

Tick-Borne Diseases

Executive Summary

Tick-borne diseases are a public health concern to humans, livestock, and companion animals. The length of tick season and incidence of tick-borne diseases have increased as Missouri's climate becomes warmer and wetter. An ongoing state-wide tick surveillance program can increase understanding of when and where tick-borne pathogens are more likely to be acquired and efficiently identify any emerging tick species and diseases in the state. This increased understanding can then aid medical practitioners in quicker diagnosis and treatment, improving patient outcomes and decreasing medical costs. A Missouri Tick-Borne Disease Task Force could be created to craft a statewide action plan, draft legislation that empowers patients, and identify research gaps to better understand the transmission of tick-borne diseases as well as strategies to reduce the tick population and mitigate the spread of tick-borne diseases.

Science Highlights

- The length of tick season and incidence of tick-borne diseases have increased as Missouri's climate becomes warmer and wetter.
- Tick and tick-borne disease surveillance programs, proper land management, and education and awareness campaigns for clinicians and the general public can help mitigate the spread of and impacts of tick-borne diseases.
- A One Health approach, such as integrating communication and collaboration between human and animal medical practitioners and researchers, is a valuable tool in addressing tick-borne diseases and their impacts.

Limitations

- Citizen science surveillance programs can be limited by the willingness and capability of broad-scale public participation and barriers to streamlined communication.
- There is evidence that areas with high vacant housing rates have higher incidences of Ehrlichiosis, but more surveillance and research needs to be performed to understand socioeconomic health disparities that may be associated with tick-borne diseases.

Research Background

Tick-Borne Disease Transmission

Tick-borne diseases are transmitted via the bite of an infected tick and can be caused by bacteria, viruses, and parasites. Wildlife such as deer and certain species of mice are common natural hosts for ticks. Ticks can become infected with a disease-causing agent by feeding on an infected

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host, then transmit the disease to people, livestock, or companion animals (Figure 1). In particular, Missourians that spend time outdoors working in deeply wooded areas or enjoying nature, hiking, or hunting are at a higher risk of tick exposure. [Personal protective measures](#) that can help decrease the risk of acquiring a tick-borne disease through tick bites include avoiding wooded or brushy areas, treating clothing with 0.5% permethrin when camping or spending time in wooded areas, and thoroughly checking one's body for ticks once inside after spending time in a potentially tick-infested area.

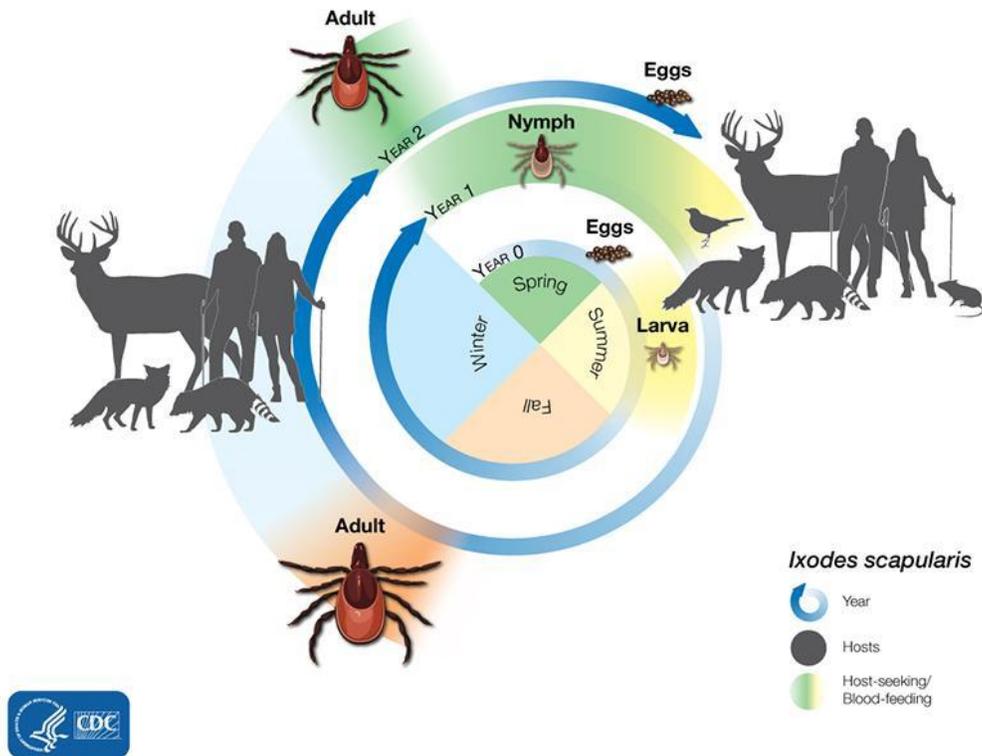


Figure 1. Tick Life Cycle. Source: Centers for Disease Control & Prevention

Geographic & Seasonal Range of Ticks

The [geographic range](#) of tick species that transmit these pathogens depends on temperature, humidity, the distribution of animal hosts they feed on, and land-use change.³ This geographic range has been expanding in recent decades, contributing to an increase in tick-borne diseases affecting the Midwest (Figure 2), primarily due to increased temperatures caused by [climate change](#).¹³ Moreover, the seasonality of acquiring tick-borne diseases is expanding. While tick-borne diseases are most commonly acquired in the summer months, the Missouri tick [season](#) can last at least seven months, beginning in March and going through October.¹ These changes have considerable public health implications for humans, livestock, and companion animals.

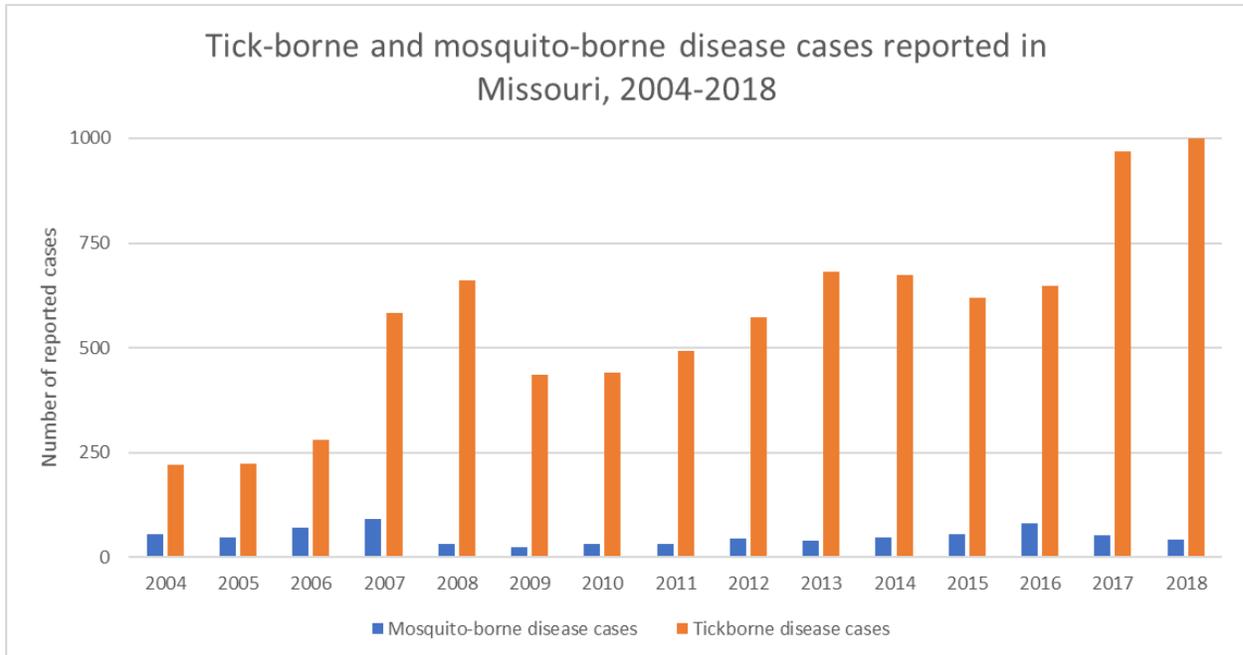


Figure 2. Tick-borne disease cases reported in Missouri. Source: Centers for Disease Control & Prevention

Tick-borne Diseases in Missouri

Tick-borne diseases that can be acquired in Missouri are Ehrlichiosis, Rocky Mountain Spotted Fever (RMSF), Tularemia, Heartland Virus, Bourbon Virus, Lyme Disease, and Southern Tick Associated Rash Illness (STARI). Of these, Ehrlichiosis is the most common, but the others are still of concern and may pose more serious threats as the climatic landscape becomes more conducive for their survival. Ehrlichiosis, caused most commonly by the bacterial species *E. chaffeensis* and *E. ewingii*, is recognized as a nationally notifiable disease by the Centers for Disease Control and Prevention. *Ehrlichia* bacteria are transmitted by the most predominant tick species in Missouri, the Lone Star Tick.

Reported cases of Ehrlichiosis in the United States are four times higher than they were at the start of the twenty-first century, and Ehrlichiosis is an emerging threat in Missouri. Missouri has become an epicenter of Ehrlichiosis as it has the [second highest](#) state-reported incidence rate of *E. chaffeensis* and is tied for the highest incidence rate of *E. ewingii*.⁷ While increases in reported cases are, in part, a result of increased surveillance and awareness of tick-borne diseases, they are also a function of the changing environment.^{7,9}

Symptoms of tick-borne diseases include fever, chills, muscle pain, joint pain, headache, and skin rashes. Without prompt treatment, tick-borne diseases can be fatal. Up to 57% of patients with Ehrlichiosis require hospitalization and 11% develop a life-threatening [complication](#).¹⁰ An antibiotic, Doxycycline, is the standard form of [treatment](#) for Ehrlichiosis.⁹ A significant factor associated with the severity of disease is the delay in starting appropriate antibiotic therapy.¹⁰ A [difficulty](#) with Ehrlichiosis (along with other tick-borne diseases) is that they can resemble other

infectious and noninfectious diseases, making diagnosis difficult. Furthermore, traditional diagnostic tests are difficult to clinically interpret and cannot always provide diagnostic confirmation early in the course of the disease.¹⁰

In addition to transmitting Ehrlichiosis, the Lone Star Tick has also been implicated in the development of [Alpha-gal Syndrome](#), a condition that results in a potentially life-threatening allergy to certain animal-sourced foods and [products](#).^{8,16} Additionally, with tick-borne diseases on the rise, there is the potential for increased risk of donor-derived infections via organ transplants, as described in a recent [case study](#) of five organ recipients, in which one of the organ donors was from Missouri.¹²

Programmatic and Policy Mitigation Strategies

Within the past few years, there have been a number of state-based and federally commissioned task forces, working groups, and surveillance programs to address the growing concern for tick-borne diseases across the US. These are further described below.

Surveillance Program

The [Missouri Department of Conservation](#) and A.T. Still University are utilizing a citizen science approach to develop a comprehensive map of tick species' locations throughout the state, along with the diseases they carry. Citizen science is not only a useful tool in tick surveillance programs, but it also raises public awareness about tick-borne diseases and how to prevent them. Having citizens mail in ticks they find also provides researchers with real-world insights regarding what types of ticks and their associated diseases people are naturally exposed to.

Moreover, understanding the distribution of tick-borne disease agents in a certain geographic locale can be used to sensitize health care providers to those specific health risks, leading to more efficient diagnoses and treatments. The current project was designed as a one year study to provide baseline information of species and disease distributions in Missouri. Subsequent, long-term studies could provide additional information about how tick distribution, abundance, and disease transmission are affected by the changing climate.

An ongoing statewide tick surveillance program would provide information to better understand when and where tick-borne pathogens are more likely to be transmitted. Furthermore, surveillance programs provide opportunities to actively search for previously undiscovered tick species and new pathogens. For example, the Asian Longhorned Tick, which is a major livestock pest, was recently discovered in Missouri. The presence of this tick could be harmful to Missouri's [cattle industry](#).¹¹

Task Force

In 2018, the New York State Senate created a [Task Force](#) on Lyme and Tick-Borne Diseases, which resulted in a report highlighting the immediate need for a statewide action plan, legislation to empower patients, and funding for research to reduce the tick population. A

similar task force could be created in the Missouri legislature, which could also coordinate and share information with the federally-mandated Tick-Borne Disease Working Group. This [Working Group](#) was established to identify priorities and gaps related to tick-borne diseases and provide a report to Congress and the Department of Health and Human Services' Secretary every two years.¹⁵ The most recent report provided a variety of recommendations, including the need for improved diagnostic tests, clinician training and education, and an enhanced surveillance process. The report prioritized the need to fund a One Health interdisciplinary approach and multi-agency effort promoting research and surveillance to identify and validate integrated tick management. The report also recognized the need to fund research aimed at understanding the determinants of those most affected by tick-borne diseases (e.g., age, race, gender, socioeconomic status, and rural vs. urban).⁵

Socioeconomic Considerations

Two recent studies, one focused specifically in Missouri, found a positive correlation between vacant housing and Ehrlichiosis occurrences, providing insight into potential socioeconomic disparities of tick-borne diseases.^{2,14} The exact underlying cause for this is unknown. Proposed theories include the possibility that vacant housing units may represent regions where socioeconomic conditions result in high-risk land-use practices or that lack of maintenance associated with these housing characteristics results in higher vegetation cover that attracts ticks, or their associated animal hosts.

The study also found Ehrlichia infections were more common in areas that have a high density of white-tailed deer and a low human population density (i.e., rural areas). Therefore, potential mitigation programs could include both environmental (e.g., deer population management) and social interventions (e.g., awareness campaigns in rural communities).^{2,14}

One Health Approach

[One Health](#) is an approach that recognizes that the health of people is closely connected to the health of animals and our shared environment, and this approach can be strategically used to address tick-borne diseases. Ehrlichia species affecting [dogs](#) are also increasing across the U.S.⁶ Veterinarians annually test dogs for tick-borne diseases, including Ehrlichia. Since dogs live in close proximity with humans, streamlining communication and sharing of diagnostic information between veterinarians and human physicians is a One Health strategy that could leverage dogs as sentinels for human infections.⁴

Land Use Management

Finally, modifying tick habitats through proper land management can decrease the risk of tick-borne disease transmission by decreasing the number of ticks present. Further studies on management techniques and their influence on reducing either tick numbers or their capability to transmit disease are needed to draw firm conclusions.⁷

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