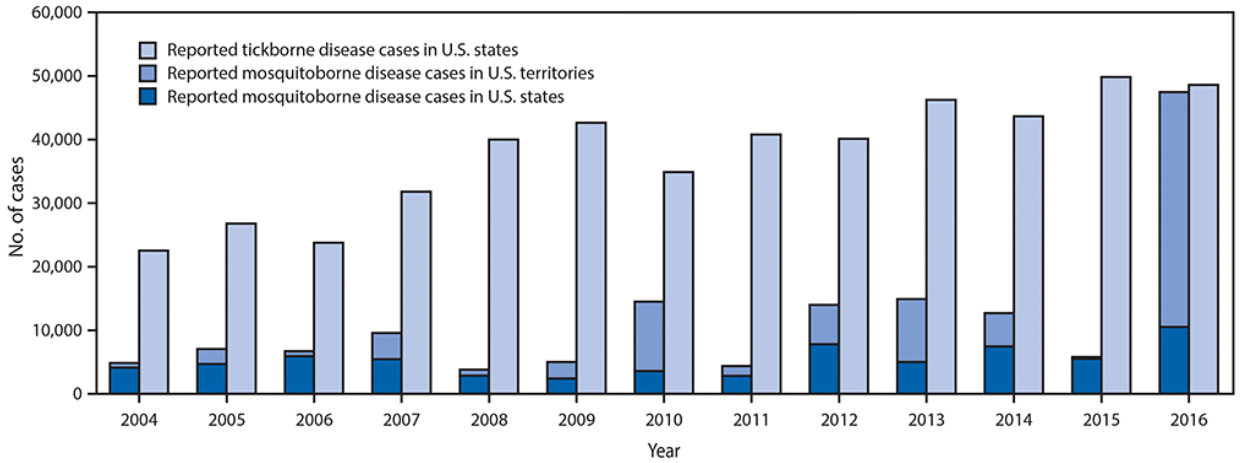
ASTHO Report
In-depth coverage of leading state and territorial public health issues.
June 2020

Case Studies in Tick Surveillance and Tick-borne Disease Prevention

Tick-borne diseases—such as Lyme disease, Rocky Mountain spotted fever, and Powassan encephalitis—rarely capture national attention like the mosquito-borne Zika received in 2016. National surveillance data show that ticks cause more disease than mosquitoes. Tick-borne disease cases almost doubled in the United States between 2004 and 2016.[1]

Figure 1. Reported nationally notifiable mosquito-borne* and tick-borne disease cases—U.S. states and territories, 2004–2016.†



* Mosquito-borne case counts include both locally transmitted and travel-associated cases. Only 305 arbovirus cases were reported from the territories in 2015.
† A total of 89 flea-borne disease cases (plague) were reported during 2004-2018, ranging from two cases in 2010 to 16 cases in 2015. The cases are not depicted on the figure.[2]

The public health response to vector-borne disease threats includes actions by federal, state, and local agencies. In many states, control of mosquitos is the responsibility of local agencies.[3,4] No comparable local infrastructure exists for tick control, although in some states like California, local mosquito control agencies are participating in campaigns to increase public awareness of the risks of tick-borne disease. This lack of local infrastructure places state and territorial public health agencies on the front lines of the ever-increasing problem of tick-borne disease, a response "…. hampered by suboptimal diagnostics, lack of treatment options for emerging viruses, and a paucity of vaccines."[5] States often rely on the Centers for Disease Control and Prevention (CDC) funding to maintain programs to track tick-borne disease.

This ASTHO report includes three case studies capturing how state vector-borne disease control officials have responded to specific issues relating to the public health threats posed by ticks. These case studies serve as guides for responding to similar problems in other states. In addition to this report, ASTHO's evaluation of the legal basis for state mosquito control programs can inform state officials regarding the applicability of these case studies to their states vector control program.[6] Understanding a state

agency's legislative or regulatory vector control mandates provides a foundation for designing a state strategy for controlling ticks.

Case Study #1

New York State's Response to the Emerging Threats of the Asian Longhorned Tick

New York state has taken a leading role in preparing for the potential threat of the Asian longhorned tick. New York State Department of Health's active tick surveillance program informs activities related to the Asian longhorned tick that include research on its distribution and biology, public outreach and education on potential risks, and passive surveillance. The New York State Department of Health partners with other organizations, including the Northeast Regional Center for Excellence in Vector-Borne Diseases, which is funded by CDC.

Case Study #2

Maine's Use of Environmental Public Health Tracking and Geographical Information System Application to Enhance Public Access to Tick-borne Disease Surveillance Data

Maine experiences some of the highest incidence rates of Lyme disease and other tick-borne diseases in the nation. Facing an overwhelming volume of requests for tick-borne disease surveillance data from local agencies, the media, and the public, Maine's Center for Disease Control and Prevention, a division of the Maine Department of Health and Human Services, uses its Environmental Public Health Tracking Network to provide public access to these surveillance data.

Case Study #3

Risk Communication and Public Outreach on Tick-borne Diseases in California

Strategies to control tick-borne disease rely heavily on outreach to inform the public on how to avoid tick bites and the need to act quickly to remove ticks when bites occur. For the California Department of Public Health's Vector-Borne Disease Section, risk communication plays an important role in its tick-borne disease prevention, surveillance, and control activities.

Case Study #1: New York State's Response to the Emerging Threats of the Asian Longhorned Tick

Background

In the United States, controlling emergent infectious or vector-borne diseases, like Ebola in 2014 and Zika in 2015 and 2016, requires a rapid and coordinated response by local, state, and federal public health agencies. However, in the case of the invasive Asian longhorned tick (*Haemaphysalis longicornis*), the appropriate public health response was less clear when it first appeared in the United States in 2017. This tick can transmit disease agents to both people and animals in Asia. In 2018, there was no indication that such transmission had occurred in the U.S.[7] Some New York State health officials were concerned about the possibility of the Asian longhorned tick transmitting locally occurring human pathogens including *Babesia*, *Rickettsia, Borrelia, Ehrlichia, Anaplasma,* Heartland virus, and Powassan virus. In its native range in Asia, this tick is a vector of severe fever with thrombocytopenia syndrome virus. This tick was also a concern to the health of livestock. Adverse impacts on livestock productivity and health can result from either disease agents (such as those causing theileriosis) or blood loss when thousands of ticks feed on a single animal.

The United States Department of Agriculture (USDA) and the CDC have responded to these concerns in the United States by publishing information about this tick's known range. As of March 2020, the tick is found in 12 states. Because the Asian longhorned tick has the potential to spread disease agents, CDC has published guidance about surveillance, identification, and recommendations following a bite.[8] As this tick's range expands, state and local public health agencies should anticipate how to best address the concerns of a worried public. This case study describes how the New York State Department of Health (NYSDOH) has responded to this tick's emergence within New York state boundaries.

Basis for an Aggressive Public Health Response in New York State

Female Asian longhorned ticks are able to lay eggs and reproduce without a male. In 2018, over 100,000 larval ticks were found in a single sampling event in Westchester County, NY.[9,10] Despite the absence of human pathogens in samples of Asian longhorned ticks from New York and other states, in 2018, NYSDOH launched an aggressive surveillance campaign to identify where this tick could be found in the state. In addition, NYSDOH launched a research program to answer basic questions about the biology and lifecycle of this tick, information essential to its management and control. Regardless of the current status of public health threats from the Asian longhorned tick, the public expects NYSDOH to be a credible source of information, with knowledgeable responses to their questions and concerns. This often extends beyond human exposure to include pets and companion animals.

Many New York residents have experience with blacklegged or deer ticks (*Ixodes scapularis*) and are generally aware of the potential for ticks to spread disease agents, such as the bacterium causing Lyme disease. However, this experience has not fully prepared New York residents for potential exposure to the Asian longhorned tick. Walking through an area heavily infested with Asian longhorned ticks can result in 200 or more ticks crawling on the clothes and skin of a single person or pet, and local health departments have experienced panicked calls after such exposures. NYSDOH is working to make sure it can address these concerns with accurate information.

Active Surveillance as the Foundation

NYSDOH supports an active tick surveillance program.[11] Prior to the emergence of the Asian longhorned tick, reporting of the findings from this program focused on the blacklegged tick and the presence of pathogens that cause Lyme disease and Powassan encephalitis.

Approximately 30 species of ticks are found in New York state. Ten species commonly bite people and four of these have the potential to spread disease agents. The active surveillance program has monitored ticks across the state since 2008 using standardized dragging or flagging surveys.[12] This sampling method involves dragging a cloth that is 1 square meter in size across the ground or flagging the cloth across low brush and vegetation. Ticks are counted and collected from the cloth, sorted by species and life stage, and placed in vials for processing and testing for pathogens by NYSDOH Arbovirus Laboratories.

NYSDOH's active tick surveillance routinely monitors 100 to 150 sites twice each year and includes every county in New York. Some locations are sampled annually, while others are sampled on a rotation of every two to five years. Monitoring at different times of the year allows experts to sample ticks at different life stages. The May-September surveillance samples nymphs, while October-December surveillance primarily captures adults. Protocols require each site visit to drag or flag a minimum of 1,000 square meters and collect at least 50 ticks, which may require sampling an area much larger than 1,000 square meters. Typically, the program collects approximately 15,000 ticks each year.

After the emergence of the Asian longhorned tick the program added approximately 25 new surveillance sites and increased the sampling frequency at some sites. In 2018, these sites were monitored twice weekly from July until late November. This expanded surveillance helped document the tick's life cycle and how its population density and life stages changes over time. Over 126,000 Asian longhorned ticks were collected as a result of this expanded surveillance.

Archived tick samples from collections in other states indicated that the tick may have been present in the United States as early as 2010. However, no Asian longhorned ticks were found in archived tick collections from New York. Currently, the Asian longhorned tick in New York appears to be confined to areas in and around New York City, distant from where most livestock are raised. The tick has been found on people, domestic animals (dogs), and wildlife, especially deer.

Within a year of finding the first Asian longhorned tick in New York, approximately 350 Asian longhorned ticks were tested for the presence of more than 10 human and veterinary pathogens, no pathogens were found. This testing was conducted through the collaboration between the NYSDOH, New York State Department of Agriculture and Markets, and Cornell University College of Veterinary Medicine.

Passive Surveillance

Because testing ticks for pathogens has limited use in medical case management, NYSDOH decided to discontinue providing tick identification and testing services to New York state residents.

Tick identification services are available at some local New York health departments (e.g., Orange County), and Cornell Cooperative Extension service has created a tick identification smartphone app, which can be used for passive surveillance.[13] The Animal Health Diagnostic Center at Cornell University also provides tick identification and testing services to veterinarians.

Using Active Surveillance Data to Inform Prevention and Control of the Asian Longhorned Tick

Surveillance data are used to map the Asian longhorned tick's distribution and estimate tick population. These data are the basis for informing residents of their risk of encountering this tick; for understanding this tick's biology and lifecycle; and for developing effective strategies for preventing tick bites and controlling potential disease threats. Surveillance data point to important differences between this tick and other human biting ticks, like the blacklegged tick. Therefore, guidance concerning avoiding blacklegged tick bites while hiking ("stay in the center of trails") and home landscaping ("tick habitat is confined to the edge of lawns") may be inappropriate for the Asian longhorned tick.

Research studies are still needed to collect information concerning this tick's behavior, which can be used to develop effective strategies for controlling its spread and preventing tick bites. For example, as part of its efforts to control blacklegged ticks, the NYSDOH is testing strategies aimed at mice, a blacklegged tick host. Information is lacking on whether mice are important hosts for the Asian longhorned tick. NYSDOH is planning studies to collect information on this and other questions, including:

- What is the seasonal activity of *H. longicornis*?
- What are the tick's stage-specific hosts? Are mice important?
- Can the tick's stage-specific habitat preferences be defined?
- Are these ticks biting people?
- What are these ticks infected with? What can they transmit?
- What is the best way to conduct surveillance for these ticks? Drag sampling? Host trapping?
- How does overwintering, temperature, or humidity impact this tick and its seeking of hosts?
- What methods or strategies are effective for preventing Asian longhorned tick bites and controlling infestations?

Information for States Developing a Response to the Asian Longhorned Tick

Surveillance data provide the foundation for informed responses, and New York is one of the few states that conducts active tick surveillance. Passive surveillance (i.e., tracking information on ticks collected by members of the public for identification purposes) can also provide useful data. Important partners in this effort can include agricultural cooperative extension programs, local health departments, universities, veterinarians, and healthcare providers. For those states in the Northeast, the Northeast Regional Center for Excellence in Vector-Borne Diseases can be a helpful resource.[14] Some nongovernmental organizations, such as the Tick Encounter Resource Center (https://tickencounter.org/about), provide tick identification services nationwide.[15] Vermont has created a passive surveillance system that relies on crowdsourcing to report tick findings.[16]

ASTHO provides guidance to states on creating vector control plans and communicating about vector-borne disease risks.[17,18] Although these documents were created to address mosquitoes, the information on public engagement and planning is relevant to strategies for tick control. State health departments may want to consider modifying existing vector control plans or creating a new vector control plan that includes steps for responding to the finding of the Asian longhorned tick in your state. Stakeholders from both human and animal health sectors, as well as federal partners like CDC and USDA, can assist in this process. USDA and CDC are actively developing and updating guidance concerning the emergence of the Asian longhorned tick and its potential threat to public health.

Case Study #2: Maine's Use of Environmental Public Health Tracking and Geographical Information Systems Applications to Enhance Public Access to Tick-borne Disease Surveillance Data

Background

CDC's National Environmental Public Health Tracking Network brings together health and environmental data from national, state, and city sources. CDC provides funds to 25 states and one city to develop tracking programs where grantees submit data measures on environments and hazards, health effects, and population health to the national tracking network.[19,20,21,22] Programs develop individual data portals to present these nationally consistent measures as well as unique data relevant to their communities. This case study features the Maine Tracking Network and geographical information systems (GIS) applications for displaying and disseminating data on three tick-borne diseases: Lyme disease, anaplasmosis, and babesiosis.

CDC first highlighted the Maine Tracking Network's Lyme disease data in 2014 as a Tracking Network success story.[23] The web-based data portal expanded in 2018 to include data on other tick-borne diseases, including data in near real-time and tracking weekly tick-related emergency department visits.

Surveillance of Ticks and Tick-Borne Diseases in the Maine

The number of new cases of tick-borne disease in Maine has increased dramatically over the past two decades. Maine's incidence of Lyme disease, anaplasmosis, and babesiosis are some of the highest in the United States. In Maine, anaplasmosis, babesiosis, and Lyme disease are all reportable diseases. Maine Centers for Disease Control and Prevention (Maine CDC), a division of the Maine Department of Health and Human Services, conducts case management follow-up in response to all case reports of these tick-borne diseases. For a report of anaplasmosis and babesiosis, Maine CDC contacts the individual's healthcare providers to verify symptoms and will conduct patient follow-up as needed. In

response to reports of Lyme disease, Maine CDC sends the patient's healthcare provider a case report form to obtain data on symptoms and onset date.

Cases are defined based on symptoms and laboratory information per the Council of State and Territorial Epidemiologists case definitions, and are classified as either confirmed, probable, suspect, or not a case. Case definitions are subject to change over time.[24] Maine CDC enters case data into the National Electronic Disease Surveillance System Base System and creates a view that the tracking network can access. The Maine Tracking Network then processes and displays the data.

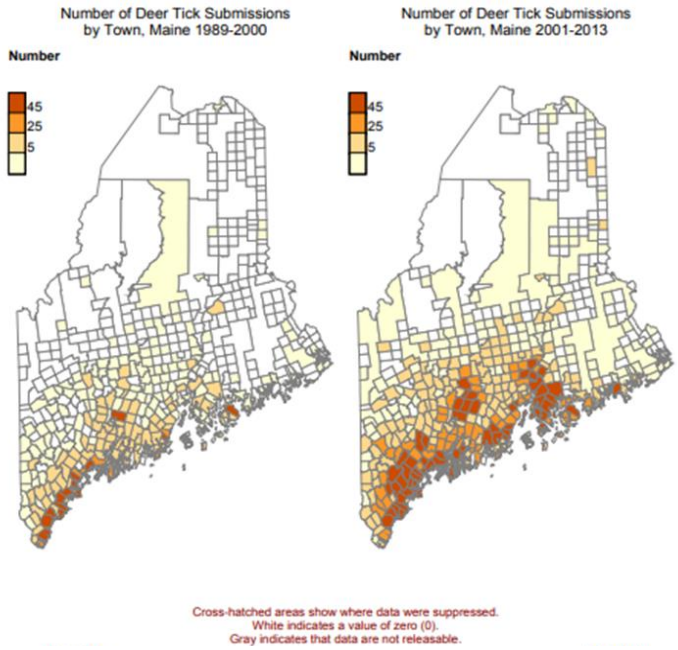


Figure 2. Number of blacklegged tick submissions by town, Maine, 1989-2013.

In addition to case reports of disease, Maine CDC conducts syndromic surveillance by tracking the symptoms of people who visit emergency departments because of tick bites. Data from 2017 show that, at the peak of a busy season, suspected tick exposures can prompt more than 100 emergency department visits per day statewide.[25] In general, rates of tick-related emergency department visits reliably show the seasonal pattern of tick-borne diseases in Maine.

In 1989, Maine Medical Research Institute's Vector-borne Disease Laboratory launched a program to support passive tick surveillance. Through the program, people bitten by a tick could remove the tick and send it to the lab for identification. The lab also collected information on the date and location of the bite and the age and gender of the person bitten. Information on the submitted ticks appears on the Maine Tracking Network and shows how the blacklegged or deer tick (*Ixodes scapularis)* range has expanded within Maine. In 2014, the University of Maine Cooperative Extension Service took over this tick identification service, and Maine CDC is also planning to update the maps to include data from its submission program.

Maine's Collaborative Approach to Tick-Borne Disease

Maine CDC uses a collaborative approach to tracking and sharing state tick-borne disease data. It collects tick-borne disease data through support from CDC's Epidemiology and Laboratory Capacity Cooperative Agreement. Epidemiologists funded through this Cooperative Agreement collect, clean, and analyze the data, which can then be made available to other programs or public health and community partners.

In 2010, Maine had the opportunity to work with a new program funded by CDC's Climate-Ready States and Cities Initiative. Through this initiative, CDC promotes the use of the five-step Building Resilience Against Climate Effects (BRACE) framework to help communities identify likely climate impacts, potential health effects associated with these impacts, and their most at-risk populations and locations.[26] The BRACE framework then helped states develop and implement health adaptation plans and address gaps in critical public health functions and services. Maine's climate-related health impacts of greatest concern include tick-borne disease. The range and population densities of the blacklegged tick, which can transmit the pathogens that cause anaplasmosis, babesiosis, and Lyme disease, are expected to expand under conditions of increasing temperature and humidity.

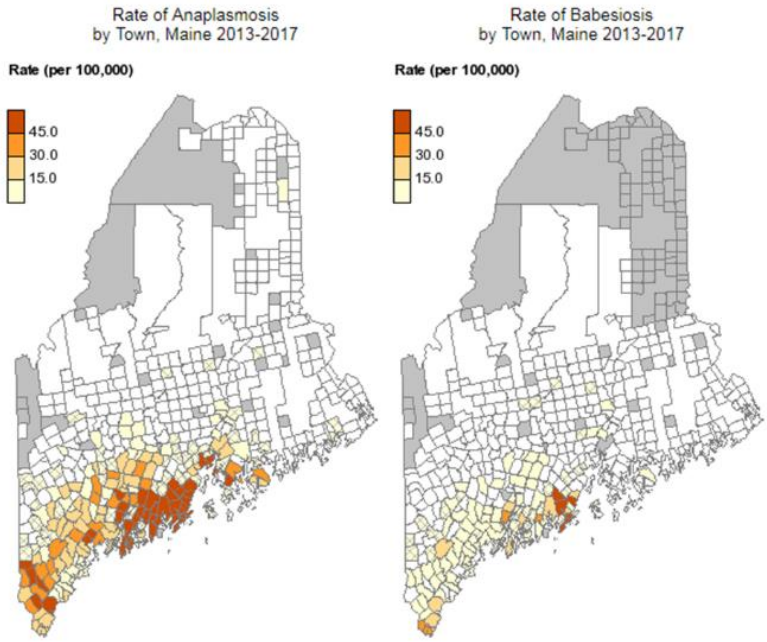


Figure 3. Rate of anaplasmosis and babesiosis by town, Maine, 2013-2017.

In 2009, Maine CDC launched the Maine Tracking Network data portal with just a few topics. In 2012, Maine CDC added data on Lyme disease to the data portal as a result of frequent tick-borne disease data requests from the general public, communities, and the media, and to raise awareness of the threat of tick-borne disease. Maine has since expanded the portal's tables and maps to include town-level data for anaplasmosis, babesiosis, and Lyme disease, as well as near real-time data for all three tick-borne diseases. Users can also track trends and view data by age group and sex. The interactive interface allows users to generate thousands of combinations of tables, charts, and map displays, and output to PDF or Excel formats if desired.

In 2018, the data portal's tick-borne disease site received over 13,000-page views and 3,000 user sessions, greatly reducing Maine CDC staff's need to manually respond to data requests.[27] Maine CDC hopes that the portal has allowed the public to see the scope of the problem and helped Maine state and local officials make informed policy decisions.

The Power of Geographic Information System Mapping and Tracking Network Reports

Geographical Information System tools enhance the use of Maine Tracking Network data. Maps allow side-by-side visual comparison. Figure 3, which compares rates of anaplasmosis and babesiosis, clearly shows the lower babesiosis burden, particularly in the Midcoastal region. These maps also reveal that

the geographic spread of anaplasmosis and babesiosis is following the trend that Lyme disease set a decade ago.

In Figure 4, Lyme disease rates are much higher than for anaplasmosis or babesiosis. (Note that these real time maps were generated in the spring when disease transmission is low compared to summer and fall rates.)

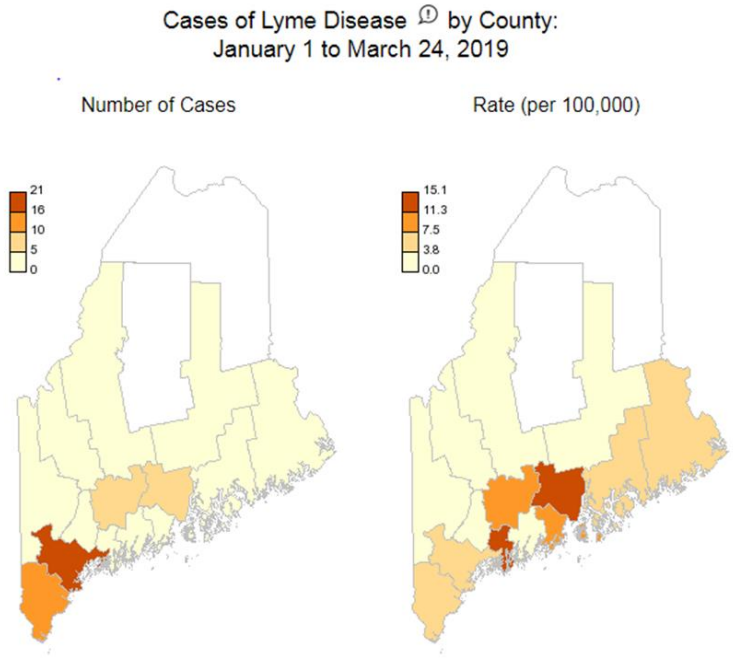


Figure 4. Cases of Lyme disease by Maine county. Some towns have had incidence rates of as high as 3,000 cases per 100,000.

Challenges

Maine's high incidence rates of tick-borne disease result in hundreds of case reports each year, representing a significant burden on those responsible for managing the data. For example, in 2018, Maine CDC followed up on nearly 4,000 reports of vector-borne diseases, of which nearly 2,000 met a confirmed or probable case status.

The Maine CDC found that the initial cleaning and formatting data for the Maine Tracking Network was time intensive. As a result, Maine CDC developed coding that could greatly simplify the process for subsequent years. However, applying Maine CDC's privacy policy and determining which data should be excluded remain manual processes that are complicated and time consuming.

Despite the remaining challenges, creating an innovative system for reporting tick-borne diseases and tick-related emergency department visits presented many challenges, but Maine CDC was successful in developing a near-real time reporting system. Building an entirely new data display took over a year but resulted in users being able to access the data they needed without assistance from Maine CDC staff.

The challenges in handling the disease reports also affect the near real-time dashboard. The resulting delay means that case counts and rates may be artificially low until Maine CDC staff complete case classification. This delay in reporting cases complicates data interpretation. However, Maine CDC believes that maintaining near real-time reporting relieves staff time that would be devoted to filling data requests and allows the public and state and local officials in Maine to make informed policy decisions.

Applications Informing Tick-bite Prevention and Tick Control Efforts

Strategies for preventing tick-borne disease include raising public awareness of the risk of tick-borne diseases, educating the public about ways to reduce exposures to ticks, and promoting the need to check for ticks and detect tick bites early. Public outreach campaigns that promote these strategies include links to the tracking portal's web page on tick-borne disease, which received over 13,000 visits in 2018.[28] Local governments are exploring other tick control strategies, such as culling deer populations. Maine's Department of Inland Fisheries and Wildlife used the Maine Tracking Network portal to access the data needed to develop the department's big game management 10-year strategy, particularly for recommendations regarding white-tailed deer.[29]

ASTHO supports vector control efforts through several capacity building opportunities. ASTHO's Environmental Public Health Tracking Fellowship Program, developed in partnership with CDC and with support from Esri, offers health agencies that are not funded by CDC's Tracking Program with the opportunity to conduct pilot projects on environmental health issues of importance to their communities, receive mentorship from current CDC grantees, and become familiar with CDC standards and resources for environmental public health tracking.[30] Through the program, ASTHO also offers GIS training workshops, with a focus on vector-borne disease applications, for states that require assistance. Since 2009, this peer-to-peer fellowship program has supported 43 projects across 26 state, local, and territorial health departments, of which six became CDC grantee states.

Helping Maine Communities to Be Better Informed About Tick-Borne Disease

The tick-borne disease content area is the most frequently visited domain on the Maine Tracking Network since the site was launched in 2012, confirming the value of this information. Students use the data to help complete Lyme disease-related projects, and the press use the data when writing articles.

Currently, seven states (Connecticut, Iowa, Maine, New Hampshire, Pennsylvania, Utah, and Wisconsin) use the CDC National Tracking Network to manage and disseminate information on Lyme disease. Opportunities exist for other states to use the Maine Tracking Network's approach to reporting on Lyme disease and other tick-borne diseases.

Case Study #3: Risk Communication and Public Outreach in California

Background

State and territorial health officials rely heavily on risk communication activities to inform the public on how to prepare for and react to tick-borne diseases. This case study describes the strategies that the California Department of Public Health (CDPH) uses to improve the public's ability to prevent tick-borne diseases.[31] CDPH's Vector-Borne Disease Section (VBDS) is charged with protecting Californians' health and well-being from zoonotic diseases, including ticks.[32]

Key Messages

VBDS conducts prevention, surveillance, and control activities for vector-borne diseases, and risk communication plays a role in each of these activities. VBDS' key messages related to preventing tick-borne disease fall under three categories:

1. **Prevent tick bites**. VBDS has created specific messages for children and workers who are exposed to ticks.
2. **Check for tick bites**. VBDS urges individuals to check themselves, family members, and pets for ticks and bites.
3. **Remove attached ticks.** VBDS' messaging urges residents to remove ticks right away, following this guidance for proper technique.[33]

In addition, VBDS promotes awareness of where risk of tick exposure is highest, which ticks carry disease agents, and how to identify them.

Disseminating Key Messages

VBDS' strategies for effective risk communication include making information available to the public on the CDPH website and via social media, and by providing brochures and other materials for distribution at events, local health departments, and recreational areas. In addition, CDPH provides ongoing guidance and training on tick-borne disease risk reduction to local vector control and public health agencies.

Information available on VBDS' website includes:

- Public access to surveillance data, including interactive mapping applications.
- Guidance for healthcare providers.
- General information on ticks and tick-borne disease.
- Disease-specific factsheets.
- Multimedia toolkits that target:
    - Schools and school-aged children
    - Workplaces where exposure to ticks can occur
- Tick-borne-disease-related reports and other resources.

Social media campaigns include posts on Facebook, Twitter, YouTube, and Instagram.

Surveillance and Guidance for Healthcare Providers

Surveillance data on tick-borne diseases provides the scientific basis for VBDS' informed risk communication and public education and outreach efforts. As part of a statewide vector-borne disease surveillance program, VBDS collects information on reported human cases of tick-borne diseases. CDPH and its partner agencies also collect and test ticks for tick-borne disease pathogens. Public access to data on Lyme disease is facilitated through GIS applications available on CDPH's website.[34,35] [Note: local vector control agencies may have additional tick surveillance data for some locations which do not

appear on the CDPH website]. In California, Western blacklegged ticks (*Ixodes pacificus*) are vectors for *Borrelia burgdorferi,* which causes Lyme disease, GIS layers allow mapping data on the following:[36]

- **Western Blacklegged Tick Collections and Testing Results**: This layer provides county-level summaries of Western blacklegged tick collections and *Borrelia burgdorferi* testing results from 1985 to 2013. Clicking on the information icon allows individuals to view the details for that county, which include results for the larval, nymphal, and adult tick stages. (Note that nymphal ticks may pose a higher Lyme disease infection risk to humans than adult ticks.)[37]

- **Collection Locations, 1985-2013**: This layer shows where Western blacklegged ticks have been collected throughout the state.

- **Lyme Disease Incidence, 2002-2011**: This layer presents the number of confirmed human Lyme disease cases per 100,000 persons each year by county. Clicking on a county allows the reader to view the incidence for that county and a graph of the actual number of confirmed human Lyme disease cases by county of residence between 2002 and 2011.

CDPH creates specific information and targeted guidance for healthcare providers as well. CDPH hopes that these materials not only enlist the healthcare community in disseminating accurate information to the public, but also help build a partnership with the healthcare community upon whom the CDPH depends upon for accurate and timely reporting of tick-borne diseases. Guidance for healthcare providers includes:

- How to safely remove ticks.
- In-depth information on the epidemiology and prevention of tick-borne disease.
- Guidance for testing ticks for human pathogens.

Disease-Specific Fact Sheets

CDPH developed fact sheets specific to seven human infectious diseases caused by ticks in California: anaplasmosis, babesiosis, ehrlichiosis, Lyme disease, spotted fever group rickettsia and Rocky Mountain spotted fever, tick-borne relapsing fever, and tularemia.[38] Additionally, there is a fact sheet for tick paralysis, a condition in which toxins in tick saliva may cause paralysis in humans and animals. This condition resolves after the tick is removed. Each fact sheet describes the causative agents, vectors, symptoms, diagnosis, and treatment of the disease along with prevention guidance, a link to information on the CDC website, and the California guidance manual for healthcare providers.

Toolkits

VBDS created and packaged materials into toolkits specifically targeted for audiences at schools and workplaces. For schools, the "Don't Let the Ticks Bite!" campaign materials include a PowerPoint presentation, classroom posters, brochures, bookmarks, a curriculum guide, testing/assessment materials, coloring pages, and word search puzzles.[39] The occupational toolkit includes three videos, an information sheet on ticks for outdoor workers, brochures, a poster, and tick ID cards, all available electronically. Hard copies of written materials are available as well, in both English and Spanish. VBDS

also created an insect repellent toolkit, Don't Give Bugs a Biting Chance, which is applicable to both tick and mosquito bite prevention.[40]

Reports and Other Resources

VBDS maintains lists of publications and VBDS annual reports.[41,42] Each annual report contains a chapter on tick surveillance activities, including surveillance of human cases of tick-borne diseases, disease agents found in ticks, and surveillance of mammals for agents that cause tularemia and tick-borne relapsing fever.

Social Media

VBDS develops and shares tick-related social media messages on Facebook, Twitter, YouTube , and Instagram, targeting thousands of followers statewide. Key messaging emphasizes tick bite prevention, including proper repellent application, and awareness of tick habitat and life stages. VBDS' major social media messaging coincides with adult and nymphal tick risk periods. Each year around Halloween, VBDS begins sharing social media messages for adult tick awareness in California. Its nymphal tick awareness messaging continues through the spring and early summer.

Partners

VBDS has shipped thousands of tick-borne disease communications materials to county health departments, vector control agencies, and national forests. The Tick ID Card (in English and Spanish) continues to be VBDS' most requested tick prevention material.[43, 44]

- **USDA Forest Service**. In 1992, VBDS entered into a Challenge Cost-Share Agreement with the Pacific Southwest Region (Region 5) of USDA's Forest Service (found in Chapter 5, pg. 21).[45] The agreement maintains cooperative surveillance and control of vector-borne diseases within the national forests, and through it VBDS staff provide recommendations on risk reduction for tick-borne diseases, hantavirus, and plague.
- **Public Health Vector Control Technician certification**. In California, every government agency employee who handles, applies, or supervises the use of any pesticide for public health purposes must obtain CDPH certification. VBDS administers the Public Health Vector Control Technician certification examination in May and November each year to certify agency personnel to control vectors for the health and safety of the public. Vector-borne disease prevention is a key element of the training curriculum. The Mosquito and Vector Control Association of California supports this work.[46] Its mission is to provide quality public information, comprehensive mosquito and vector-borne disease surveillance, training to high professional standards, and effective legislative advocacy on behalf of California mosquito and vector control districts to protect the health of people living and visiting California.

This case study provides just a brief description of VBDS' comprehensive strategies to communicate the risks of tick-borne disease to the public. For more information, see VBDS' website.

In Summary

As shown in Figure 1, there has been a gradual increase in national rates of tick-borne disease since 2004. As ticks expand their ranges to more states, State health departments will need to be prepared for the predicted increase in tick-borne disease. As these case studies highlight, some states are using CDC's Environmental Public Health Tracking Network, GIS mapping, and improved risk communications as tools to prepare and respond to these threats.

ASTHO is grateful for CDC's financial support for this work through CDC Cooperative Agreement OT18-1802, Strengthening Public Health Systems and Services through National Partnerships to Improve and Protect the Nation's Health. ASTHO also thanks the three states who contributed to this report and NAVCO members for their input.

The National Association of Vector-Borne Disease Control Officials

The National Association of Vector-Borne Disease Control Officials (NAVCO) is an ASTHO affiliate and works with ASTHO to hold routine meetings of the NAVCO membership and to collaborate on ASTHO products. Through this partnership, NAVCO members routinely share information and work together on issues related to ticks, mosquitoes, and other disease vectors.

[1] Rosenberg R, Lindsey NP, Fischer M, *et al*. "*Vital Signs*: Trends in Reported Vector-borne Disease Cases – United States and Territories, 2004-2016." *CDC Morbidity and Mortality Weekly Report.* 2018. 67(17);496–501. Available at https://www.cdc.gov/mmwr/volumes/67/wr/mm6717e1.htm?s_cid=mm6717e1_w. Accessed 12-10-2019.
[2] Ibid.
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