Tick-Borne Infections Council of North Carolina, Inc.

NEWSLETTER 2019, Volume 5

Quote: - "Studies done so far suggest that it takes about two days of attachment and feeding before spirochetes are being transmitted to a host animal. This is referred to as the "safety period," during which a person could remove a tick without becoming infected. I personally don't subscribe to this theory, because there are about 5 to 10 percent of infected ticks that have a generalized infection, including salivary glands and saliva at the time of attachment. In such cases, transmission of spirochetes would and does occur immediately at time of attachment."

Willie Burgdorfer, during an interview by Deirdre Boggs of Historical Research Associates in Hamilton, Montana on July 10, 2001. The interview was done at the request of the National Institutes of Health.

Highlights…

- **Several abstracts about diseases and ticks in the south**
- **Do you like to visit Maine? Report on ticks and pathogens from the CDC**
- **A 117-year analysis of ticks in Pennsylvania**
- **A viral disease from the Rocky Mountain wood tick**
- **Report from the USDA on the Longhorn tick distribution**
- **An icky report: tick-borne Ehrlichia in leeches**
- **Borrelia (Lyme disease bacteria) transmission from tick to person can be immediate**
- **Australia has a tick that can cause anaphylaxis upon removal**
- **Ticks, spiders, and more: review of Bartonella**
- **Citizen science in the NE**
- **Review of Borrelia persisters**
- **Risk of Lyme disease in urban parks in Lyme areas**
- **Most tularemia in the US vectored by American dog ticks**

- **First report of tick paralysis in horses**
- **Tick Identification Pilot Program Act of 2019**
- **Call for Congress to investigate past research on the use of ticks and biological warfare**
- **US posttreatment Lyme disease cases may be as high as 2,000,000 by 2020**

State Vector-Borne Disease Working Group 2019 Meeting Schedule

Tentative 2019 VBWG meeting dates: November 15, 2019 9:30am
(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

The link to the letter the state Department of Public Health issues every year to medical providers on Lyme disease and the Rickettsial diseases such as RMSF is on the home page on the right of our Facebook site: www.facebook.com/TICNC/. Even if you are not a Facebook number you should be able to look at the page.

CDC, July 2019. The CDC again states that their case definitions are for *surveillance only*.

The Centers for Disease Control and Prevention (CDC) has agreed to add a disclaimer to the surveillance case definition for Lyme disease that it is "*not intended to be used by healthcare providers for making a clinical diagnosis or determining how to meet an individual patient's health needs."* https://www.cdc.gov/lyme/stats/forms.html. Accessed 22 September 2019.

CDC: The Emerging Issues in Tickborne Diseases webinar, presented June 13, 2019, is now online.

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 Tickborne Diseases webinar, presented June 13, 2019, is now online.

State tick research

North Carolina report about tick and mosquito activities in the Mid-Atlantic Mosquito Control Association spring newsletter, 4/26/19: Tick portion

Mosquito- and tick-borne disease prevention efforts at the state level have increased in the past few years, especially due to partnerships between the Communicable Disease Branch of the North Carolina Division of Public Health and multiple North Carolina universities. Lyme disease research published by Paul Lantos in 2015 elucidating the extent of Lyme expansion into North Carolina used human disease surveillance data to suggest that Lyme will continue to creep into North Carolina along the southwestern border of Virginia. With the help of CDC Expanding Laboratory Capacity (ELC) funding in 2018, the Communicable Disease branch contracted Dr. Gideon Wasserberg at UNC-G, Dr. Michael Reiskind of North Carolina State University, Dr. Steve Seagle of Appalachian State University, and Dr. Graham Hickling of the University of Tennessee to survey at total of 19 counties in the northwest portion of North Carolina, and counties in Virginia and Tennessee that border North Carolina. Additionally, Dr. Reiskind is targeting three counties in central North Carolina including Wake, Chatham, and Johnston counties.

Entomological surveillance in these nineteen counties is ongoing, and ticks collected will be sent to the CDC in Fort Collins for pathogen testing. Preliminary results indicate that Borrelia burgdorferi is present in ticks collected via flagging in the northeastern part of North Carolina, but not in central North Carolina. Additionally, in June 2018, NC DPH initiated the **NC Tick Identification Program**, patterned after the West Virginia Veterinary Tick Submission Project. The goal is to document the distribution of disease-causing ticks across North Carolina including Ixodes scapularis, Dermacentor variabilis, Amblyomma americanum, and Amblyomma maculatum. Small animal veterinarians throughout the state were asked to submit ticks collected from animal specimens to the DPH. In conjunction with the discovery of Haemaphysalis longicornis [Asian longhorn] in Polk County by the USDA (July 2018), the program was adapted to include large animal veterinary hospital submissions, so that the distribution of Haemaphysalis longicornis could be properly documented. So far, the program has identified the longhorned ticks in two additional North Carolina counties (Rutherford and Davidson). Ticks collected through the NC Animal Tick Identification Program are not being tested for pathogens.
… Mosquito section omitted here

These efforts work in tandem with annual state funding to 15 North Carolina counties that have shown an interest and capacity to create Integrated Mosquito and Tick Management programs. The efforts of local vector control personnel have resulted in several improvements, not the least of which is adding daily mosquito surveillance data to MosquitoNet. Finally, the state is working to improve

communication about mosquito-borne and tick-borne diseases, including the introduction of annual vector-borne disease surveillance summaries (9) and a visual data summary website.(10) This website displays human mosquito and tick case data back to at least 2004, not to mention human data for dozens of other communicable diseases. Submitted By: A. Barbarin and M. Doyle to MAMCA
Entire article and list of references can be accessed at: https://www.mamca.org/news

References:
9. https://epi.ncpublichealth.info/cd/figures.html
10. https://public.tableau.com/profile/nc.cdb

From the NC Wildlife Resources Commission: What they are doing to protect their workers

When most people think about occupational exposures, tick-borne illnesses usually do not come to mind. In fact, tick-borne illnesses were not even on the rise in our agency, but we were seeing an increase in tick bites. The culture that we are trying to establish with our employees is simply "report everything that has caused or has the potential to cause injury or illness." While we realize the reporting has created additional work, the data we collect is being used to monitor trends and mitigate potential injury and illness.

To be proactive our agency put together a "tick kit" which is a pocket first aid kit that comes with standard first aid kit items. In addition, we include tweezers that incorporate a magnifying glass, as well as a pocket card that contains facts about ticks, such as prevention, removal and the signs and symptoms associated with tick-borne illnesses. We have also increased our education and awareness about tick-borne illness, and we have started to stock various tick repellants and pre-treatment for clothing.

Our reporting tools have changes as well to include a reporting form that is strictly for tick related incidents. My hope is that we will gather enough data to see which groups of employees have the greatest risk of exposure and determine which tick treatments work best. My goal as a safety professional has always been to safeguard the health and wellbeing of our employees. I believe this proactive approach will accommodate this goal.

Allen Strickland // Safety Director, May 2019
Mailing Address: 1701 Mail Service Center
Raleigh, North Carolina 27699-1700

Report from the State or Vectorborne Disease Work Group meeting

None. July meeting canceled.

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

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. These data are no longer collected.

Call for congress to investigate past US research in using ticks as biological weapons. July 2019.

Roll Call, a Capitol Hill publication, reports that the U.S. House of Representative wants the Pentagon to investigate whether the Department of Defense experimented with ticks and other insects as biological weapons between the years of 1950 and 1975. Story at: https://www.rollcall.com/news/house-orders-pentagon-report-whether-weaponized-ticks

TIC-NC Activities

Focus on our Asheville volunteer, Janet Dooley

Janet Dooley at the Biltmore House

What Janet did at the May 2019 at the event where the Asheville mayor read the Tickborne Disease Awareness Proclamation: Janet wore one of her T-shirts for the occasion. It said "tell your doctor to report your tickborne disease to the CDC." She talked about using tweezers for safe tick removal, and she got the town of Black Mountain to put information from TIC-NC in their newsletter.

She says people stop her every day to tell her their tick story when they see her shirts. She gives them the Asheville Lyme Disease Proclamation from the mayor and one of our booklets.

Thank you, Janet!

Janet Dooley's bio: In 1995, while living in New England, my body became hijacked by a tick bite that carried 5 different infections. Like many of you, I went to a ridiculous number of doctors and alternative practitioners with no diagnosis. I was suicidal, anxious, angry, a shell of the once optimistic and outgoing woman I had always been. I was 52 years old, had had a stroke, and couldn't move my body because of horrible fatigue. I got labeled with 'chronic fatigue' and 'menopausal issues.' I endured 12 years of 'negative' blood tests and the shame of leaving a doctor's office in tears after being made to feel I was wasting their time.

About the time I finally got diagnosed by a wonderful neurologist, *Cure Unknown* by Pamela Weintraub and the movie, *Under Our Skin*, came out. I thought healthcare providers would then be educated about Lyme disease. Apparently, not. The neurologist referred me to a wonderful doctor in Boston and I started getting better.

While in Massachusetts, I ran a Lyme hotline for seven years even though I could barely walk. I heard about Asheville and how people could get well there, so, I moved. Now I can walk 3 miles and am very active. I never leave the house without one of my tick warning shirts on.

Now I know people can get Lyme disease around Asheville, too. I worked with the town to get the mayor to release a 'Tickborne Awareness Proclamation' every May. My colleagues and I copy it and have handed out over 3000 now in parks, stores, trails, the Y, and other such places. We also give them a TIC-NC booklet and other TIC-NC materials if we have them with us. The booklet is a wonderful source of education. My doctor keeps a few in her drawer to identify ticks when patients come in with one attached. I am now 75 years old. I won't quit trying to educate people about the risks of tickborne infections and Lyme disease.

Janet's T-shirts:

TIC-NC Talks and Materials Distributed

Brochures/booklets:
- **Ocracoke Health Clinic**
- **L&L Market, Eli Whitney, NC**
- **Selected folks in Asheville (Thanks, Janet!)**
  - **County school system**
  - **2 police officers**
  - **5 lifeguards at the Senior Center**
  - **People at the YMCA, Chamber of Commerce,**
  - **And a PT clinic**
- **New River State Park**
- **Grayson Highlands State Park, Va**
- **Piedmont Health Burlington**
- **Eno River Association**
- **Samantha's Pupusas**
- **Ixtapa Mexican Restaurant**
- **A volunteer to her church group Mebane**

Article: Mid-Atlantic Mosquito Control Association Newsletter Spring 2019

ᴎᴎ North Carolina and South ᴎᴎ

Collaborative-Tick Surveillance Works: An academic and government partnership for tick surveillance in the Southeastern United States (Acari: Ixodidae)

Tick surveillance provides essential information on distributions and encounter frequencies; it is a component of operational activities in public health practice. Our research objectives were a proof-of-concept for collaborative surveillance, which involved establishing an academic and government partnership to enhance tick surveillance efforts.

The University of Tennessee (UT) collaborated with United States Department of Agriculture Forest Service, Southern Research Station Forest Inventory Analysis (FIA) in an Occupational Health and Safety partnership. UT provided FIA crews in the southeastern United States with vials containing 80% ethanol (July 2014–November 2017). Crew members were instructed to put all encountered ticks into the vials and return them to FIA headquarters. UT identified all submitted ticks to species and life stage, and screened *Amblyomma americanum* (L.) for *Ehrlichia* bacteria using a nested-PCR assay.

From the 198 returned vials, 1,180 ticks were submitted, including *A. americanum* (90.51%; 202 larvae, 503 nymphs, and 363 adults), *Dermacentor variabilis* Say (7.12%; 1 nymph, 83 adults), *Ixodes scapularis* (Say) (1.61%; 19 adults), *Amblyomma maculatum* Koch (0.59%; 1 nymph, 6 adults), and *Amblyomma cajennense* (Fabricius) (0.17%; 1 nymph, 1 adult). FIA crews encountered *A. americanum* with *Ehrlichia* and collection information was used to generate baseline occurrence data of tick encounters. Results indicate that this collaborative-tick surveillance can be improved and used to generate useful data including pathogen detection, and because crews revisit these sites, changes in tick encounters can be monitored. Trout et al. *Journal of Medical Entomology*, tjz055, https://doi.org/10.1093/jme/tjz055.

The first report of the Asian Longhorned Tick probably carrying *B. burgdorferi* in West Virginia

Incidence of B. burgdorferi in tick populations of Upshur County, West Virginia

Lyme disease is the most wide-spread vector-borne disease in the eastern United States. Lyme disease is caused by a bacterium, *Borrelia burgdorferi*, that is transmitted by a tick vector, most commonly *Ixodes scapularus*. In this study, 400 ticks were collected from around Upshur county, West Virginia, and tested by PCR for the presence of *B. burgdorferi* DNA. Tick specimen belong to *Ixodes scapularus, Rhipicephalus sanguineus*, or are unidentified. One unidentified sample, which tested positive for *B. burgdorferi*, has been tentatively identified as the new invasive *Haemaphysalis longicorni*. This is the first report of the Asian Longhorned Tick carrying *B. burgdorferi* in West Virginia. In the future, this ongoing project will expand its sampling techniques, as well as expand testing for the presence of other possible tick-borne diseases in collected samples. Winters et al. Winters, et al. Proceedings of the West Virginia Academy of Science, Vol 91, No 1, 2019. www.pwvas.org/index.php/pwvas/article/view/599.

Ed note: We communicated with the CDC to see if they were aware of this and had had any other reports of the Longhorn tick carrying the Lyme disease bacteria. They were not. Per Dr. Charles Beard, 19 April 2019, the CDC does not plan to follow up unless requested by state and local health departments.

Rickettsial pathogens in ticks in SW Georgia and NW Florida forestry workers and a report of a tick not previously known to prey on humans

Rickettsiales in Ticks Removed from Outdoor Workers, Southwest Georgia and Northwest Florida, USA

We determined the prevalence of selected Rickettsiales in 362 ticks removed from outdoor workers in southwest Georgia and northwest Florida, USA. Persons submitted an average of 1.1 ticks/month. We found Ehrlichia chaffeensis in an Amblyomma maculatum tick, and Panola Mountain Ehrlichia sp. in 2 A. maculatum ticks and 1 Dermacentor variabilis tick.

This study also found larvae and nymphs of A. tuberculatum ticks were submitted on multiple occasions. Since this has been thought to be rarely reported on humans, further study is warranted. Gleim et al. Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 25, No. 5, May 2019 | DOI: https://doi.org/10.3201/eid2505.180438 | wwwnc.cdc.gov/eid/article/25/5/pdfs/18-0438.pdf.

35% of Gulf Coast ticks in the metropolitan area of Atlanta positive for *Rickettsia parkeri*

Rickettsia parkeri and "*Candidatus* Rickettsia andeanae" in *Amblyomma maculatum* (Acari: Ixodidae) collected from the Atlanta metropolitan area, Georgia, United States

Rickettsia parkeri is a recently recognized human pathogen transmitted in the southeastern United States by Amblyomma maculatum, the Gulf Coast tick. Since *R. parkeri* was conclusively identified as a human pathogen in 2004, over 40 cases of *R. parkeri* rickettsiosis have been identified in the United States, most of which occur in the southeastern states. During 2012–2014, five of these cases were identified by a single urgent care practice in Coweta County, a Georgia county within the Atlanta metropolitan area. To investigate the occurrence of *R. parkeri*-infected *A. maculatum* in the Atlanta metropolitan area, ticks were collected from 6 counties around the city of Atlanta and evaluated for infection with a *Rickettsia* species.

A total of 263 questing adult *A. maculatum* were collected during 2015 and 2016. Of these, 93 (35%) were PCR-positive for DNA of *R. parkeri* and an additional 46 (17%) were PCR-positive for DNA of "*Candidatus* Rickettsia andeanae," a spotted fever group *Rickettsia* species of unknown pathogenicity. No co-infections of these two rickettsiae were detected; however four of the six counties sampled showed presence of both rickettsial organisms. The high frequency of *R. parkeri* in these tick populations indicates a potential risk for those living, working, or recreating in *A. maculatum*-infested habitats within these six counties in the Atlanta metropolitan area. Allerdice et al. Ticks and Tick-borne Diseases. https://doi.org/10.1016/j.ttbdis.2019.05.013.

Relatively new tickborne virus, Bourbon virus, problem in the Midwest and southern United States

Essential Role of Interferon Response in Containing Human Pathogenic Bourbon Virus

Bourbon virus (BRBV) is a recently discovered tick-transmitted viral pathogen that is prevalent in the Midwest and southern United States. Since 2014, zoonotic BRBV infections have been verified in several human cases of severe febrile illness, occasionally with fatal outcomes, indicating a possible public health threat.

We analyzed the pathology of BRBV infection in mice and found a high sensitivity of the virus to the host interferon system. Infected standard laboratory mice did not show clinical signs or virus replication. However, in mice carrying defects in the type I and type II interferon system, the virus grew to high titers and caused severe pathology. In cell culture, BRBV was blocked by antiviral agents like ribavirin and favipiravir (T705). Our data suggest that persons having severe BRBV infection might have a deficiency in their innate immunity and could benefit from an already approved antiviral treatment. Fuchs et al. Emerg Infect Dis. 2019 Jul. https://doi.org/10.3201/eid2507.181062. The entire article at the link under the title.

◘◘ National Section ◘◘

Borrelia transmission time “can be immediate,” from a section of interview with Willie Burgdorfer 2001

Deirdre Boggs of Historical Research Associates interviewing Dr. Willy Burgdorfer in Hamilton, Montana on July 10, 2001. The interview was done at the request of the National Institutes of Health.

Entire interview at: history.nih.gov/archives/downloads/wburgdorfer.pdf

Pg 55-56
WB: Studies done so far suggest that it takes about two days of attachment and feeding before spirochetes are being transmitted to a host animal. This is referred to as the "safety period," during which a person could remove a tick without becoming infected. I personally don't subscribe to this theory, because there are about 5 to 10 percent of infected ticks that have a generalized infection, including salivary glands and saliva at the time of attachment. In such cases, transmission of spirochetes would and does occur immediately at time of attachment.
DB: So, the longer process is only the case for ticks that carry spirochete only in the midgut.
WB: Correct.
DB: And, of course, it was in the midgut that you found your spirochete the first time.
W B: Correct.
DB: As far as you know, is there a relationship between the location of the spirochete in the human victim and the clinical manifestations of Lyme disease?
WB: Well, we know that spirochetes are surrounding the erythema migrans lesion and we know that the spirochete can be isolated from the blood and even from the cerebral spinal fluid of a patient.

DB: Dr. Burgdorfer, have you yourself seen *Borrelia burgdorferi* in any locations in the tick other than in the mid gut?
WB: Yes. We have followed the development of *Borrelia burgdorferi* in individual ticks and especially the passage of the organism through the gut wall into the body cavity. We also have found them in salivary gland tissues and especially in the ovarian tissues. There they can affect the egg to the point that it will die. So, we have seen them throughout the tissues throughout the tick, as we also find in the case with relapsing fever Borrelia.
DB: When you're saying "we've seen that", you yourself have seen that. Is that right?
WB: Yeah.
DB: And have you yourself done any work to determine how the spirochete is transferred from the tick into its victim?
WB: Oh yes. As far as the Lyme disease spirochete is concerned, it's via saliva, saliva being injected during the feeding process.

A Martha's Vineyard/Nantucket experiment with gene altered mice using CRISPR-based genome editing to decrease Lyme-infected ticks

Mice Against Ticks: an experimental community-guided effort to prevent tick-borne disease by altering the shared environment.

Mice Against Ticks is a community-guided ecological engineering project that aims to prevent tick-borne disease by using CRISPR-based genome editing to heritably immunize the white-footed mice (Peromyscus leucopus) responsible for infecting many ticks in eastern North America. Introducing antibody-encoding resistance alleles into the local mouse population is anticipated to disrupt the disease transmission cycle for decades. Technology development is shaped by engagement with community members and visitors to the islands of Nantucket and Martha's Vineyard, including decisions at project inception about which types of disease resistance to pursue.

This engagement process has prompted the researchers to use only white-footed mouse DNA if possible, meaning the current project will not involve gene drive. Instead, engineered mice would be released in the spring when the natural population is low, a plan unlikely to increase total numbers above the normal maximum in autumn. Community members are continually asked to share their suggestions and concerns, a process that has already identified potential ecological consequences unanticipated by the research team that will likely affect implementation.

As an early example of CRISPR-based ecological engineering, Mice Against Ticks aims to start small and simple by working with island communities whose mouse populations can be lastingly immunized without gene drive. This article is part of a discussion meeting issue 'The ecology and evolution of prokaryotic CRISPR-Cas adaptive immune systems'. Buchthal et al. Philos Trans R Soc Lond B Biol Sci. 2019;74(1772):20180105. doi: 10.1098/rstb.2018.0105. Ed note: We wonder if this is safe and what guidelines are in place nationwide, if any, at this point.

Quantifying the relationship between human Lyme disease and Borrelia burgdorferi exposure in domestic dogs

Lyme disease (LD) is the most common vector-borne disease in the United States. Early confirmatory diagnosis remains a challenge, while the disease can be debilitating if left untreated. Further, the decision to test is complicated by under-reporting, low positive predictive values of testing in non-endemic areas and travel, which together exacerbate the difficulty in identification of newly endemic areas or areas of emerging concern. Spatio-temporal analyses at the national scale are critical to establishing a baseline human LD risk assessment tool that would allow for the detection of changes in these areas. A well-established surrogate for human LD incidence is canine LD seroprevalence, making it a strong candidate covariate for use in such analyses. In this paper, Bayesian statistical methods were used to fit a spatio-temporal spline regression model to estimate the relationship between human LD incidence and canine seroprevalence, treating the latter as an explanatory covariate. A strong non-linear monotonically increasing association was found. That is, this analysis suggests that mean incidence in humans increases with canine seroprevalence until the seroprevalence in dogs reaches approximately 30%. This finding reinforces the use of canines as sentinels for human LD risk, especially with respect to identifying geographic areas of concern for potential human exposure. Liu et al. Geospatial Health 2019; volume 14:750.

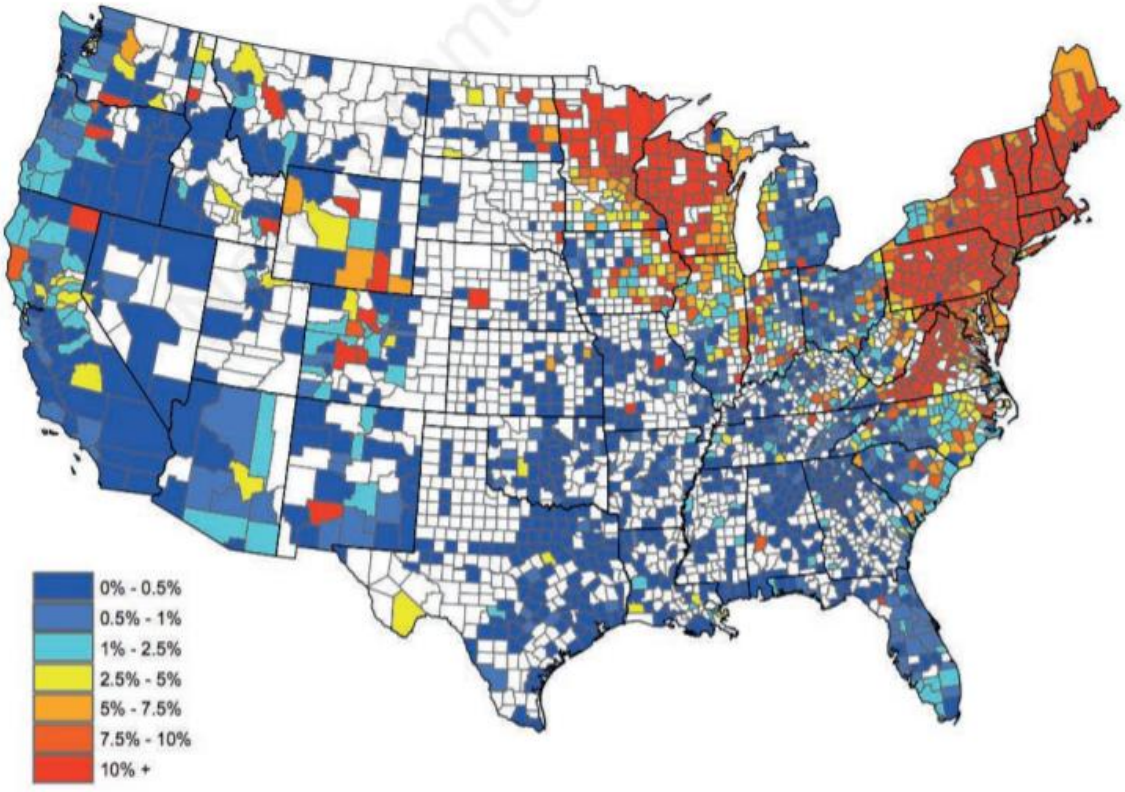


Figure 1. Average empirical canine *Borrelia burgdorferi* seroprevalence for 2012-2016. The overall seroprevalence for the five-year period is displayed for each county reporting data.

Tick-borne relapsing fever in dogs cross-reacts with the Lyme disease bacteria in tests

Antibodies to *Borrelia turicatae* in experimentally-infected dogs cross-react with *B. burgdorferi* serologic assays

Tick-borne relapsing fever (TBRF) is caused by several *Borrelia* spp (including *Borrelia turicatae*). which are primarily transmitted by *Ornithodoros* ticks. Relapsing fever group species are found worldwide except for Antarctica. Approximately 500 human cases were reported between 1990-2011 in the United States (likely an underestimate), while cases in domestic and wild dogs were reported from Florida, Texas, and Washington. TBRF spirochetes are related to *Borrelia burgdorferi*, the agent of Lyme borreliosis. Dogs are routinely screened for *B. burgdorferi*, but it is unknown if infection with TBRF agents produce antibodies cross-reactive with *B. burgdorferi* assays. These data are critical for accurate surveillance of TBRF and Lyme borreliosis in dogs.

In this study, *B. burgdorferi*-negative dogs were inoculated with *B. turicatae*and seroconversion was confirmed by the rBipA Western blot. Seropositive samples were tested with commercial and veterinary diagnostic laboratory *B. burgdorferi*-based tests. *Borrelia turicatae-seroreactive* samples cross-reacted with a whole cell IFA and two multi-antigen tests; but not with single antigen tests using C6. Cross-reactivity with TBRF can confound epidemiology and surveillance efforts, and confuse recommendations made by veterinarians for prevention and control.

These findings demonstrate the need to critically evaluate results of *B. burgdorferi* diagnostic tests in the context of the assay type, the animal's geographical location, and history of travel as well as highlighting the need for commercially-available specific diagnostic tests for TBRF spirochetes. Gettings et al. American Society for Microbiology, doi: 10.1128/JCM.00628-19.

Do you like to visit Maine? Report on ticks and pathogens from the CDC

Seroprevalence of Borrelia burgdorferi, B. miyamotoi, and Powassan Virus in Residents Bitten by Ixodes Ticks, Maine, USA.

We conducted a serosurvey of 230 persons in Maine, USA, who had been bitten by *Ixodes scapularis* or *I. cookei* ticks. We documented seropositivity for *Borrelia burgdorferi* (13.9%) and *B. miyamotoi* (2.6%), as well as a single equivocal result (0.4%) for Powassan encephalitis virus. Smith, et al. (2019). *Emerging Infectious Diseases*, *25*(4), 804-807. https://dx.doi.org/10.3201/eid2504.180202. Entire article free at: wwwnc.cdc.gov/eid/article/25/4/18-0202_article

Lyme disease testing and positivity rate has increased at Quest Labs

Laboratory Blood-Based Testing for Lyme Disease at a National Reference Laboratory A 7-Year Experience (2010-2016)

We evaluated trends in Lyme disease (LD) testing at a national reference laboratory. Methods: LD screening enzyme immunoassay and Western blot testing data performed at Quest Diagnostics during 2010 to 2016 were analyzed nationally and at the state level.

Overall, 593,800 (11.3%) results were positive of 5,255,636 tests. There was an increase in the rate of positivity over the last 2 years of the study and an increase in the number of positive tests in 2016. Positive tests were observed in all 50 states and the District of Columbia. New York had the most positive tests, whereas Connecticut had the highest positivity rate when normalized to state populations. Some states with historically low rates of LD (eg, Texas, Florida, and California) showed significant increases in testing and positivity rates over time.

LD testing and positivity have increased in recent years, including in states not historically associated with the disease. Lee,Lewandrowski, et al. Am J Clin Pathol. 2019 Apr 15. pii: aqz030. doi: 10.1093/ajcp/aqz030.

A 117-year retrospective analysis of Pennsylvania tick community dynamics

Tick-borne diseases have been increasing at the local, national, and global levels. Researchers studying ticks and tick-borne diseases need a thorough knowledge of the pathogens, vectors, and epidemiology of disease spread. Both active and passive surveillance approaches are typically used to estimate tick population size and risk of tick encounter. Our data consists of a composite of active and long-term passive surveillance, which has provided insight into spatial variability and temporal dynamics of ectoparasite communities and identified rarer tick species. We present a retrospective analysis on compiled data of ticks from Pennsylvania over the last 117 years.

We compiled data from ticks collected during tick surveillance research, and from citizen-based submissions. The majority of the specimens were submitted by citizens. However, a subset of the data was collected through active methods (fagging or dragging, or removal of ticks from wildlife). We analyzed all data from 1900–2017 for tick community composition, host associations, and spatio-temporal dynamics.

In total there were 4491 submission lots consisting of 7132 tick specimens. Twenty-four different species were identified, with the large proportion of submissions represented by five tick species. We observed a shift in tick community composition in which the dominant species of tick (Ixodes cookei) was overtaken in abundance by Dermacentor variabilis in the early 1990s and then replaced in abundance by I. scapularis. We analyzed host data and identified overlaps in host range amongst tick species.

We highlight the importance of long-term passive tick surveillance in investigating the ecology of both common and rare tick species. Information on the geographical distribution, host-association, and seasonality of the tick community can help researchers and health-officials to identify high-risk areas. Pak et al. Parasites Vectors (2019) 12:189 https://doi.org/10.1186/s13071-019-3451-6.

A viral disease from the Rocky Mountain wood tick

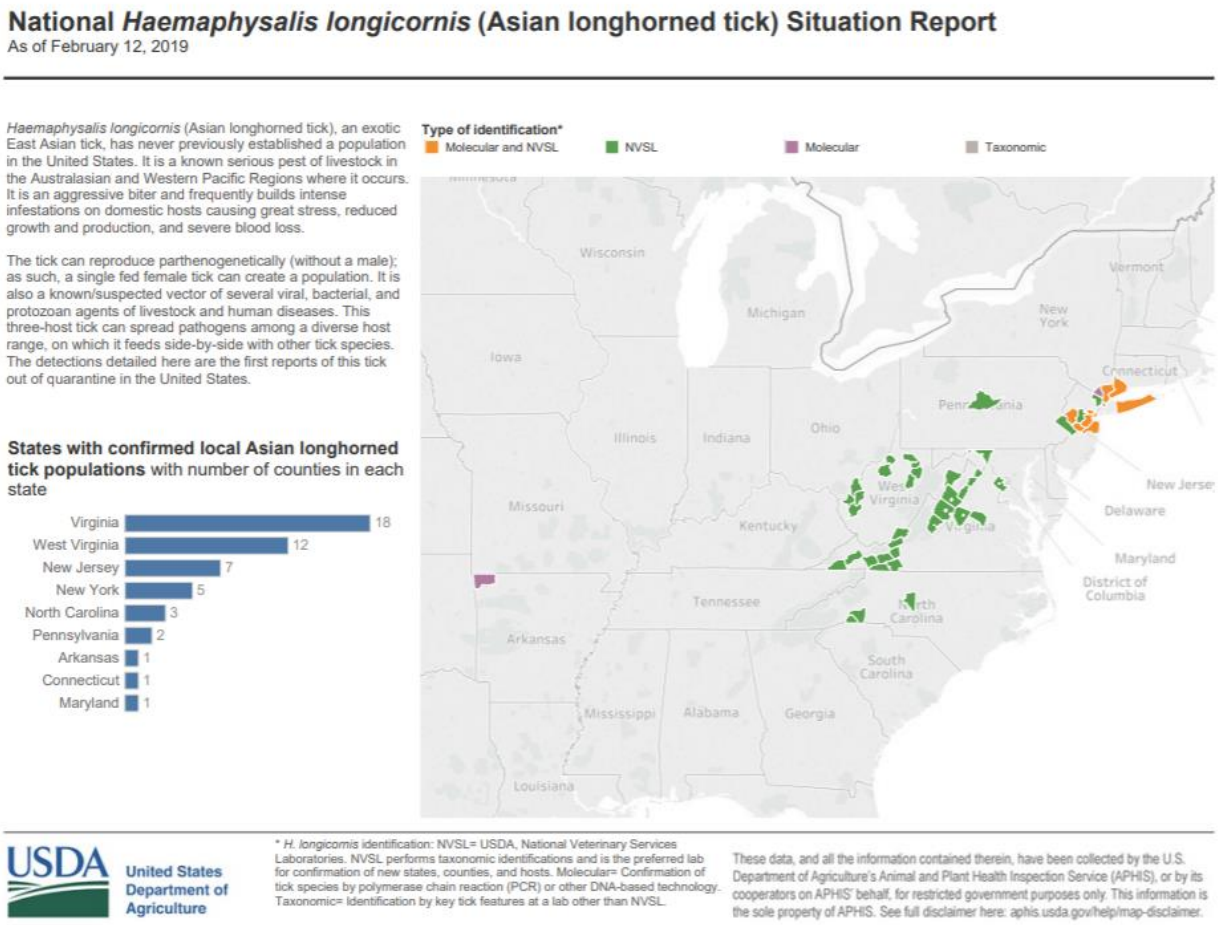
Notes from the Field: Investigation of Colorado Tick Fever Virus Disease Cases — Oregon, 2018

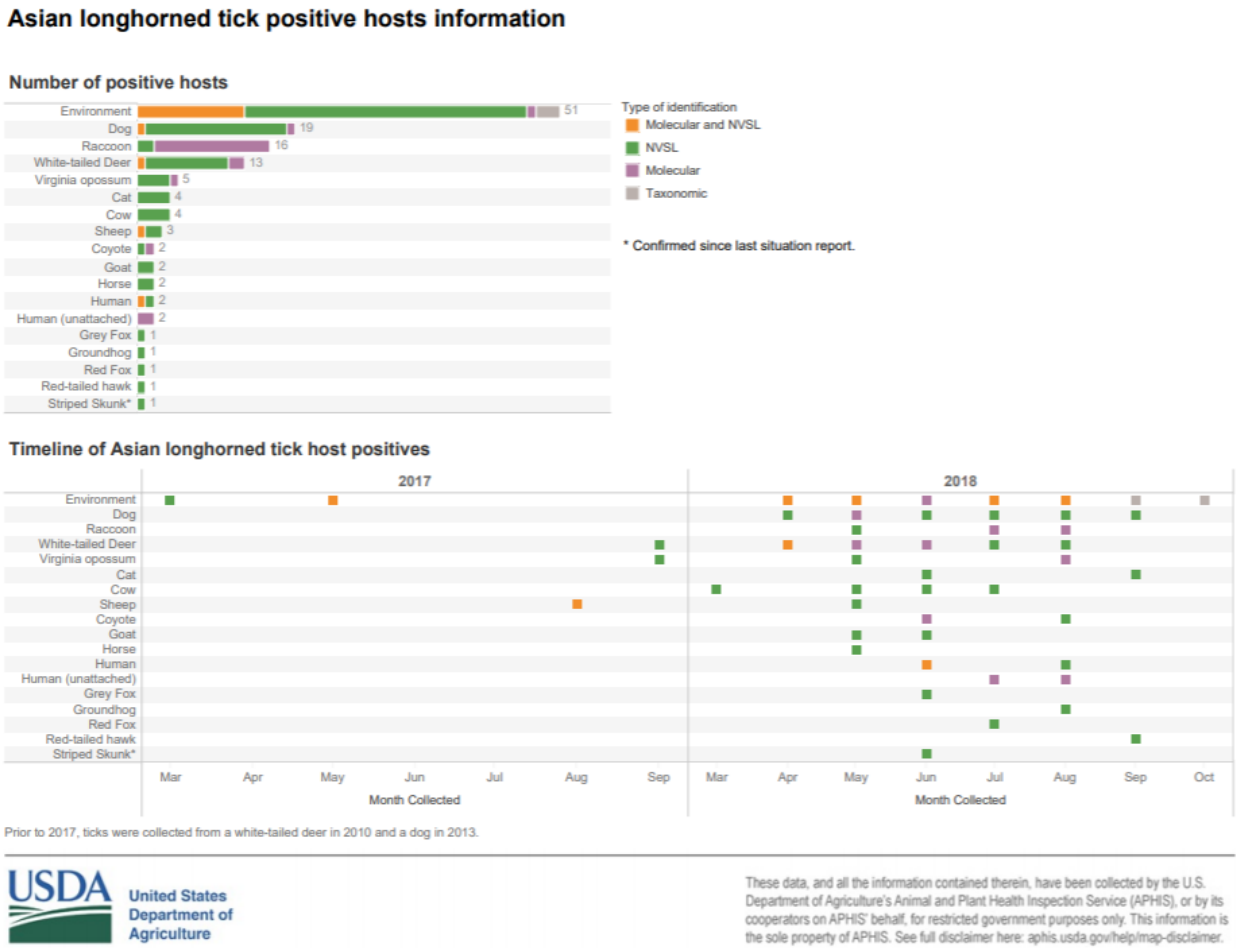
In early summer 2018, four cases of Colorado tick fever (CTF) were reported in residents of central Oregon; CTF virus infection was confirmed using CDC's reverse transcription–polymerase chain reaction (RT-PCR) assay (*1*). CTF is caused by a coltivirus that is transmitted by infected Rocky Mountain wood ticks (*Dermacentor andersoni*) (*2*). The tick is found throughout the western United States and Canada, typically at 4,000–10,000 feet (1,219–3,048 meters) above sea level in grassy areas

near sage brush (*3*). CTF virus causes an acute febrile illness with nonspecific symptoms, and although fatal cases are rare, up to 30% of persons with CTF virus disease require hospitalization (*4*). Because there is no definitive treatment for CTF virus disease, clinical management is supportive. Biphasic illness pattern, leukopenia, absence of rash, and place of exposure can help distinguish CTF from other arthropod-borne infections (*2*,*5*). CTF is a reportable condition in six states, including Oregon, but is not nationally notifiable. Over the past decade, the Oregon Health Authority has reported an average of less than one case of CTF per year… .

More CTF cases were identified in Oregon in 2018 than in previous years, possibly because of increased tick activity or heightened provider awareness and testing. No common locations of tick exposure were identified, indicating the pathogen was circulating in several areas of central Oregon in spring 2018. Health departments need to reinforce tick prevention measures, including use of EPA-registered insect repellents, and target messaging to persons participating in outdoor activities with high risk for tick exposure. McDonald et al. *MMWR* / March 29, 2019 / 68(12);289–290. Entire article free of charge: http://www.cdc.gov/mmwr/volumes/68/wr/mm6812a4.htm

From the USDA about the Longhorn tick thus far:





Posttreatment Lyme disease cases in the US by 2020 may be as high as 2,000,000

Estimation of cumulative number of posttreatment Lyme disease cases in the US, 2016 and 2020

Lyme disease (LD) is an infectious multi-system illness caused by the bacterial genus Borrelia and spread by bites of infected ticks. Although most patients are successfully treated by timely antibiotic therapy, it is broadly accepted that a sizeable number of patients experience treatment failure and continue to suffer long-term, debilitating symptoms, including pain, fatigue, cognitive dysfunction and other symptoms. This is known as posttreatment LD (PTLD), for which diagnosis is not standardized and treatment remains controversial. The prevalence and societal burden of PTLD is unknown.

In an effort to help characterize the LD landscape, we estimated the number of PTLD cases in the US in 2016 and 2020 using Monte-Carlo simulation techniques, publicly-available demographic datasets, uncertainty in the inputs and realistic assumptions about incidence and treatment failure rates. Depending on the input assumptions, PTLD prevalence estimates for 2016 ranged from 69,011 persons (95% CI 51,796 to 89,312) to 1,523,869 (CI 1,268,634 to 1,809,416). Prevalence in 2020 is predicted to be higher than 2016, and may be as high as 1,944,189 (CI 1,619,988 to 2,304,147) cases.

The cumulative prevalence of PLTD in the United States is estimated to be high and continues to increase. These findings will be of interest to epidemiologists and health economists studying disease burden in the US and elsewhere, and justify funding to study PTLD diagnosis and treatment. DeLong et al. BMC Public Health (2019) 19:352 https://doi.org/10.1186/s12889-019-6681-9. Paper free of charge using doi link.

There is still a risk of Lyme disease in urban parks in Lyme areas

Enhancement of Risk for Lyme Disease by Landscape Connectivity, New York, New York, USA

Most tickborne disease studies in the United States are conducted in low-intensity residential development and for-ested areas, leaving much unknown about urban infection risks. To understand Lyme disease risk in New York, New York, USA, we conducted tick surveys in 24 parks through-out all 5 boroughs and assessed how park connectivity and landscape composition contribute to Ixodes scapularis tick nymphal densities and Borrelia burgdorferi infection. We used circuit theory models to determine how parks differentially maintain landscape connectivity for white-tailed deer, the reproductive host for I. scapularis ticks.

We found forested parks with vegetated buffers and increased connectivity had higher nymph densities, and the degree of park connectivity strongly determined B. burgdorferi nymphal infection prevalence. Our study challenges the perspective that tickborne disease risk is restricted to suburban and natural settings and emphasizes the need to understand how green space design affects vector and host communities in areas of emerging urban tickborne disease. VanAcker et al. Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 25, No. 6, doi.org/10.3201/eid2506.18174)

Standing with Experts from SUNY Upstate & ESF, Rep. Katko Announces Legislation to Combat Lyme Disease, Tick-Borne Illnesses

The *Tick Identification Pilot Program Act of 2019* works to educate the general public on general tick-bite prevention methods, engage the public on tick-borne illnesses to improve public health outcomes, and collect data on tick populations as well as the frequency, seasonality, and geographic locations of tick encounters and/or bites. Specifically, this legislation would establish a pilot grant program under the CDC allowing states to apply for grants to establish tick identification programs. The tick identification programs would allow individuals to send pictures of ticks they encounter to a vector-borne biologist who would identify the tick and respond to the individual with:

- The species and life stage of the tick;
- An estimate of the risk that the tick is carrying a disease;
- A recommendation of the best practices for the individual who encountered the tick (including seeking medical evaluation and submitting the tick for testing);
- Additional education on best methods to avoid ticks and prevent contagion of tick-borne illnesses.

"Year after year, our region is plagued with high rates of tick-borne diseases, like Lyme disease and Powassan — and families and individuals out enjoying nature during the warmer months here in Central New York need to have better access to information," said Rep. Katko. "The bipartisan measure I've introduced will complement much of the ongoing research here in our community at SUNY Upstate and ESF. The bill establishes programming to ensure individuals who encounter ticks have rapid access to information on the tick, identify the likeliness that the tick was carrying a disease, and provide a recommendation on next steps towards seeking care." Rest of article at: http://www.urbancny.com/standing-with-experts-from-suny-upstate-esf-rep-katko-announces-legislation-to-combat-lyme-disease-tick-borne-illnesses/

Lyme Disease: An Unusual Cause of a Mitral Valve Endocarditis

Lyme disease is a tick-borne infection caused by Borrelia burgdorferi. Cardiac manifestations are rare, occurring in 0.5% to 10% of patients. Lyme carditis and atrioventricular block are established manifestations of Lyme disease. Endocarditis caused by Borrelia has been reported only twice previously, and in both cases, these were species (Borrelia afzelii and Borrelia bissettii) not present in North America. We report a unique case of mitral valve endocarditis caused by B burgdorferi. Fatima et al. 2018 Mayo Foundation for Medical Education and Research. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license. Mayo Clin Proc Inn Qual Out 2018;2(4):398-401.

Citizen science informs human-tick exposure in the Northeastern United States

…A total of 3740 submissions, comprising 4261 ticks, were submitted from the Northeastern US and were reported to be parasitizing humans. Of the three species submitted, blacklegged ticks were the most prevalent followed by American dog ticks and lone star ticks. Submissions peaked in May with the majority of exposure occurring during every-day activities.

The most common pathogen in blacklegged ticks was B. burgdorferi s.l. followed by hard-tick relapsing fever Borrelia.

…Citizen science provides a method for broad pathogen and tick surveillance, which is highly related to human disease, allowing for inferences to be made about the epidemiology of tick-borne disease. Porter et al. ij-healthgeographics.biomedcentral.com/track/pdf/10.1186/s12942-019-0173-0. Entire paper free at link.

Oklahoma County: All year around tick collections found 4 species established including the black-legged tick where it was thought only the dog tick was present

Tick species establishment in Oklahoma County, Oklahoma, U.S.A., identified by seasonal sampling in residential and non-residential sites.

In recent years, human tick-borne disease occurrence has risen in Oklahoma, U.S.A., but year-round data on tick presence in frequently used recreational areas is not widely available. In this study, ticks were collected monthly for one year at residential and non-residential sites in a suburban area of Oklahoma County, OK, U.S.A.

At each trapping site, dry ice traps were used in both woodland and grassland areas and fabric tick drags were used in grassland areas. Four species were collected from each park: Amblyomma americanum, Amblyomma maculatum, Dermacentor variabilis, and Ixodes scapularis. Prior to this study, A. americanum was the only species with an established population in Oklahoma County. Consistent with this, A. americanum was collected in all months of the year and accounted for over 90% of ticks collected at each site. Based on our tick survey, we report that A. maculatum, D. variabilis, and I. scapularis, which were each collected in numbers greater than six within a single sampling occasion, are now each confirmed as established populations in Oklahoma County.

Most tularemia in the US vectored by American dog ticks

Ticks and Tularemia: Do we know what we don't know?

Francisella tularensis, the causative agent of the zoonotic disease tularemia, is characterized by high morbidity and mortality rates in over 190 different mammalian species, including humans. Based on its low infectious dose, multiple routes of infection, and ability to induce rapid and lethal disease, *F. tularensis* has been recognized as a severe public health threat—being designated as a NIH Category A Priority Pathogen and a CDC Tier 1 Select Agent. Despite concerns over its use as a bioweapon, most U.S. tularemia cases are tick-mediated and ticks are believed to be the major environmental reservoir for *F. tularensis* in the U.S. The American dog tick (*Dermacentor variabilis*) has been reported to be the primary tick vector for *F. tularensis*, but the lone star tick (*Amblyomma americanum*) and other tick species also have been shown to harbor *F. tularensis*. This review highlights what is known, not known, and is debated, about the roles of different tick species as environmental reservoirs and transmission vectors for a variety of *F. tularensis* genotypes/strains. Zellner and Huntley. Front Cell Infect Microbiol. 2019; 9: 146. doi: 10.3389/fcimb.2019.00146.

Parasite prevalence maps

From petsandparasites.org. Are there parasites in your state or county? Check the Parasite Prevalence Map below to find out!

www.petsandparasites.org/parasite-prevalence-maps#2019/all/lyme-disease/dog/united-states/. Click on the state you want.

International & General Section

Lyme disease guidelines from the United Kingdom, a little more 'liberal' than ours

Lyme disease: summary of NICE guidance

Major points:

- Lyme disease can occur anywhere in the UK
- Erythema migrans is diagnostic of Lyme disease. Use a combination of clinical presentation and laboratory testing to guide diagnosis and treatment in people without erythema migrans
- Serological testing is a two tier approach: a sensitive initial test is performed first (ELISA), followed by a more specific confirmatory test (immunoblot) in case of a positive or equivocal initial result
- Symptoms of Lyme disease may take months or years to resolve even after treatment for several reasons, including alternative diagnoses, reinfection, treatment failure, immune reaction, and organ damage caused by Lyme disease

- Consider a second course of antibiotics for people with ongoing symptoms as treatment may have failed

What's new in this guidance

- Tests used to support diagnosis should be carried out at UK accreditation service (UKAS) accredited laboratories that use validated tests and participate in a formal external quality assurance programme
- Doses and durations of antibiotics at the higher ranges …

BMJ 2018; 361: doi.org/10.1136/bmj.k1261. Entire paper free of charge: www.bmj.com/content/361/bmj.k1261

Review: Metamorphoses of Lyme disease spirochetes: phenomenon of Borrelia persisters

The survival of spirochetes from the Borrelia burgdorferi (sensu lato) complex in a hostile environment is achieved by the regulation of differential gene expression in response to changes in temperature, salts, nutrient content, acidity fluctuation, multiple host or vector dependent factors, and leads to the formation of dormant subpopulations of cells. From the other side, alterations in the level of gene expression in response to antibiotic pressure leads to the establishment of a persisters subpopulation. Both subpopulations represent the cells in different physiological states. "Dormancy" and "persistence" do share some similarities, e.g. both represent cells with low metabolic activity that can exist for extended periods without replication, both constitute populations with different gene expression profiles and both differ significantly from replicating forms of spirochetes. Persisters are elusive, present in low numbers, morphologically heterogeneous, multi-drug-tolerant cells that can change with the environment. The definition of "persisters" substituted the originally-used term "survivors", referring to the small bacterial population of Staphylococcus that survived killing by penicillin.

The phenomenon of persisters is present in almost all bacterial species; however, the reasons why Borrelia persisters form are poorly understood. Persisters can adopt varying sizes and shapes, changing from well-known forms to altered morphologies. They are capable of forming round bodies, L-form bacteria, microcolonies or biofilms-like aggregates, which remarkably change the response of Borrelia to hostile environments. Persisters remain viable despite aggressive antibiotic challenge and are able to reversibly convert into motile forms in a favorable growth environment. Persisters are present in significant numbers in biofilms, which has led to the explanation of biofilm tolerance to antibiotics. Considering that bioflms are associated with numerous chronic diseases through their resilient presence in the human body, it is not surprising that interest in persisting cells has consequently accelerated. Certain diseases caused by pathogenic bacteria (e.g. tuberculosis, syphilis or leprosy) are commonly chronic in nature and often recur despite antibiotic treatment. Three decades of basic and clinical research have not yet provided a definite answer to the question: is there a connection between persisting spirochetes and recurrence of Lyme disease in patients? Rudenko et al. Parasites Vectors (2019) 12:237 https://doi.org/10.1186/s13071-019-3495-7.

We think we have problems: Australia has a tick that can cause anaphylaxis upon removal and used to cause death of people from paralysis

Tick killing *in situ* before removal to prevent allergic and anaphylactic reactions in humans: a cross-sectional study

Tick anaphylaxis is a potentially fatal outcome of improper tick removal and management. This study investigated whether killing ticks in-situ with ether-containing sprays or permethrin cream, before careful removal by the mouthparts could reduce this risk.

This was a prospective study at Mona Vale Hospital Emergency Department (ED) in Sydney, New South Wales, over a 6-month period during the peak tick season of 2016. Tick removal methods, allergic/anaphylactic reactions were recorded for patients presenting with ticks *in situ* or having already removed the ticks themselves. Primary endpoint was allergic/anaphylactic reaction after tick killing/removal.

One hundred twenty-one patients met study inclusion criteria. Sixty-one patients (28 known tick-hypersensitive) had ticks killed with Wart-Off Freeze or Lyclear Scabies Cream (5% w/w permethrin) before removal with fine-tipped forceps or Tick Twister. Three patients (2 known tick-hypersensitive) had allergic reactions (5%), none anaphylactic. The 2 known hypersensitive patients suffered reactions during the killing process and the third patient had a particularly embedded tick meaning it could not be removed solely by mouthparts. Fifty patients presented to the ED posttick removal by various methods, none using either fine-tipped forceps or Tick Twister, of which 43 (86%) experienced allergic reactions – 2 anaphylactic. Five patients suffered allergic reactions before presentation despite no attempt at kill or removal, but ticks had likely been disturbed by some other method. Five patients had live ticks removed in ED – 3 refused killing and had no reaction despite 1 having known hypersensitivity; 2 had ticks on eyelids contraindicating killing, 1 with known hypersensitivity but both had allergic reactions post removal.

Results support killing ticks in-situ before careful removal by mouthparts to reduce allergic/anaphylactic reactions although further research is still required.

Taylor at al. Asia Pac Allergy. 2019 Apr;9(2):e15. English.
Published online Apr 18, 2019. Entire paper free of charge at doi.org/10.5415/apallergy.2019.9.e15.

An icky report: tick-borne Ehrlichia in leeches (other pathogens, too), vector-host transmission and other forms of transmission still needs investigating

Ehrlichia species in pond-farmed leeches (*Hirudinaria* sp.) in Hubei Province, China

Leeches are frequently used in traditional Chinese medicine. However, they are potentially hazardous to human and animal health by transmitting several pathogens. Studies of diseases transmitted by leeches are scarce. The purpose of this study was to analyze the pathogens carried in pond-farmed medicinal leech in China. Leeches were collected from 6 farms in Hubei Province in central China.

DNA was extracted from the internal organ of leeches to analyze the origin of blood meal. Leech genera were confirmed through amplification of 18S rRNA and mitochondrial gene cytochrome oxidase I (*COI*) gene by PCR and host animal species were identified through amplification of

mitochondrial cytochrome *b* gene. Species of *Ehrlichia* in the leech specimens were screened with PCR using specific primers. PCR amplification and DNA sequencing showed that 620 leeches were *Hirudinaria* sp. *Ehrlichia* DNA was detected in 39 specimens from 2 farms. We obtained a total of 65 sequences of the *cytB* gene from 620 leech internal organ samples including sequences of human (n = 5), rat (n = 1), domestic pig (n = 10), duck (n = 23), goose (n = 12) and buffalo (n = 14).

Phylogenetic analysis of the *rrs* and *groEL*gene sequences showed that *Ehrlichia* detected in the study were closely related to *Ehrlichia*sp. in ticks from Korea and Japan. To the best of our knowledge, this is the first report on *Ehrlichia* DNA being detected from leeches. Our findings provided new data on *Ehrlichia* spp. and farmed leech species in China. Zhou et al. doi.org/10.1371/journal.pone.0215082.

Highly technical article on Lyme, other borreliae, and vaccines for those with the scientific background

Antigen Engineering Approaches for Lyme Disease Vaccines

Increasing rates of Lyme disease necessitate preventive measures such as immunization to mitigate the risk of contracting the disease. At present, there is no human Lyme disease vaccine available on the market. Since the withdrawal of the first and only licensed Lyme disease vaccine based on lipidated recombinant OspA, vaccine and antigen research has aimed to overcome its risks and shortcomings. Replacement of the putative cross-reactive T-cell epitope in OspA via mutation or chimerism addresses the potential risk of autoimmunity. Multivalent approaches in Lyme disease vaccines have been pursued to address sequence heterogeneity of Lyme borreliae antigens and to induce a repertoire of functional antibodies necessary for efficient heterologous protection.

This review summarizes recent antigen engineering strategies that have paved the way for the development of next generation vaccines against Lyme disease, some of which have reached clinical testing. Bioconjugation methods that incorporate antigens to self-assembling nanoparticles for immune response potentiation are also discussed. Federizon et al. Bioconjugate Chem. 2019. doi: 10.1021/acs.bioconjchem.9b00167.

5% of questing Irish black-legged ticks found to have Borrelia miyamotoi

Metagenomic 16S rRNA gene sequencing survey of Borrelia species in Irish samples of Ixodes ricinus ticks

The spirochetal bacterium Borrelia miyamotoi is a human pathogen and has been identified in many countries throughout the world. This study reports for the first time the presence of Borrelia miyamotoi in Ireland, and confirms prior work with the detection of B. garinii and B. valaisiana infected ticks. Questing Ixodes ricinus nymph samples were taken at six localities within Ireland. DNA extraction followed by Sanger sequencing was used to identify the species and strains present in each tick.

The overall rate of borrelial infection in the Irish tick population was 5%, with a range from 2% to 12% depending on the locations of tick collection. The most prevalent species detected was B. garinii (70%) followed by B. valaisiana (20%) and B. miyamotoi (10%). Knowledge of Borrelia species prevalence is important and will guide appropriate selection of antigens for serology test kit manufacture, help define the risk of infection, and allow medical authorities to formulate appropriate

strategies and guidelines for diagnosis and treatment of Borrelia diseases. Lambert et al. PLoS ONE 14(4): e0209881. https://doi.org/10.1371/journal. pone.0209881. Entire paper free of charge with doi link.

Ticks, spiders, and more: review of Bartonella as a human and animal pathogen

Human Bartonellosis: An Underappreciated Public Health Problem?

Bartonella spp. bacteria can be found around the globe and are the causative agents of multiple human diseases. The most well-known infection is called cat-scratch disease, which causes mild lymphadenopathy and fever. As our knowledge of these bacteria grows, new presentations of the disease have been recognized, with serious manifestations. Not only has more severe disease been associated with these bacteria but also *Bartonella* species have been discovered in a wide range of mammals, and the pathogens' DNA can be found in multiple vectors.

This review will focus on some common mammalian reservoirs as well as the suspected vectors in relation to the disease transmission and prevalence. Understanding the complex interactions between these bacteria, their vectors, and their reservoirs, as well as the breadth of infection by *Bartonella*around the world will help to assess the impact of Bartonellosis on public health. Cheslock & Embers. *Trop. Med. Infect. Dis.* 2019, 4 (2), 69; https://doi.org/10.3390/tropicalmed4020069. Entire article free at doi link.

Review of Tick Viruses

The Ecology of New Constituents of the Tick Virome and Their Relevance to Public Health

Ticks are vectors of several pathogens that can be transmitted to humans and their geographic ranges are expanding. The exposure of ticks to new hosts in a rapidly changing environment is likely to further increase the prevalence and diversity of tick-borne diseases. Although ticks are known to transmit bacteria and viruses, most studies of tick-borne disease have focused upon Lyme disease, which is caused by infection with Borrelia burgdorferi. Until recently, ticks were considered as the vectors of a few viruses that can infect humans and animals, such as Powassan, Tick-Borne Encephalitis and Crimean–Congo hemorrhagic fever viruses. Interestingly, however, several new studies undertaken to reveal the etiology of unknown human febrile illnesses, or to describe the virome of ticks collected in different countries, have uncovered a plethora of novel viruses in ticks.

Here, we compared the virome compositions of ticks from different countries and our analysis indicates that the global tick virome is dominated by RNA viruses. Comparative phylogenetic analyses of tick viruses from these different countries reveals distinct geographical clustering of the new tick viruses. Some of these new tick RNA viruses (notably severe fever with thrombocytopenia syndrome virus and Heartland virus) were found to be associated with serious human diseases. Their relevance to public health remains unknown. It is plausible that most of these newly identified tick viruses are of endogenous origin or are restricted in their transmission potential, but the efforts to identify new tick viruses should continue. Indeed, future research aimed at defining the origin, the ecology and the spillover potential of this novel viral biodiversity will be critical to understand the relevance to public health. Vanderfrift & Kapoor. Viruses 2019, 11, 529; doi:10.3390/v11060529. Entire article free at link.

First report of tick paralysis in horses

Presumptive tick paralysis in 2 American Miniature horses in the United States

Tick paralysis has not been reported in horses in North America. Clinical Findings: Two American Miniature horses were examined for progressive weakness and recumbency. Numerous ticks (Dermacentor variabilis) were found on both horses. Horse 1 was recumbent (grade 5/5 gait deficit) on presentation, whereas Horse 2 was standing but ataxic (grade 4/5 gait deficit) and tetraparetic. Both horses had decreased tongue and tail muscle tone, and had normal spinal reflexes. Cerebrospinal fluid cytology was normal. Equine herpesvirus-1 testing was negative. Pertinent Interventions: Ticks were removed within 24 hours of presentation. Both horses were treated topically with permethrin. Supportive care included fluid therapy, treatment for corneal ulceration, and frequent repositioning during recumbency.

Within 48 hours of tick removal, both horses were neurologically normal. Clinical Relevance: Ours is the first reported case of presumptive tick paralysis in horses in North America. Although rare, tick paralysis should be considered in horses presented with acute-onset weakness progressing to recumbency. Trumpp et al. J Vet Intern Med. 2019;1–5 DOI: 10.1111/jvim.15540. Open access.

☼☼☼

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

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

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

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

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