

# 2017 Lyme and Other Tickborne Diseases Surveillance Report

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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.<sup>1</sup> Early symptoms, typically occurring in the first 3 to 30 days after a tick bite, include fever, headache and a rash with a distinctive bull's eye shape known as erythema migrans (EM). The classic 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.<sup>2</sup>

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 2015, only 14 states reported 95% of all LD cases. In 2017, the last year for which there are national data, Pennsylvania reported more LD cases than any other state. Pennsylvania had the third highest incidence of LD per 100,000 following Maine and Vermont in 2017.<sup>3,4</sup> 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 and 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*).<sup>5,6,7</sup>

## Overview

In 2017, 11,900 LD cases were reported in Pennsylvania, representing an incidence of 93.1 cases/100,000 persons. Most were reported in the summer months. All counties in Pennsylvania reported LD, ranging from 14 cases in Montour county to 658 cases in Butler county. Incidence ranged from 12.6 cases/100,000 persons in Philadelphia county to 658.0 cases/100,000 persons in Jefferson county.

In 2017, Pennsylvania reported 94 anaplasmosis cases, 19 ehrlichiosis cases and 28 SFR cases.

## Methods

In Pennsylvania, suspect 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.<sup>8</sup> 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 Center for Disease Control and Prevention's (CDC) surveillance case definition. In addition, for LD, a computer algorithm is used to ensure that cases are classified correctly. CDC case definitions, which are designed for consistency in case counting and are not intended for diagnostic purposes, can be found at <https://wwwn.cdc.gov/nndss/case-definitions.html>.

Cases that were designated as confirmed or probable according to the 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 this data via the EpiCenter application by Health Monitoring Systems. EpiCenter collects de-identified data from most hospitals in Pennsylvania to monitor for chief complaint trends. In 2017, data regarding date and reason for visit, home zip code, and other information were obtained from over 90% 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 2017, 11,900 LD cases were reported in Pennsylvania. This represents an incidence of 92.9 cases/100,000 persons in Pennsylvania and was a 4% increase from the 2016 case count. In 2017, Pennsylvania reported 28% of all LD cases in the United States and ranked first in number of cases reported and third in incidence. Reported cases and incidence of Lyme disease have been increasing nationally as well. This may be due to expanded habitat for *Ixodes scapularis* and white-footed mice, which also harbor the *Borrelia burgdorferi* bacteria. Additionally, *Ixodes scapularis* ticks are more likely to survive winter as the weather warms. Humans are also spreading into rural areas to build homes and participate in leisure activities, making human and tick contact more frequent. 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, 2008-2017**

Year	Lyme Disease Case Count			Population	Lyme Disease Incidence per 100,000
	Confirmed	Probable	Total		
2008	3818	173	3991	12,448,279	32.06
2009	4950	772	5722	12,604,767	45.40
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

Source: PA-NEDSS; Pa. 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 2017, 48.6% of cases reported that their onset of LD symptoms was in June or July. More people spend time outdoors and are more likely to come into 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 before they are able to transmit Lyme bacteria. 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, 2017**

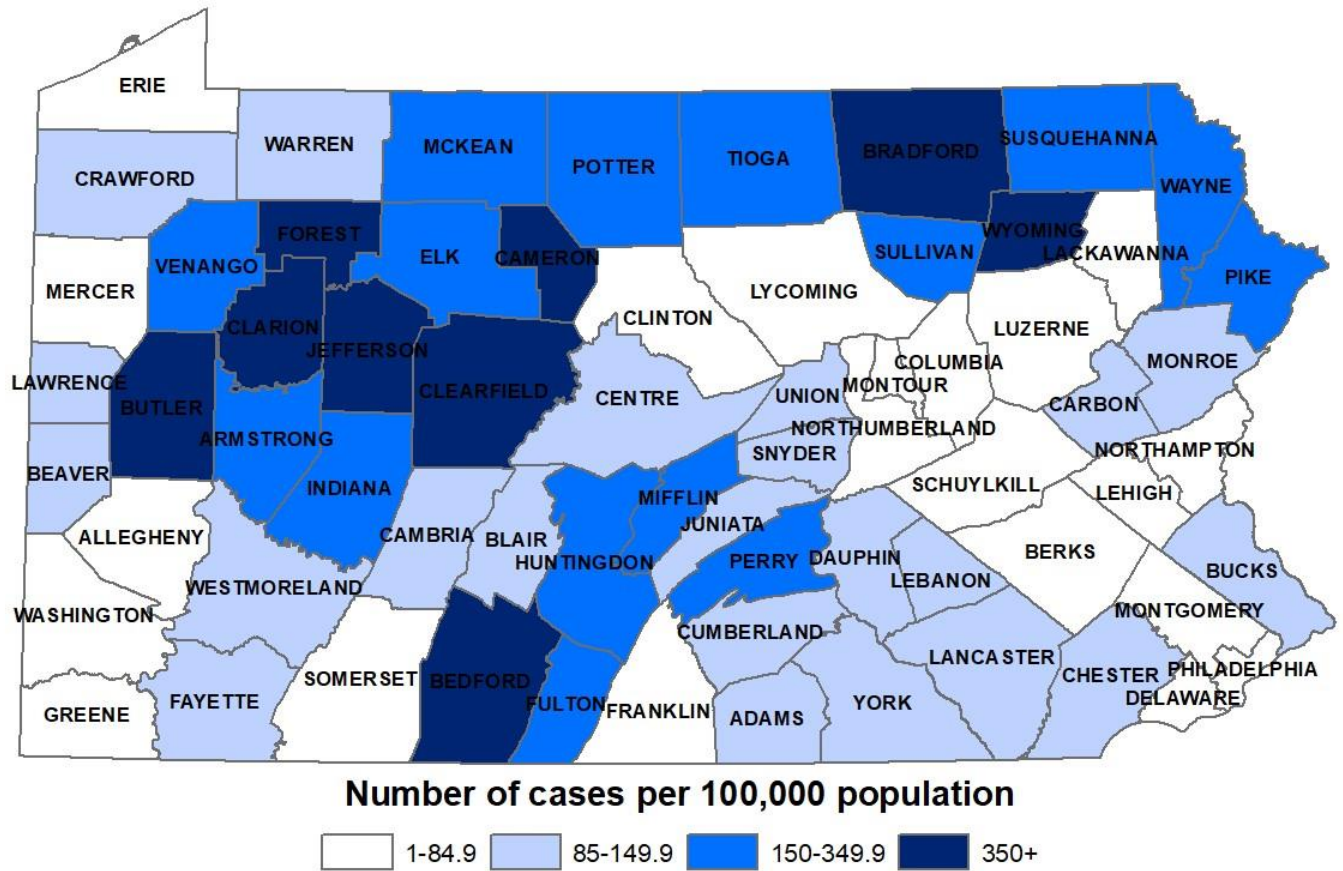
<b>Month</b>	<b>Confirmed Cases</b>	<b>Probable Cases</b>	<b>Total</b>
January	252	116	368
February	213	83	296
March	237	147	384
April	330	140	470
May	790	262	1052
June	2462	534	2996
July	2317	472	2789
August	1017	305	1322
September	543	186	729
October	525	189	714
November	335	124	459
December	229	92	321
<b>Total</b>	<b>9250</b>	<b>2650</b>	<b>11900</b>

Source: PA-NEDSS

### Geographic Distribution

*Ixodes scapularis* ticks are found in all counties in Pennsylvania, and *Ixodes scapularis* ticks have been found to be infected with *Borrelia burgdorferi* in all 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 other 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 2017, counties in the northwest area of the state reported the highest incidence of LD. Map 1 shows the county incidence of LD cases in 2017. Table 3 shows the case counts by county in 2017.

**Map 1 – Lyme Disease Incidence per 100,000 by County, Pennsylvania, 2017**



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

**Table 3 – Lyme Disease Case Counts by County, Pennsylvania, 2017**

<b>County</b>	<b>Lyme Disease Case Count</b>	<b>County</b>	<b>Lyme Disease Case Count</b>
Adams	144	Lackawanna	126
Allegheny	432	Lancaster	564
Armstrong	215	Lawrence	82
Beaver	211	Lebanon	160
Bedford	175	Lehigh	296
Berks	142	Luzerne	182
Blair	167	Lycoming	71
Bradford	245	McKean	127
Bucks	563	Mercer	75
Butler	658	Mifflin	104
Cambria	173	Monroe	175
Cameron	22	Montgomery	532
Carbon	74	Montour	14
Centre	179	Northampton	178
Chester	628	Northumberland	48
Clarion	198	Perry	106
Clearfield	323	Philadelphia	197
Clinton	28	Pike	92
Columbia	51	Potter	48
Crawford	85	Schuylkill	61
Cumberland	238	Snyder	47
Dauphin	240	Somerset	60
Delaware	389	Sullivan	18
Elk	90	Susquehanna	129
Erie	121	Tioga	85
Fayette	130	Union	48
Forest	30	Venango	147
Franklin	109	Warren	53
Fulton	34	Washington	172
Greene	29	Wayne	113
Huntingdon	143	Westmoreland	507
Indiana	183	Wyoming	99
Jefferson	290	York	411
Juniata	34	<b>Total</b>	<b>11900</b>

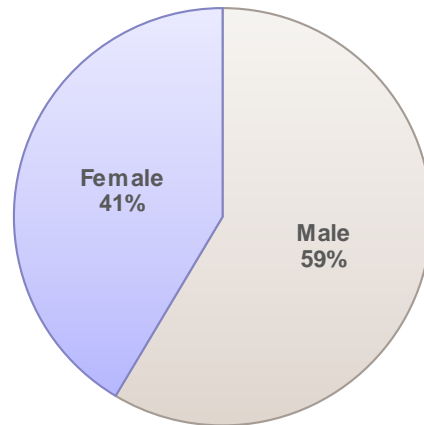
Source: PA-NEDSS



## LD Case Characteristics

Nationally, LD is more commonly diagnosed in males. This pattern was seen in the 2017 Pennsylvania LD data as well, with males comprising 59% 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 which require work outdoors. Figure 1 shows the sex distribution of LD cases in 2017.

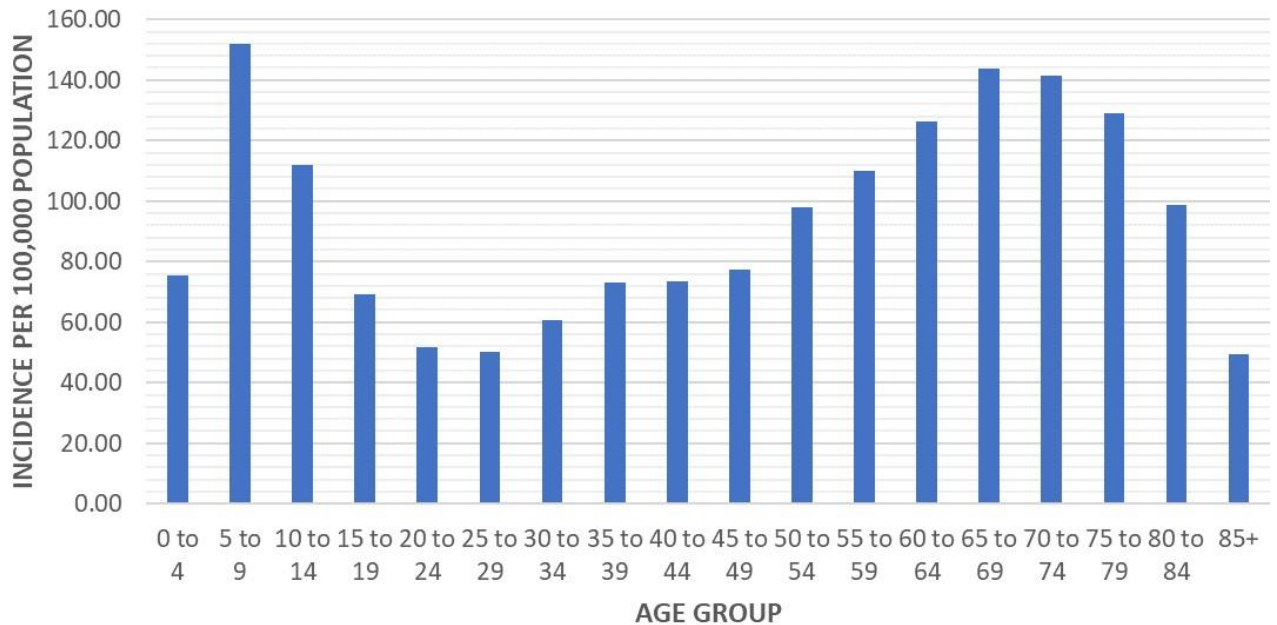
**Figure 1 – Lyme Disease by Sex, Pennsylvania, 2017**



Source: PA-NEDSS

LD incidence was highest in children ages 5-9 and in older adults. This is consistent with national trends. Children in the 5-9 year age group are more likely to play outside, are lower to the ground, may cuddle more with pets, 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, an increased likelihood to seek care for Lyme disease-related symptoms, and/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 2017 is 94.0 cases per 100,000. Figure 2 displays the incidence of LD by age groups in 2017.

**Figure 2 – Lyme Disease Incidence by Age Group, Pennsylvania, 2017**



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

### Clinical Manifestations of LD

The erythema migrans rash is the most distinctive sign of LD; 48.9% 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, in fact, 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 a number of other signs and symptoms associated with different stages of LD. More serious complications of Lyme disease, 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 2017. 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, as 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, 2017**

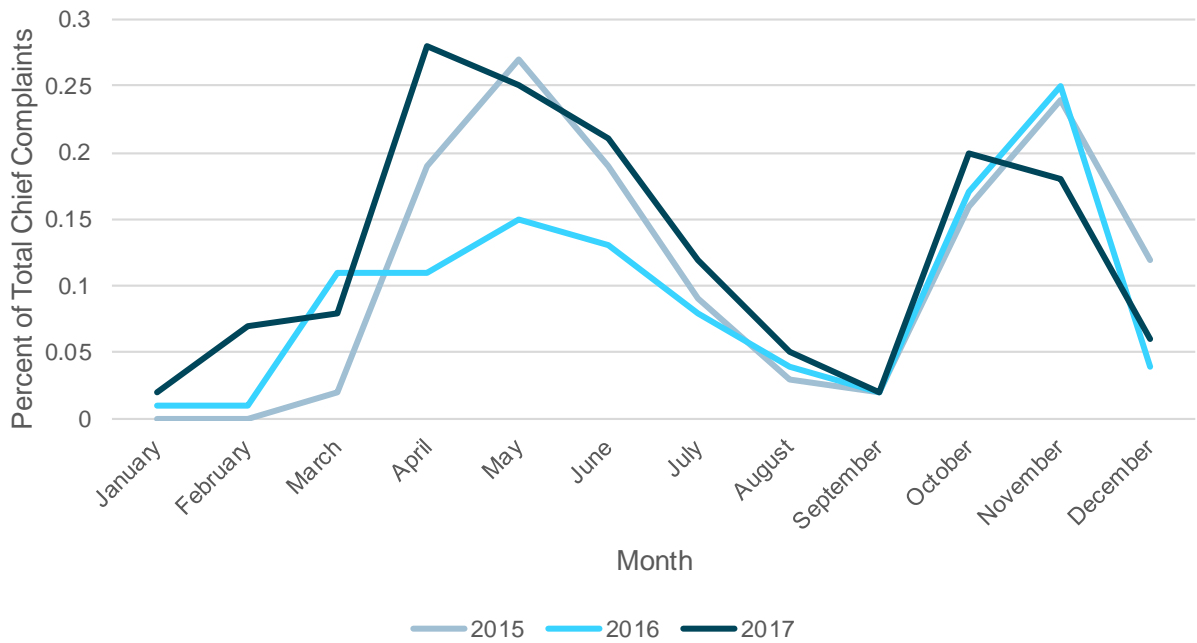
Symptom	Percent (%) Who Reported Experiencing this Symptom
Erythema migrans (EM)	48.9
Joint swelling	35.2
Bells palsy	5.6
Radiculoneuropathy	3.4
Lymphocytic meningitis	0.4
Encephalitis/Encephalomyelitis	0.4
Second or third degree atrioventricular block	0.8

Source: PA-NEDSS

### Tick Bites

A review of syndromic emergency department surveillance data revealed an increase in visits attributed to tick bites occurred in April 2017, when weather warmed and people were more likely to spend time outdoors. This is consistent with prior years. *Ixodes scapularis* nymphs emerge in late spring and early summer, which may contribute to the sustained increase in tick-related complaints through early summer. The nymphs feed until mid-summer. A decrease in tick-related complaints can be seen around this time. Adult *Ixodes scapularis* ticks feed in the fall when a second peak in tick-related emergency department complaints occurs. Figure 3 shows the timing of tick-related complaints reported in Pennsylvania emergency departments in 2015-2017.

**Figure 3 – Tick-Related Emergency Department Chief Complaints, Pennsylvania, 2015-2017**



Source: Health Monitoring Systems

# 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 94 cases in 2017. 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.<sup>8</sup> This likely accounts for the increase in *I. scapularis* transmitted infections like anaplasmosis. In 2017, Pennsylvania reported 94 anaplasmosis cases, 19 ehrlichiosis cases and 28 SFR cases. Table 5 shows the case counts of these three tickborne diseases over the last 10 years.

**Table 5 – Anaplasmosis, Ehrlichiosis and SFR Case Counts, Pennsylvania, 2008-2017**

Year	Anaplasmosis	Ehrlichiosis	Spotted Fever Rickettsiosis
2008	2	7	15
2009	2	32	23
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

Source: PA-NEDSS

## Seasonality

Very similar trends in the month of onset of TBRI are found with Lyme, with the bulk of the reports occurring in June and July. Ticks are most active in the warmer months, and people

are more likely to be outdoors and exposed to ticks during these months. Table 6 shows the 2017 cases of other tickborne diseases by month of report.

**Table 6 – Anaplasmosis, Ehrlichiosis and SFR Case Counts by Month of Onset, Pennsylvania, 2017**

Month of Onset Date	Anaplasmosis	Ehrlichiosis	Spotted Fever Rickettsiosis
January	0	0	1
February	1	0	0
March	2	0	0
April	2	2	0
May	12	4	1
June	23	1	5
July	15	3	5
August	6	1	0
September	1	0	1
October	3	2	1
November	6	1	0
December	2	0	0

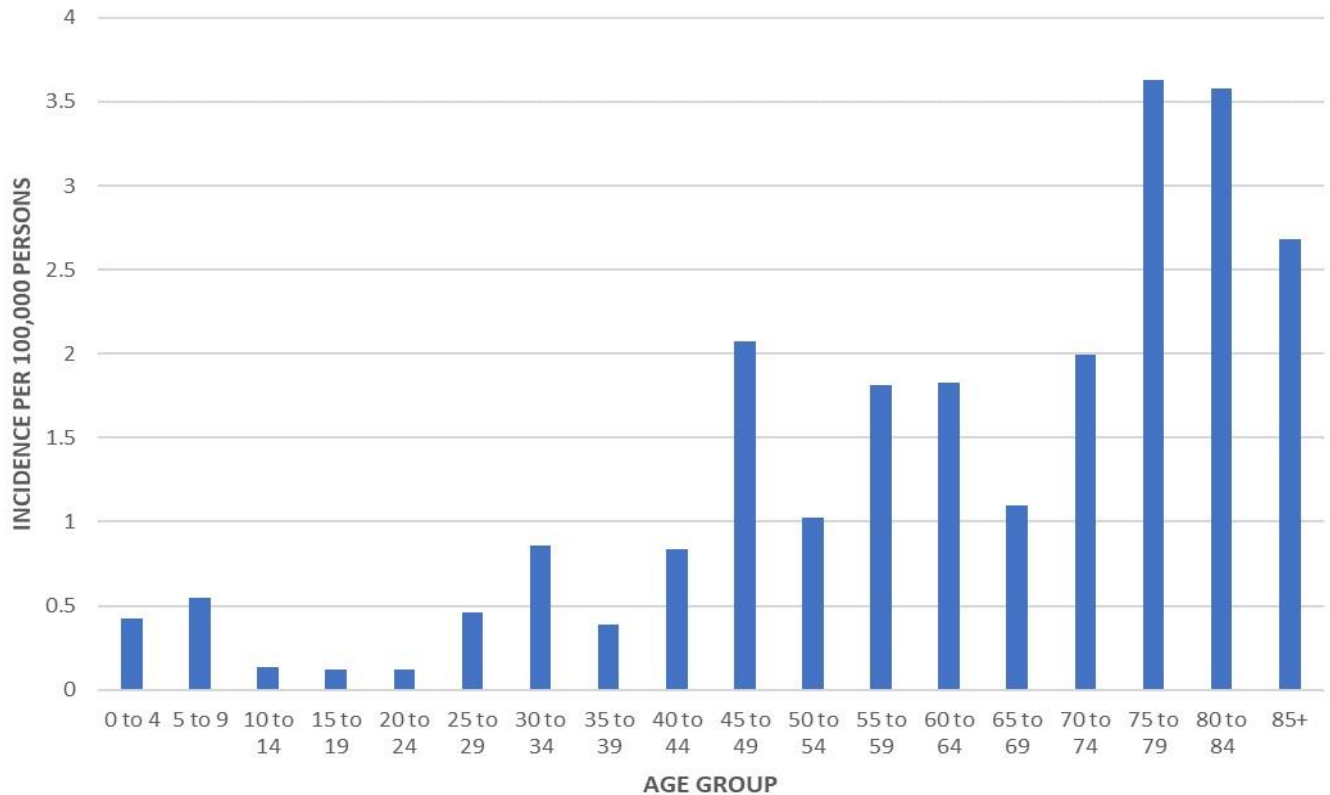
Source: PA-NEDSS

### Case Characteristics

Similar to LD, males are more likely to report these other tickborne diseases, with 59.6% of cases occurring in males.

However, in contrast to LD, 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, 2017**



Source: PA-NEDSS and Pa. DOH Bureau of Vital Statistics

### Geographic Distribution

In 2017, 38 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 eastern counties. Case counts may increase in western counties in subsequent years, following the same pattern exhibited by LD, which first appeared in eastern counties to then spread westward throughout the state. Table 8 shows the number of TBRI cases by county in 2017.

**Table 8 – Anaplasmosis, Ehrlichiosis and SFR Case Counts by County, Pennsylvania, 2017\***

County	Anaplasmosis	Ehrlichiosis	SFR
Adams	-	0	0
Allegheny	-	0	0
Armstrong	0	-	0
Beaver	-	0	0
Bedford	0	0	-
Berks	-	-	0
Bucks	5	-	6
Butler	-	0	0
Cambria	-	-	0
Cameron	0	-	0
Centre	-	-	0
Chester	--	-	-
Clarion	-	0	0
Clearfield	-	0	0
Clinton	-	0	0
Crawford	-	0	0
Cumberland	-	0	-
Dauphin	-	0	0
Delaware	-	0	-
Elk	-	0	0
Franklin	-	0	0
Jefferson	-	-	0
Lackawanna	0	0	-
Lancaster	-	-	-
Lehigh	-	0	-
Luzerne	-	0	0
Lycoming	6	0	0
McKean	-	0	0
Monroe	7	0	0
Montgomery	5	-	-
Montour	-	0	0
Northampton	-	-	0
Philadelphia	-	-	7
Pike	--	-	-
Potter	0	-	0
Schuylkill	-	0	-
Wayne	-	0	0
Westmoreland	-	0	0

Source: PA-NEDSS

\*Case counts <5 have been redacted in accordance with Pa. DOH policy.



## Citations

- <sup>1</sup> CDC. "Lyme Disease Transmission." Last modified March 4, 2015.  
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<https://www.pacode.com/secure/data/028/chapter27/subchapBtoc.html>
- <sup>9</sup> Sonenshine, D. (2018) "Range Expansion of Tick Disease Vectors in North America: Implications for Spread of Tick-Borne Disease." *Int J Environ Res Public Health*. Mar; 15(3): 478.