

2022 Lyme and Other Tickborne Diseases Surveillance Report

Division of
Infectious Disease
Epidemiology

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pennsylvania
DEPARTMENT OF HEALTH

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Table of Abbreviations

Abbreviation	Meaning
BRFSS	Behavioral Risk Factor Surveillance System
CDC	Centers for Disease Control and Prevention
CSTE	Council of State and Territorial Epidemiologists
DEP	Pennsylvania Department of Environmental Protection
DOH	Pennsylvania Department of Health
ED	emergency department
EM	erythema migrans
LD	Lyme disease
SFR	spotted fever rickettsiosis

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 about 20–30% of cases. Later symptoms that typically occur 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 LD can be successfully treated, especially when identified early. Delaying treatment can lead to heart and nervous system-related symptoms.²

In 2022, the national case definition for LD was modified by the Centers for Disease Control and Prevention (CDC) and the Council of State and Territorial Epidemiologists (CSTE). The 2022 CDC/CSTE case definition can be found [here](#).³ For states with a high number of cases per population, known as incidence, like Pennsylvania, case counts are now based on positive LD lab reports alone and no longer require investigation by public health staff. This reduces the burden on both public health staff tasked with investigating thousands of LD reports and healthcare staff who had to respond to data requests from the Pennsylvania Department of Health (DOH) on LD reports. Prior to 2022, states with a high incidence of cases used a variety of surveillance approaches, making it difficult to make direct comparisons among states. This modification will allow comparisons between states with a high incidence as all are now using identical surveillance methods.

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 2022, only 14 states reported more than 95.1% of all LD cases. In 2022, Pennsylvania reported the second highest number of individual LD cases. However, Pennsylvania has a large population, so the number of cases per 100,000 population was ninth following Rhode Island, Vermont, Maine, West Virginia, Wisconsin, New York, New Hampshire, and Massachusetts.^{4,5}

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 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*).^{6,7,8}

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.⁹ Babesiosis is not currently reportable in Pennsylvania, so the DOH relies on labs and facilities to voluntarily report cases. Therefore, these data are estimates and may be an undercount of the true burden of disease.

Overview

In 2022, 8,413 LD cases were reported in Pennsylvania, representing an incidence of 64.9 cases/100,000 persons. Most were reported between May and August, with 47.9% reported in June, July and August. All 67 counties in Pennsylvania reported LD, ranging from 8 cases in Sullivan County to 601 cases in Chester County. Incidence ranged from 10.4 cases/100,000 persons in Lehigh County to 431.6 cases/100,000 persons in Potter County.

In 2022, Pennsylvania reported 581 anaplasmosis cases, 57 ehrlichiosis cases, <5 SFR cases, and 92 babesiosis cases.

Methods

Cases of LD, anaplasmosis, ehrlichiosis, and SFR, as well as positive laboratory test results for these diseases, are reportable by health care providers and laboratories to the DOH per Chapter 27 of the Pennsylvania Health and Safety code.¹⁰ 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 for all conditions excluding LD, which since 2022 is reported based on laboratory reports alone. The investigator then determines if the reported case meets the CDC/CSTE surveillance case definition. National 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/>.

For LD, cases that are designated as probable and for all other tickborne diseases, cases that were 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 for 2022 were obtained from the DOH Bureau of Vital Statistics.

Age adjusted calculations were made using case counts by age group and age group population data.

DOH also conducts syndromic surveillance of visits to Pennsylvania emergency departments and collects these data via the EpiCenter application. EpiCenter collects de-identified data from most hospitals in Pennsylvania to monitor trends in reason for visits. In 2022, data regarding date and reason for visit, home zip code, and other information were obtained from 100% 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, such as “tick,” “tick bite,” and variant spellings that indicated the patient had found a tick on their body or was bitten by a tick. Chief complaints, such as “Lyme,” “Lymes,” and discharge diagnoses related to Lyme disease were selected to identify ED visits related to LD.

Pennsylvania participates in the Behavioral Risk Factor Surveillance System (BRFSS) survey which is a phone-based survey conducted with randomly selected residents to identify a variety of health-related risk behaviors, chronic illnesses, and healthcare use.¹¹ In 2022, three vectorborne disease related questions were asked on the Pennsylvania BRFSS survey for the first time. The questions included how often the respondent uses insect repellent, conducts tick checks, and if the respondent found a tick on their body in the prior year. These data were analyzed to better understand risks for tickborne diseases in Pennsylvania.

Lyme Disease Findings

Annual Trends

In 2022, 8,413 LD cases were reported in Pennsylvania. This case count translated to an incidence of 64.9 cases/100,000 persons in Pennsylvania, which was a 190.1% increase from the 2021 case count. Although there is an overall increase for LD reported cases and incidence nationally over the last decade, in 2020 and 2021, LD cases decreased in many Lyme endemic states as all states were significantly affected by the COVID-19 pandemic.¹² The new 2022 case definition also resulted in higher cases counts in most high incidence states. The long-term national trend in increasing case counts may be due to expanded habitat for *Ixodes scapularis* and white-footed mice, which also harbor the *Borrelia burgdorferi* bacteria.¹³ Additionally, *Ixodes scapularis* ticks are more likely to survive winter as ambient temperatures increase as the climate changes. Humans are 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, 2013–2022

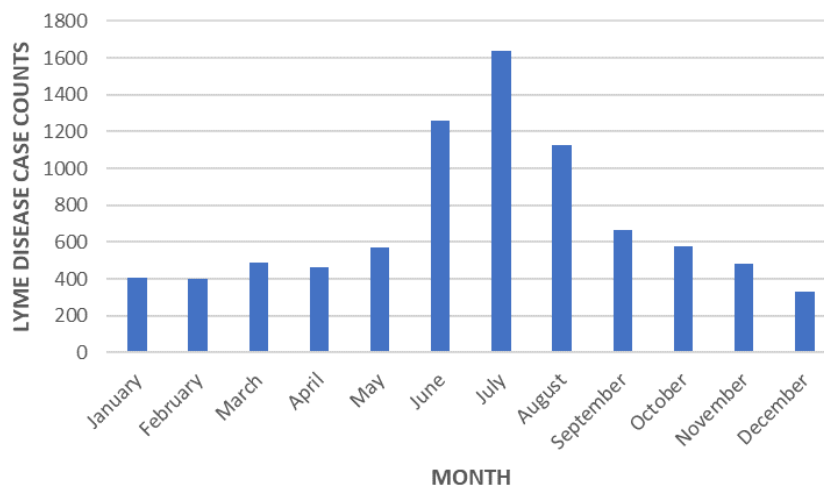
Year	Lyme Disease Case Count			Population	Lyme Disease Incidence per 100,000
	Confirmed	Probable	Total		
2013	5126	778	5904	12,773,801	46.22
2014	6470	1017	7487	12,787,209	58.55
2015	7655	1772	9427	12,802,503	73.63
2016	8988	2455	11443	12,784,227	89.51
2017	9250	2650	11900	12,805,537	92.93
2018	7920	2288	10208	12,807,060	79.71
2019	6763	2235	8998	12,801,989	70.29
2020	2641	693	3334	12,989,625	26.00
2021	2333	567	2900	12,964,056	22.37
2022	N/A	8413	8413	12,972,008	64.86

Source: PA-NEDSS; DOH, Bureau of Vital Statistics
National LD case definition changed on January 1, 2022.

Seasonality

LD can be acquired year-round in Pennsylvania; however, most LD cases occur in the late spring and summer months. In 2022, 54.7% of cases were reported between May and August. 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. Figure 1 shows the report month of LD cases in 2022..

Figure 1 – Lyme Disease by Report Month, Pennsylvania, 2022

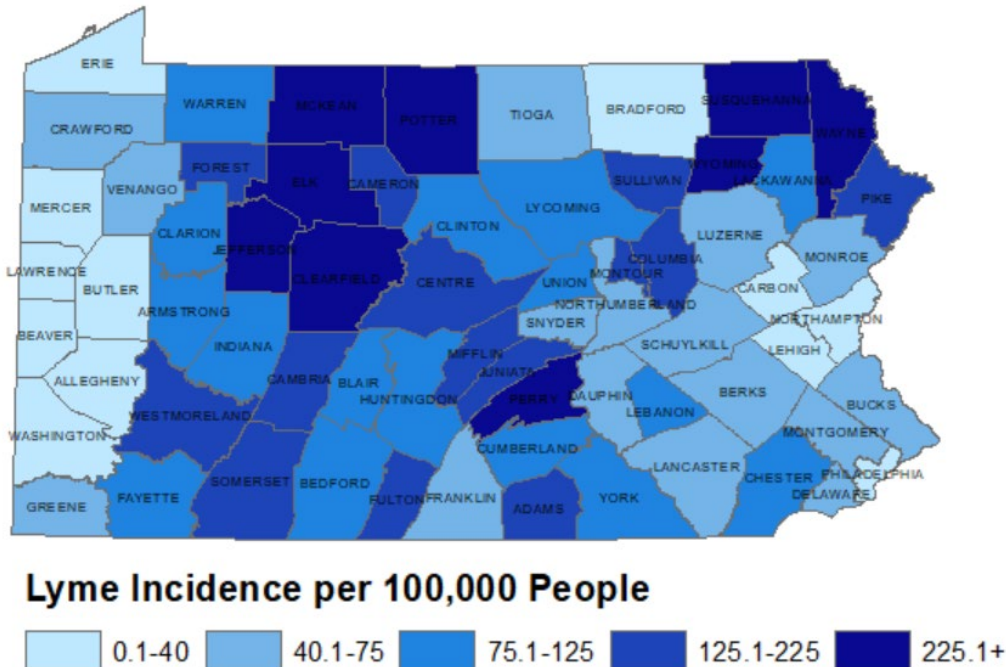


Source: PA-NEDSS

Geographic Distribution

Ixodes scapularis ticks infected with *Borrelia burgdorferi* were found in all 67 (100%) counties in Pennsylvania. Persons were also diagnosed with LD in all counties in Pennsylvania. LD incidence varies by county. Urban areas tend to have a lower incidence than more rural counties. In 2022, counties in the northeast area of the state reported the highest incidence of LD. Map 1 shows the county incidence of LD cases in 2022. Table 2 shows the case counts by county in 2022.

Map 1 – Lyme Disease Incidence per 100,000 by County, Pennsylvania, 2022



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

Table 2 – Lyme Disease Case Counts by County, Pennsylvania, 2022

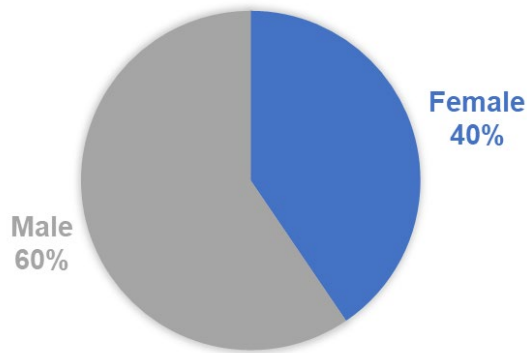
County	Lyme Disease Case Count	County	Lyme Disease Case Count
Adams	143	Lackawanna	177
Allegheny	210	Lancaster	375
Armstrong	64	Lawrence	18
Beaver	63	Lebanon	117
Bedford	38	Lehigh	39
Berks	303	Luzerne	223
Blair	100	Lycoming	104
Bradford	14	McKean	116
Bucks	390	Mercer	41
Butler	63	Mifflin	83
Cambria	229	Monroe	79
Cameron	10	Montgomery	433
Carbon	12	Montour	29
Centre	230	Northampton	88
Chester	601	Northumberland	68
Clarion	33	Perry	114
Clearfield	202	Philadelphia	231
Clinton	37	Pike	109
Columbia	94	Potter	70
Crawford	49	Schuylkill	76
Cumberland	209	Snyder	20
Dauphin	185	Somerset	95
Delaware	282	Sullivan	8
Elk	88	Susquehanna	114
Erie	41	Tioga	20
Fayette	96	Union	50
Forest	11	Venango	20
Franklin	90	Warren	37
Fulton	21	Washington	75
Greene	24	Wayne	161
Huntingdon	43	Westmoreland	445
Indiana	93	Wyoming	63
Jefferson	155	York	456
Juniata	36	Total	8413

Source: PA-NEDSS

LD Case Characteristics

Nationally, LD is more commonly diagnosed in males. This pattern was seen in the 2022 Pennsylvania LD data as well; 60% of cases were reported in males. 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 2 shows the sex distribution of LD cases in 2022.

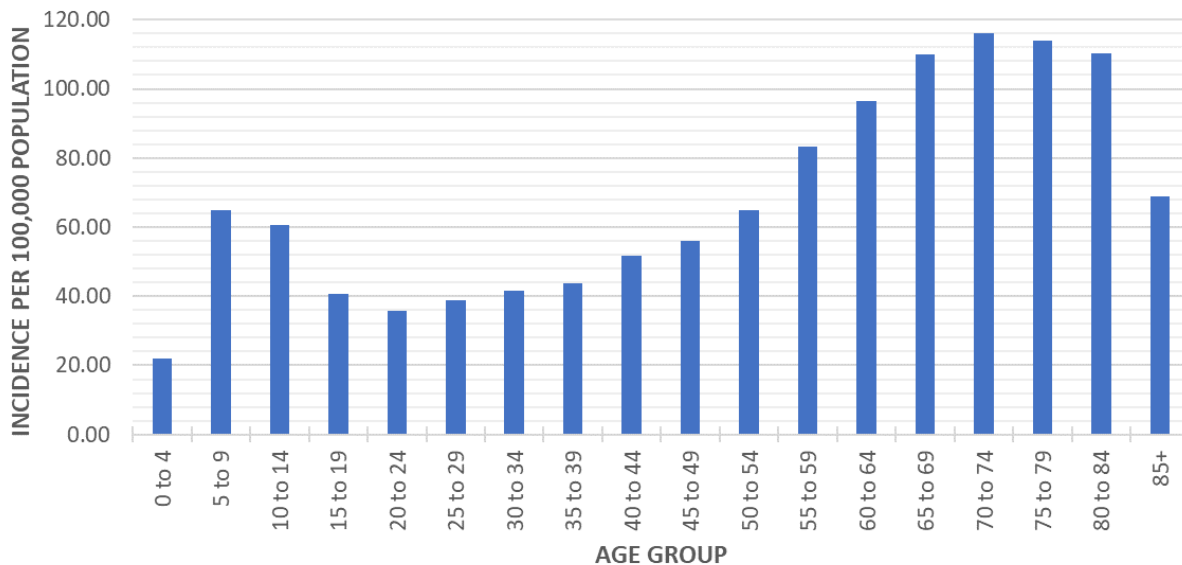
Figure 2 – Lyme Disease by Sex, Pennsylvania, 2022



Source: PA-NEDSS

LD incidence was highest in children ages 5–9 and in older adults, ages 55-84. This is consistent with national trends. Hypotheses for this trend include children in the 5–9 year age group being more likely to play outside, are lower to the ground, may cuddle more with pets who might have ticks, are more likely to play in leaves and tall grass, and may be less likely to notice and report an attached tick. 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 LD-related symptoms, increased time post-retirement to participate in outdoor leisure activities, such as dog walking, gardening, bird watching, and nature walks, or higher likelihood of testing due to overlap of LD and health concerns associated with typical aging. The age-adjusted LD incidence for 2022 is 67.8 cases per 100,000 persons. Figure 3 displays the incidence of LD by age groups in 2022.

Figure 3 – Lyme Disease Incidence by Age Group, Pennsylvania, 2022



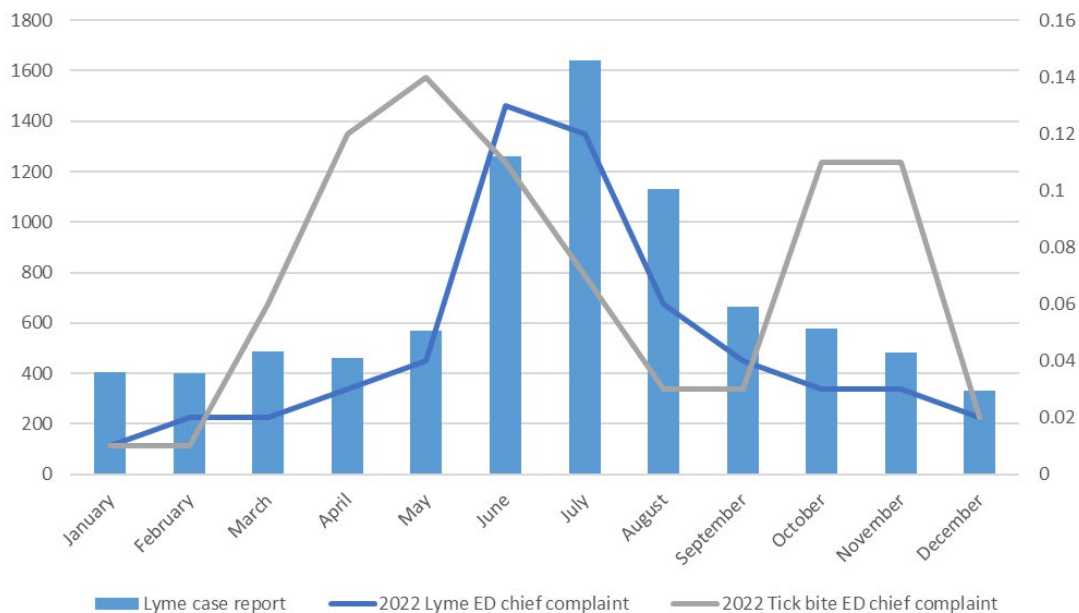
Source: PA-NEDSS; DOH, Bureau of Vital Statistics

Emergency Department Surveillance Data

A review of syndromic emergency department (ED) surveillance data typically shows an increase in visits attributed to tick bites occurring in April each year when weather warms and people were more likely to spend time outdoors. This pattern is seen in the 2022 syndromic surveillance data. Spring tick bites are typically attributed to adult *Ixodes scapularis* and adult *Dermacentor variabilis* (dog ticks). *Ixodes scapularis* nymphs emerge in late spring and early summer. Tick bite complaints, which are inclusive of several species of ticks, are 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 2022 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 4 shows the timing of tick-related and LD complaints reported in Pennsylvania emergency departments in 2022.

Figure 4 – Tick and Lyme Related Emergency Department Chief Complaints, Pennsylvania, 2022



Source: Health Monitoring Systems; PA-NEDSS

Impact of 2022 Lyme Disease Case Definition

Due to the change in the LD case definition that began on January 1, 2022, case counts increased significantly from 2021 when LD cases required both laboratory and symptom data to be considered when assigning a case classification. Eliminating the symptom portion may mean some non-LD cases will be included in the final case counts, but offsetting this are the cases diagnosed on symptoms alone without any laboratory data. The case definition will not capture the exact number of LD cases in Pennsylvania, but it is an estimate of cases and will be useful for monitoring trends in LD cases. In addition, symptom data will no longer be captured and published. Onset dates will also no longer be analyzed; the date of report to the DOH will be used instead. As a result, the peak reporting period is likely to shift slightly towards later in the year as there is a lag between symptom onset and date of report to DOH.

Tickborne Rickettsial Infections 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, although an all-time high of 57 ehrlichiosis cases was seen in 2022. Anaplasmosis, on the other hand, was infrequently reported a decade ago but has increased steadily to a high of 683 cases in 2021 and decreasing in 2022 to 581 cases.

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.⁹ This increase in geographic range likely accounts for the increase in *I. scapularis* transmitted infections like anaplasmosis. The high number of ehrlichiosis cases in 2022 may be a result of increased geographic range of lone star ticks or may be due to increased awareness of the disease by healthcare providers. In 2022, Pennsylvania reported 581 anaplasmosis cases, 57 ehrlichiosis cases and <5 SFR cases. Table 3 shows the case counts of these 3 tickborne diseases over the last 10 years.

Table 3 – Anaplasmosis, Ehrlichiosis and SFR Case Counts, Pennsylvania, 2013–2022

Year	Anaplasmosis	Ehrlichiosis	Spotted Fever Rickettsiosis
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
2020	216	*	*
2021	683	15	8
2022	581	57	*

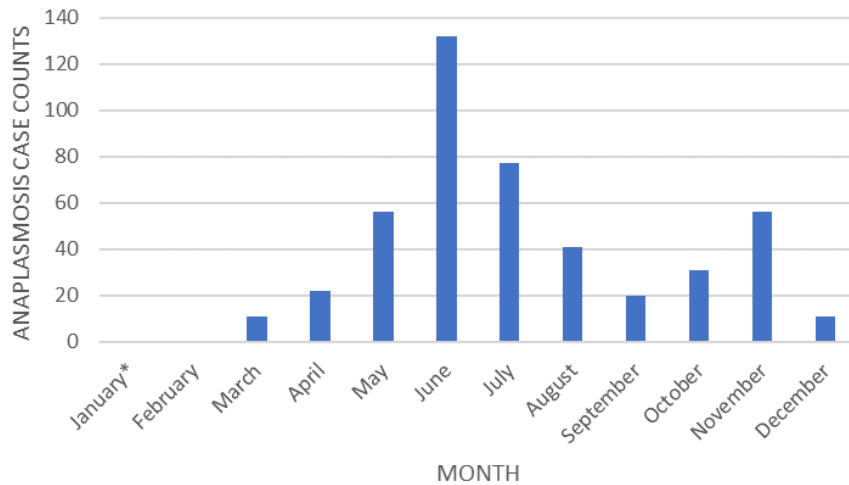
Source: PA-NEDSS

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

Seasonality

Onset months of tickborne rickettsial infections cases differ slightly from typical onset months of LD. 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. Like LD, anaplasmosis cases are more likely to report onset dates in the warm months of May through July. Unlike LD, there is also another smaller peak of 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 more likely to transmit anaplasmosis than LD, possibly due to a shorter attachment time needed to transmit anaplasmosis from tick to host. Most ehrlichiosis cases report onset in May through August. However, SFR cases most commonly report onset in July through August. Figure 5 shows the 2022 cases of anaplasmosis cases by month of report. Ehrlichiosis and SFR are transmitted by *A. americanum* and *D. variabilis*, respectively, which have different life cycles than *I. scapularis*.

Figure 5 – Anaplasmosis Case Counts by Month of Onset, Pennsylvania, 2022



Missing = 122

Source: PA-NEDSS

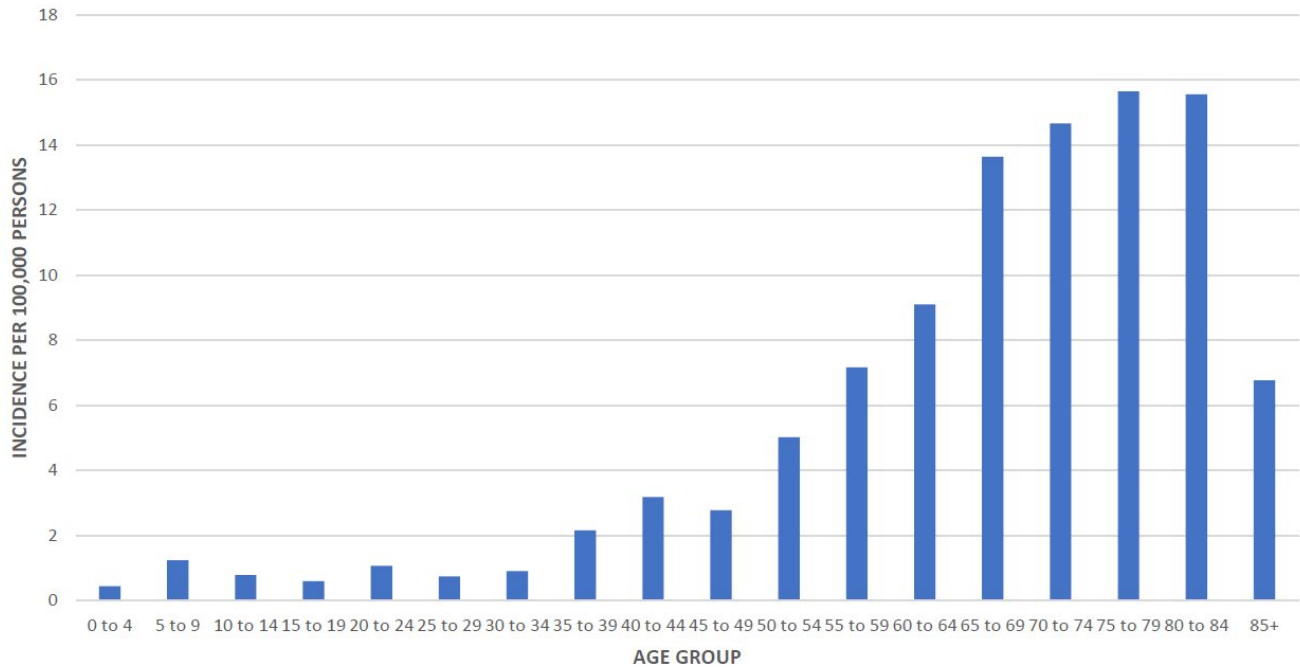
*Case counts <5 have been redacted to help protect patient confidentiality, in accordance with DOH policy.

Case Characteristics

Like LD, males are more likely than females to report these other tickborne diseases, with 64.0% of cases occurring in males. In both anaplasmosis and spotted fever rickettsiosis, we see more males than females affected, 64.5% and 100.0%, respectively. However, for ehrlichiosis, we see a slightly lower proportion in males, 56.1%.

In LD, we see a high incidence in children (ages 5-9) and older adults (ages 55-84). However, in tickborne rickettsial infections 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, but it may be due to more severe symptoms in older age and a higher susceptibility to tickborne diseases. Figure 6 shows the number of cases per 100,000 in each age category.

Figure 6 – Anaplasmosis, Ehrlichiosis and SFR Incidence by Age Group per 100,000 Persons, Pennsylvania, 2022

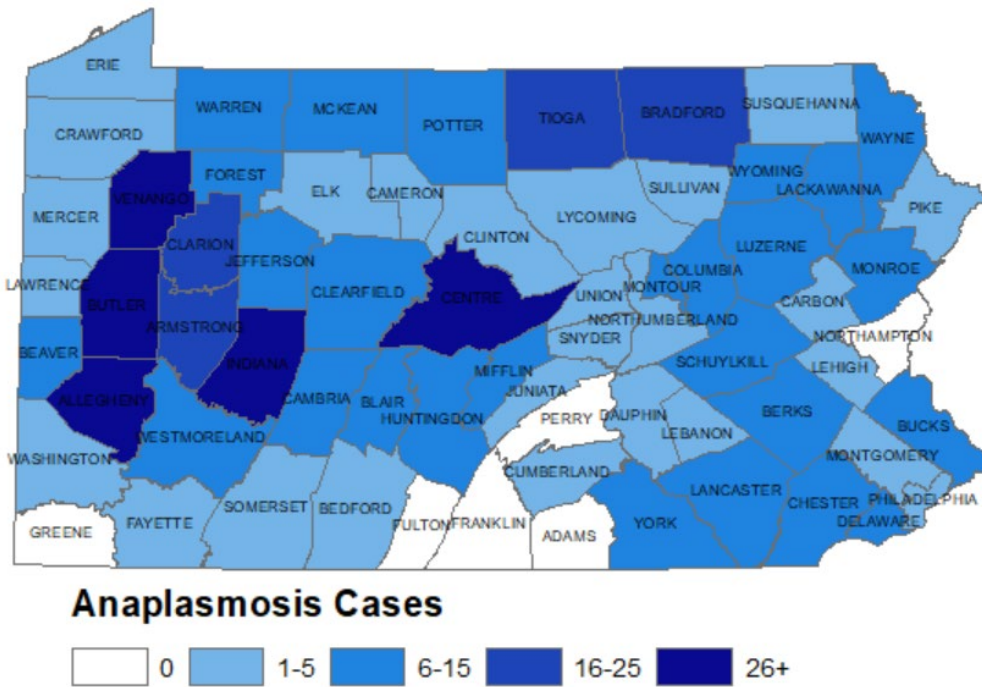


Source: PA-NEDSS and DOH Bureau of Vital Statistics

Geographic Distribution

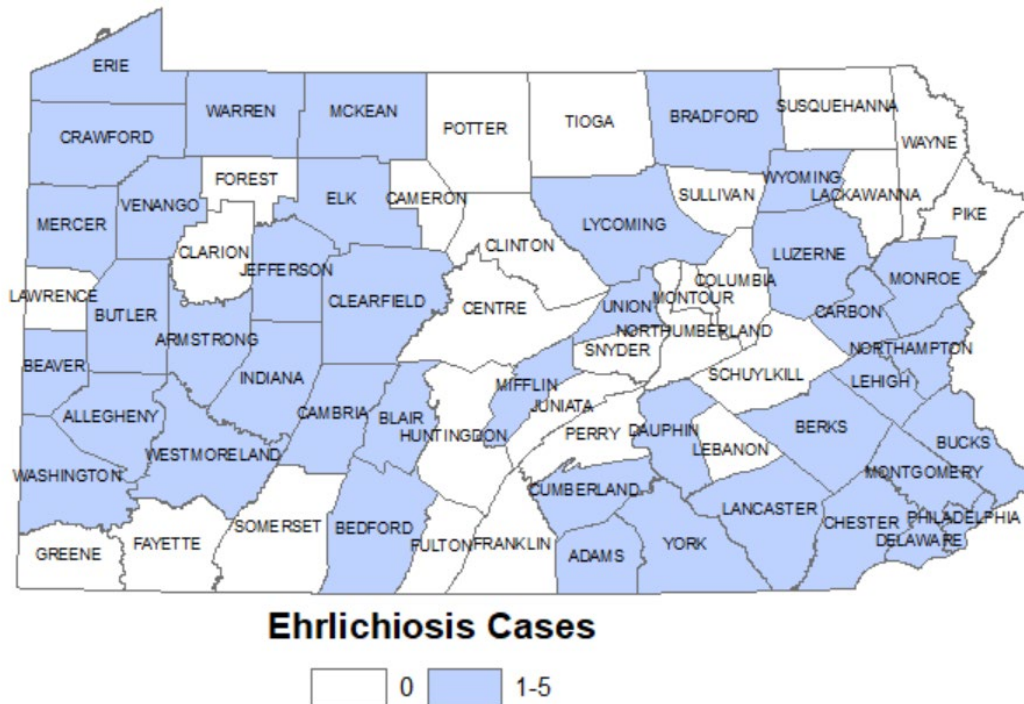
In 2022, 63 of 67 (94%) counties reported at least one case of anaplasmosis, ehrlichiosis, or SFR. The highest number of cases are reported in the eastern counties of the state. This is primarily driven by anaplasmosis, which has had high numbers of cases in the northeastern counties. Case counts have 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. Map 2 shows anaplasmosis cases by county in 2022. Map 3 shows ehrlichiosis cases by county in 2022 and Map 4 shows SFR cases by county in 2022.

Map 2 – Anaplasmosis Cases by County, Pennsylvania, 2022



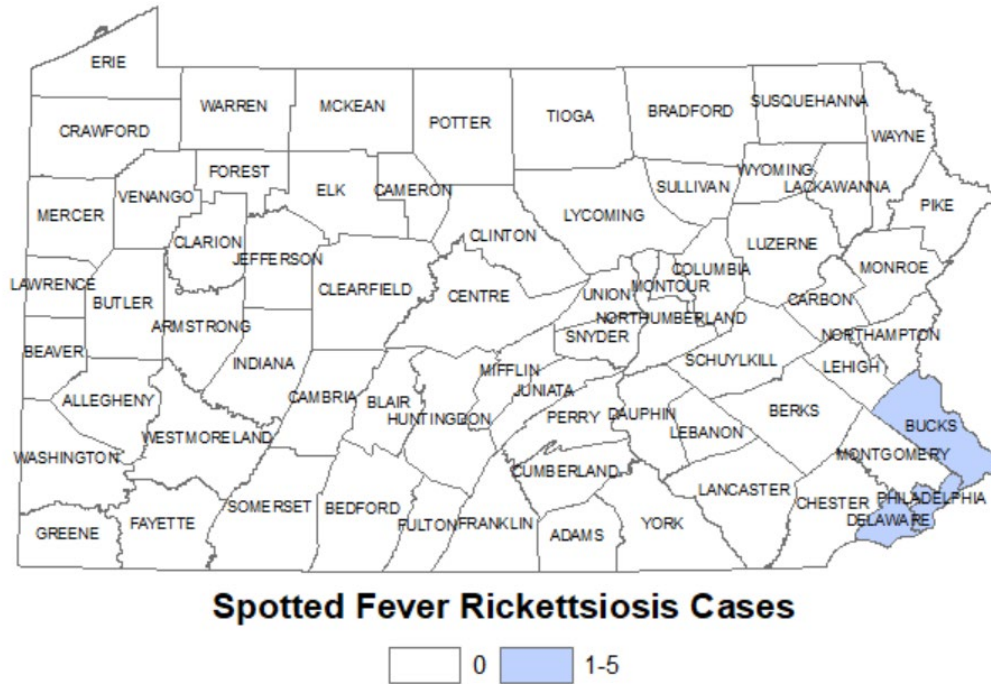
Source: PA-NEDSS

Map 3 – Ehrlichiosis Cases by County, Pennsylvania, 2022



Source: PA-NEDSS

Map 4 – Spotted Fever Rickettsiosis Cases by County, Pennsylvania, 2022



Source: PA-NEDSS

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; however, it is unclear if the increase in case counts is associated with true case burden or due to labs and facilities opting to report more cases. In 2022, 92 babesiosis cases were reported in the state. Table 4 shows the babesiosis case counts for the last ten years.

Table 4 – Babesiosis Case Counts, Pennsylvania, 2013–2022

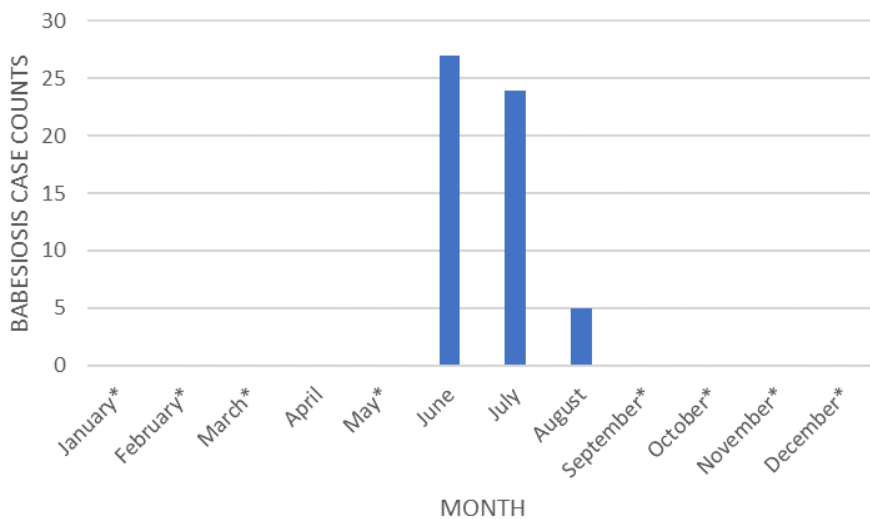
Year	Babesiosis
2013	25
2014	11
2015	45
2016	36
2017	81
2018	72
2019	68
2020	40
2021	104
2022	92

Source: PA-NEDSS

Seasonality

Since babesiosis is transmitted by the *I. scapularis* tick, the seasonality of babesiosis is similar to that of LD, with most cases reporting onset in June and July. There are also high case numbers in August which may be due to a longer incubation period which may last up to four weeks. Figure 7 shows the onset month of babesiosis cases for 2022.

Figure 7 – Babesiosis Case Counts by Month of Onset, Pennsylvania, 2022



Source: PA-NEDSS

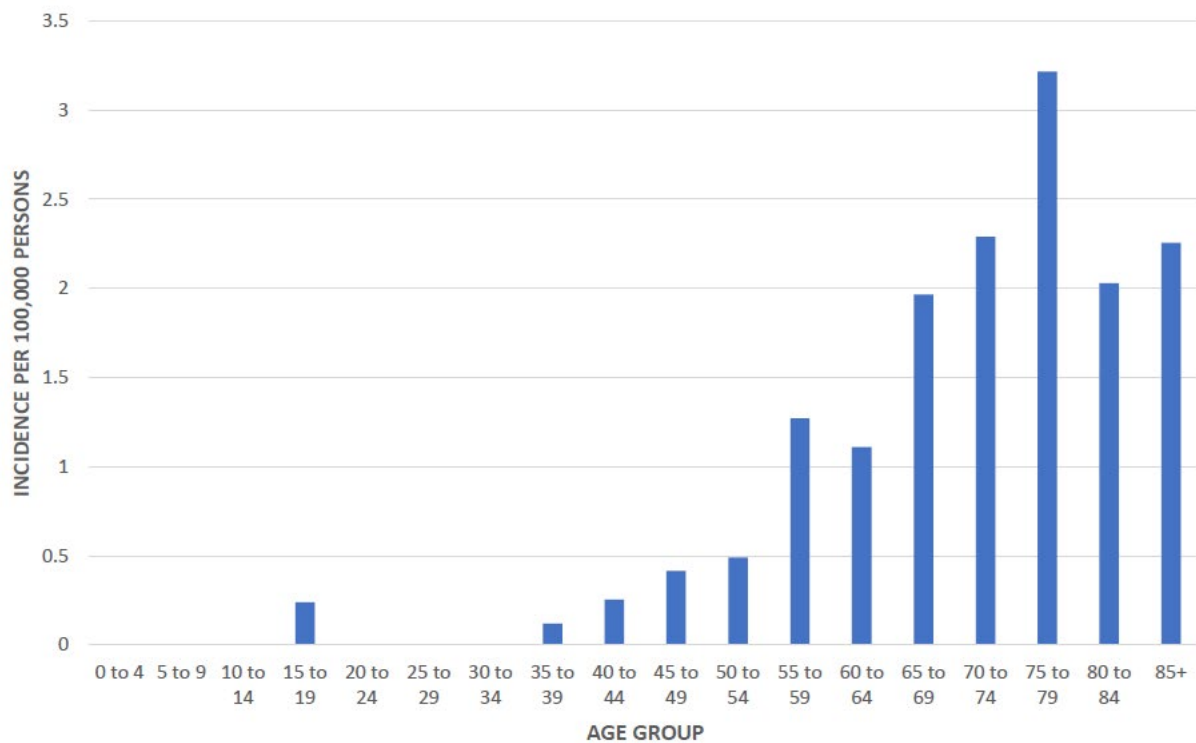
*Case counts <5 have been redacted to help protect patient confidentiality, in accordance with Pa. DOH policy.

Case Characteristics

Like LD, males are more likely than females to report babesiosis, with 60.9% of cases occurring in males.

However, in contrast with LD but consistent with tickborne rickettsial infections, 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 8 shows the number of cases per 100,000 in each age category.

Figure 8 – Babesiosis Incidence by Age Group per 100,000 Persons, Pennsylvania, 2022

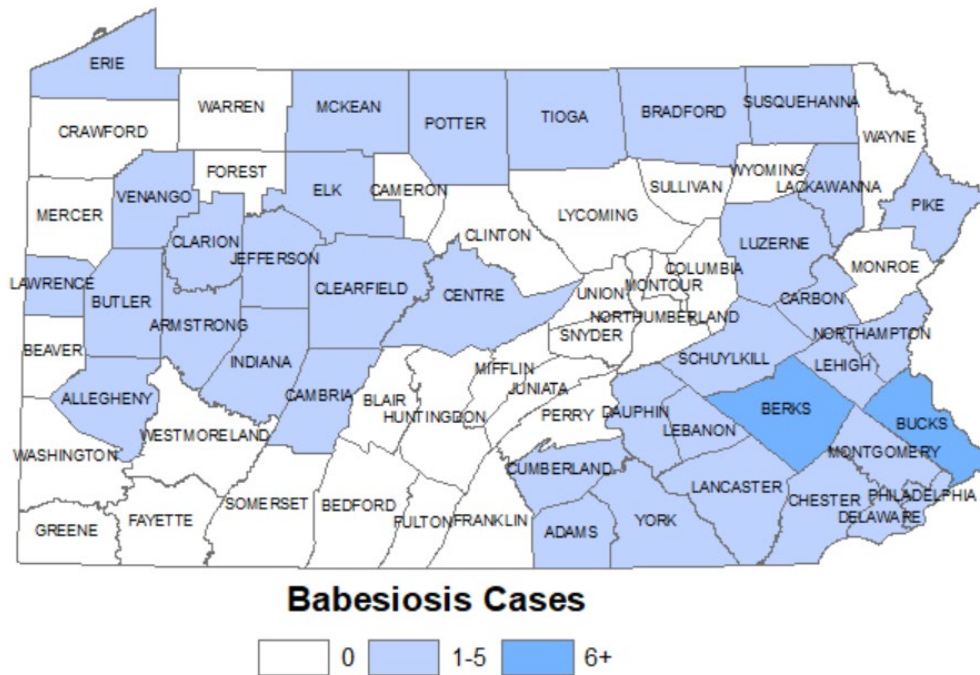


Source: PA-NEDSS and DOH Bureau of Vital Statistics

Geographic Distribution

In 2022, 37 of 67 (55%) counties reported at least one case of babesiosis. The highest number of cases are reported in the southeastern counties of the state. Map 5 shows babesiosis cases by county in 2022.

Map 5 – Babesiosis Cases by County, Pennsylvania, 2022



Source: PA-NEDSS

Behavioral Risk Factor Surveillance System (BRFSS) Findings

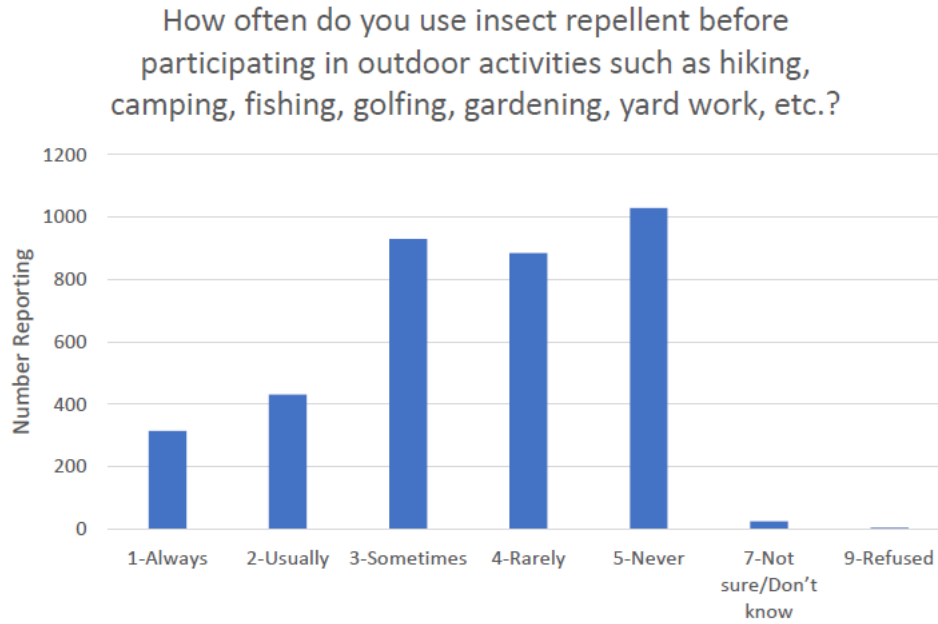
Pennsylvania participates in the Behavioral Risk Factor Surveillance System (BRFSS) survey. This phone-based survey is conducted with randomly selected residents to identify a variety of health-related risk behaviors, chronic illnesses, and healthcare use. In 2022, three tickborne disease related questions were asked on the Pennsylvania BRFSS survey for the first time. The questions were:

- How often the respondent uses insect repellent?
- How often does the respondent conduct tick checks?
- Did the respondent find a tick on their body in the prior year?

These data were analyzed to better understand risks for tickborne diseases in Pennsylvania.

BRFSS survey respondents were asked “How often do you use insect repellent before participating in outdoor activities such as hiking, camping, fishing, golfing, gardening, yard work, etc.?” The highest number of respondents (28.4%) stated they never use insect repellent before participating in these activities, followed by 25.7% who stated they sometimes use insect repellent. Figure 9 shows the responses to this question.

Figure 9 – BRFSS Survey Response, Pennsylvania, 2022



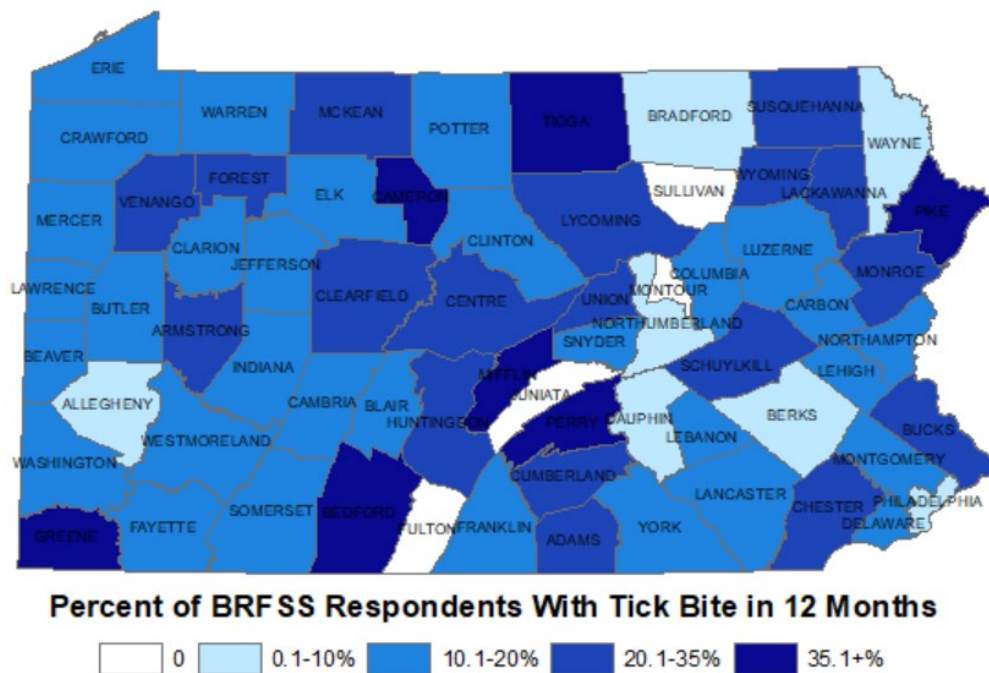
BRFSS survey respondents were asked, “After participating in such outdoor activities, how often do you inspect yourself for ticks?” The highest number of respondents (30.8%) stated they always conduct tick checks after participating in outdoor activities, followed by 20.1% who stated they never conduct tick checks. Figure 10 shows the responses to this question.

Figure 10 – BRFSS Survey Response, Pennsylvania, 2022



BRFSS survey respondents were asked, “In the past 12 months, have you found one or more ticks on yourself?” About 1 out of 6 respondents (14.6%) stated they had found at least one tick on them in the prior year. Extrapolated to the general Pennsylvania population, this would represent about 1,893,913 persons who experienced at least one tick bite. Map 6 shows the county distribution of ticks found on BRFSS respondents.

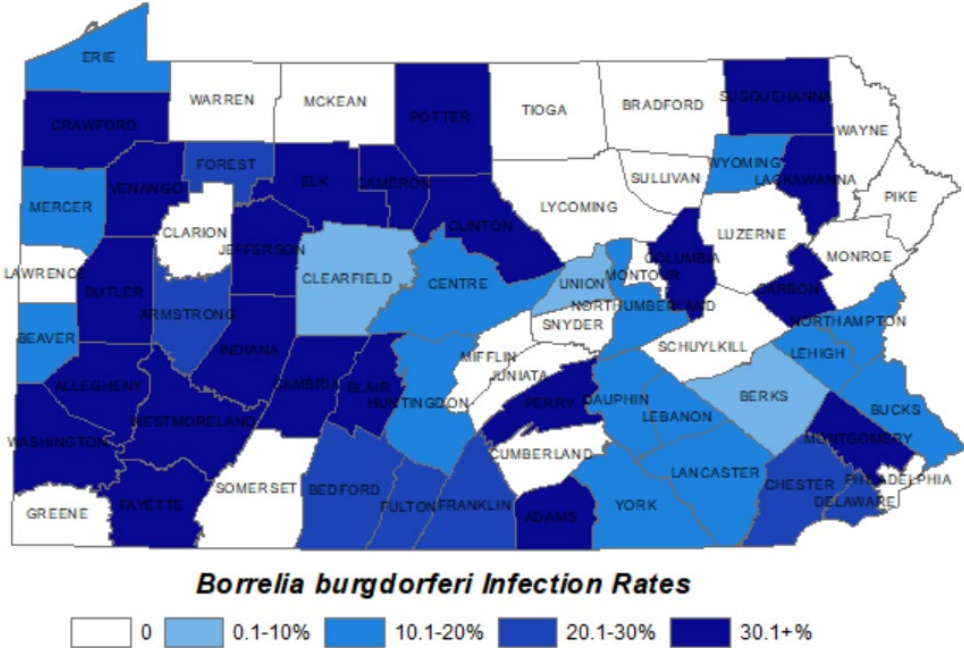
Map 6 – BRFSS Ticks Found on Self County Distribution, Pennsylvania, 2022



Tick Surveillance Findings

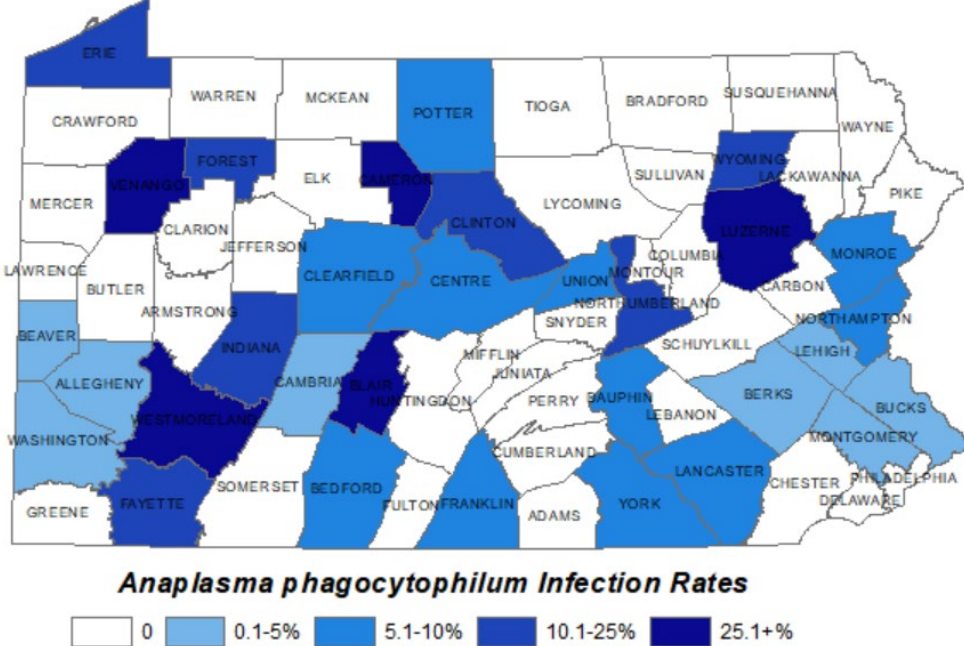
Beginning in the fall of 2018, the Pennsylvania Department of Environmental Protection (DEP) began a robust tick surveillance program. This program involved collecting a minimum of 50 *Ixodes scapularis* ticks from each county from at least two sites per county per season. These ticks were tested for the primary *I. scapularis* pathogens to understand the infection rate of the disease vector. During the 2022 nymphal *I. scapularis* season (late April through late July), 1,445 nymphal *Ixodes scapularis* ticks were collected from all 67 Pennsylvania counties. Of these, 1,431 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). Among the ticks tested, statewide *B. burgdorferi* infection rates were 24.5%. *A. phagocytophilum* infection rates were 5.4%. *B. microti* infection rates were 3.1% which is double the *B. microti* infection rates found in prior years. Maps 7–9 show the county infection rates of the nymph *I. scapularis* ticks collected in 2022.

Map 7 – *Borrelia burgdorferi* Infection Rates in Nymph *Ixodes scapularis* by County, Pennsylvania, 2022



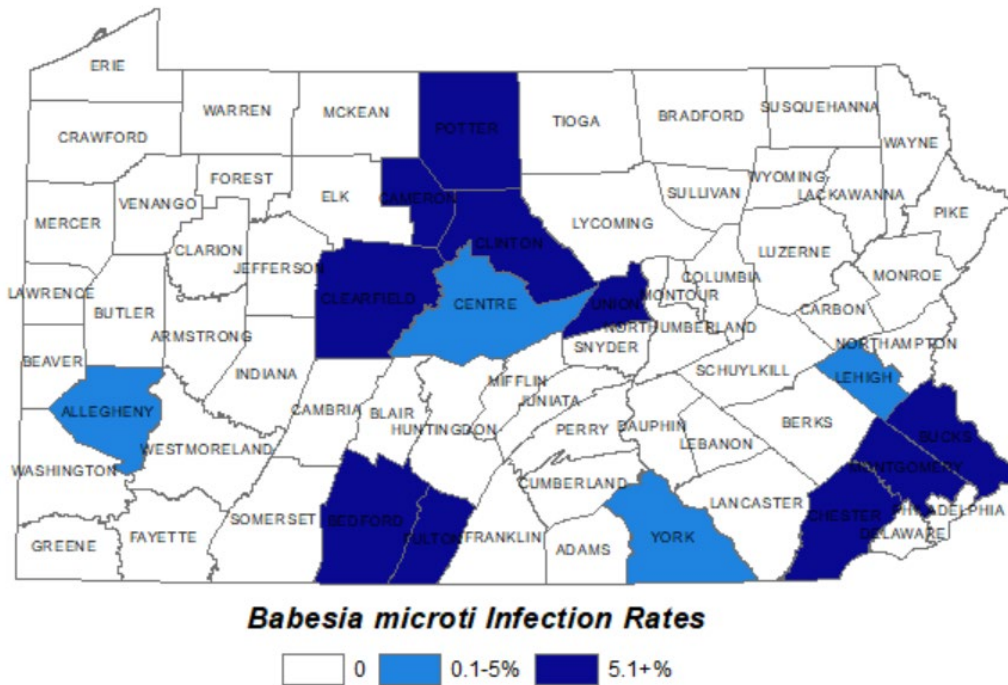
Source: Department of Environmental Protection

Map 8 – *Anaplasma phagocytophilum* Infection Rates in Nymph *Ixodes scapularis* by County, Pennsylvania, 2022



Source: Department of Environmental Protection

Map 9 – *Babesia microti* Infection Rates in Nymph *Ixodes scapularis* by County, Pennsylvania, 2022

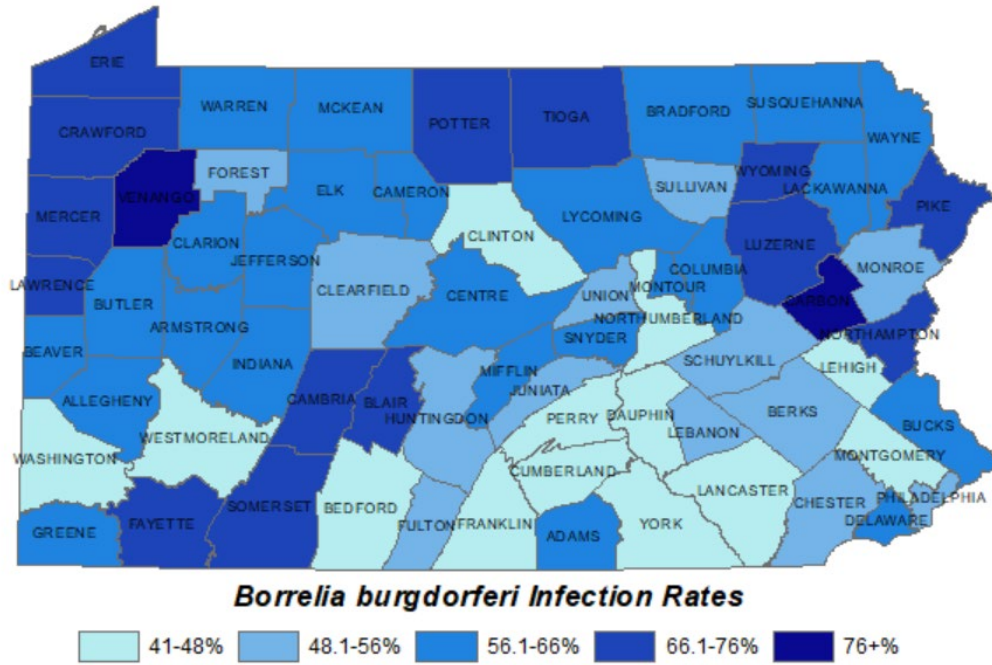


Source: Department of Environmental Protection

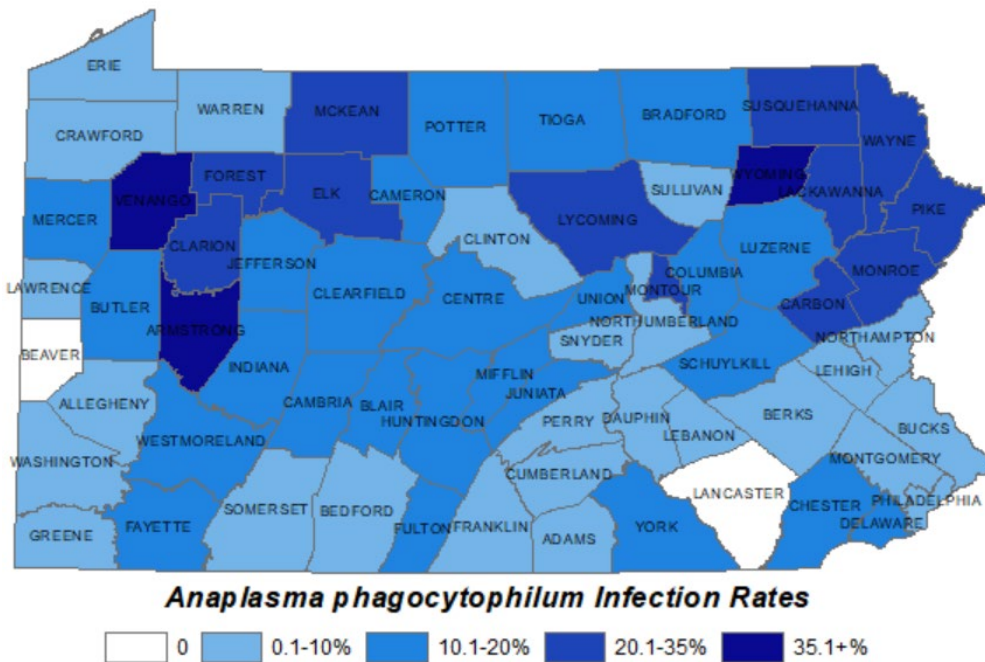
During the 2022–2023 adult *I. scapularis* season (October 2022 through April 2023), 4,795 adult *Ixodes scapularis* ticks were collected from all 67 Pennsylvania counties. Of these, 3,531 were tested for both common and rare or emerging *I. scapularis* pathogens including *Borrelia burgdorferi* (the bacteria that causes LD), *Anaplasma phagocytophilum* (the bacteria that causes anaplasmosis), *Babesia microti* (the parasite that causes babesiosis), and Powassan virus. Rarer pathogens are more difficult to find in nymphs, as nymphs have only taken one blood meal from an animal that may be a reservoir for a bacterial, parasitic, or viral pathogen. Adult ticks that have taken two blood meals have about twice the likelihood of being infected with a pathogen.

Among the ticks tested, statewide *B. burgdorferi* infection rates were 59.5%, *A. phagocytophilum* infection rates were 15.0% and *B. microti* infection rates were 5.9% (about double previous rates) and Powassan virus infection rates were 1.2%. In four counties in 2022–2023, small areas with high Powassan virus infection rates were identified. Tick mitigation consistent with established methods was conducted in these areas. Mitigation efforts included cutting back overgrown weeds and shrubs, clearing leaves and brush and more clearly separating human and pet use areas from nonuse areas. Maps 10–13 show the county infection rates of the adult *I. scapularis* ticks collected between 2022–2023.

Map 10 – *Borrelia burgdorferi* Infection Rates in Adult *Ixodes scapularis* by County, Pennsylvania, 2022–2023

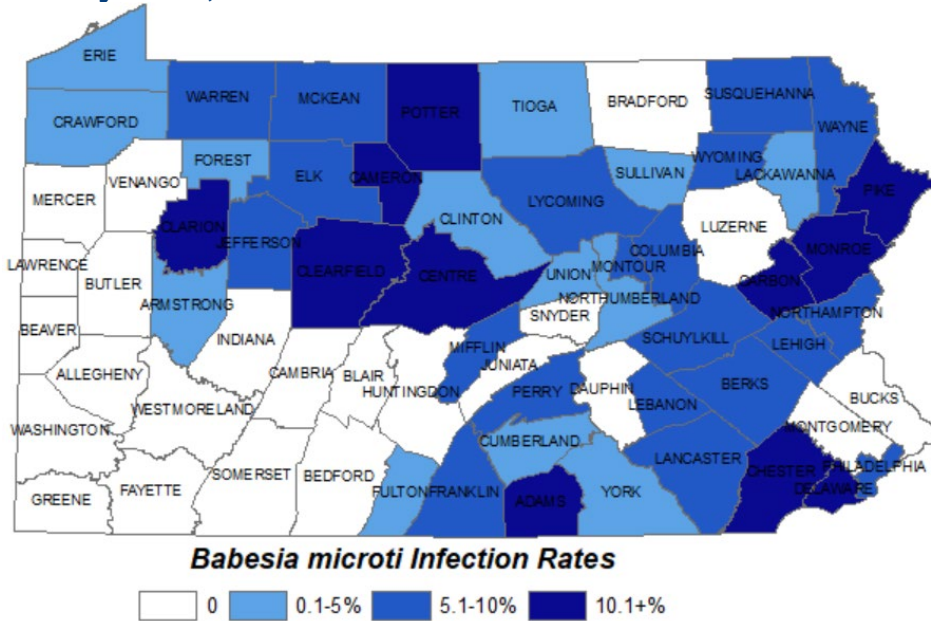


Map 11 – *Anaplasma phagocytophilum* Infection Rates in Adult *Ixodes scapularis* by County, Pennsylvania, 2022–2023



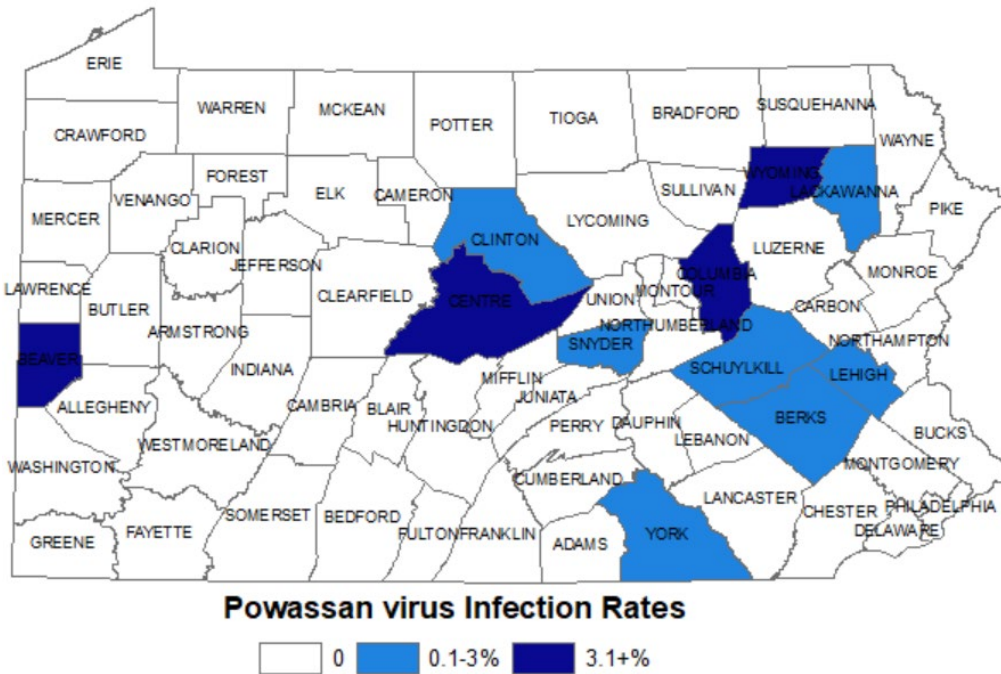
Source: Department of Environmental Protection

Map 12 – *Babesia microti* Infection Rates in Adult *Ixodes scapularis* by County, Pennsylvania, 2022–2023



Source: Department of Environmental Protection

Map 13 – Powassan Virus Infection Rates in Adult *Ixodes scapularis* by County, Pennsylvania, 2022–2023



Source: Department of Environmental Protection

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