

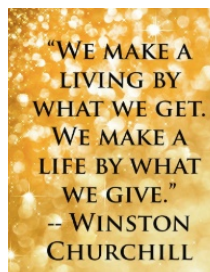


Tick-Borne Infections Council  
of North Carolina, Inc.

## NEWSLETTER 2017, Volume 6



Quote of the season: -



## HAPPY HOLIDAYS TO ALL OUR READERS!

### Highlights...

Scroll down to see these features and more!

- **CDC no longer publishing weekly and monthly Lyme disease case numbers, only annually**
- **Alpha Gal-Induced anaphylaxis to Herpes Zoster Vaccination**
- **Lyme disease bacteria ancient, recent emergence of human Lyme disease probably reflects ecological change**
- **A new 'biosignature' approach may distinguish Lyme disease from southern tick-associated rash illness (STARI)**
- **Several species of squirrels and chipmunks in California carry Lyme disease bacteria**
- **Lyme disease bacteria found to have been circulating silently in forests for at least 60,000 years**
- **Free new academic search tool: [Semantic Scholar](#)**
- **Even Iceland has ticks that can vector Lyme disease**
- **Alpha-gal (red meat allergy) and Lyme disease in Sweden**

## **State Vector-Borne Disease Working Group 2018 Meeting Schedule**

Tentative 2018 VBWG meeting dates: January 26<sup>th</sup>, April 27<sup>th</sup>, Jul 27<sup>th</sup>, and October 26<sup>th</sup>

(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**


Visit our home page to access links to the letters on Lyme disease and the Rickettsial diseases such as RMSF that the state Department of Public Health issues every year to medical providers (see the right side of the home page of <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 when establishing critical diagnosis”**

Go to: [www.cdc.gov/lyme/healthcare/index.html](http://www.cdc.gov/lyme/healthcare/index.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.

## **CDC no longer publishing weekly and monthly Lyme disease case numbers, only annually**

Until the definition for Lyme disease case reported was changed this year (see Volume II of our newsletter), Lyme disease case numbers were reported in the CDC's *Morbidity and Mortality Weekly Report* (MMWR) publication. See, for example:

[www.cdc.gov/mmwr/volumes/66/wr/mm6630md.htm?s\\_cid=mm6630md\\_e](http://www.cdc.gov/mmwr/volumes/66/wr/mm6630md.htm?s_cid=mm6630md_e)

We recently learned this change was part of the new CSTE case definition (which the CDC adopts) 16-ID-10: [http://c.ymcdn.com/sites/www.cste.org/resource/resmgr/2016PS/16\\_ID\\_10.pdf](http://c.ymcdn.com/sites/www.cste.org/resource/resmgr/2016PS/16_ID_10.pdf)

“We also propose that final Lyme disease case numbers be included in the MMWR annual surveillance

reports and omitted from the weekly MMWR surveillance tables. Lyme disease cases are complex to classify and reporting of reliable case numbers is often delayed, making weekly case numbers of limited utility when comparing week to week or to that week in previous years. A large proportion of case numbers reported in the weekly MMWR tables are deleted after case review so these numbers do not accurately reflect Lyme disease trends and are inconsistent with final data.”

Ed. note: Between getting rid of ‘endemic’ areas (as part of the new 2017 definition) and now only reporting case numbers annually, the CDC has changed the data-driven face of Lyme disease considerably.

	<b>Total cases by year of report 2015 Final</b>	<b>Total cases by year of report 2016 Preliminary</b>	<b>2017</b>
<b>Disease</b>	<b>Confirmed + Probable (Confirmed/Probable/Suspected)</b>	<b>Confirmed + Probable (Confirmed/Probable/Suspected)*</b>	<b>(Probable/Confirmed)**</b>
Lyme disease	38/192/46		
Rickettsioses	5/454/130	n/a	n/a
Ehrlichioses	16/58/18		
Anaplasmosis	4/15/3		

\*This is the year of report, not year of illness onset

\*\* Illness onset may be prior to 1/1/15

**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 Talks and Materials Distributed**

**Brochures/booklets:** Shakori Hills Music Festival

**Talks:** Siler City Senior Center  
Pittsboro Senior Center

**Letter of endorsement:** for Chatham County’s Health Department’s 2018 Community Health Assessment

## **Report from the Vector-Borne Disease Work Group meeting**

The October 2017 meeting was reported on in Volume 5 of the newsletter, available on our website.

### ⌘⌘ TIC-NC Activities ⌘⌘

## **2017 Distribution of our trifold English/Spanish brochure (folleto)**

El Centro Hispano Durham	50	Day Laborers Center – Carrboro	50
Catholic Charities Durham	50	Porch Program – Orange County	400
El Centro Hispano de Carrboro	50	NC Farmworker Health Program	200+

Hillsborough Hispanic Bakery	40	OC Convenience Center	80
El Restaurante Ixtapa	60	Senior Center Durham	40
Colorado Burrito	40	Cliff's Meat Market Carrboro	75
La Michoacana	40	Hispanic Clinic Durham	75
Compare Market	40	Great Outdoors Provision Co Chapel Hill and Greensboro	200
Durham Bakery	50	Townsend Bertrand Sporting Goods Carrboro	80
Piedmont Health	800	Jordan Lake State Park	80+
Weaver St Market Hillsborough	80+	REI in Cary, Durham, Greensboro	300+
Hillsborough Arts Council Gallery	50+	Mountain to Sea Trail events	100
Hillsborough Garden Club	50+	Festival on the Eno – State Parks, MST, Eno River Assoc	100
Wm B Umstead State Park	100+		

The Chatham Health Alliance, in partnership with Chatham Hospital and the Chatham County Public Health Department, is starting the 2018 Community Assessment process. **TIC-NC** was pleased to submit a letter of support for this assessment. The survey will contain several questions about tick exposure and tick-borne disease experience. Chatham residents will be randomly selected to participate in the Community Opinion Survey, an opportunity for residents to share their perspectives on the strengths, concerns, resources, and emerging issues in the county. For more information on the assessment visit, [www.ChathamHealthAllianceNC.org/Assessment](http://www.ChathamHealthAllianceNC.org/Assessment).

## »» North Carolina and Southeast Section »»

### **Eastern Maryland infected with a recently found *Borrelia*, a potential hazard to humans**

#### ***Borrelia miyamotoi*, Other Vector-Borne Agents in Cat Blood and Ticks in Eastern Maryland**



We collected blood and tick samples in eastern Maryland to quantify vector-borne pathogen exposure and infection in healthy cats and to assess occupational disease risk to veterinary professionals and others who regularly interact with household pets. Thirty-six percent of healthy cats parasitized by ticks at time of examination (9/25) were exposed to, and 14% of bloods (7/49) tested PCR-positive for, at least one vector-borne pathogen including several bloods and ticks with *Borrelia miyamotoi*, a recently recognized tick-borne zoonotic bacterium. There was no indication that high tick burdens were associated with exposure to vector-borne

pathogens. Our results underscore the potential importance of cats to human vector-borne disease risk. pp 1-5, Sept 2017. Shannon et al.

## **An abstract from NC at the American Public Health Association annual meeting**

### **Factors Associated with Incidence of Lyme Disease in North Carolina**

**Background:** Lyme disease is a multisystem bacterial infection caused by the bacterium, *Borrelia burgdorferi*. This most common vector-borne illness in the United States is an escalating public health concern in North Carolina. Lyme disease cases in the state have increased by six-fold since 2010 and in 2014, five counties were declared endemic by the North Carolina Department of Public Health.

**Objectives:** The purpose of this study was to examine the geographic distribution and other factors that influence the occurrence of disease to aid public health officials in developing efficient prevention techniques and educational programs. **Methods:** For the purposes of this study, secondary data was collected from the Centers for Disease Control and Prevention, North Carolina Wildlife Resources Commission and United States Census Bureau and analyzed using the Statistical Package for the Social Sciences (SPSS) software. Individual counties were analyzed to determine significant differences between county characteristics and Lyme disease prevalence. County characteristics that were analyzed include population, gender, race, education, poverty and the number of whitetail deer harvested.

**Results:** Lyme disease in North Carolina was more common in more densely populated counties. Additionally, gender, education and the number of whitetail deer harvested were all significantly associated with the occurrence of Lyme disease. **Conclusion:** Future research should be conducted to analyze additional county characteristics as well as expand on the associations found within this analysis, which potentially could be significant in predicting and understanding Lyme disease occurrence in North Carolina. Abs: 4193.0, Nov 7. Adams et al. Campbell University

## **■ ■ National Section ■ ■**

### **Deadly tick virus, Bourbon virus, found to be carried by lone star ticks**

#### **Bourbon virus in field-collected ticks, Missouri, USA.**

Bourbon virus (BRBV) was first isolated in 2014 from a resident of Bourbon County, Kansas, USA, who died of the infection. In 2015, an ill Payne County, Oklahoma, resident tested positive for antibodies to BRBV, before fully recovering. We retrospectively tested for BRBV in 39,096 ticks from northwestern Missouri, located 240 km from Bourbon County, Kansas. We detected BRBV in 3 pools of *Amblyomma americanum* (L.) ticks: 1 pool of male adults and 2 pools of nymphs. Detection of BRBV in *A. americanum*, a species that is aggressive, feeds on humans, and is abundant in Kansas and Oklahoma, supports the premise that *A. americanum* is a vector of BRBV to humans. BRBV has not been detected in nonhuman vertebrates, and its natural history remains largely unknown.

From the discussion: “ We hypothesize that *A. americanum* ticks acquire BRBV from occasional blood meals from  $\geq 1$  vertebrate hosts; that the virus successfully replicates and is transstadially transmitted in *A. americanum* ticks; and that *A. americanum* ticks transmit the virus to incidental hosts, such as humans. The pool of male adult *A. americanum* ticks, MO-2013-1246, also was positive for HRTV (5), suggesting some overlap in the transmission cycles of HRTV and BRBV. BRBV and antibodies to BRBV have not been detected in vertebrates, other than the 2 humans, and the natural history of the virus remains unknown.” Savage HM, et al. Emerg Infect Dis. 2017 Dec. <https://doi.org/10.3201/eid2312.170532>

## **Alpha Gal-Induced anaphylaxis to Herpes Zoster Vaccination. Vaccine contains pork gelatin.**

A 73-year-old female presented to Stony Brook Emergency Department (NY) for near syncope after obtaining her herpes zoster vaccination. She was successfully treated for anaphylaxis. Examination of vaccination contents revealed use of porcine gelatin - a meat product felt to have induced an IgE response in the setting of alpha gal allergy. Alpha gal allergy is a relatively novel presentation of tick borne illness induced by the Lone Star Tick commonly found in the southern, midwest and northeastern United States. Akella et al. Meeting presentation, DOI: <http://dx.doi.org/10.1016/j.chest.2017.08.036>. American College of Chest Physicians.

## **Lyme disease bacteria ancient, recent emergence of human Lyme disease probably reflects ecological change**

### **Genomic insights into the ancient spread of Lyme disease across North America**

Lyme disease is the most prevalent vector-borne disease in North America and continues to spread. The disease was first clinically described in the 1970s in Lyme, Connecticut, but the origins and history of spread of the Lyme disease bacteria, *Borrelia burgdorferi* sensu stricto (s.s.), are unknown. To explore the evolutionary history of *B. burgdorferi* in North America, we collected ticks from across the USA and southern Canada from 1984 to 2013 and sequenced them, to our knowledge, largest collection of 146 *B. burgdorferi* s.s. genomes. Here, we show that *B. burgdorferi* s.s. has a complex evolutionary history with previously undocumented levels of migration. Diversity is ancient and geographically widespread, well pre-dating the Lyme disease epidemic of the past ~40 years, as well as the Last Glacial Maximum ~20,000 years ago. This means the recent emergence of human Lyme disease probably reflects ecological change—climate change and land use changes over the past century—rather than evolutionary change of the bacterium. Walter et al. *Nature Ecology & Evolution* (2017). <https://www.nature.com/articles/s41559-017>.

## **Unproven new biosignature approach to differentiating organisms by molecular patterns claims to distinguish Lyme disease from southern tick–associated rash illness (STARI)**

### **Metabolic differentiation of early Lyme disease from southern tick–associated rash illness (STARI)**

Lyme disease, the most commonly reported vector-borne disease in the United States, results from infection with *Borrelia burgdorferi*. Early clinical diagnosis of this disease is largely based on the presence of an erythematous skin lesion for individuals in high-risk regions. This, however, can be



confused with other illnesses including southern tick–associated rash illness (STARI), an illness that lacks a defined etiological agent or laboratory diagnostic test, and is coprevalent with Lyme disease in portions of the eastern United States.

By applying an unbiased metabolomics approach with sera retrospectively obtained from well-characterized patients, we defined biochemical and diagnostic differences between early Lyme disease and STARI. Specifically, a metabolic biosignature consisting of 261 molecular features (MFs) revealed that altered N-acyl ethanolamine and primary fatty acid amide metabolism discriminated early Lyme disease from STARI.

Development of classification models with the 261-MF biosignature and testing against validation samples differentiated early Lyme disease from STARI with an accuracy of 85 to 98%. These findings revealed metabolic dissimilarity between early Lyme disease and STARI, and provide a powerful and new approach to inform patient management by objectively distinguishing early Lyme disease from an illness with nearly identical symptoms. Molins et al. Science Translational Medicine 16 Aug 2017. DOI: 10.1126/scitranslmed.aal2717. <http://stm.sciencemag.org/content/9/403/eaal2717>

## **Fatal Rocky Mountain Spotted Fever along the United States–Mexico Border, 2013–2016**

Rocky Mountain spotted fever (RMSF) is an emerging public health concern near the US–Mexico border, where it has resulted in thousands of cases and hundreds of deaths in the past decade. We identified 4 patients who had acquired RMSF in northern Mexico and subsequently died at US healthcare facilities. Two patients sought care in Mexico before being admitted to US-based hospitals. All patients initially had several nonspecific signs and symptoms, including fever, headache, nausea, vomiting, or myalgia, but deteriorated rapidly without receipt of a tetracycline-class antimicrobial drug. Each patient experienced respiratory failure late in illness. Although transborder cases are not common, early recognition and prompt initiation of appropriate treatment are vital for averting severe illness and death. Clinicians on both sides of the US–Mexico border should consider a diagnosis of RMSF for patients with rapidly progressing febrile illness and recent exposure in northern Mexico. Drexler, et al. Emerging Infectious Diseases, 23(10), 1621-1626. <https://dx.doi.org/10.3201/eid2310.170309>.

## **Several species of squirrels and chipmunks in California are infected with either *B. burgdorferi* sensu stricto or *Borrelia bissettiae*, forms of Lyme disease**

### **Distribution and Diversity of *Borrelia burgdorferi* sensu lato Group Bacteria in Sciurids of California**

California has a remarkable diversity of squirrel and chipmunk species (sciurids), and five named and several unnamed genospecies in the *Borrelia burgdorferi* sensu lato group (BBSL) of bacteria as well, many of which utilize sciurids as reservoirs. We investigated the prevalence, spatial distribution, and diversity of BBSL in sciurids of California by literature search, PCR of 585 ear tissue samples from 15 sciurid species prospectively collected across 19 California counties, and DNA sequencing when possible. Seven publications documented BBSL infections in western gray squirrels (*Sciurus griseus*), fox squirrels (*Sciurus niger*), eastern gray squirrels (*Sciurus carolinensis*), Douglas squirrels (*Tamiasciurus douglasii*), and redwood chipmunks (*Tamias ochrogenys*) in northern California.

Prospective sampling added new BBSL infection records for long-eared chipmunks (*Tamias quadrimaculatus*), Allen's chipmunks (*Tamias senex*), and Siskiyou chipmunks (*Tamias siskiyou*). Infection was detected in the Mendocino, North Coast, West Sierra, and Central Valley regions of California. The overall PCR prevalence was 9.4% ( $n = 585$ ), and exceeded 40% ( $n = 84$ ) in Mendocino and farther north along the Pacific coast. Redwood (40.7%,  $n = 81$ ) and Siskiyou (22.2%,  $n = 18$ ) chipmunks had the highest prevalence of BBSL infection. BBSL infections were associated with arboreal and semiarboreal sciurid species and species occurring in conifer forests.

Western gray squirrels and Allen's chipmunks in Humboldt County and redwood chipmunks in Mendocino County were infected with *B. burgdorferi* sensu stricto, while we identified *Borrelia bissettiae* in Douglas squirrels and Siskiyou chipmunks in Humboldt and Del Norte Counties. This indicates that further study of sciurids can aid in describing the ecology of BBSL in California. Austin N, et al. Vector-Borne and Zoonotic Diseases. <https://doi.org/10.1089/vbz.2017.2134>

## International & General Section

### New academic search tool: Semantic Scholar

Semantic Scholar, **launched in 2015**, is an academic search engine aiming to tackle the problem of information overload. It uses artificial intelligence (AI) to help users sift through huge numbers of scientific papers and understand (to a limited extent) their content. The free tool was developed by the Allen Institute for Artificial Intelligence (AI2), a nonprofit based in Seattle, Washington, that was co-founded in 2014 by Microsoft Co-Founder Paul Allen.

Semantic Scholar's archive of searchable literature initially focused on computer science, and last year expanded to include neuroscience. Today, it is expanding again, to include the millions of biomedical research papers indexed by **PubMed** and other sources; overall, Semantic Scholar's archive is now approaching 40 million papers.

Last year, Semantic Scholar's programmers also added functionality that allows it to measure the influence of researchers and organizations, based on what they call "highly influential citations"—which takes into account the context around citations, excluding any self-citations—and other information.

...With scientific literature doubling roughly every 9 years, keeping up is becoming increasingly difficult, says Marie Hagman, senior product manager at AI2. There's "a ton of information trapped in these articles and we want to bring it to life," she says. "We think there are potential cures or ways to improve or save human lives that may be buried away in a PDF somewhere."

...One limitation of the tool is that it can't trawl paywalled papers. Hagman notes, however, that her group is negotiating with publishers for varying levels of access.

Many other academic search engines, such as Google Scholar and Microsoft Academic Search, already exist. And any of these search tools will do the job for those who are experts in a particular field and know what they are looking for, Hagman says. But for those exploring connections between different fields or looking into new areas, she believes no other tool provides the "discovery experience" offered



## **Man in Southern Ontario locally acquired a *Babesia* species not thought to be in Canada**

### **First record of locally acquired human babesiosis in Canada caused by *Babesia duncani*: a case report**

Babesiosis is a zoonosis caused by a malaria-like parasite typically transmitted by ixodid (hard-bodied) ticks (Acari: Ixodidae). Worldwide, there are over 100 *Babesia* species (Piroplasmida: Babesiidae) and, in North America, at least 4 *Babesia* species (i.e., *Babesia bovis*, *Babesia canis*, *Babesia duncani*, and *Babesia microti*) will cause human babesiosis.

The aim of this clinical assessment was to ascertain whether a 70-year-old Canadian patient, who had no history of out-of-country travel, had contracted a *Babesia* infection. The adult human male developed constitutional symptoms, which included sweats, chills, and immobilizing fatigue, and was screened for human babesiosis. Subsequent testing included a complete *Babesia* panel. Both the IgM serology and the molecular FISH RNA probe were positive for *B. duncani*; all tests for *B. microti* were negative. Based on clinical symptoms and laboratory tests, the patient was diagnosed with human babesiosis. Interestingly, the patient's wife also was confirmed positive using serological and molecular testing.

This is the first report of a locally acquired case of human babesiosis in Canada caused by *Babesia duncani*. The geographical distribution of *B. duncani* in North America is much greater than previously anticipated, especially north of the Canada-United States border. Since the patient was bitten by a blacklegged tick, *Ixodes scapularis*, a carrier of multiple zoonotic pathogens, the author suggests that this tick species is a vector of *B. duncani*. Health-care providers must be aware that *B. duncani* is present in Canada, and poses a public health risk. Scott J. *SAGE Open Medical Case Reports*. [doi.org/10.1177/2050313X17725645](https://doi.org/10.1177/2050313X17725645).

Ed. note. The history is of interest. The patient saw 4 doctors before getting a diagnosis: An untravelled adult human male, age 70, living in southern Ontario developed profound fatigue, night sweats, chills, malaise, fractured sleep, fever, increased thirst, body aches, mild headaches, joint pain, and loss of concentration 3 months following a tick bite confirmed as a blacklegged nymph. The tick was negative for Lyme disease. At initial presentation, the primary physician attributed the symptoms to "old age." Subsequently, another physician made a diagnosis of fibromyalgia, while a third physician diagnosed chronic fatigue syndrome. When the patient consulted the fourth physician, he had a fever of 39.4°C, and *Babesia* testing was authorized.

## **Even Iceland has ticks that can vector Lyme disease**

### **Surveillance of *Ixodes ricinus* ticks (Acari: Ixodidae) in Iceland**

*Ixodes ricinus* is a three-host tick, a principal vector of *Borrelia burgdorferi* (s.l.) and one of the main vectors of tick-borne encephalitis (TBE) virus. Iceland is located in the North Atlantic Ocean with subpolar oceanic climate. During the past 3–4 decades, average temperature has increased, supporting more favourable conditions for ticks. Reports of *I. ricinus* have increased in recent years. If these ticks were able to establish in a changing climate, Iceland may face new threats posed by tick-borne diseases.

Active field surveillance by tick flagging was conducted at 111 sites around Iceland from August 2015 to September 2016. A total of 52 *A. sylvaticus* were live-trapped but no ticks were found nor on 315 *V. lagopus* carcasses. Passive surveillance data collected since 1976, reports further 214 *I. ricinus* ticks from 202 records, with an increase of submissions in recent years. The continental probability of presence model correctly predicts approximately 75% of the recorded presences, but fails to predict a fairly specific category of recorded presence in areas where the records are probably opportunistic and not likely to lead to establishment.

To the best of our knowledge, this study represents the first finding of questing *I. ricinus* ticks in Iceland... Furthermore, the amount of records on dogs, cats and humans indicate that ticks were acquired locally, presenting a local biting risk. Tick findings on migratory birds highlight a possible route of importation. Obtaining questing larvae is now a priority to confirm that *I. ricinus* populations are established in Iceland. Alfredsson et al. *Parasites & Vectors* 201710:466  
<https://parasitesandvectors.biomedcentral.com/articles/10.1186/>

## **European study of songbirds suggests transmission of multiple tick-borne infections to humans may be common**

### **Pathogen communities of songbird-derived ticks in Europe's low countries**

Birds play a major role in the maintenance of enzootic cycles of pathogens transmitted by ticks. Due to their mobility, they affect the spatial distribution and abundance of both ticks and pathogens. In the present study, we aim to identify members of a pathogen community [*Borrelia burgdorferi* (s.l.), *B. miyamotoi*, 'Ca.*Neorhlichia mikurensis*', *Anaplasma phagocytophilum* and *Rickettsia helvetica*] in songbird-derived ticks from 11 locations in the Netherlands and Belgium (2012–2014).

...Of the 671 bird-derived ticks, 51% contained DNA of at least one pathogenic agent and 13% showed co-infections with two or more pathogens... Our findings highlight the contribution of European songbirds to co-infections in tick individuals and consequently to the exposure of humans to multiple pathogens during a tick bite. Although poorly studied, exposure to and possibly also infection with multiple tick-borne pathogens in humans seems to be the rule rather than the exception. Heylen et al. *Parasites & Vectors* 201710:497. <https://doi.org/10.1186/s13071-017-2423-y>

## **Something called 'the stringent response'**

### **Sleeper cells: the stringent response and persistence in the *Borrelia* (*Borrelia*) *burgdorferi* enzootic cycle.**

Infections with tick-transmitted *Borrelia burgdorferi*, the cause of Lyme disease, represent an increasingly large public health problem in North America and Europe. The ability of these spirochetes to maintain themselves for extended periods of time in their tick vectors and vertebrate reservoirs is crucial for continuance of the enzootic cycle as well as for the increasing exposure of humans to them.

The stringent response mediated by the alarmone (p)ppGpp has been determined to be a master regulator in *B. burgdorferi*. It modulates the expression of identified and unidentified open reading frames needed to deal with and overcome the many nutritional stresses and other challenges faced by the spirochete in ticks and animal reservoirs. The metabolic and morphologic changes resulting from

activation of the stringent response in *B. burgdorferi* may also be involved in the recently described non-genetic phenotypic phenomenon of tolerance to otherwise lethal doses of antimicrobials and to other antimicrobial activities.

It may thus constitute a linchpin in multiple aspects of infections with Lyme disease borrelia, providing a link between the micro-ecological challenges of its enzootic life-cycle and long-term residence in the tissues of its animal reservoirs, with the evolutionary side effect of potential persistence in incidental human hosts. Cabello et al. *Environ Microbiol.* 2017 Aug 24. doi: 10.1111/1462-2920.13897.

## German Saxon forest: up to 12% ticks carry Lyme disease bacteria and 4% *Borrelia miyamotoi*

### Prevalence of *Borrelia miyamotoi* and *Borrelia burgdorferi* sensu lato in questing ticks from a recreational coniferous forest of East Saxony, Germany

The hard tick *Ixodes ricinus* is the most important vector of tick-transmitted pathogens in Europe, frequently occurring in urban parks and greenbelts utilized for recreational activities. This species is the most common vector of the causative agents of Lyme borreliosis in Europe. Similarly, the species spreads *Borrelia miyamotoi*, causing a relapsing-fever like illness. A total of 1774 *Ixodes ricinus* (50 females, 68 males, 840 nymphs and 818 larvae) were collected with flagging between March and September 2014 in a coniferous forest patch in Niederkaina near the town of Bautzen in Saxony, Germany.



Prevalence of *B. burgdorferi* s.l. was 9.4% (female: 6%, male: 2.9%, nymph: 12.2%, larva: 0%) and minimum prevalence of *B. miyamotoi* was 1.2% (female: 0%, male: 4.3%, nymph: 2.8%, larva: 0.1%) in the 714 samples with real-time polymerase chain reaction. A real-time PCR reaction was utilized first to target the histone-like protein gene (*hbb*) of *B. burgdorferi* s.l., a hemi-nested outer surface protein (*ospA*) gene conventional PCR was then performed followed by a restriction enzyme analysis to distinguish *B. burgdorferi* s.l. genospecies. Seven *B. afzelii*, one *B. burgdorferi* s.s., one *B. bavariensis* and four *B. miyamotoi* infections were confirmed. Prevalence of Lyme borreliosis spirochetes was significantly higher in nymphs than in adults ( $p < 0.01$ , Fisher exact test) probably due to the diluting effect of the local roe deer population. Our data highlight the potential risk of human infection with the emerging pathogen *B. miyamotoi* within the study area. Szekeres et al. *Ticks and Tick-borne Diseases*. <https://doi.org/10.1016/j.ttbdis.2017.08.002>

## Lyme-like disease in Brazil

### *Borrelia burgdorferi* sensu lato in *Ixodes longiscutatus* ticks from Brazilian Pampa

- Occurrence of Lyme-like syndrome cases has been increasing in Brazil.
  - The etiologic agent and the potential vectors are unknown.
  - *Borrelia* spp. was investigated in ticks of rodents from Brazilian Pampa.
  - *Borrelia burgdorferi* sensu lato DNA was detected in *Ixodes longiscutatus* ticks.
  - This paper is the first report of *Borrelia burgdorferi* sensu lato in *Ixodes* ticks from Brazil.
- Dall'Agnol et al. *Ticks and Tick-borne Diseases*. doi:10.1016/j.ttbdis.2017.08.003

## Alpha-gal (red meat allergy) and Lyme disease in Sweden

### IgE reactivity to $\alpha$ -Gal in relation to Lyme borreliosis

An association between tick bites, the development of immunoglobulin E (IgE) antibodies to galactose- $\alpha$ -1, 3-galactose ( $\alpha$ -Gal) and red meat allergy has recently been reported. Here we wanted to elucidate the relation between tick exposure, IgE antibodies to  $\alpha$ -Gal and Lyme borreliosis (LB).

In the highly LB endemic area of Kalmar County, Sweden, serum samples and health inquiries from 518 blood donors were included. All sera were investigated for multiple IgG anti-Borrelia antibodies using a multiplex assay (recomBead, Mikrogen). In addition, three serially collected sera over a six month period from 148 patients with clinically defined erythema migrans (EM) were included. IgE antibodies against  $\alpha$ -Gal were determined using ImmunoCAP (Thermo Fisher Scientific).

In blood donors reporting previous LB ( $n = 124$ ) IgE to  $\alpha$ -Gal was found in 16%, while in donors denying previous LB but with multiple anti-Borrelia antibodies ( $n = 94$ ; interpreted as asymptomatic LB) 10% were IgE  $\alpha$ -Gal-positive. Finally, in donors without Borrelia antibodies denying previous LB ( $n = 300$ ) 14% showed IgE to  $\alpha$ -Gal. No significant difference in proportions among the groups were found. In EM patients, IgE to  $\alpha$ -Gal was found in 32/148 (22%) at diagnosis, 31/148 (21%) after two-three months and 23/148 (16%) after six months. A significant reduction of proportion and level of IgE to  $\alpha$ -Gal was found between the second and third sample.

IgE to  $\alpha$ -Gal reactivity was common in a tick endemic area but showed no significant relation to previous LB. IgE anti- $\alpha$ -Gal reactivity in EM patients peaked within three months of diagnosis of EM, after which it waned indicating that recent tick exposure is of importance in  $\alpha$ -Gal sensitization. Furthermore, IgE anti  $\alpha$ -Gal was more common in men compared with women. Tjernberg et al. IgE reactivity to  $\alpha$ -Gal in relation to Lyme borreliosis. PLoS ONE 12(9): e0185723. 2017. Entire paper at: <http://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0185723&type=printable>

## Not ready for use, but new botanical compound that works against lone star ticks is of interest

### Botanical Compound p-Anisaldehyde Repels Larval Lone Star Tick (Acari: Ixodidae), and Halts Reproduction by Gravid Adults

The lone star tick, *Amblyomma americanum* (L.), widely distributed across eastern, southeastern, and midwestern regions of the United States and south into Mexico, is an obligate blood feeder that attaches to three hosts during the larval, nymphal, and adult stages. White-tailed deer and wild turkey are common hosts, as well as a wide variety of other avian and mammalian hosts. *Amblyomma americanum* is the most frequently reported species of tick to bite humans in the southeastern and southcentral United States, and it can transmit diseases that include ehrlichiosis, rickettsiosis, tularemia, and protozoan infections.

As *A. americanum* resistance to conventional insecticides becomes more common, alternative control tactics, such as application of bioactive botanical natural products are being investigated. *p*-Anisaldehyde has been found in many plant species and it has shown effects that include mortality, attractancy, and interference with host seeking.

The compound at a relatively low concentration applied to gravid adults strongly reduces egg laying and the few eggs that are produced do not hatch. Aside from repelling larval *A. americanum* and halting reproduction, *p*-anisaldehyde has a variety of effects on other arthropods including attraction. Research on this compound as a potentially multifaceted pest management tool has been sparse. This study, for example, is the first to demonstrate *p*-anisaldehyde's repellent properties against an arthropod pest. *p*-Anisaldehyde might also act as a strong repellent against other tick species. Showler T, Harlien L. *Journal of Medical Entomology*, t158, <https://doi.org/10.1093/jme/t158>

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