Rhode Island Lyme Disease Surveillance Summary 2014–2016

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INTRODUCTION

Cases of Lyme disease are concentrated in the Northeast and Midwest of the United States, following the distribution of the *Ixodes scapularis* ticks that transmit the disease. Early symptoms of Lyme disease include fever, chills, headache, fatigue, and muscle aches. The characteristic erythema migrans (EM) rash, is identified in 70–80% of cases and typically presents 3–30 days following a tick bite.[1] Later signs and symptoms appear days to months after tick bite and include arthritis, facial palsy, heart palpitations, and problems with short term memory. The peak transmission risk season in Rhode Island is from May to September.

In 2015, Rhode Island had the fourth highest rate of confirmed Lyme disease, behind Vermont, Maine, and Pennsylvania.[2] However, surveillance data used to determine these rates can depend on a state's ability to capture and classify cases, which is dependent on personnel and other resources. Since May 2013, funding to enhance Lyme surveillance has enabled RI to actively reach out to providers to obtain additional clinical information necessary to classify cases as "Confirmed" or "Probable" based on the national Centers for Disease Control and Prevention (CDC) case definition.[3] Note that the CDC case definition does not include post-treatment Lyme disease syndrome or chronic Lyme disease cases. Prior to May 2013, RI employed a passive system of Lyme surveillance, which has been previously described.[4] This article will summarize findings from 2014-2016, which represents three full years of data from RI's enhanced Lyme disease surveillance system. This article will discuss observed case counts and rates over time, geographic trends, clinical characteristics, and co-infections.

METHODOLOGY

The Rhode Island Department of Health's Center for Acute Infectious Disease Epidemiology (CAIDE) staff receives Lyme disease reports from healthcare providers, hospitals, and laboratories via mail, fax, or electronic laboratory reporting. When laboratory tests are positive, CAIDE staff follow up actively with providers to obtain clinical information. The lab information, combined with the clinical information, is used to classify cases as "Suspect", "Probable", or "Confirmed" based on the CDC Lyme disease case definition.[4] Importantly, an EM rash greater than or equal to 5cm is sufficient to classify a case as confirmed and no laboratory results are necessary. All clinical case information is entered into RI's web-based electronic disease surveillance system, reviewed for accuracy, and then transmitted to CDC.

Lyme data were exported from the surveillance system to calculate rates over time, describe clinical characteristics, and identify co-infections with other reportable tickborne diseases during the surveillance period. ArcGIS was used to show disease burden geographically by city/town.

RESULTS

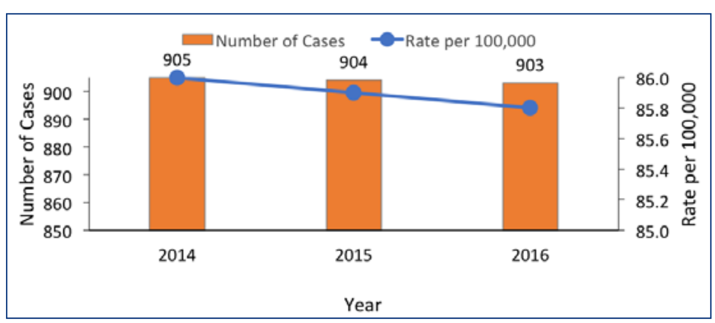
Case counts and rates over time

Reports of Lyme disease were observed to be stable from 2014 to 2016 (**Figure 1**). Approximately 900 confirmed and probable Lyme cases were identified each year and the incidence rate was in the range of 85–86 cases per 100,000 population.

Geographic distribution

From 2014 and 2016, rates of Lyme disease were consistently observed to be highest among Washington County residents and consistently lowest among Providence County residents. The three-year average incidence rate among Washington County residents was 197.0 cases per 100,000 population, compared to 59.6 per 100,000 among Providence County residents. Newport County had the second highest average incidence rate of 115.8 cases per 100,000 population, followed by Bristol County with an average

Figure 1. Number and rate of confirmed and probable cases of Lyme disease reported in Rhode Island, 2014-2016. Cases classified using CDC's Lyme disease case definition.



incidence rate of 105.6 per 100,000, and then Kent County at 78.6 per 100,000. A gradient of average three-year incidence rates is shown by city/town (**Figure 2**). Consistent with the observed county trends, a high incidence of Lyme is observed in the southwest part of the state, among cities and towns in Washington County. Although, the incidence of Lyme is lowest overall in Providence County, a high rate of Lyme disease is observed in the more rural cities and towns of the county, such as Foster and Scituate.

Clinical characteristics of confirmed cases

Erythema migrans greater than 5cm was reported among at least 45% of confirmed Lyme disease cases for each of the years (**Table 1**). Arthritis was the most commonly reported late-stage manifestation, ranging from approximately 35% in 2014 to approximately 48% in 2016. Other later-stage manifestations were less common, reported among fewer than 10% of confirmed cases. Note that probable cases are not included in this analysis as clinical features are not always available in the report to classify a case as probable.

Co-infections

Among the probable and confirmed cases of Lyme disease that were reported each year, between 2 and 3% were reported to be co-infected with at least one other tickborne disease (**Table 2**). For all years, babesia was the most commonly reported co-infection, followed by anaplasma.

DISCUSSION

This article summarizes Rhode Island's Lyme disease surveillance data from 2014–2016. While performing the enhanced surveillance methodology described, case counts and rates were high, but stable during this time period. The case counts and rates observed from 2014–2016 are higher than the case counts and rates observed during the three years prior (2011–2013), but these differences are likely attributable to enhanced surveillance and not increased illness. Underreporting still exists in the enhanced surveillance system; however, by following a consistent methodology CAIDE can better understand these data and identify relative increases and decreases that may be related to true changes in Lyme incidence.

Figure 2. Three-year average rates of Lyme disease by City/Town, Rhode Island, 2014–2016. Rates shown as a gradient and expressed per 100,000 population based on estimates obtained from RI Department of Labor and Training website: http://www.dlt.ri.gov/lmi/census/pop/townest.htm.

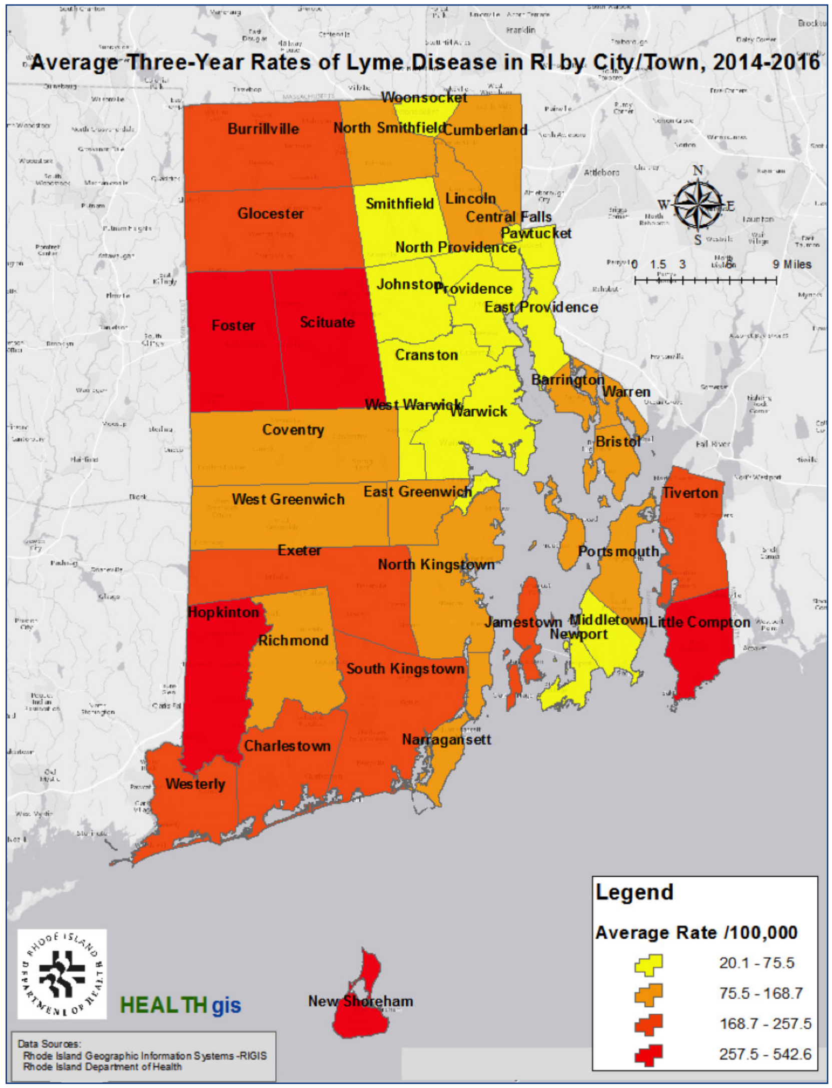


Table 1. Clinical characteristics of Lyme disease cases,[1] Rhode Island, 2014–2016.

	2014 (N=570)		2015 (N=564)		2016 (N=535)	
Clinical Characteristics	N	% of confirmed cases	N	% of confirmed cases	N	% of confirmed cases
Erythema migrans	313	54.9	289	51.2	242	45.2
Arthritis	198	34.7	212	37.6	255	47.7
Bell's Palsy	50	8.8	52	9.2	41	7.7
Radiculoneuropathy	19	3.3	21	3.7	16	3.0
Lymphocytic meningitis	10	1.8	11	2.0	5	0.9
Encephalitis	6	1.1	7	1.2	1	0.2

[1]Based on CDC Lyme disease case definition for confirmed cases.

Table 2. Reported co-infections[1] with Lyme disease in Rhode Island, 2014-2016.
Co-infections displayed as percentages of the total Lyme disease cases and of the total co-infections identified each year.

	2014 (N=905)			2015 (N=904)			2016 (N=903)		
Co-infections with Lyme	**N**	**% of total Lyme cases**	**% of co-infections**	**N**	**% of total Lyme cases**	**% of co-infections**	**N**	**% of total Lyme cases**	**% of co-infections**
Babesia	19	2.1	86.4	19	2.1	65.5	11	1.2	57.9
Anaplasma	2	0.2	9.1	9	1.0	31.0	6	0.7	31.6
Babesia and Anaplasma	0	0	0	1	0.1	3.4	0	0.0	0.0
Ehrlichia	1	0.1	4.5	0	0.0	0.0	1	0.1	5.3
Rocky Mountain Spotted Fever	0	0	0	0	0.0	0.0	1	0.1	5.3
TOTAL	**22**	**2.4**	**100.0**	**29**	**3.2**	**100.0**	**19**	**2.1**	**100.0**

[1]Co-infection identified if case met CDC's probable or confirmed case definition for Lyme and at least one other tickborne disease, with reported illness onset dates or specimen collection dates between conditions differing by 30 days or fewer.

Generally, the highest Lyme burden was observed in rural areas of the state, with rates tending to be the highest among cities/towns in Washington County. Adopting personal protection measures is critical in these areas and any area where high grass and levels of leaf litter can be found, as these conditions are favorable tick habitats. Individuals can protect themselves by wearing long pants and sleeves, using repellents containing DEET or products that contain permethrin on shoes and clothing, and bathing as soon as they come indoors. It is important to conduct frequent tick checks and wear light colored clothing so ticks can be spotted more easily. Anticipatory guidance and prevention counseling in physician offices as well as widespread public information education campaigns are key to informing the public about risk and prevention for this common disease.

Data from RI's enhanced surveillance allowed CAIDE to characterize clinical features and co-infections. An erythema migrans (EM) rash was reported in 45 to 55% of the confirmed cases, which is lower than the 70–80% reported by CDC.[1] This discrepancy could be due to underreporting by clinicians, incomplete clinical information being provided on the case reporting form, or providers not having the opportunity to diagnose an EM if the patient is seen after the rash has resolved or if the EM rash is marginally smaller than 5cm. A case is considered "Confirmed" if an EM rash greater than 5cm in size is observed, thus it is important for providers to report these cases to ensure they are included in the surveillance system.

Consistent with other literature, babesia was the most common co-infection that was identified among reported Lyme cases.[5] Among all reported Lyme cases from 2014–2016, 2–3% were reported to be co-infected with another tickborne disease, which may be accurate, but is also subject to limitations. In an attempt to distinguish concurrent from subsequent infections, a case was considered to be co-infected if the illness onset dates or specimen collection dates differed by 30 days or fewer between the two reported conditions. However, as noted in the literature, the case definition used can determine whether a case is counted as a co-infection.[6] Since patients are often tested for many tickborne diseases at the same time, it is possible that they meet the case definition for multiple tickborne diseases but may not be true co-infections. Literature has shown that cases co-infected with multiple tickborne diseases may have more severe symptoms and longer illness durations[5], so this is something that could be explored as part of active surveillance in the future. In conclusion, CAIDE's enhanced Lyme disease surveillance system has consistently been employed for three full years, which has allowed for analyses that documents a stable endemicity of disease in recent years and has described some basic clinical characteristics of cases. Continued enhanced surveillance is critical to identify the true and changing burden of Lyme disease in RI.

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