are currently likely to be present in broader regions across the Eastern Seaboard as well as in the Upper Midwest, where this species could be expanding its range. Further northward and westward expansion of these ticks can be expected as a result of ongoing climate change, under both low- and high-emissions scenarios. Raghavan RK et al. PLoS ONE 14(1): e0209082. <https://doi.org/10.1371/journal.pone.0209082>. Article free at doi link.



Sites of collection for study



Areas now suitable for lone stars

## Lyme disease studies underway at Stanford University 2018

### Investigating the Sexual Transmission and Developmental Consequences of *Borrelia burgdorferi*

PI: Victoria Mascetti PhD

Postdoctoral Scholar in the Stem Cell Bio Regenerative Department

The investigative team includes Michal Tal Ph.D., a Postdoctoral Scholar in the Stem Cell Bio Regenerative Department and Maia Shoham, Life Science Research Professional at the Stem Cell Bio Regenerative Med Institute.

### **Proteome-wide Profiling of *Borrelia burgdorferi* to Identify Temperature Sensitive Modulators of Infection and Persistence**

PI: Balyn Wood Zaro, PhD

Postdoctoral Scholar in the Stem Cell Bio Regenerative Department

### **Evaluating GABA depletion as the major cause for symptomatic pain, fatigue, and brain fog in post-treatment Lyme disease syndrome (PTLDS) using disulfiram treatment**

PI: Lawrence Steinman, MD

Professor of Neurology and Neurological Sciences in the Neurology Department

The investigative team includes John Wesson Ashford, a Clinical Professor (affiliated) in the Department of Psychiatry and Behavioral Sciences and Jayakumar Rajadas, Director, BioADD and Assistant Director of CV Pharmacology in the Diomaterials and Advanced Drug Delivery laboratory.

### **Functional MRI and sensory evaluation of central mechanisms of chronic pain associated with Lyme disease**

PI: Danielle D. DeSouza, MSc, PhD

Instructor in the Department of Neurology and Neurological Sciences

## **A systematic review on the impact of gestational Lyme disease in humans on the fetus and newborn**

Lyme disease (LD), caused by bacteria of the *Borrelia burgdorferi* sensu lato species complex, is the most common vector-borne disease in North America and Europe. A systematic review (SR) was conducted to summarize the global literature on adverse birth outcomes associated with gestational LD in humans. The SR followed an *a priori* protocol of pretested screening, risk of bias, and data extraction forms. Data were summarized descriptively and random effects meta-analysis (MA) was used where appropriate. The SR identified 45 relevant studies, 29 describing 59 cases reported as gestational LD in the United States, Europe, and Asia (1969–2017). Adverse birth outcomes included spontaneous miscarriage or fetal death ( $n = 12$ ), newborn death ( $n = 8$ ), and newborns with an abnormal outcome (e.g. hyperbilirubinemia, respiratory distress and syndactyly) at birth ( $n = 16$ ). Only one report provided a full case description (clinical manifestations in the mother, negative outcome for the child, and laboratory detection of *B. burgdorferi* in the child) that provides some evidence for vertical transmission of *B. burgdorferi* that has negative consequences for the fetus.

The results of 17 epidemiological studies are included in this SR. Prevalence of adverse birth outcomes in an exposed population (defined by the authors as: gestational LD, history of LD, tick bites or residence in an endemic area) was compared to that in an unexposed population in eight studies and no difference was reported. A meta-analysis of nine studies showed significantly fewer adverse birth outcomes in women reported to have been treated for gestational LD (11%, 95%CI 7–16) compared to those who were not treated during pregnancy (50%, 95%CI 30–70) providing indirect evidence of an association between gestational LD and adverse birth outcomes. Other risk factors investigated; trimester of exposure, length of LD during pregnancy, acute vs. disseminated LD at diagnosis, and symptomatic LD vs. seropositive women with no LD symptoms during pregnancy were not



significantly associated with adverse birth outcomes. This SR summarizes evidence from case studies that provide some limited evidence for transplacental transmission of *B. burgdorferi*. There was inconsistent evidence for adverse birth outcomes of gestational LD in the epidemiological research, and uncommon adverse outcomes for the fetus may occur as a consequence of gestational LD. The global evidence does not fully characterize the potential impact of gestational LD, and future research that addresses the knowledge gaps may change the findings in this SR.

Given the current evidence; prompt diagnosis and treatment of LD during pregnancy is recommended. Waddell, et al. [oi.org/10.1371/journal.pone.0207067](https://doi.org/10.1371/journal.pone.0207067). Free of charge.



## **Fatal attraction: lone star ticks (*Amblyomma americanum*) exhibit preference for human female breath over male breath**

Ticks use a variety of chemical cues to locate hosts, the main cue being carbon dioxide, which is exhaled by hosts. This study sought to experimentally determine whether ticks exhibit preference among human hosts based on host sex, as the chemical components of human male and female breath have been shown to differ.

We focused on the lone star tick, *Amblyomma americanum*, due to its importance as a disease vector in the United States and its active host-seeking behavior. To test the hypothesis that ticks exhibit preference based upon host sex, we conducted a binary choice behavioral bioassay. Male and female human volunteers (n = 20 pairs) breathed into opposite sides of a secured polycarbonate tube containing 10 adult *A. americanum* and the proportion of ticks that exhibited a host preference was recorded.

We found that under controlled conditions, human females attract a significantly larger proportion of ticks than males. Possible mechanisms to explain these results include that (1) female breath contains components that ticks find attractive, and/or (2) male breath contains a repellent chemical component. Josek et al. Experimental and Applied Acarology, Front. Cell. Infect. Microbiol. | doi: 10.3389/fcimb.2019.00003.

## **Evaluating polymicrobial immune responses in patients suffering from tick-borne diseases**

There is insufficient evidence to support screening of various tick-borne diseases (TBD) related microbes alongside *Borrelia* in patients suffering from TBD. To evaluate the involvement of multiple microbial immune responses in patients experiencing TBD we utilized enzyme-linked immunosorbent assay. Four hundred and thirty-two human serum samples organized into seven categories followed Centers for Disease Control and Prevention two-tier Lyme disease (LD) diagnosis guidelines and Infectious Disease Society of America guidelines for post-treatment Lyme disease syndrome.

All patient categories were tested for their immunoglobulin M (IgM) and G (IgG) responses against 20 microbes associated with TBD. Our findings recognize that microbial infections in patients suffering from TBDs do not follow the one microbe, one disease Germ Theory as 65% of the TBD patients produce immune responses to various microbes. We have established a causal association between TBD patients and TBD associated co-infections and essential opportunistic microbes following Bradford Hill's criteria.



This study indicated an 85% probability that a randomly selected TBD patient will respond to *Borrelia* and other related TBD microbes rather than to *Borrelia* alone. A paradigm shift is required in current healthcare policies to diagnose TBD so that patients can get tested and treated even for opportunistic infections. Garg et al. Scientific Reports, [10.1038/s41598-018-34393-9](https://doi.org/10.1038/s41598-018-34393-9). Entire paper free of charge.

## **The European cow tick, aka as ornate dog tick or meadow tick, can transmit canine babesia within 8 hours, even after feeding on other animals**

### **Early *Babesia canis* transmission in dogs within 24 h and 8 h of infestation with infected pre-activated male *Dermacentor reticulatus* ticks**

This study was designed to assess the ability of fed male *Dermacentor reticulatus* ticks to transmit *Babesia canis* to dogs after being detached from previous canine or ovine hosts...

This study demonstrates the ability of male *D. reticulatus* to transmit *B. canis* to dogs. The study also illustrates for the first time that, regardless of the first host on which ticks may attach and start feeding, *Babesia canis* can be transmitted to dogs within 8 h of infestation. Since no minimal transmission time can be established for all possible natural situations, a strategy of prevention based on anti-attachment or repellency is recommended. Varloud et al. Parasites & Vectors (2018) 11:41 [DOI 10.1186/s13071-018-2637-7](https://doi.org/10.1186/s13071-018-2637-7)

## **Johns Hopkins, Bristol-Myers must face \$1 billion syphilis infections suit | Reuters**

(Reuters) - A federal judge in Maryland said The Johns Hopkins University, Bristol-Myers Squibb Co and the Rockefeller Foundation must face a \$1 billion lawsuit over their roles in a 1940s U.S. government experiment that infected hundreds of Guatemalans with syphilis.  
<https://www.reuters.com/article/us-maryland-lawsuit-infections/johns-hopkins-bristol-myers-must-face-1-billion-syphilis-infections-suit-idUSKCN1OY1N3>

## **Many human pathogens found in German ticks: *Borrelia miyamotoi*, *Borrelia garinii*, *Bartonella* spp., *Rickettsia helvetica*, *Francisella tularensis* and *Anaplasma phagocytophilum***

### **Combination of microbiome analysis and serodiagnostics to assess the risk of pathogen transmission by ticks to humans and animals in central Germany**

Arthropod-borne diseases remain a major health-threat for humans and animals worldwide. To estimate the distribution of pathogenic agents and especially *Bartonella* spp., we conducted tick microbiome analysis and determination of the infection status of wild animals, pets and pet owners in the state of Hesse, Germany.

Results: In total, 189 engorged ticks collected from 163 animals were tested. Selected ticks were analyzed by next generation sequencing (NGS) and confirmatory PCRs, blood specimens of 48 wild animals were analyzed by PCR to confirm pathogen presence and sera of 54 dogs, one cat and 11 dog owners were analyzed by serology. *Bartonella* spp. were detected in 9.5% of all ticks and in the blood of 17 roe deer. Further data reveal the presence of the human and animal pathogenic species of genera in the family Spirochaetaceae (including *Borrelia miyamotoi* and *Borrelia garinii*), *Bartonella* spp.

(mainly *Bartonella schoenbuchensis*), *Rickettsia helvetica*, *Francisella tularensis* and *Anaplasma phagocytophilum* in ticks. Co-infections with species of several genera were detected in nine ticks. One dog and five dog owners were seropositive for anti-*Bartonella henselae*-antibodies and one dog had antibodies against *Rickettsia conorii*.

The high number of various detected pathogens suggests that ticks might serve as an excellent sentinel to detect and monitor zoonotic human pathogens. Regier et al. *Parasites & Vectors* (2019) 12:11 <https://parasitesandvectors.biomedcentral.com/articles/10.1186/s13071-018-3240-7>.

## Blood smears have poor sensitivity for confirming *Borrelia miyamotoi* disease

*Borrelia miyamotoi* disease (BMD) is a newly recognized borreliosis that is co-transmitted by ticks wherever Lyme disease is zoonotic. Unlike *Borrelia burgdorferi* sensu lato, the agent of Lyme disease, *B. miyamotoi* is closely related to relapsing fever spirochetes such as *B. hermsi*. Some authors have suggested that the disease caused by *B. miyamotoi* should be considered a hard-tick transmitted relapsing fever, and thus the main mode of confirming a diagnosis for that infection, microscopy to analyze a blood smear, may have clinical utility.

To determine whether blood smears may detect *B. miyamotoi* in the blood of acute BMD patients, we made standard malariological thick smears from anticoagulated blood samples that were previously determined to contain this agent (by PCR) and analyzed them for morphological evidence of spirochetes. Spirochetes were not detected in the blood smears from 20 PCR positive patient blood samples after examination of 100 thick smear fields, and only 2 of 20 demonstrated spirochetes when the examination was extended to 300 thick smear fields. Inoculation of severe combined immunodeficient mice (SCID) mice yielded isolates from 5 of 5 samples, but 0 of 3 balb/c mice became infected.



We conclude that in strong contrast to the diagnosis of typical relapsing fever, microscopy of blood smears is not sensitive enough for confirming a diagnosis of BMD but that SCID mouse inoculation could be a useful complement to PCR. Telford et al. [DOI: 10.1128/JCM.01468-18](https://doi.org/10.1128/JCM.01468-18)

## Human Tick-Borne Diseases in Australia

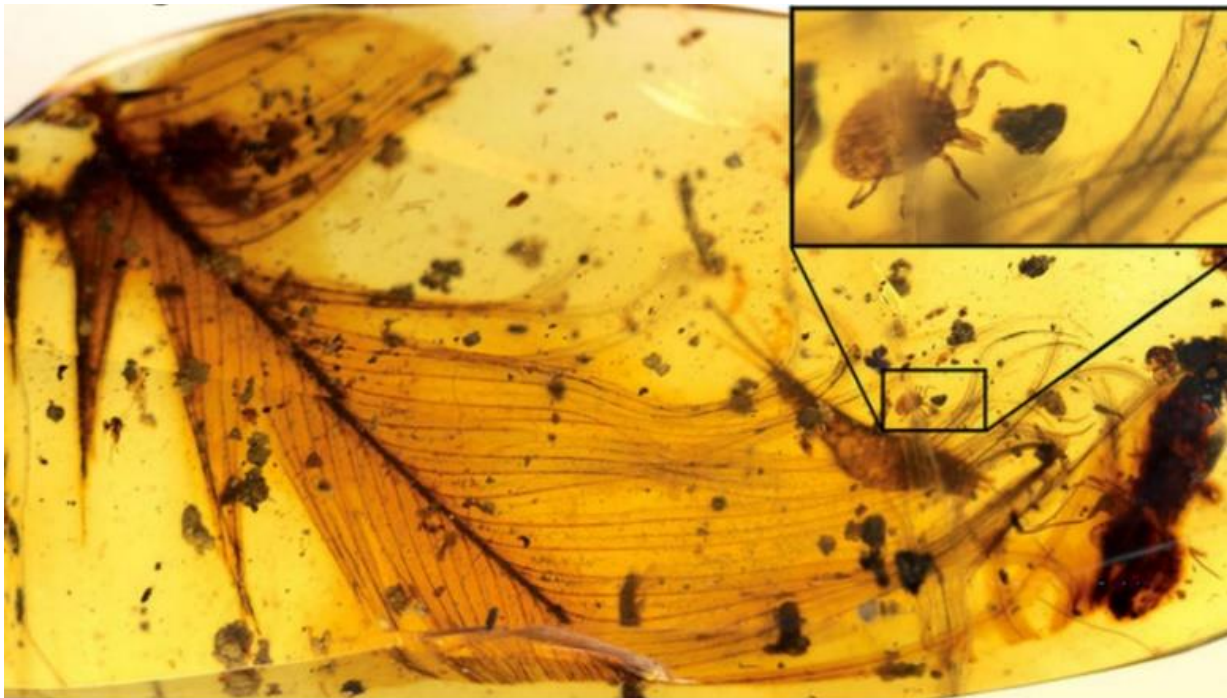
There are 17 human-biting ticks known in Australia. The bites of *Ixodes holocyclus*, *Ornithodoros capensis*, and *Ornithodoros gurneyi* can cause paralysis, inflammation, and severe local and systemic reactions in humans, respectively. Six ticks, including *Amblyomma triguttatum*, *Bothriocroton hydrosauri*, *Haemaphysalis novaeguineae*, *Ixodes cornuatus*, *Ixodes holocyclus*, and *Ixodes tasmani* may transmit *Coxiella burnetii*, *Rickettsia australis*, *Rickettsia honei*, or *Rickettsia honei* subsp. *marmionii*. These bacterial pathogens cause Q fever, Queensland tick typhus (QTT), Flinders Island spotted fever (FISF), and Australian spotted fever (ASF). It is also believed that babesiosis can be transmitted by ticks to humans in Australia.

In addition, *Argas robertsi*, *Haemaphysalis bancrofti*, *Haemaphysalis longicornis*, *Ixodes hirsti*, *Rhipicephalus australis*, and *Rhipicephalus sanguineus* ticks may play active roles in transmission of

other pathogens that already exist or could potentially be introduced into Australia. These pathogens include *Anaplasma* spp., *Bartonella* spp., *Burkholderia* spp., *Francisella* spp., Dera Ghazi Khan virus (DGKV), tick-borne encephalitis virus (TBEV), Lake Clarendon virus (LCV), Saumarez Reef virus (SREV), Upolu virus (UPOV), or Vinegar Hill virus (VINHV)...

There are some human pathogens, such as *Rickettsia conorii* and *Rickettsia rickettsii* that are not currently present in Australia, but can be transmitted by some human-biting ticks found in Australia, such as *Rhipicephalus sanguineus*, if they enter and establish in this country. Despite these threats, our knowledge of Australian ticks and tick-borne diseases is in its infancy. Dehghani et al. *Frontiers in Cellular and Infection Microbiology*, <https://www.frontiersin.org/articles/10.3389/fcimb.2019.00003/full>

**Happy Spring!** Consider the fact that ticks have been around at least 99 million years! Take care.



A tick preserved in amber clutching a dinosaur feather E. PEÑALVER ET AL., *NATURE COMMUNICATIONS*, DOI:10.1038/S41467-017-01550-Z, 2017

## 99-million-year-old ticks sucked the blood of dinosaurs

Ticks may be a disease-carrying menace for hikers and pets, but they're also masters of survival: The parasites were sucking the blood of dinosaurs 99 million years ago, according to a set of amber fossils from Myanmar. One of the samples, in which a tick is hanging onto a dino feather, provides the oldest direct evidence of what these ancient parasites ate.

The find is a "paleontologist's dream," says Ricardo Pérez-de la Fuente, a paleontologist at the Oxford University Museum of Natural History in the United Kingdom who helped lead the work.

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