



Tick-Borne Infections Council  
of North Carolina, Inc.

## NEWSLETTER 2020, Volume 3



Quote: - "It's no longer accurate to simply argue that chronic Lyme disease doesn't exist."  
-John Aucott, MD, Johns Hopkins Lyme Disease Clinical Research Center and Past Chair  
Tick-borne Disease Working Group, Washington, DC

### Highlights...

- **Alpha-gal syndrome: Implications for cardiovascular disease**
- **Increased Incidence of *Ehrlichia chaffeensis* Infections in the US, 2012- 2016**
- **Lyme disease and anaplasma species in northern California**
- **Lyme disease and Canadian children**
- **Lyme Endocarditis as an emerging infectious disease**
- **Azlocillin and cefotaxime combined for Lyme disease works well in mice**
- **Watch out for leaf piles**
- **Certain ticks are attracted by electromagnetic radiation**
- **RMSF from a needle-stick, Brazil**
- **C6 Lyme ELISA "not an ideal test"**
- **Transplant patients and tick-borne diseases**
- **Lyme disease in bats**
- **Lone star ticks drink water**
- **Permethrin-treated clothing partly works against blacklegged ticks**

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

There are no meetings this year due to Covid-19.

## **Link to Letter to Medical Providers from the State Department of Public Health on Lyme Disease and Rickettsial Diseases**

The state has started issuing only one letter. Please see the home page of our website to access.  
[www.tic-nc.org](http://www.tic-nc.org)

### **From the CDC**



### **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.

CDC: The Emerging Issues in Tick-borne Diseases webinar, presented June 13, 2019, is [now online](#).

## **Stemming the Rising Tide of Human-Biting Ticks and Tick-borne Diseases, United States**

Ticks and tick-borne diseases are increasingly problematic. There have been positive developments that should result in improved strategies and better tools to suppress ticks, reduce human tick bites, and roll back tick-borne diseases. However, we equally need to address the question of who is responsible for implementing the solutions. The current model of individual responsibility for tick control evolved from a scenario in the 1990s focusing strongly on exposure to blacklegged ticks and Lyme disease spirochetes in peridomestic settings of the northeastern United States.

Today, the threat posed by human-biting ticks is more widespread across the eastern United States, increasingly complex (multiple tick species and >10 notable tick-borne pathogens), and, across tick species, more spatially diffuse (including backyards, neighborhood green spaces, and public recreation areas). To mitigate tick-associated negative societal effects, we must consider shifting the responsibility for tick control to include both individual persons and professionally staffed tick-management programs. Eisen, L. (2020). *Emerging Infectious Diseases*, 26(4), 641-647.

<https://dx.doi.org/10.3201/eid2604.191629>.

## State tick research and/or reports– none



NC DEPARTMENT OF  
**HEALTH AND  
HUMAN SERVICES**

ROY COOPER • Governor  
MANDY COHEN, MD, MPH • Secretary  
BETH LOVETTE • Interim Director, Division of Public Health

Developed by the North Carolina Division of Public Health, Communicable Disease Branch

### *Lyme Disease Surveillance Summary from 2013–2018*

**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.

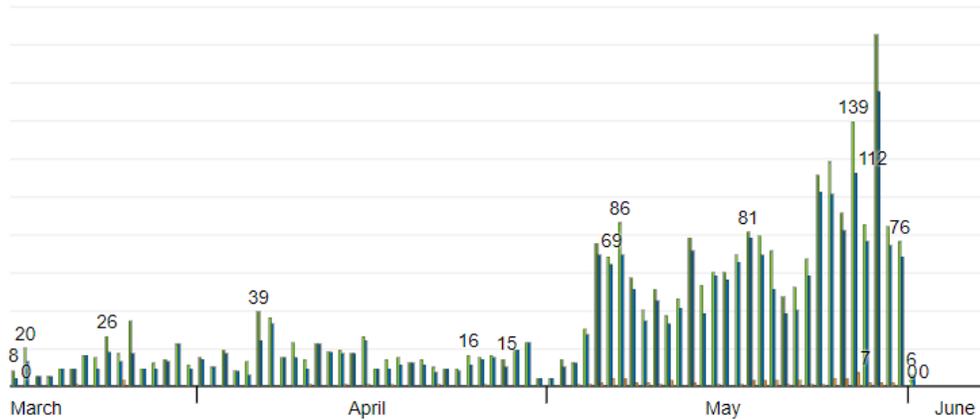
## Report from the State or Vector-borne Disease Work Group meeting

## 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

## §§ TIC-NC Activities §§



This interesting graph from the TIC-NC website shows how the stay-at-home orders to combat Covid-19 affected our hits. The day Gov. Cooper lifted the orders our hits increased dramatically, presumably because people were suddenly getting out into parks and hiking, thus, getting exposed to ticks.

### TIC-NC Talks and Materials Distributed

#### Brochures/booklets, Folletos:

- Farm Show, Raleigh
- Vets and Cooperative Extensions in the Surry County area (thanks to Dwight Seal)
- Vecinos Farmworker Health Program
- Jordan Lake State Park
- Carolina Hemlocks Recreation Area
- Ayr Mount Poet's Walk

#### Talks:

- Staying Safe from Ticks in the Time of Covid-19. Chatham Council on Aging, Zoom presentation, June 2, 2020

## §§ North Carolina and South §§

### Indirect Evidence of Bourbon Virus (Thogotovirus, Orthomyxoviridae) Infection in North Carolina

...We report here that neutralizing antibodies against Bourbon virus were detected in white-tailed deer in North Carolina, suggesting that the virus is present in the state. for a seroprevalence rate of 56% (95% confidence interval 39%–72%)... samples were from deer killed during the 2014 hunting season from Stanly and New Hanover counties.

Human infection with Bourbon virus results in a nonspecific viral syndrome that includes fever, nausea, diarrhea, myalgia (muscle pain), arthralgia (joint pain), leucopenia (low white blood cell count), and thrombocytopenia (low blood platelet count)... . Health care providers should consider Bourbon and Heartland virus testing in patients presenting with an acute febrile illness with either leukopenia or thrombocytopenia not explained by another condition, or who were suspected to have a tick-borne bacterial disease but did not improve following appropriate treatment (e.g., doxycycline). Komar N, et al. N C Med J. 2020;81(3):214-215. (Article excerpted by Ed. MH-G) Entire article at: <https://www.ncmedicaljournal.com/content/ncm/81/3/214.full.pdf>

## **Increased Incidence of *Ehrlichia chaffeensis* Infections in the United States, 2012 Through 2016**

Human ehrlichioses are tick-borne diseases that have been increasing in incidence in the United States during recent years. *Ehrlichia chaffeensis* is one of the primary bacteria that cause ehrlichiosis in humans, which typically results in fever-like symptoms, but may also be fatal if left untreated. *E. chaffeensis* infections are reported to the Centers for Disease Control and Prevention (CDC) through the National Notifiable Diseases Surveillance System (NNDSS).

This study analyzed the cases of *E. chaffeensis* infections reported by the NNDSS from 2012 through 2016. There were 6786 cases and the incidence rate was 4.46 cases per million persons per year. The demographic group most commonly infected was white males between the ages of 40 and 64. Infections were most abundant in the southeast and midwest, particularly in Arkansas, Missouri, Tennessee, and Oklahoma, as well as much of the east coast.

The number of cases reported each year from 2012 through 2016 was higher than the number reported in any of the previous 4 years. Ongoing surveillance and reporting of tick-borne diseases are critical to inform public health practice and guide disease treatment and prevention efforts. Mogg et al. Vector-Borne and Zoonotic Diseases, [doi.org/10.1089/vbz.2019.2595](https://doi.org/10.1089/vbz.2019.2595)

## **North Carolina has Heartland virus and Bourbon virus**

### **Tick-borne viruses of North America**

The global incidence of tick-borne infectious diseases has increased since the beginning of the 21st century. The expansion of tick populations into new geographic locations and a variety of anthropogenic and natural factors are all drivers of the increase. In addition to the establishment of known tick-borne pathogens in new areas, several novel agents, including many viruses, have also emerged.

At present in North America, there are five tick-borne viruses that are known to cause human disease: deer tick virus, Powassan virus, Colorado tick fever virus, Heartland virus, and Bourbon virus. Although uncommon causes of disease, these viruses pose formidable threats to the health of individuals residing in regions of endemicity, especially since there are currently no medical countermeasures available to combat them. This review focuses on the basic biology, ecology,

## ▣▣ National Section ▣▣

### **History of Lyme Disease as a Predictor of Atrial Fibrillation.**

In many cases, atrial fibrillation (AF) is associated with a history of cardiac inflammation. One of the potential pathogens responsible for atrial inflammation might be *Borrelia burgdorferi* - a pathogen involved in Lyme carditis. This study aimed to assess whether the serological history of *Borrelia* infection was associated with the risk of AF. The study included 113 AF patients and 109 patients in sinus rhythm. All patients underwent a clinical evaluation, echocardiography and had their blood taken for the assessment of anti-*Borrelia* IgG antibodies. Patients with AF compared with the non-AF group had more often serological signs of *Borrelia* infection (34.5% vs 6.4%;  $p < 0.0001$ ).

The multivariate analysis showed that positive results for anti-*Borrelia* IgG antibodies were a strong independent predictor of AF (odds ratio 8.21; 95% confidence interval 3.08 to 21.88;  $p < 0.0001$ ). In conclusion, presented data show that exposure to *Borrelia* spp. infection is associated with an increased risk of AF. Whether the early treatment of Lyme disease lowers the risk of AF development remains to be explored. [Szymanska A et al. Am J Cardiol. 2020 Mar 13. pii: S0002-9149\(20\)30209-5. \[https://www.ajconline.org/article/S0002-9149\\(20\\)30209-5/fulltext\]\(https://www.ajconline.org/article/S0002-9149\(20\)30209-5/fulltext\)](#)

### **Prevalence and Coinfection of Three Tick-Borne Pathogens in Questing Adult Blacklegged Ticks *Ixodes scapularis* (Vilas County, Wisconsin)**

**Introduction:** In North America, the blacklegged tick (*Ixodes scapularis*) is a vector of several human pathogens, and tick-borne disease incidence is increasing. **Objectives:** We estimated the prevalence of questing blacklegged ticks vectoring three zoonotic pathogens in Vilas County, Wisconsin.

**Materials and Methods:** We collected 461 adult blacklegged ticks and used PCR to screen for the presence of pathogens that cause Lyme disease (*Borrelia burgdorferi*), human granulocytic anaplasmosis (HGA, *Anaplasma phagocytophilum*), and babesiosis (*Babesia microti*). **Results:** We found that 52.5% of ticks carried at least one pathogen. The estimated infection prevalence in the TIC population was 17.4% (Lyme disease), 14.3% (HGA), and 6.5% (babesiosis). Multiple pathogens were present in 14.3% of ticks surveyed.

**Conclusion:** About half of questing ticks tested in this study carried at least one zoonotic pathogen. Coinfection was common in our study area and, if not properly recognized, leads to greater risk of underdiagnosis. Westwood M, et al. Vectorborne and Zoonotic Diseases, <https://www.liebertpub.com/doi/10.1089/vbz.2020.2619>

## **Combined treatment with azlocillin and cefotaxime effectively killed doxycycline-tolerant *B. burgdorferi* in mice, human trials coming**

### **Azlocillin can be the potential drug candidate against drug-tolerant *Borrelia burgdorferi sensu stricto* JLB31**

Lyme disease is one of most common vector-borne diseases, reporting more than 300,000 cases annually in the United States. Treating Lyme disease during its initial stages with traditional tetracycline antibiotics is effective. However, 10–20% of patients treated with antibiotic therapy still shows prolonged symptoms of fatigue, musculoskeletal pain, and perceived cognitive impairment. When these symptoms persists for more than 6 months to years after completing conventional antibiotics treatment are called post-treatment Lyme disease syndrome (PTLDS). Though the exact reason for the prolongation of post treatment symptoms are not known, the growing evidence from recent studies suggests it might be due to the existence of drug-tolerant persisters.

In order to identify effective drug molecules that kill drug-tolerant *borrelia* we have tested two antibiotics, azlocillin and cefotaxime that were identified by us earlier. The *in vitro* efficacy studies of azlocillin and cefotaxime on drug-tolerant persisters were done by semisolid plating method. The results obtained were compared with one of the currently prescribed antibiotic doxycycline. We found that azlocillin completely kills late log phase and 7–10 days old stationary phase *B. burgdorferi*. Our results also demonstrate that azlocillin and cefotaxime can effectively kill *in vitro* doxycycline-tolerant *B. burgdorferi*.

Moreover, the combination drug treatment of azlocillin and cefotaxime effectively killed doxycycline-tolerant *B. burgdorferi*. Furthermore, when tested *in vivo*, azlocillin has shown good efficacy against *B. burgdorferi* in mice model. These seminal findings strongly suggests that azlocillin can be effective in treating *B. burgdorferi sensu stricto* JLB31 infection and furthermore in depth research is necessary to evaluate its potential use for Lyme disease therapy. Pothineni, V.R., et al. *Sci Rep* **10**, 3798 (2020). <https://doi.org/10.1038/s41598-020-59600-4>. Open access.

## **Protective Effectiveness of Long-Lasting Permethrin Impregnated Clothing Against Tick Bites in an Endemic Lyme Disease Setting: A Randomized Control Trial Among Outdoor Workers**

Tick-borne diseases are a growing threat to public health in the United States, especially among outdoor workers who experience high occupational exposure to ticks. Long-lasting permethrin-impregnated clothing has demonstrated high initial protection against bites from blacklegged ticks, *Ixodes scapularis* Say (Acari: Ixodidae), in laboratory settings, and sustained protection against bites from the lone star tick, *Amblyomma americanum* (L.) (Acari: Ixodidae), in field tests.

However, long-lasting permethrin impregnation of clothing has not been field tested among outdoor workers who are frequently exposed to blacklegged ticks. We conducted a 2-yr randomized, placebo-controlled, double-blinded trial among 82 outdoor workers in Rhode Island and southern Massachusetts. Participants in the treatment arm wore factory-impregnated permethrin clothing, and the control group wore sham-treated clothing. Outdoor working hours, tick encounters, and bites were recorded weekly to assess protective effectiveness of long-lasting permethrin-impregnated garments. Factory-impregnated clothing significantly reduced tick bites by 65% in the first study year and by 50% in the second year for a 2-yr protective effect of 58%. No significant difference in other tick bite

prevention method utilization occurred between treatment and control groups, and no treatment-related adverse outcomes were reported.

Factory permethrin impregnation of clothing is safe and effective for the prevention of tick bites among outdoor workers whose primary exposure is to blacklegged ticks in the northeastern United States. Mitchell C et al. *Journal of Medical Entomology*, tjaa061, [doi.org/10.1093/jme/tjaa061](https://doi.org/10.1093/jme/tjaa061).

## Alpha-gal syndrome: Implications for cardiovascular disease

Alpha-gal syndrome (AGS) refers to a potentially life-threatening allergy to the molecule galactose- $\alpha$ 1,3-galactose (gal), which is expressed on most mammalian tissues but, importantly, is not expressed by humans. This syndrome can manifest as an allergic reaction to mammalian meat products, but other sources of mammalian tissue can also provoke an immune response, including injectable and implantable medical products. This syndrome has been linked to coronary atherosclerosis, and medical products that express gal are routinely used in cardiology and cardiac surgery.

This article seeks to discuss potential implications of alpha syndrome as it relates to cardiovascular health and to heighten awareness in the cardiovascular community about this emerging public health issue. Bianchi et al. *GLOBAL CARDIOLOGY SCIENCE AND PRACTICE*, <http://dx.doi.org/10.21542/gcsp.2019.20>. Paper free of charge.

## Report on tick-borne diseases from Maine: entire report available at link below

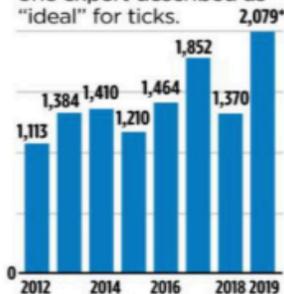
Portland Press Herald – January 16, 2020

### Lyme disease cases in Maine hit a record high last year

The state had at least 2,079 cases of the tick-borne illness in 2019, well above the 1,852 cases in 2018 – and more reports may come in.

#### Lyme disease in Maine

Reported cases hit a record high in Maine in 2019, a year featuring weather conditions that one expert described as “ideal” for ticks.



\*As of 01/16/20

SOURCE: Maine Center for Disease Control and Prevention

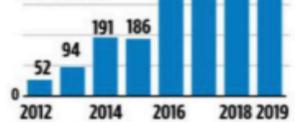
STAFF GRAPHIC | MICHAEL FISHER

#### Tick-borne illnesses Lyme and anaplasmosis increase in Maine in 2019

Since 2012, the state has had a more-than tenfold increase in cases of anaplasmosis, which has more severe symptoms than Lyme disease.

#### Anaplasmosis in Maine

The state saw a record number of anaplasmosis cases in 2019, as tick-borne diseases continue to spread and testing increases.



\*Preliminary figures

SOURCE: Maine Center for Disease Control and Prevention

STAFF GRAPHIC | MICHAEL FISHER

<https://extension.umaine.edu/ticks/wp-content/uploads/sites/42/2020/02/UMaine-Tick-Surveillance-Program-Annual-Report-2019-web-1.pdf>

## **Lyme disease and Anaplasma species in northern California**

### ***Borrelia burgdorferi* and *Anaplasma phagocytophilum* Genospecies in Northern California**

The sensu lato (s.l.) complexes of *Borrelia burgdorferi* and *Anaplasma phagocytophilum* include pathogenic genospecies each with distinct ecologies in northern California, yet, most work conflates the genospecies of each pathogen into one sensu lato species... DNA sequencing was performed to differentiate genospecies of *Borrelia* and *Anaplasma* from PCR-positive dusky-footed woodrats (*Neotoma fuscipes*) and sciurids (chipmunks, *Tamias* spp., and Douglas squirrels, *Tamiasciurus douglasii*) at four sites in northwestern California...

Host species was a significant predictor for *Borrelia bissettae*, *B. burgdorferi* sensu stricto (s.s.), *A. phagocytophilum* s.s., and the DU1 *Anaplasma* genospecies. Woodrats were significantly more likely to be PCR-positive for *B. bissettae* and *A. phagocytophilum* DU1 genospecies, while *A. phagocytophilum* s.s. and *B. burgdorferi* s.s. were significantly associated with sciurids. We report a single *Borrelia lanei* in an Allen's chipmunk (*Tamias senex*) from the Hoopa Valley Tribal Reservation. A significant spatial cluster of *A. phagocytophilum* s.s. was detected at Hendy Woods State Park in Mendocino County. These results highlight the need to better understand genospecies partitioning according to host species to further assess human risks, aid in future surveillance, and inform targeted research. Sholty et al. *Vector-Borne and Zoonotic Diseases*, [doi.org/10.1089/vbz.2019.2483](https://doi.org/10.1089/vbz.2019.2483)

## **Ecology and Epidemiology of Tick-borne Pathogens, Washington, USA, 2011–2016**

Tick-borne diseases are rare in Washington, USA, and the ecology of these pathogens is poorly understood. We integrated surveillance data from humans and ticks to better describe their epidemiology and ecology. During 2011–2016, a total of 202 tick-borne disease cases were reported in Washington residents. Of these, 68 (34%) were autochthonous, including cases of Lyme disease, Rocky Mountain spotted fever, tick-borne relapsing fever, and tularemia. During May 2011–December 2016, we collected 977 host-seeking ticks, including *Ixodes pacificus*, *I. angustus*, *I. spinipalpis*, *I. auritulus*, *Dermacentor andersoni*, and *D. variabilis* ticks.

The prevalence of *Borrelia burgdorferi* sensu stricto in *I. pacificus* ticks was 4.0%; of *B. burgdorferi* sensu lato, 3.8%; of *B. miyamotoi*, 4.4%; and of *Anaplasma phagocytophilum*, 1.9%. We did not detect *Rickettsia rickettsii* in either *Dermacentor* species. Case-patient histories and detection of pathogens in field-collected ticks indicate that several tick-borne pathogens are endemic to Washington. Dykstra et al. *Emerging Infectious Diseases*, 26(4), 648-657. [https://wwwnc.cdc.gov/eid/article/26/4/19-1382\\_article](https://wwwnc.cdc.gov/eid/article/26/4/19-1382_article).

## **Artificial Accumulation of Leaf Litter in Forest Edges on Residential Properties via Leaf Blowing Is Associated with Increased Numbers of Host-Seeking *Ixodes scapularis* (Acari: Ixodidae) Nymphs**

We examined whether routine fall yard maintenance, specifically depositing leaves removed from lawns and landscaping along forest margins, may increase densities of nymphal *Ixodes scapularis* Say

and *Amblyomma americanum* (L.) ticks within these managed areas. Leaf blowing activities in fall 2017 and 2018 on residential properties in New Jersey, United States, significantly increased leaf litter depth in managed edge areas (range = 259.8–352.8 mm) compared to unmanaged edges (77.6–188.0 mm) and adjacent forest (39.4–166.2 mm). Drag sampling conducted on 20 and 30 dates in spring 2018 and 2019, respectively, yielded  $\geq 3$ -fold more *I. scapularis* nymphs in managed edge plots compared to natural edge and forest plots in both years. In 2018, we collected more *A. americanum* nymphs from forest plots than from either natural or managed edge plots, but 2019 natural edge plots yielded the greatest number of the ticks. Nearly half of *A. americanum* adults were collected in forest plots in both years.

Our data suggest that the acarological risk of human encounters with *I. scapularis* nymphs may be significantly greater in areas receiving an accumulation of leaves from leaf blowing or raking compared to adjacent unmanaged forest edges. This artificially elevated acarological risk can be mitigated if homeowners avail themselves of curbside leaf pickup or composting services offered by many municipalities or request that lawn/landscaping contractors remove collected leaves offsite, or at least to areas of less frequent use, rather than concentrating them along the lawn-forest edge. Jordan RA and Schulze T, *Journal of Medical Entomology*, jaa033, <https://doi.org/10.1093/jme/tjaa033>.

## §§ International & General Section §§

### C6 Lyme ELISA “not an ideal test”

#### Multicenter Evaluation of the C6 Lyme ELISA Kit for the Diagnosis of Lyme Disease

Lyme disease (LD), caused by infection with *Borrelia burgdorferi*, is the most common tick-borne infection in many regions of Eurasia. Antibody detection is the most frequently used laboratory test, favoring a two-step serodiagnostic algorithm; immunoenzymatic detection of antibodies to C6 has been shown to perform similarly to a standard two-step workflow. The aim of this study was the performance evaluation of the C6 Lyme ELISA kit compared to a standard two-step algorithm in three laboratories located in the northeastern region of Italy which cater to areas with deterrent LD epidemiology.

A total of 804 samples were tested, of which 695 gave concordant results between C6 testing and routine workflow (564 negative, 131 positive). Wherever available, clinical presentation and additional laboratory tests were analyzed to solve discrepancies. The C6 based method showed a good concordance with the standard two-step algorithm (Cohen's  $\kappa = 0.619$ ), however, the distribution of discrepancies seems to point towards a slightly lower specificity of C6 testing, which is supported by literature and could impact on patient management. The C6 ELISA, therefore, is not an ideal stand-alone test; however, if integrated into a two-step algorithm, it might play a part in achieving a sensitive, specific laboratory diagnosis of LD.

From the paper: "On the other hand, false negatives resulting from the two-tier algorithm are common, resulting from factors such as patient seronegativity, and genetic diversity among disease-causing *Borrelia* strains. [21–23] ELISA assays are restricted in sensitivity as are confirmatory Western Blots [24] and about 20–30% of infected patients do not make detectable antibodies to *B. burgdorferi* [25].

To this purpose, laboratory diagnosis of LD must not overlook a judicious request of serological testing on the clinician's part, in accordance with national guidelines. Nonetheless, the genetic diversity of *Borrelia* spp. has repercussions on test performance, as most commercially available LD kits are based on detection of just one strain, B31, making the CDC-endorsed two-step workflow highly specific for *B. burgdorferi sensu stricto* (Bbss), [26,27] sacrificing sensitivity and focusing on a narrow case definition of LD. Testing for *Borrelia* spirochetes should encompass the spectrum of *Borrelia* organisms capable of causing disease, including Bbss, *B. burgdorferi sensu lato* (Bbsl) and the Relapsing Fever *Borrelia* (RFB). Ideally, testing should detect both LD and RFB and should differentiate between the two." Zannoli et al. *Microorganisms* 2020, 8, 457 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7143974/>.

## **Seroprevalence in Bats and Detection of *Borrelia burgdorferi* in Bat Ectoparasites.**

The role of bats in the enzootic cycle of Lyme disease and relapsing fever-causing bacteria is a matter of speculation. In Canada, *Borrelia burgdorferi sensu stricto* (ss) is the genospecies that is responsible for most cases of Lyme disease in humans. In this study, we determined if big brown bats, *Eptesicus fuscus*, have been exposed to spirochetes from the genus *Borrelia*. We collected serum from 31 bats and tested them for the presence of anti-*Borrelia burgdorferi* antibodies using a commercial enzyme-linked immunosorbent assay (ELISA).

We detected cross-reactive antibodies to *Borrelia* spp. in 14 of 31 bats. We confirmed the ELISA data using a commercial immunoblot assay. Pooled sera from ELISA-positive bats also cross-reacted with *Borrelia* antigens coated on the immunoblot strips, whereas pooled sera from ELISA-negative bats did not bind to *Borrelia* spp. antigens. Furthermore, to identify if bat ectoparasites, such as mites, can carry *Borrelia* spp., we analyzed DNA from 142 bat ectoparasites that were collected between 2003 and 2019. We detected DNA for the *Borrelia burgdorferi flaB* gene in one bat mite, *Spinturnix americanus*. The low detection rate of *Borrelia burgdorferi* DNA in bat ectoparasites suggests that bats are not reservoirs of this bacterium.

Data from this study also raises intriguing questions about *Borrelia* infections in bats, including the role of humoral immunity and the ability of bats to be infected with *Borrelia burgdorferi*. This study can lead to more sampling efforts and controlled laboratory studies to identify if bats can be infected with *Borrelia burgdorferi* and the role of bat ectoparasites, such as *S. americanus*, in the transmission of this spirochete. Furthermore, we outlined reagents that can be used to adapt ELISA kits and immunoblot strips for use with bat sera. Banerjee A, et al. *Microorganisms*. 2020 Mar 20;8(3). pii: E440. doi: 10.3390/microorganisms8030440. [View Full-Text](#)

## **Rocky Mountain spotted fever presenting with meningoencephalitis and bilateral abducens nerve palsies**

Rocky Mountain spotted fever, a disease caused by tick-borne infection with *Rickettsia rickettsii*, is a treatable but often under-recognized consideration in the differential diagnosis of an acute febrile illness. It may present with meningoencephalitis and focal neurological signs. Prompt initiation of antibiotic therapy is essential and therefore it is important to recognize the various ways in which the disease can manifest.

A 19-year-old woman presented with fever, headache, neck stiffness, rash, altered mental status, and blurred vision. On examination, she had bilateral inward deviation of the eyes with restriction of abduction. There was no evidence of papilledema. She was started on empiric treatment for meningitis. A lumbar puncture was done and cerebrospinal fluid studies were notable for lymphocytic pleocytosis and elevated protein. Serology for *Rickettsia rickettsia* was strongly reactive with IgG>1:1024 and IgM>1:256. She completed a course of doxycycline with complete resolution of her headache and fever and normalization of her mental status.

Early diagnosis of Rocky Mountain spotted fever can be challenging. Central nervous system involvement is a serious complication and tends to occur late in the disease course. Cranial nerve palsies can be associated with rickettsial infections in the absence of raised intracranial pressure. Diagnosis is confirmed with serology, but treatment should be initiated as soon as the diagnosis is suspected. Doxycycline is the antibiotic of choice. Ng et al. Neurology Apr 2020, 94 (15 Supplement) 955 [https://n.neurology.org/content/94/15\\_Supplement/955](https://n.neurology.org/content/94/15_Supplement/955).

## **Infected *Ixodes ricinus* ticks are attracted by electromagnetic radiation of 900 MH**

The electromagnetic field (EMF) is known to influence functions of the nervous, cardiovascular and reproductive systems of many animals, including ticks. The aim of this study was to test the behavior of ticks in the presence of radio-frequency EMF. For testing, 160 adult male and 140 adult female unfed *Ixodes ricinus* ticks were used. Individuals were exposed to 900 MHz EMF in the Radiation–Shielded Tube (RST).

Ticks were attracted to the irradiated area. This effect was significantly stronger for ticks infected with *Rickettsia* spp., suggesting that pathogens can alter the ticks' response to environmental stimuli. These results lead to the question of whether man-made EMF may have an impact on *I. ricinus* activity and, as such, be a contributing factor to the ongoing changes in the distribution of the tick and its pathogens currently observed in Europe and elsewhere. Fraczak et al. Ticks and Tick-borne Diseases, [doi.org/10.1016/j.ttbdis.2020.101416](https://doi.org/10.1016/j.ttbdis.2020.101416).

## **Lyme disease in children: Data from the Canadian Paediatric Surveillance Program**

...There were 95 cases that met inclusion criteria as confirmed or probable cases. The median age was 7 years; 38 % were 5–9 years and 35 % were 10–15 years of age. Most cases were acquired in known Canadian endemic locations; 5 were acquired during travel to the US. Most cases were reported from Nova Scotia and Ontario (46 % and 38 % respectively). The most common clinical presentation was arthritis (59 % of all cases), which is a manifestation of the late disseminated stage of LD. Late disseminated disease presented through the year, whereas early LD (Erythema migrans) and early disseminated LD presented during the summer and fall. Antibiotic choice and duration of therapy generally followed accepted guidelines.

This study of the clinical spectrum of LD in Canadian children underlines the need for preventive measures to protect children in Canada from emerging LD, and the need for health care provider awareness. Ogden et al. [www.sciencedirect.com/journal/ticks-and-tick-borne-diseases/vol/11/issue/2](https://www.sciencedirect.com/journal/ticks-and-tick-borne-diseases/vol/11/issue/2). Article 101347.

## Lone star ticks drink water

### Liquid water intake of the lone star tick, *Amblyomma americanum*: Implications for tick survival and management

Ixodid ticks are ectoparasites that feed exclusively on blood as their source of nutrients. Although ticks spend most of their life off the host, until now it has been assumed that the blood and the water vapor are the only sources of water to maintain water balance and prevent desiccation. Here we report for the first time that adult lone star ticks, *Amblyomma americanum*, also actively drink nutrient-free water, which greatly increases their survival. The volume of ingested water is greater in females than males ( $0.55 \pm 0.06$  vs  $0.44 \pm 0.07$   $\mu$ l) and most likely due to differences in tick size.

Water uptake occurs through mouthparts and it can be later observed in the salivary glands and the midgut. We also exploited this behavior by adding a variety of inorganic compounds and microorganisms to water. Addition of inorganic salts to drinking water such as  $\text{KH}_2\text{PO}_4 + \text{NaCl} + \text{KNO}_3$  resulted in 100% tick mortality within 3 days. As a proof of concept for using the water drinking as a delivery route of toxic reagents for ticks, we also show that adding *Pseudomonas aeruginosa* to drinking water quickly leads to tick death. This tick behavior can be exploited to target important physiological systems, which would make ticks vulnerable to dehydration and microbial dysbiosis. Maldonado-Ruiz, LP, et al. *Sci Rep* **10**, 6000 (2020), / [https://www.researchgate.net/publication/340483711\\_Liquid\\_water\\_intake\\_of\\_the\\_lone\\_star\\_tick\\_Amblyomma\\_americanum\\_Implications\\_for\\_tick\\_survival\\_and\\_management](https://www.researchgate.net/publication/340483711_Liquid_water_intake_of_the_lone_star_tick_Amblyomma_americanum_Implications_for_tick_survival_and_management)

### Possible Lyme Carditis with Sick Sinus Syndrome

*Borrelia burgdorferi* (*B. burgdorferi*) is a spirochete bacterium that is transmitted via the *Ixodes* tick. Infection results in Lyme disease with possible cardiac manifestations, which is also known as Lyme carditis. Patients can present with bradycardia due to rapidly fluctuating atrioventricular block (AVB), which is the hallmark of Lyme carditis.

However, we present a rare case of sick sinus syndrome (SSS) without AVB in a 47-year-old man with Lyme disease. He initially presented with a headache and subsequently developed new onset bradycardia and a right cranial nerve (CN) VI palsy with diplopia. *B. burgdorferi* enzyme-linked immunosorbent assay (ELISA) screen and IgM western blot were positive. He was admitted to the intensive care unit. Electrocardiography (EKG) indicated a heart rate in the high 30 s beats per minute (BPM) with several pauses, but no AVB was present. The patient responded well to therapy, and was discharged with an outpatient regimen of doxycycline. Lyme carditis should be considered in patients who develop new onset bradycardia and live in endemic areas. Cheung et al. ID Cases. [doi.org/10.1016/j.idcr.2020.e00761](https://doi.org/10.1016/j.idcr.2020.e00761).

### Lyme Endocarditis as an Emerging Infectious Disease: A Review of the Literature

Lyme endocarditis is extremely rare manifestation of Lyme disease. The clinical manifestations of Lyme endocarditis are non-specific and can be very challenging diagnosis to make when it is the only manifestation of the disease. Until now, only a few cases were reported. Physicians should keep in mind the possibility of borrelial etiology of endocarditis in endemic areas. Appropriate valve tissue sample should be sent for histopathology, culture, and PCR especially in case of endocarditis of unknown origin. PCR on heart valve samples is recommended. With more frequent PCR, *Borrelia* spp. may be increasingly found as a cause of infective endocarditis.

Prompt diagnosis and treatment of Lyme carditis may prevent surgical treatment and pacemaker implantations. Due to climate change and global warming Lyme disease is a growing problem. Rising number of Lyme disease cases we can expect and rising number of Lyme endocarditis. Nikolic et al. Front. Microbiol. 11:278. [doi.org/10.3389/fmicb.2020.00278](https://doi.org/10.3389/fmicb.2020.00278).

## **Rapid clearance of *Borrelia burgdorferi* from the blood circulation**

*Borrelia burgdorferi* is a tick-borne spirochete that causes Lyme borreliosis (LB). After an initial tick bite, it spreads from the deposition site in the dermis to distant tissues of the host. It is generally believed that this spirochete disseminates *via* the hematogenous route. *Borrelia persica* causes relapsing fever and is able to replicate in the blood stream. Currently the exact dissemination pathway of LB pathogens in the host is not known and controversially discussed.

In this study, we established a strict intravenous infection murine model using host-adapted spirochetes. Survival capacity and infectivity of host-adapted *B. burgdorferi sensu stricto* (*Bbss*) were compared to those of *B. persica* (*Bp*) after either intradermal (ID) injection into the dorsal skin of immunocompetent mice or strict intravenous (IV) inoculation *via* the jugular vein. By *in vitro* culture and PCR, viable spirochetes and their DNA load in peripheral blood were periodically monitored during a 49/50-day course post-injection, as well as in various tissue samples collected at day 49/50. Specific antibodies in individual plasma/serum samples were detected with serological methods.

Regardless of ID or IV injection, DNA of *Bp* was present in blood samples up to day 24 post-challenge, while no *Bbss* was detectable in the blood circulation during the complete observation period. In contrast to the brain tropism of *Bp*, *Bbss* spirochetes were found in ear, skin, joint, bladder, and heart tissue samples of only ID-inoculated mice. All tested tissues collected from IV-challenged mice were negative for traces of *Bbss*. ELISA testing of serum samples showed that *Bp* induced gradually increasing antibody levels after ID or IV inoculation, while *Bbss* did so only after ID injection but not after IV inoculation.

This study allows us to draw the following conclusions: (i) *Bp* survives in the blood and disseminates to the host's brain *via* the hematogenous route; and (ii) *Bbss*, in contrast, is cleared rapidly from the blood stream and is a tissue-bound spirochete. Liang, L., et al. *Parasites Vectors* **13**, 191 (2020). <https://doi.org/10.1186/s13071-020-04060-y>.

## **For those interested in cell biology and the common bacteria, *Midichloria mitochondrii*, that inhabits cell mitochondria– this one likes ticks**

### **When bacteria meet mitochondria: The strange case of the tick symbiont *Midichloria mitochondrii***

Mitochondria are key eukaryotic organelles that perform several essential functions. Not surprisingly, many intracellular bacteria directly or indirectly target mitochondria, interfering with innate immunity, energy production or apoptosis, to make the host cell a more hospitable niche for bacterial replication. The alphaproteobacterium *Midichloria mitochondrii* has taken mitochondrial targeting to another level by physically colonising mitochondria, as shown by transmission electron micrographs of bacteria

residing in the mitochondrial intermembrane space. This unique localization provokes a number of questions around the mechanisms allowing, and reasons driving intramitochondrial tropism. We suggest possible scenarios that could lead to this peculiar localization and hypothesize potential costs and benefits of mitochondrial colonisation for the bacterium and its host.

### ...2.1 *Midichloria mitochondrii*

*Midichloria* is a genus of obligate intracellular bacteria belonging to the order Rickettsiales, a group of alphaproteobacteria composed by intracellular bacteria... . Among *Midichloriae*, the most studied is *Candidatus Midichloria mitochondrii* (hereafter *M. mitochondrii*). *Midichloria mitochondrii* is present at high prevalence and abundance in females and immature *I. ricinus* ticks... Stavru et al. Cellular Biology, [doi.org/10.1111/cmi.13189](https://doi.org/10.1111/cmi.13189). Entire paper free of charge.

## Needlestick-Associated Rocky Mountain Spotted Fever, Brazil.

We report a fatal case of Rocky Mountain spotted fever (RMSF) in a man in Brazil without recent history of tick bites or environmental exposure. He received an accidental needlestick while working as a nurse. The nurse and his patient died. Both cases were confirmed as RMSF by molecular methods.

From the article: On July 30, case-patient B began having symptoms of acute febrile syndrome, including maculopapular rash, acute respiratory distress syndrome, shock, oliguria, thrombocytopenia, and leukopenia. Case-patient B died on August 5. Because RMSF was not suspected, neither case-patient received appropriate antimicrobial drugs. Vilges de Oliveira, et al. (2020) *Emerging Infectious Diseases*, 26(4), 815-816. <https://dx.doi.org/10.3201/eid2604.191251>.

## Transplant patients may acquire tick-borne infections from the transplant among other things

### Emerging and neglected zoonoses in transplant population

Zoonoses represent a problem of rising importance in the transplant population. A close relationship and changes between human, animal and environmental health (“One Health” concept) significantly influence the transmission and distribution of zoonotic diseases. The aim of this manuscript is to perform a narrative review of the published literature on emerging and neglected zoonoses in the transplant population.

Many reports on donor-derived or naturally acquired (re-)emerging arboviral infections such as dengue, chikungunya, West Nile, tick-borne encephalitis and Zika virus infection have demonstrated atypical or more complicated clinical course in immunocompromised hosts. Hepatitis E virus has emerged as a serious problem after solid organ transplantation (SOT), leading to diverse extrahepatic manifestations and chronic hepatitis with unfavorable outcomes. Some neglected pathogens such as lymphocytic choriomeningitis virus can cause severe infection with multi-organ failure and high mortality.

In addition, *ehrlichiosis* may be more severe with higher case-fatality rates in SOT recipients. Some unusual or severe presentations of *borreliosis*, *anaplasmosis* and *rickettsioses* were also reported among transplant patients. Moreover, toxoplasmosis as infectious complication is a well-recognized zoonosis in this population. Although rabies transmission through SOT transplantation has rarely been reported, it has become a notable problem in some countries. Since the spreading trends of zoonoses

are likely to continue, the awareness, recognition and treatment of zoonotic infections among transplant professionals should be imperative. Mrzljak A, et al. World J Transplant. Mar 31, 2020; 10(3): 47-63. doi: [10.5500/wjt.v10.i3.47](https://doi.org/10.5500/wjt.v10.i3.47).

## Persistence of babesia microti infection in humans

Persistent infection is a characteristic feature of babesiosis, a worldwide, emerging tick-borne disease caused by members of the genus *Babesia*. Persistence of *Babesia* infection in reservoir hosts increases the probability of survival and transmission of these pathogens. Laboratory tools to detect *Babesia* in red blood cells include microscopic detection using peripheral blood smears, nucleic acid detection (polymerase chain reaction and transcription mediated amplification), antigen detection, and antibody detection.

*Babesia microti*, the major cause of human babesiosis, can asymptotically infect immunocompetent individuals for up to two years. Chronically infected blood donors may transmit the pathogen to another person through blood transfusion. Transfusion-transmitted babesiosis causes severe complications and death in about a fifth of cases. Immunocompromised patients, including those with asplenia, HIV/AIDS, malignancy, or on immunosuppressive drugs, often experience severe disease that may relapse up to two years later despite anti-*Babesia* therapy.

Persistent *Babesia* infection is promoted by *Babesia* immune evasive strategies and impaired host immune mechanisms. The health burden of persistent and recrudescing babesiosis can be minimized by development of novel therapeutic measures, such as new anti-parasitic drugs or drug combinations, improved anti-parasitic drug duration strategies, or immunoglobulin preparations; and novel preventive approaches, including early detection methods, tick-avoidance, and blood donor screening. Kumar and Krause. Pathogens 2019, 8, 102; [doi.org/10.3390/pathogens8030102](https://doi.org/10.3390/pathogens8030102)

## Some scientists are not happy with the new name proposed for Borrelia

### Rejection of the name *Borrelia* and all proposed species comb. nov. placed therein

Rejection (*nomen rejiciendum*) of the name *Borrelia* and all new combinations therein is being requested on grounds of risk to human health and patient safety (Principle 1, subprinciple 2 and Rule 56a) and violation to aim for stability of names, to avoid useless creation of names (Principle 1, subprinciple 1 and 3) and that names should not be changed without sufficient reason (Principle 9 of the International Code of Nomenclature of Prokaryotes). Margos et al. International Journal of Systematic and Evolutionary Microbiology, 2020, doi.org/10.1099/ijsem.0.004149.

Excerpt:

The genus *Borrelia*, initially described by Swellengrebel 1907, was divided by Adeolu and Gupta [1] into two genera, one retaining the name *Borrelia* (comprising largely species associated with tick-borne relapsing fever illnesses), the other named *Borrelia* gen. nov. containing species of the *Borrelia burgdorferi* sensu lato species complex (which cause Lyme borreliosis). Subsequent work has shown that the genus separation was based on insufficient data and the drawn conclusions are only supported by a subset of species of the genus *Borrelia* [2–5]. Following publication of the genus separation the names of eight out of 20 species were validated in Validation List 163 [6]. In a later list [7] three further species were re-named. As this will generate confusion amongst medical practitioners and health professionals, it may seriously affect human health and welfare... Given the situation outline above, the proposed changes in taxonomy of the genus *Borrelia*, i.e. the creation of two different genera is a violation of principle 1, subprinciples 1 and 3 of the Code as the proposed changes are premature, i.e. based on insufficient data, which does not support stability of names (violation of subprinciple 1) and uselessly creates new names (subprinciple 3)...

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