2019 Lyme and Other Tickborne Diseases Surveillance Report

Division of Infectious Disease Epidemiology

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pennsylvania
DEPARTMENT OF HEALTH

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Introduction

Lyme disease (LD) is a tickborne disease caused by the bacterium *Borrelia burgdorferi*. It may be transmitted by the bite of *Ixodes scapularis* ticks, also known as blacklegged ticks or deer ticks, if the tick carries the bacteria.[1] Early symptoms, typically occurring in the first 3 to 30 days after a tick bite, include fever, headache, and a rash, sometimes with a distinctive bull's eye shape, known as erythema migrans (EM). The EM rash is not present in approximately 20–30% of cases. Disseminated symptoms, typically occurring days to months after the tick bite, include joint pain and swelling, several EM rashes anywhere on the body, heart palpitations or irregular heartbeat, dizziness, nerve pain, facial palsy, and short-term memory loss. Most cases of Lyme disease can be successfully treated, especially when identified early. Delaying treatment can lead to heart and nervous system-related symptoms.[2]

In the United States, LD is the most common tickborne disease. Transmission of LD occurs primarily in the Northeast and upper Midwest regions of the country. In 2019, only 14 states reported 93% of all LD cases. In 2019, Pennsylvania reported more LD cases than any other state. Pennsylvania has a large population, so the incidence of cases per 100,000 population was fifth following Maine, Vermont, New Hampshire, and Delaware in 2019.[3,4] However, states where LD is endemic use a variety of surveillance approaches. Thus, it is difficult to make direct comparisons between states.

Other tickborne diseases can occur in Pennsylvania. The most common of these are anaplasmosis, ehrlichiosis, and spotted fever rickettsiosis (SFR). Anaplasmosis is caused by *Anaplasma phagocytophilum* bacteria, while ehrlichiosis is caused by various species of *Ehrlichia* bacteria. Anaplasmosis is transmitted by the *Ixodes scapularis* tick, the same tick that transmits LD. Ehrlichiosis is transmitted by the lone star tick (*Amblyomma americanum*). SFR is caused by species of *Rickettsia* bacteria and is transmitted by the American dog tick (*Dermacentor variabilis*).[5,6,7]

Babesiosis is an emerging tickborne disease in Pennsylvania. Babesiosis is caused by the parasite *Babesia microti*. *B. microti* is transmitted by *I. scapularis* ticks, the same ticks which transmit LD.[8] Babesiosis is not currently reportable in Pennsylvania so we rely on labs and facilities to voluntarily report cases to us. Therefore, the data we have are estimates and may be an undercount of the true burden of disease.

Overview

In 2019, 8,998 LD cases were reported in Pennsylvania, representing an incidence of 70.3 cases/100,000 persons. Most were reported between May and August, with 45% reported in June and July. All 67 counties in Pennsylvania reported LD, ranging from <5 cases in Mifflin County to 470 cases in Chester County. Incidence ranged from 8.7 cases/100,000 persons in Mifflin County to 424.3 cases/100,000 persons in Venango County.

In 2019, Pennsylvania reported 214 anaplasmosis cases, 23 ehrlichiosis cases, 29 SFR cases, and 68 babesiosis cases.

Methods

Cases of LD, anaplasmosis, ehrlichiosis, and SFR, as well as positive laboratory test results for these diseases, are reportable by providers and laboratories to the Pennsylvania Department of Health (DOH) per Chapter 27 of the Pennsylvania Health and Safety code.[9] Upon receiving the report, state public health nurses or county/municipal health department staff attempt to collect more information about the case from the ordering physician. The investigator then determines if the reported case meets the Council of State and Territorial Epidemiologists (CSTE)/Centers for Disease Control and Prevention's (CDC) surveillance case definition. CDC case definitions, which are designed for standardization of national case counting and are not intended for diagnostic purposes, can be found at https://ndc.services.cdc.gov/.

Cases that were designated as confirmed or probable according to the CSTE/CDC case definition are included in the case counts described in this report. In addition to comparing case counts to those from previous years, seasonal trends, geographic location and characteristics of cases were analyzed. Population data were obtained from the Pennsylvania Department of Health Bureau of Vital Statistics.

DOH also conducts syndromic surveillance of visits to Pennsylvania emergency departments and collects these data via the EpiCenter application, hosted by Health Monitoring Systems. EpiCenter collects de-identified data from most hospitals in Pennsylvania to monitor trends in reason for visits. In 2019, data regarding date and reason for visit, home zip code, and other information were obtained from 97% of emergency departments in the state. This information was analyzed to determine seasonal trends in tick-related emergency department visits. Chief complaints were searched for the presence of terms and variant spellings that indicated the patient had found a tick on their body or was bitten by a tick.

Lyme Disease Findings

Annual Trends

In 2019, 8,998 LD cases were reported in Pennsylvania. This represents an incidence of 70.3 cases/100,000 persons in Pennsylvania and was a 12% decrease from the 2018 case count. In 2019, Pennsylvania reported 29% of all confirmed LD cases in the United States and ranked first in number of cases reported and fifth in incidence. Although there is an overall increase for Lyme disease reported cases and incidence nationally over the last decade, in 2019, Lyme disease cases decreased in many Lyme endemic states, although a number reported increases.[10] The national trend in increasing cases may be due to expanded habitat for *Ixodes scapularis* and white-footed mice, which also harbor the *Borrelia burgdorferi* bacteria.[11] Additionally, *Ixodes scapularis* ticks are more likely to survive winter as the climate warms. Humans are also spreading into rural areas to build homes and participate in leisure activities, making human and tick contact more frequent. Year to year variations are not unusual and may be related to changes in tick activity, white-footed mouse populations, and weather patterns. Table 1 shows the case counts by classification and total incidence by year for the last 10 years.

Table 1 – Lyme Disease Cases by Classification and Total Incidence per 100,000 Population, Pennsylvania, 2010–2019

Year	Lyme Disease Case Count			Population	Lyme Disease Incidence per 100,000
	Confirmed	Probable	Total		
2010	3298	507	3805	12,702,379	29.96
2011	4739	623	5362	12,742,886	42.08
2012	4146	887	5033	12,763,536	39.43
2013	5126	778	5904	12,773,801	46.22
2014	6470	1017	7487	12,787,209	58.55
2015	7655	1772	9427	12,802,503	73.63
2016	8988	2455	11443	12,784,227	89.51
2017	9250	2650	11900	12,805,537	92.93
2018	7920	2288	10208	12,807,060	79.71
2019	6763	2235	8998	12,801,989	70.29

Source: PA-NEDSS; DOH, Bureau of Vital Statistics

Seasonality

LD can be acquired year-round in Pennsylvania, however, most LD cases occur in the late spring and summer months. In 2019, 48.8% of cases with known onset dates reported that their onset of LD symptoms was in June or July. More people spend time outdoors and are more likely to come in contact with ticks in these months. In addition, *Ixodes scapularis* nymphs are most active in the late spring and early summer. Most cases of Lyme disease are attributed to nymphal ticks. Their small size makes them very hard to detect and remove in order to prevent Lyme bacteria transmission. Table 2 shows the months of onset of symptoms of LD by classification status. A higher proportion of confirmed cases were reported in June and July than probable cases. This is likely because acute cases of Lyme presenting with erythema migrans, a symptom which is diagnostic for Lyme disease, are more likely to be quickly diagnosed. Probable cases, which are defined by laboratory criteria and later-stage signs and symptoms, are more likely to be diagnosed after some time has passed.

Table 2 – Lyme Disease by Onset Month*, Pennsylvania, 2019

Month	Confirmed Cases	Probable Cases	Total
January	114	53	167
February	84	22	106
March	87	42	129
April	168	85	253
May	418	136	554
June	1213	288	1501
July	1080	315	1395
August	470	156	626
September	301	111	412
October	283	109	392
November	164	65	229
December	117	55	172
Total	4499	1437	5936

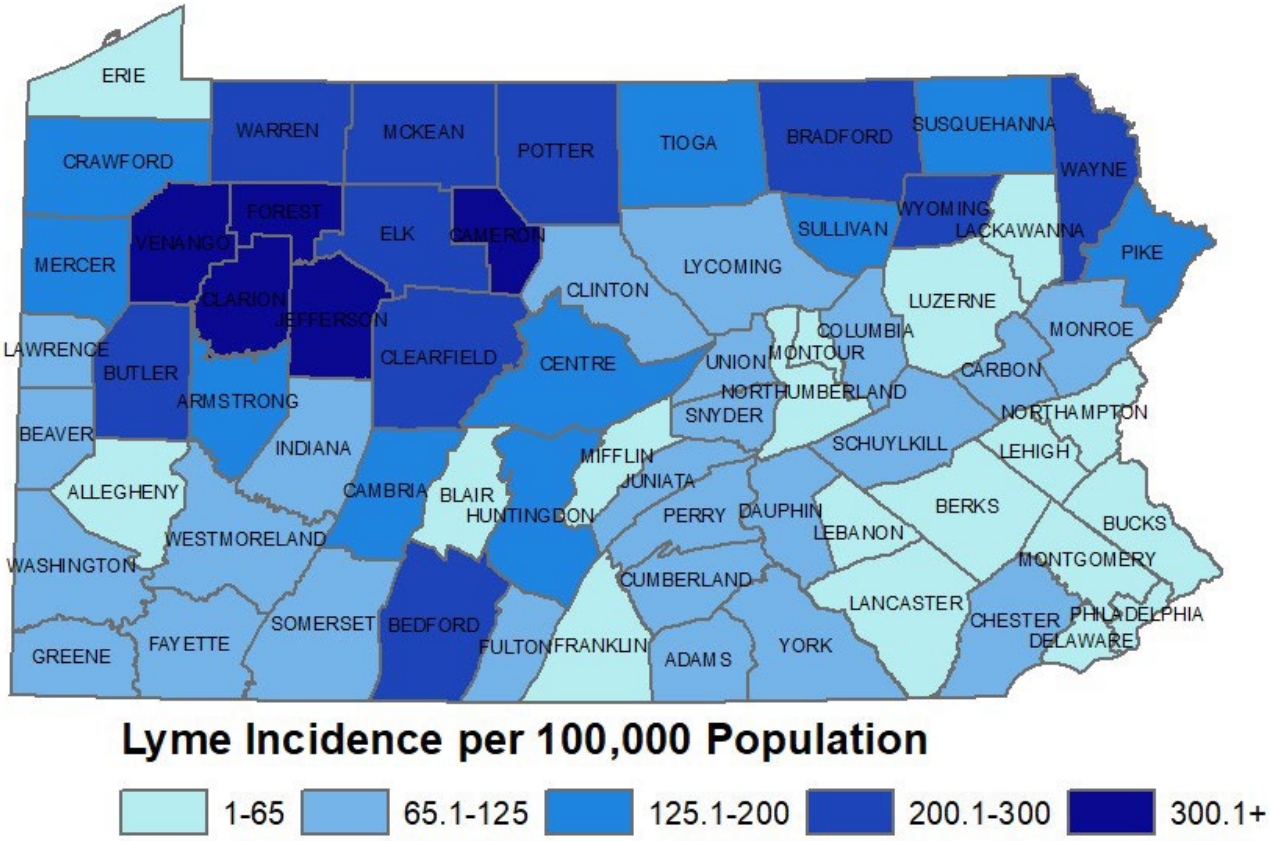
Source: PA-NEDSS

* Onset date is unknown for 33% of cases.

Geographic Distribution

Ixodes scapularis ticks infected with *Borrelia burgforferi* have been found in all 67 counties in Pennsylvania. Persons have also been diagnosed with LD in all counties in Pennsylvania. LD incidence varies by county. Urban areas like Philadelphia tend to have a lower incidence than more rural counties. In addition, because classifying cases of LD requires data from providers to be reported to public health nurses in Pennsylvania's health departments, case counts could appear lower in counties with lower staffing levels or in areas in which providers are less likely to respond. Due to these surveillance complexities, the counties reporting the most cases may not actually have the greatest burden of Lyme disease. In 2019, counties in the northwest area of the state reported the highest incidence of LD. Map 1 shows the county incidence of LD cases in 2019. Table 3 shows the case counts by county in 2019.

Map 1 – Lyme Disease Incidence per 100,000 by County, Pennsylvania, 2019



Source: PA-NEDSS; DOH, Bureau of Vital Statistics

Table 3 – Lyme Disease Case Counts by County, Pennsylvania, 2019

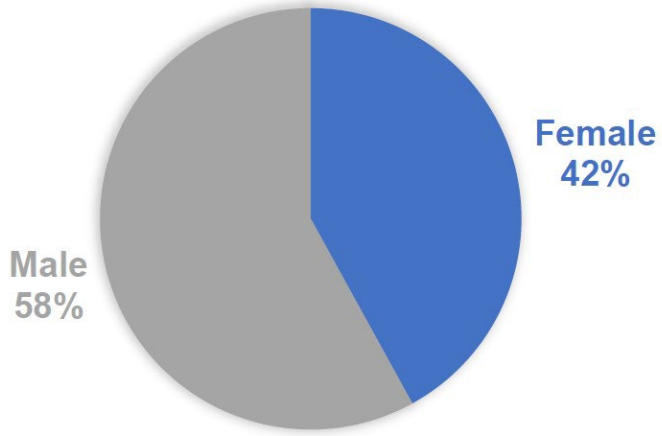
County	Lyme Disease Case Count	County	Lyme Disease Case Count
Adams	98	Lackawanna	108
Allegheny	294	Lancaster	245
Armstrong	88	Lawrence	100
Beaver	150	Lebanon	83
Bedford	114	Lehigh	211
Berks	235	Luzerne	199
Blair	44	Lycoming	78
Bradford	138	McKean	87
Bucks	363	Mercer	144
Butler	388	Mifflin	*
Cambria	175	Monroe	166
Cameron	14	Montgomery	363
Carbon	50	Montour	7
Centre	255	Northampton	141
Chester	470	Northumberland	54
Clarion	141	Perry	55
Clearfield	204	Philadelphia	181
Clinton	43	Pike	89
Columbia	53	Potter	49
Crawford	139	Schuylkill	100
Cumberland	169	Snyder	29
Dauphin	186	Somerset	72
Delaware	171	Sullivan	9
Elk	75	Susquhanna	79
Erie	142	Tioga	63
Fayette	150	Union	39
Forest	26	Venango	215
Franklin	65	Warren	86
Fulton	13	Washington	150
Greene	36	Wayne	136
Huntingdon	85	Westmoreland	435
Indiana	89	Wyoming	57
Jefferson	144	York	333
Juniata	24	Total	8998

Source: PA-NEDSS
*Case counts <5 have been redacted to help protect patient confidentiality, in accordance with DOH policy.

LD Case Characteristics

Nationally, LD is more commonly diagnosed in males. This pattern was seen in the 2019 Pennsylvania LD data as well, with males comprising 58% of reported cases. Males may spend more time engaging in outdoor activities, such as camping and hunting, may be more likely to do yard work, and may be more likely to have jobs that require work outdoors. Figure 1 shows the sex distribution of LD cases in 2019.

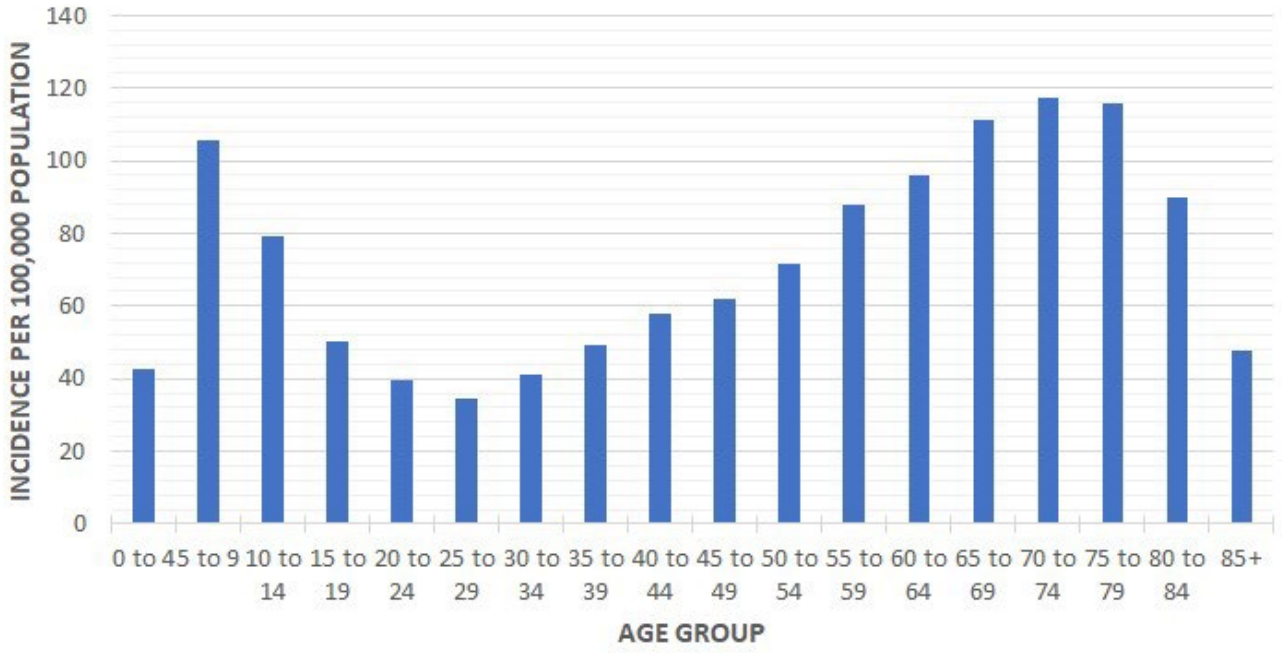
Figure 1 – Lyme Disease by Sex, Pennsylvania, 2019



Source: PA-NEDSS

LD incidence was highest in children ages 5–9 and in older adults. This is consistent with national trends. Hypotheses for this trend include that children in the 5–9 year age group are more likely to play outside, are lower to the ground, may cuddle more with pets who might have ticks, and are more likely to play in leaves and tall grass. There is also a high incidence in older adults. The reason for this is not clear but may be due to more severe symptoms resulting in an increased likelihood to seek care for Lyme disease-related symptoms, or increased time post-retirement to participate in outdoor leisure activities, such as dog walking, gardening, bird watching, and nature walks. The age-adjusted LD incidence for 2019 is 72.1 cases per 100,000 persons. Figure 2 displays the incidence of LD by age groups in 2019.

Figure 2 – Lyme Disease Incidence by Age Group, Pennsylvania, 2019*



Source: PA-NEDSS; DOH, Bureau of Vital Statistics
*A previously published version of this report included an incorrect Lyme Disease Incidence by Age Group chart. The chart was corrected on 8/1/2022.

Clinical Manifestations of LD

The erythema migrans rash is the most distinctive sign of LD; 42.2% of Pennsylvania cases in which the data were available were reported as having the classic rash. It should be noted that, according to CDC, EM is diagnostic for LD, and treatment should be initiated. Lab testing is not required in this circumstance, and serologic tests may be negative if done too soon after the onset of illness. Since most LD cases are reported to DOH by laboratories, it is likely many cases diagnosed on the basis of EM alone are not reported to the department at all. Therefore, the proportion of cases with EM seen in our data are likely an underrepresentation of the true incidence of EM in LD cases. As noted earlier, there are several other signs and symptoms associated with different stages of LD. More serious complications of LD, like meningitis, encephalitis, and atrioventricular block, are rare. Table 4 shows the frequency with which the most common signs and symptoms of LD were reported in 2019. In cases in which the onset date of symptoms was reported, the median number of days between symptom onset and diagnosis of LD was eight days. However, onset date is not always reported and may be less likely to be reported in cases that have been experiencing LD symptoms for a longer period of time, since these cases may not remember when their LD symptoms began.

Table 4 – Signs and Symptoms of Lyme Disease Reported by Providers Among Lyme Disease Cases, Pennsylvania, 2019

Symptom	Percent (%) Who Reported Experiencing this Symptom
Erythema migrans (EM)	43.3
Joint swelling	37.2
Bell's palsy	5.4
Radiculoneuropathy	4.0
Lymphocytic meningitis	0.4
Encephalitis/encephalomyelitis	0.3
Second or third degree atrioventricular block	0.7

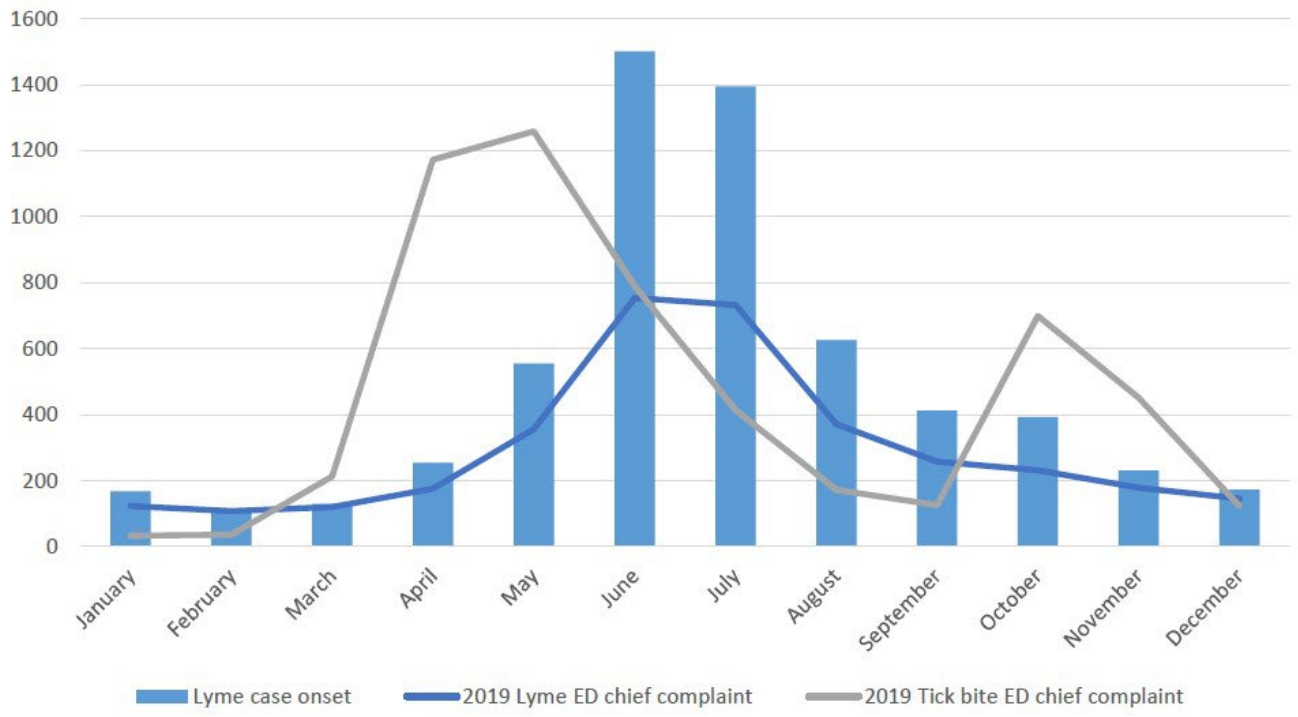
Source: PA-NEDSS

Emergency Department Surveillance Data

A review of syndromic emergency department surveillance data revealed that an increase in visits attributed to tick bites occurred in April 2019, when weather warmed and people were more likely to spend time outdoors. This is consistent with prior years, and coincides with increased adult *Ixodes scapularis* activity, as well as *Dermacentor variablis* (dog tick) activity. *Ixodes scapularis* nymphs emerge in late spring and early summer. Tick bite complaints, which are inclusive of several species of ticks, are still elevated during late spring and early summer despite *I. scapularis* adult activity decreasing. *I. scapularis* nymphs, however, are active from late May to mid–July, which corresponds with the spike in LD reports with onset date in June and July. These cases do not appear to be associated with visits to the emergency department (ED) for tick bites; it is possible that nymphal activity is less noticeable and results in fewer ED visits, although these bites still contribute to LD incidence. There is a second peak in tick-related emergency department complaints in the fall, which is consistent with the fact that adult *I. scapularis* ticks feed during October and November. Since tick bite-related emergency department visits peak prior to the peak of Lyme incidence, this indicates persons may be more likely to present to the emergency department with an adult tick bite than a nymphal tick bite.

Emergency department visits specifically related to LD increased in May 2019 reaching a peak in June and July, corresponding to the onset dates of reported LD cases. LD related emergency department visits are highly correlated to the timing of LD onset month and can be an early indicator of an increase in LD cases. Figure 3 shows the timing of tick-related and LD complaints reported in Pennsylvania emergency departments in 2019.

Figure 3 – Tick and Lyme Related Emergency Department Chief Complaints, Pennsylvania, 2019



Source: Health Monitoring Systems; PA-NEDSS

Tickborne Rickettsial Infections (TBRI) Findings (Anaplasmosis, Ehrlichiosis, Spotted Fever Rickettsiosis)

Annual Trends

Ehrlichiosis and spotted fever rickettsiosis (SFR) case counts have been steady in Pennsylvania over the last 10 years, with counts typically ranging between 10-30 cases per year. Anaplasmosis, on the other hand, was infrequently reported a decade ago but has increased steadily to a high of 214 cases in 2019. Ehrlichiosis and SFR are transmitted by *Amblyomma americanum* (the lone star tick) and *Dermacentor variabilis* (the American dog tick), respectively. Anaplasmosis is transmitted by the *Ixodes scapularis* (deer tick), the same tick which transmits LD. Tick surveys have shown that the geographic range of *I. scapularis* has increased in Pennsylvania and the density of *I. scapularis* ticks has increased as well.[8] This likely accounts for the increase in *I. scapularis* transmitted infections like anaplasmosis. In 2019, Pennsylvania reported 214 anaplasmosis cases, 23 ehrlichiosis cases and 29 SFR cases. Table 5 shows the case counts of these 3 tickborne diseases over the last 10 years.

Table 5 – Anaplasmosis, Ehrlichiosis and SFR Case Counts, Pennsylvania, 2009-2018

Year	Anaplasmosis	Ehrlichiosis	Spotted Fever Rickettsiosis
2010	1	5	15
2011	6	10	19
2012	8	23	41
2013	34	28	16
2014	25	10	7
2015	21	14	16
2016	58	23	22
2017	94	19	28
2018	108	18	25
2019	214	33	29

Source: PA-NEDSS

Seasonality

Onset months of TBRI cases differ slightly from typical onset months of Lyme disease. Most cases occur in warm months, as ticks are most active in the warmer months and people are more likely to be outdoors and exposed to ticks during these months. However, compared to LD, anaplasmosis cases are more likely to report onset dates in the warm months of May-July. There is also another smaller peak in anaplasmosis in the cooler fall months of October and November when adult *I. scapularis* are feeding. This trend may indicate that adult *I. scapularis* ticks are as likely to transmit anaplasmosis as nymphs are, given that nymphs are most active in June and July. Table 6 shows the 2019 cases of other tickborne diseases by month of report. Ehrlichiosis and SFR are transmitted by *A. americanum* and *D. variabilis*, respectively, which have different life cycles than *I. scapularis*.

Table 6 – Anaplasmosis, Ehrlichiosis and SFR Case Counts by Month of Onset, Pennsylvania, 2019

Month of Onset Date	Anaplasmosis	Ehrlichiosis	Spotted Fever Rickettsiosis
January	1	0	0
February	1	0	0
March	1	0	0
April	9	1	1
May	24	3	0
June	26	4	1
July	39	1	5
August	9	4	2
September	6	0	3
October	11	0	3
November	12	1	0
December	1	1	0

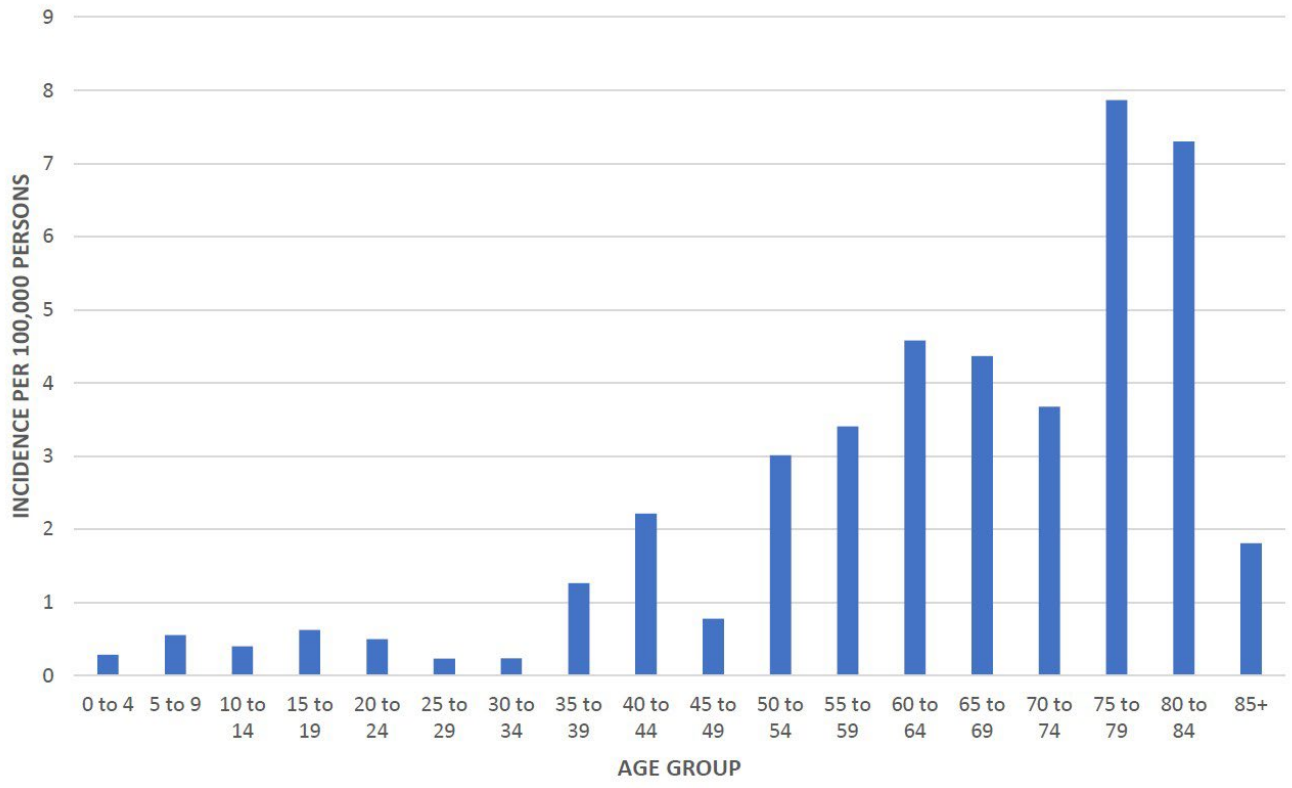
Source: PA-NEDSS

Case Characteristics

Similar to LD, males are more likely than females to report these other tickborne diseases, with 61.3% of cases occurring in males. In both anaplasmosis and spotted fever rickettsiosis, we see more males than females affected, 63.1% and 58.6%, respectively. However, for ehrlichiosis, we see a slightly lower proportion in males, 47.8%.

In LD, we see a high incidence in children and older adults. However, in TBRI cases, the incidence in young children was low, and there was a higher incidence in older adults and the elderly. The reason for this pattern is not clear. Figure 4 shows the number of cases per 100,000 in each age category.

Figure 4 – Anaplasmosis, Ehrlichiosis and SFR Incidence by Age Group, Pennsylvania, 2019



Source: PA-NEDSS and DOH Bureau of Vital Statistics

Geographic Distribution

In 2019, 49 of 67 counties reported at least one case of anaplasmosis, ehrlichiosis, or SFR. The highest number of cases are reported in the eastern counties of the state. This is primarily driven by anaplasmosis, which has had high case counts in the northeastern counties. Case counts have begun increasing in central and western counties, following the same pattern exhibited by LD, which first appeared in eastern counties and then spread westward throughout the state. Ehrlichiosis cases do not show a geographic pattern and can be found in counties in all areas of Pennsylvania. Most SFR cases are reported in eastern counties, especially southeastern counties. Table 8 shows the number of TBRI cases by county in 2019.

Table 8 – Anaplasmosis, Ehrlichiosis and SFR Case Counts by County, Pennsylvania, 2019*

County	Anaplasmosis	Ehrlichiosis	SFR
Allegheny	6	0	0
Armstrong	*	0	0
Beaver	*	*	0
Berks	*	0	*
Blair	0	0	*
Bucks	6	*	*
Camrbia	*	0	*
Carbon	*	*	0
Centre	10	0	0
Chester	11	0	*
Clarion	*	0	0
Clearfield	*	0	*
Clinton	*	*	0
Columbia	11	0	0
Cumberland	*	0	0
Dauphin	*	0	0
Delaware	*	*	*
Elk	5	0	0
Erie	*	0	0
Huntingdon	*	0	0
Indiana	*	0	*
Jefferson	7	0	0
Juniata	0	*	0
Lackawanna	10	*	0

County	Anaplasmosis	Ehrlichiosis	SFR
Lancaster	*	*	*
Lebanon	0	0	*
Lehigh	*	0	0
Luzerne	9	0	0
Lycoming	10	*	0
McKean	*	*	0
Mercer	0	0	*
Monroe	19	*	0
Montgomery	*	0	*
Montour	5	0	0
Northampton	*	*	*
Northumberland	5	0	0
Perry	*	0	0
Philadelphia	5	*	8
Pike	17	*	*
Potter	*	0	0
Schuylkill	*	*	*
Snyder	*	0	0
Somerset	*	0	0
Susquehanna	*	0	0
Tioga	*	*	0
Warren	*	0	*
Wayne	18	0	*
Westmoreland	0	*	*

Source: PA-NEDSS
*Case counts <5 have been redacted to help protect patient confidentiality, in accordance with Pa. DOH policy.

Babesiosis Findings

Annual Trends

Babesiosis is not a reportable condition in Pennsylvania, therefore, reporting is voluntary rather than mandatory. As a result, it is not clear how well the data represent the true burden of babesiosis cases in Pennsylvania. Babesiosis is an emerging tickborne disease in Pennsylvania. Case counts appear to be increasing, although the increase in case counts may be due to labs and facilities opting to report more cases. In 2019, 68 babesiosis cases were reported in the state.

Table 9 – Babesiosis Case Counts, Pennsylvania, 2010–2019

Year	Babesiosis
2010	6
2011	35
2012	11
2013	25
2014	11
2015	45
2016	36
2017	81
2018	72
2019	68

Source: PA-NEDSS

Seasonality

Since babesiosis is transmitted by the *I. scapularis* tick, the seasonality of babesiosis is similar to that of Lyme disease with most cases reporting onset in June and July. We also see high case onsets in August which may be due to the four-week incubation period.

Table 10 – Babesiosis Case Counts by Month of Onset, Pennsylvania, 2019

Month of Onset Date	Babesiosis
January	1
February	1
March	1
April	0
May	1
June	10
July	26
August	10
September	3
October	2
November	0
December	3

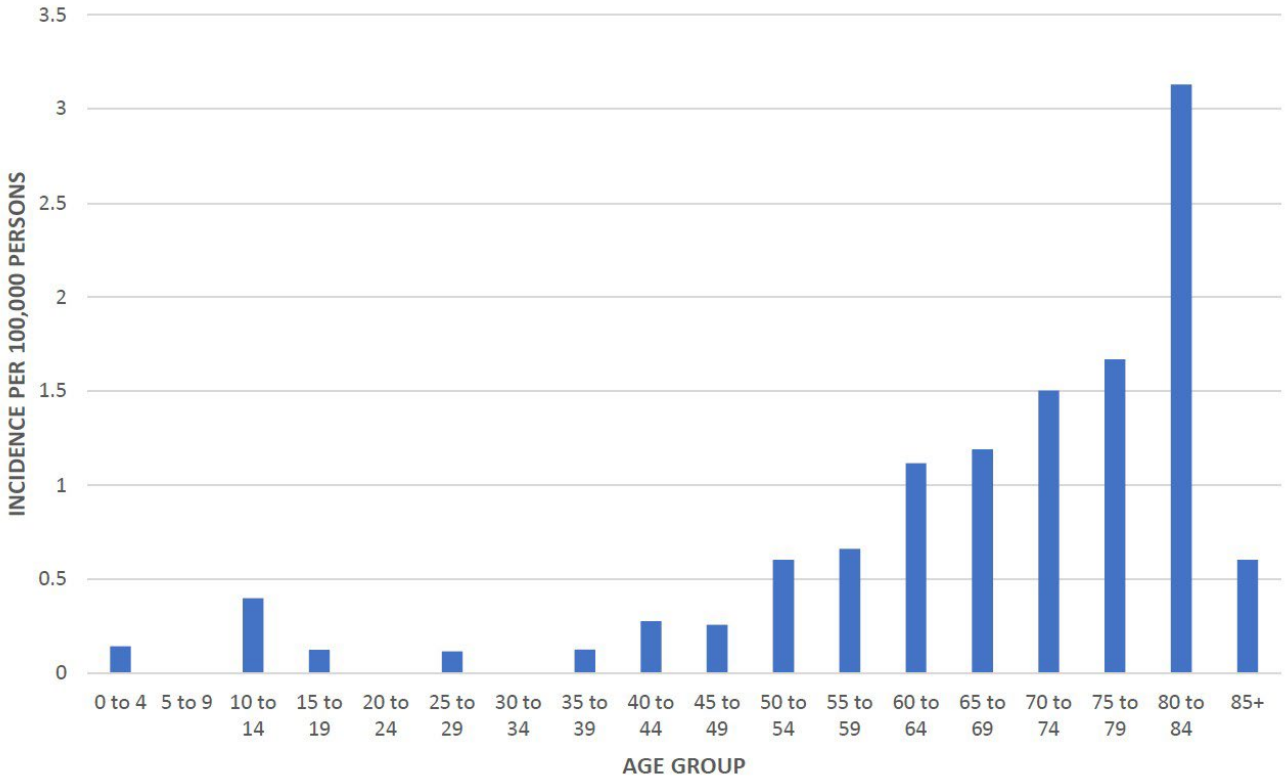
Source: PA-NEDSS

Case Characteristics

Similar to LD, males are more likely than females to report babesiosis, with 69.1% of cases occurring in males.

However, in contrast to LD and similar to TBRIs, the incidence in young children was low, and there was a higher incidence in older adults and the elderly. The reason for this pattern is not clear. Figure 5 shows the number of cases per 100,000 in each age category.

Figure 5 – Babesiosis Incidence by Age Group, Pennsylvania, 2019



Source: PA-NEDSS and DOH Bureau of Vital Statistics

Geographic Distribution

In 2019, 18 of 67 counties reported at least one case of babesiosis. The highest number of cases are reported in the eastern counties of the state. Table 11 shows the number of Babesiosis cases by county in 2019.

Table 11 – Babesiosis Case Counts by County, Pennsylvania, 2019*

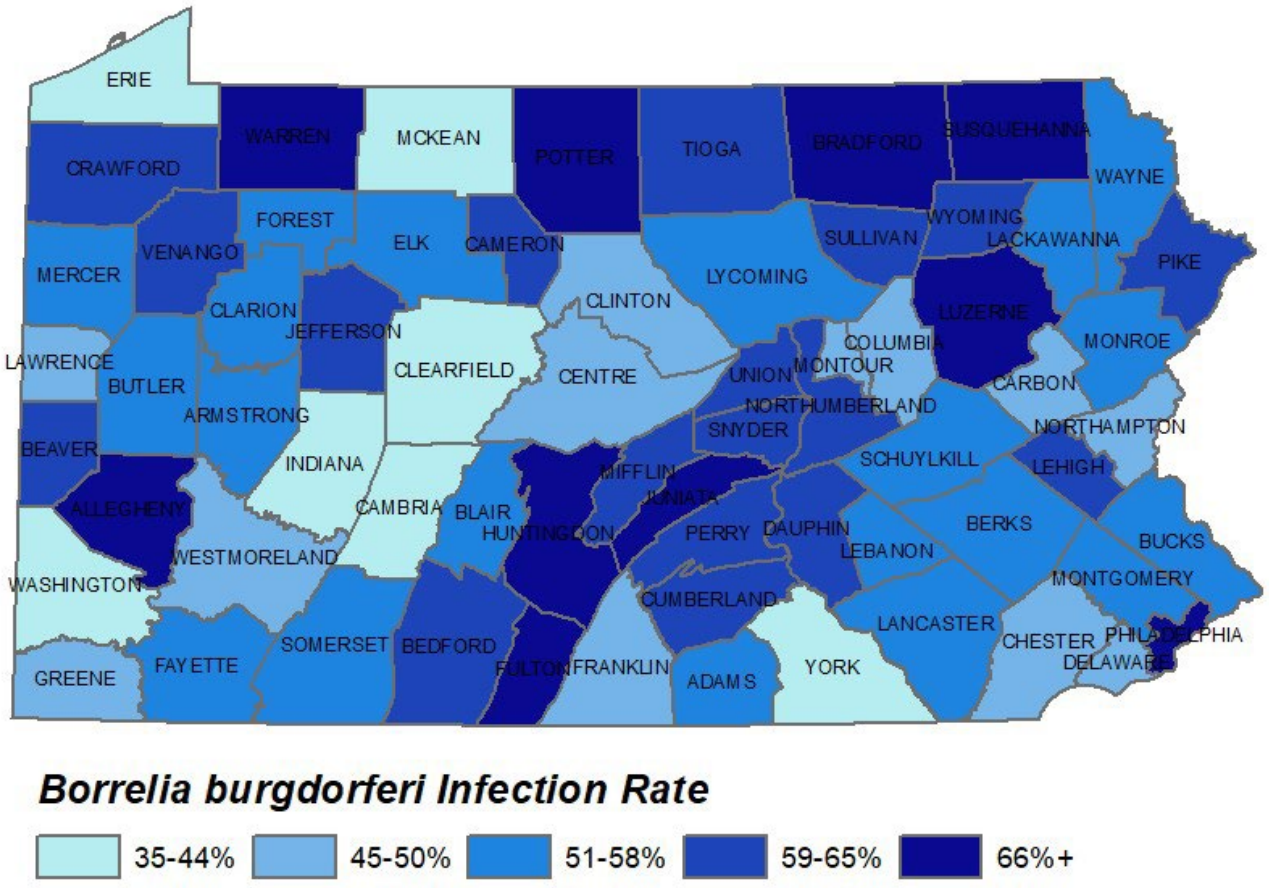
County	Babesiosis
Allegheny	*
Berks	7
Bucks	11
Chester	21
Cumberland	*
Dauphin	*
Delaware	*
Elk	*
Fayette	*
Lebanon	*
Lehigh	*
Lycoming	*
Montgomery	6
Northampton	*
Philadelphia	*
Pike	6
Potter	*
Venango	*

Source: PA-NEDSS
*Case counts <5 have been redacted to help protect patient confidentiality, in accordance with Pa. DOH policy.

Tick Surveillance Findings

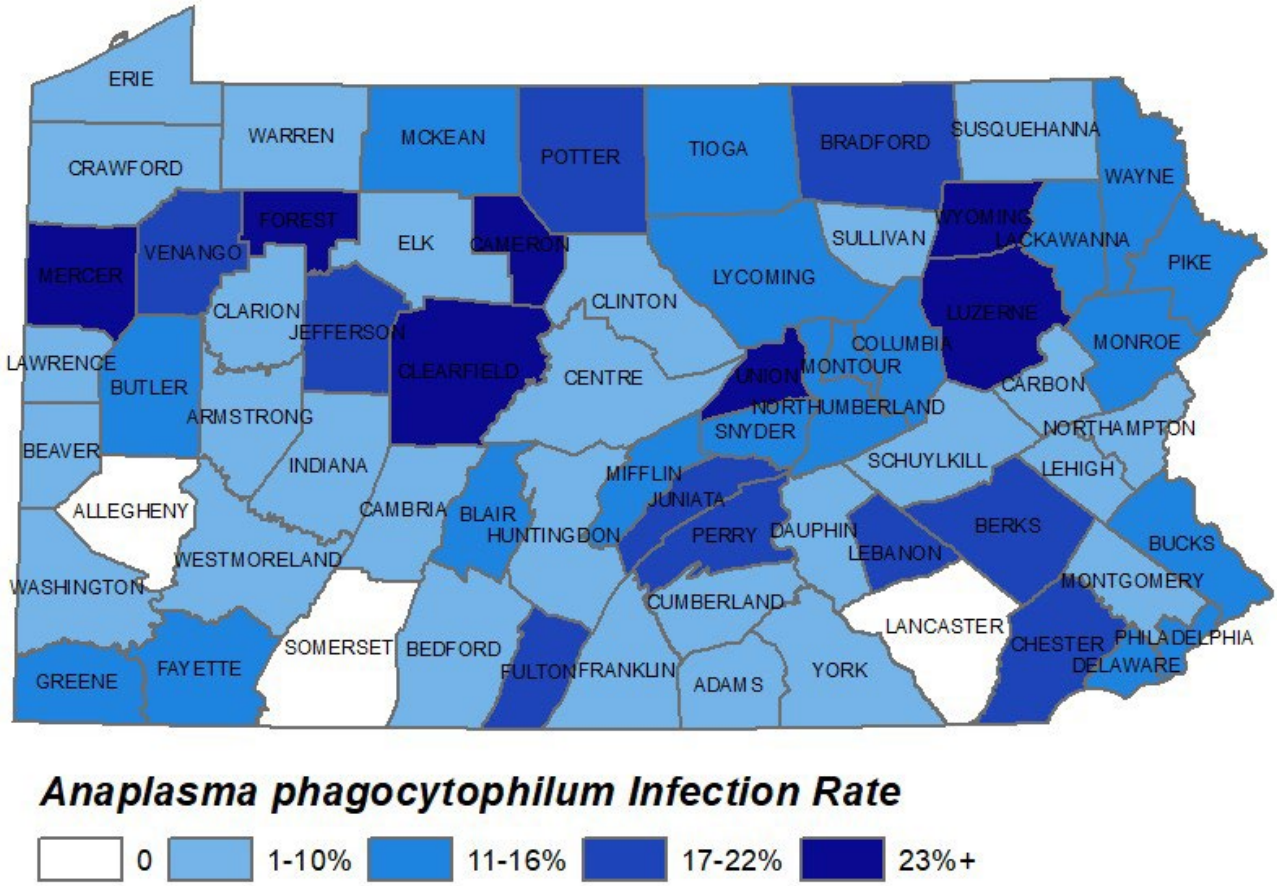
Beginning in the fall of 2018, the Department of Environmental Protection began a robust tick surveillance program. This involved collecting a minimum of 50 *Ixodes scapularis* ticks from each county and testing these ticks for the primary *I. scapularis* pathogens to understand the infection rate of the disease vector. Between fall of 2018 and fall 2019, 4314 adult *Ixodes scapularis* ticks were collected from all 67 Pennsylvania counties. Of these, 3558 were tested for the primary *I. scapularis* pathogens including *Borrelia burgdorferi* (the bacteria that causes LD), *Anaplasma phagocytophilum* (the bacteria that causes anaplasmosis) and *Babesia microti* (the parasite that causes babesiosis). Statewide *B. burgdorferi* infection rates were 56.3%, *A. phagocytophilum* infection rates were 12.6%, and *B. microti* infection rates were 2.9%. Figures 6 through 8 show the county infection rates of the adult *I. scapularis* ticks collected between fall 2018–fall 2019.

Figure 6 – *Borrelia burgdorferi* Infection Rates in Adult *Ixodes scapularis* by County, Pennsylvania, 2018–2019



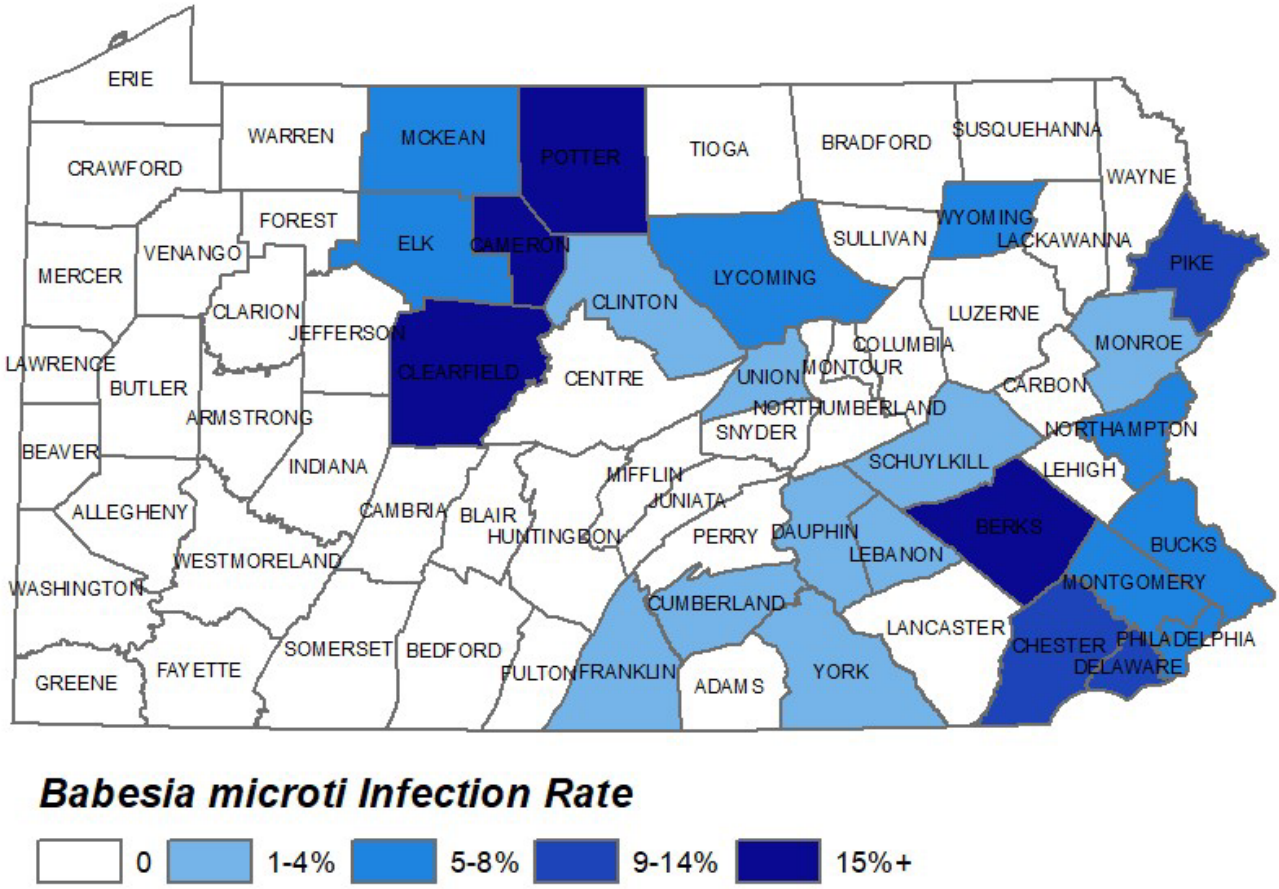
Source: Department of Environmental Protection

Figure 7 – *Anaplasma phagocytophilum* Infection Rates in Adult *Ixodes scapularis* by County, Pennsylvania, 2018–2019



Source: Department of Environmental Protection

Figure 8 – *Babesia microti* Infection Rates in Adult *Ixodes scapularis* by County, Pennsylvania, 2018–2019



Source: Department of Environmental Protection

Citations

[1] CDC. "Lyme Disease Transmission." Last modified January 29, 2020. https://www.cdc.gov/lyme/transmission/index.html

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