West Virginia Department of Health
Annual Zoonotic Disease Report
2022

Division of Infectious Disease Epidemiology

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2022

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Methods

Surveillance and Case Ascertainment Methods

West Virginia State Code 16-3-1 and 64CSR7 establishes that healthcare providers and laboratories must report certain infectious disease conditions to their local or state authorities. During the study period of 2022, passive surveillance was conducted for mosquito-borne diseases (MBDs), tickborne diseases (TBDs) and zoonotic diseases (ZDs) in West Virginia. Local health departments (LHDs) conducted initial case investigations after receiving case reports or positive laboratory results for reportable MBDs, TBDs and ZDs. LHD's then reported case information to the State Health Department using the West Virginia Electronic Disease Surveillance System (WVEDSS).

Cases were reviewed by the Zoonotic Disease Program in the State Health Department's Division of Infectious Disease Epidemiology before a final case classification status was assigned. All case classifications were determined using the most current Council of State and Territorial Epidemiologists' (CSTE) case definition for each disease or condition. Once a final case status was made, cases were reported by the State Health Department to the Centers for Disease Control and Prevention (CDC) via the National Electronic Disease Surveillance System (NEDSS) or through ArboNET.

Surveillance was also conducted using syndromic surveillance. Syndromic surveillance tracks the number of patients seeking care in emergency departments (ED) and urgent care centers (UC) with specific symptoms or concerns—before a diagnosis is confirmed. By utilizing the National Syndromic Surveillance Program's cloud-based BioSense platform, a secure integrated electronic health information system with standardized analytic tools and processes, syndromic surveillance can obtain ED and UC visit data related specifically to tick bite exposures.

Data Extraction and Analyses

Surveillance data for confirmed and probable cases of each MBD, TBD, and ZD for MMWR Year 2022 were exported from WVEDSS to an Excel database for analysis. Syndromic surveillance data was analyzed in the BioSense ESSENCE program. County- and state-level census data for 2022 were obtained from the most recent, 2020, U.S. Census Bureau https://data.census.gov/profile/West_Virginia?g=040XX00US54.

2022 Mosquito-borne Disease Surveillance Summary

Introduction

Mosquito-borne diseases, most of which are viruses, are transmitted through the bite of infected mosquitoes. Surveillance for these diseases in West Virginia (WV) focuses on four endemic mosquito-transmitted arboviral diseases—La Crosse encephalitis (LAC), West Nile virus (WNV), St. Louis encephalitis virus (SLEV), and eastern equine encephalitis virus (EEEV)—as well as other travel-associated diseases, such as chikungunya, dengue fever, malaria, and Zika virus (ZIKV). Historically, La Crosse encephalitis has been the mosquito-borne disease of most concern in West Virginia.

Most people who become infected with endemic MBDs have no clinical symptoms; however, encephalitis (inflammation of the brain) is a potentially life-threatening complication that is often reported among symptomatic patients. Symptoms generally begin one to two weeks after a mosquito

bite and include fever, headache, myalgia, meningitis, and neurologic dysfunction. There is no specific treatment available for arboviral infections.

This surveillance summary describes human cases of MBDs in West Virginia during 2022. For information on mosquito infection rates or animal disease, please see the West Virginia Mosquito and Tick Surveillance Report.

Results

Table 1 provides a comparison of human cases of MBDs reported in West Virginia from 2017 to 2022. In 2022, 6 confirmed or probable cases of MBD were reported: two probable La Crosse encephalitis (LAC, one neuroinvasive and one non-neuro invasive) and four confirmed travel associated Malaria cases.

The confirmed case of neuroinvasive LAC was reported from Fayette County (Fig. 1). The case was a three-year-old male. Illness onset month for this LAC case was August. The case was febrile and hospitalized with encephalitis and convulsions. The non-neuroinvasive case of LAC was reported in October from Putnam County (Fig. 1). This case was a 15-year-old female who presented with a fever and headache but was not hospitalized.

Table 1. Human cases of mosquito-borne disease in West Virginia from 2017 to 2022.

Disease	# (%) of Cases† (2017)	# (%) of Cases† (2018)	# (%) of Cases† (2019)	# (%) of Cases† (2020)	# (%) of Cases† (2021)	# (%) of Cases† (2022)
LAC	4 (50)	6 (50)	3 (30)	7 (100)	1 (100)	2 (33)
WNV	1 (12.5)	2 (16.7)	0 (0)	0 (0)	0 (0)	0 (0)
Malaria	1 (4.8)	2 (25)	3 (25)	2 (20)	0 (0)	4 (67)
Dengue	0 (0)	1 (8.3)	5 (50)	0 (0)	0 (0)	0 (0)
EEEV	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
SLEV	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Chikungunya	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Zika	1* (12.5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Total	7 (100)	11(100)	11 (100)	9 (100)	1 (100)	6 (100)

*Positive viremic blood donor. †Includes only cases classified as confirmed or probable.

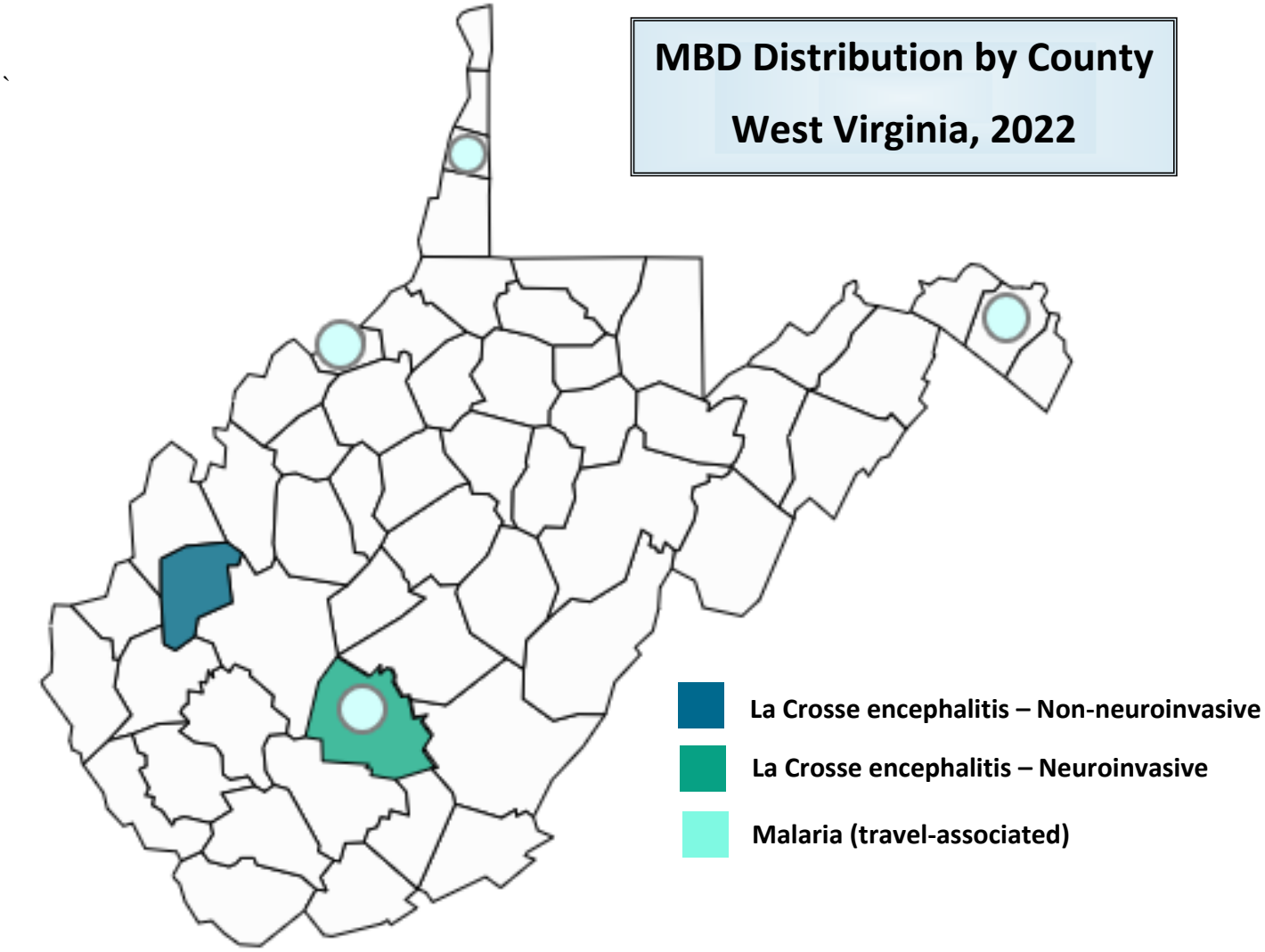

Figure 1. Distribution of human endemic mosquito-borne cases reported in West Virginia in 2022.

Discussion

The incidence of local MBDs was higher in 2022 than in 2021. LAC cases followed the epidemiologic trends previously seen in West Virginia, with cases in children 15 years of age and younger reported from southern counties.

Four travel-associated malaria cases occurred in 2022; it is important that West Virginia residents who travel internationally be mindful of MBDs endemic in their destination country at wwwnc.cdc.gov/travel. Links to CDC pages as well as to public health literature on MBDs can be found on the Office of Epidemiology and Prevention Services Mosquito-borne Disease's webpage: oeps.wv.gov/arboviral/Pages/mbd.aspx.

2022 Tickborne Disease Surveillance Summary

Introduction

Tickborne diseases (TBDs) are transmitted by the bite of an infected tick vector. In West Virginia, tick vectors responsible for disease transmission have been identified for at least seven TBDs (Table 2). Diagnosing TBDs can be challenging as some of these infections can initially produce similar, non-specific clinical symptoms (as with rickettsial diseases), while other TBDs produce highly variable symptoms (as with Lyme disease). Early recognition and treatment of TBDs by healthcare providers can prevent complications from these diseases and decrease morbidity and mortality. Most TBDs, including those listed in Table 2, are reportable to the State Health Department in West Virginia from healthcare providers and laboratories. The purpose of this summary is to describe the epidemiology of TBDs reported in West Virginia during 2022.

Table 2. Possible TBD by causative agent based on vectors found in West Virginia.[a]

Tickborne Disease	Agent	Tick Vector(s) in West Virginia
Anaplasmosis	*Anaplasma phagocytophilum*	Blacklegged tick (*Ixodes scapularis*) [b]
Babesiosis	*Babesia microti* and other *Babesia* spp.	Blacklegged tick (*Ixodes scapularis*)
Ehrlichiosis	*Ehrlichia chaffeensis* and *Ehrlichia ewingii*	Lone star tick (*Amblyomma americanum)*
Lyme disease	*Borrelia burgdorferi*	Blacklegged tick (*Ixodes scapularis*)
Powassan encephalitis	Powassan virus	Groundhog tick (*Ixodes cookei*)[c] Blacklegged tick (*Ixodes scapularis*)
Rocky Mountain Spotted Fever and other spotted fever rickettsioses	*Rickettsia rickettsii* (and other spotted fever group *Rickettsia* spp.)	American dog tick (*Dermacentor variabilis*) Brown dog tick (*Rhipicephalus sanguineus)* Lone star tick (*Amblyomma americanum*) Gulf Coast tick (*Amblyomma maculatum*) Asian longhorned tick (*Haemaphysalis longicornis*)
Tularemia[d]	*Francisella tularensis*	American dog tick (*Dermacentor variabilis*) Lone star tick (*Amblyomma americanum*)

[a] Other TBD, including but not limited to Colorado tick fever, tickborne encephalitis, and Crimean-Congo hemorrhagic fever, may result from travel to regions where these illnesses are endemic.
[b] *I. scapularis* is also commonly referred to as the deer tick.
[c] *I. cookei* does not have an official common name. Names that have been used include the groundhog tick, woodchuck tick, and the American castor bean tick.
[d] Tularemia cases are included in the "Other ZD Surveillance Summary" since other animal species more commonly transmit tularemia to humans.

Results

In 2022, 2,501 confirmed and probable TBD cases were reported in all 55 counties in West Virginia (Fig. 2). Diseases reported included anaplasmosis, ehrlichiosis, Lyme disease, and spotted fever group rickettsioses (SFGR), including Rocky Mountain Spotted Fever. No Powassan virus or babesiosis cases were reported.

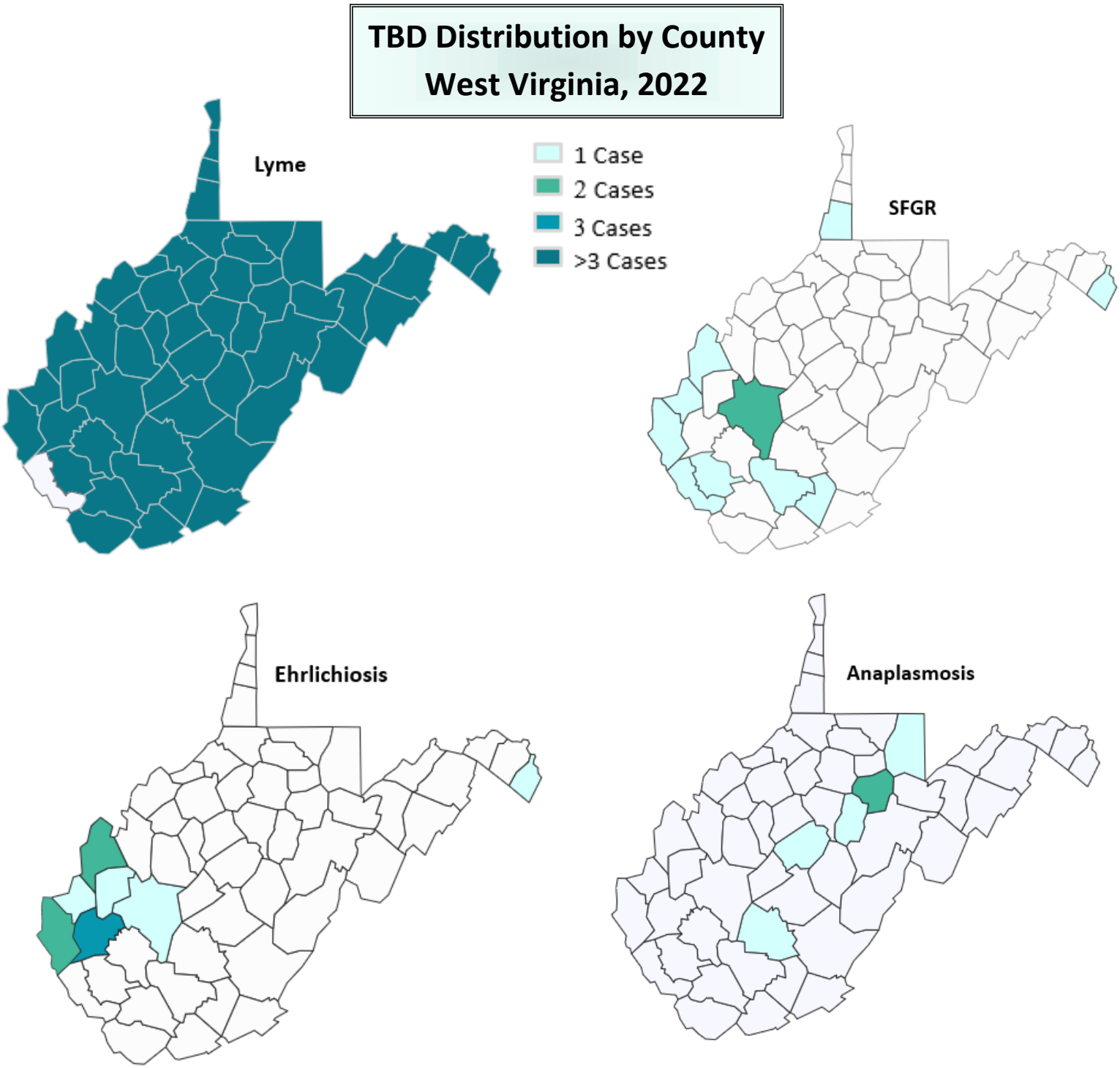

Figure 2. County level distribution of Lyme disease, anaplasmosis, ehrlichiosis, and SFGR cases West Virginia, 2022.

Lyme disease cases showed a substantial increase in 2022 due to a change in CSTE case definition. For high incidence jurisdictions like West Virginia, the case definition now relies solely on laboratory work. The last five years show increases in other TBDs as well (Table 3).

Table 3. Frequency of TBDs reported in West Virginia from 2017–2022.

Disease Name	# of 2017 cases	# of 2018 cases	# of 2019 cases	# of 2020 cases	# of 2021 cases	# of 2022 cases
Anaplasmosis	2	0	3	2	1	6
Babesiosis	1	1	0	0	0	0
Ehrlichiosis	6	4	10	3	16	13
RMSF/SFGR	17	20	26	5	12	12
Lyme disease	648	671	898	1,065	1,788	2,470
TOTAL CASES	675	697	937	1,075	1,817	2,501

Table 4. Frequency of counties reporting TBDs in West Virginia from 2017–2022.

Disease Name	Counties with cases (2017)	Counties with cases (2018)	Counties with cases (2019)	Counties with cases (2020)	Counties with cases (2021)	Counties with cases (2022)
Anaplasmosis	2	0	3	2	1	5
Babesiosis	1	1	0	0	0	0
Ehrlichiosis	6	4	8	3	6	8
RMSF/SFGR	14	12	13	4	9	12
Lyme disease	45	49	52	52	55	54
*TOTAL COUNTIES	43	47	52	54	55	55

*Note: Counties are mutually exclusive and are not double counted

Twelve ehrlichiosis cases (seven confirmed and five probable), six males and six females, were reported from 8 counties: Cabell, Grant, Jefferson, Kanawha (2), Lincoln (2), Mason (2), Putnam, and Wayne counties during MMWR Year 2022. Five of the twelve cases reported hospitalization. Their ages ranged from 4-78 years of age. All cases (100%) presented with fever, eleven (92%) presented with myalgia, ten (83%) with headache, ten (83%) with nausea, nine (75%) with rash, and eight (67%) with vomiting (Fig. 4). Seven patients (58%) presented with disseminated intravascular coagulation (DIC), and six (50%) presented with meningitis (Fig. 4). Laboratory results also showed that eleven (92%) presented with leukopenia, nine (75%) with anemia, eight (67%) with elevated hepatic enzymes, and five (42%) with thrombocytopenia (Fig. 3).

Six confirmed anaplasmosis cases, two females and four males, were reported in MMWR year 2022 from 5 counties: Barbour, Braxton, Fayette, Preston, and Upshur. Their ages ranges from 51-85 years of age. Five patients required hospitalization. The symptoms that commonly presented were fever (100%), malaise (100%), nausea (100%), eschar (83%), headache (83%), rash (83%), and vomiting (83%) (Fig. 4). Reported complications were disseminated intravascular coagulation (DIC) (67%), meningitis/encephalitis (67%), and renal failure (67%) (Fig. 4). Laboratory results also showed that six (100%) presented with leukopenia, five (100%) with anemia, five (100%) with elevated hepatic enzymes, and one (16%) with thrombocytopenia (Fig. 3).

There were 12 SFGR cases (all probable) reported during MMWR Year 2022 from 11 counties: Cabell, Jackson, Jefferson, Kanawha (2), Lincoln, Logan, Marshall, Mason, Mingo, Raleigh, and Summers counties. All cases were male. Cases ranged in age from 6-85 years of age; three cases reported hospitalization. All cases (100%) presented with fever. Other symptoms reported were headache (92%), nausea (92%), vomiting (92%), rash (83%), myalgia (83%), and malaise (83%) (Fig. 4). Patients also presented with meningitis/encephalitis (75%), disseminated intravascular coagulation (DIC) (67%), and renal failure (67%) (Fig. 4). Laboratory results also showed that 12 (100%) presented with anemia, 11 (92%) with elevated hepatic enzymes, 10 (83%) with leukopenia, and one (16%) with thrombocytopenia (Fig. 3).

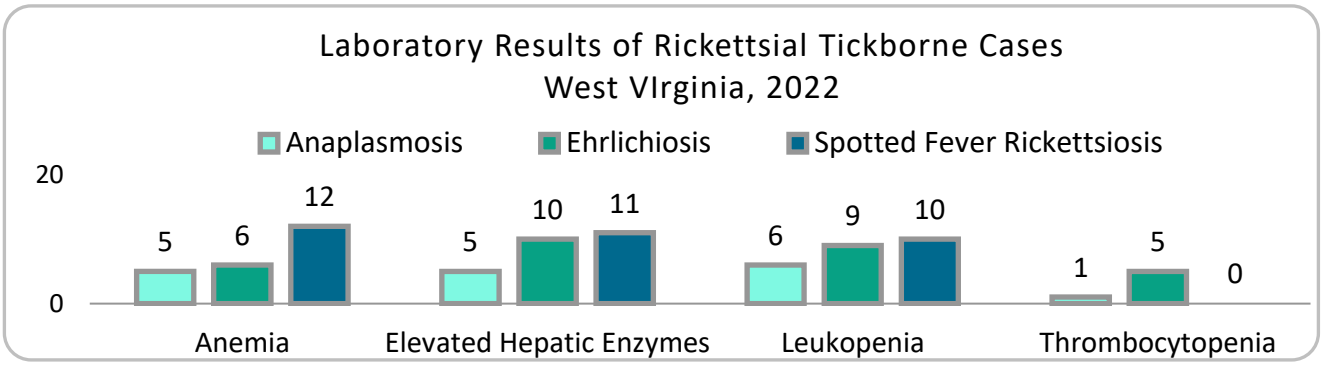

Figure 3. Laboratory Results in Cases with Rickettsial Tickborne Diseases, West Virginia MMWR 2022.

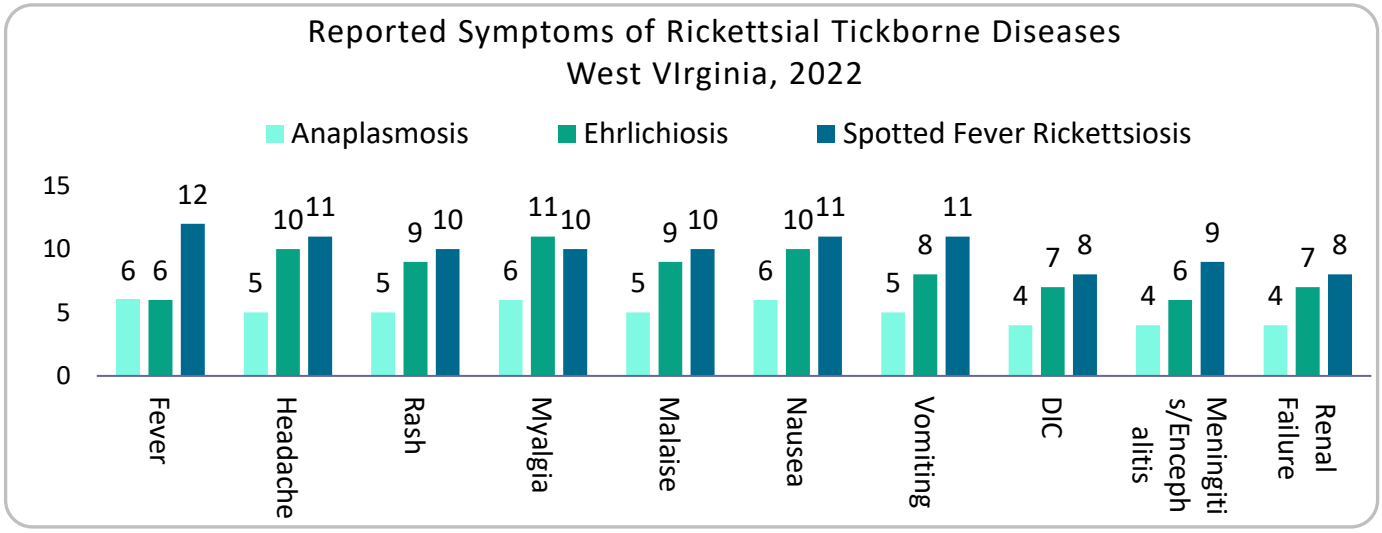

Figure 4. Symptoms Reported by Cases with Rickettsial Tickborne Diseases, West Virginia MMWR 2022.

Lyme disease cases increased during MMWR Year 2022 with 2,470 cases reported, compared to 1,788 cases reported the previous year. Lyme disease accounted for 98.75% of all TBD cases reported. Six counties reported greater than 100 cases: Harrison (n=150), Monongalia (n=148), Kanawha (n=135), Marion (n=128), Preston (n=128), and Ohio (n=120). The five counties with the highest incidence of cases per 100,000 population were Monroe (460), Barbour (446), Tucker (429), Upshur (411), and Webster (406). Figure 5 shows county level incidence rates for Lyme disease cases in all counties in 2022.

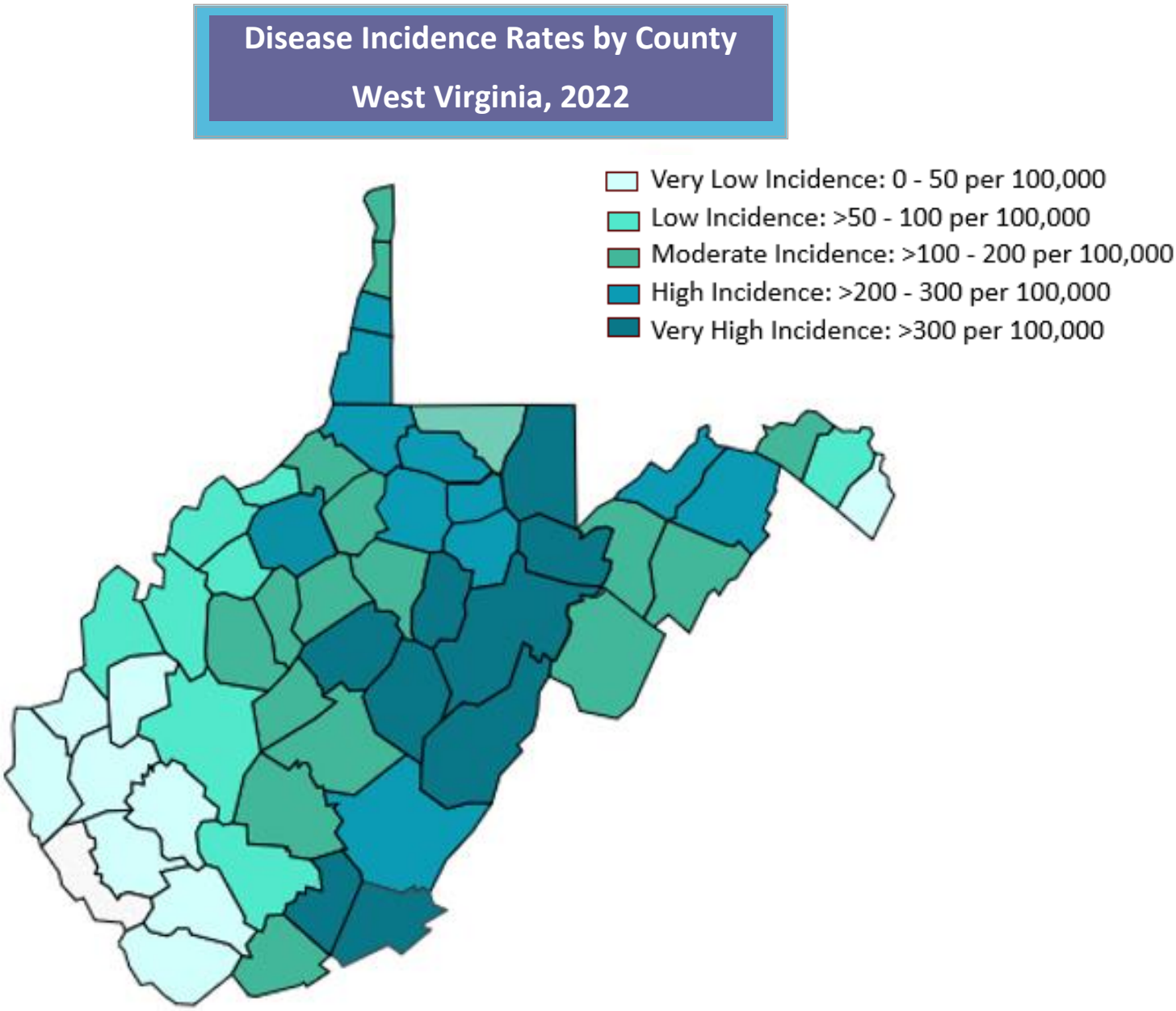

Figure 5. County level incidence rate of Lyme disease cases per 100,000 residents – West Virginia, MMWR Year 2022.

Lyme disease cases ranged in age from 1–92 years, the highest proportion of cases were reported in the 61-70 age range (18%) with the age range of 51-60 years old (14%) following closely (Figure 4).

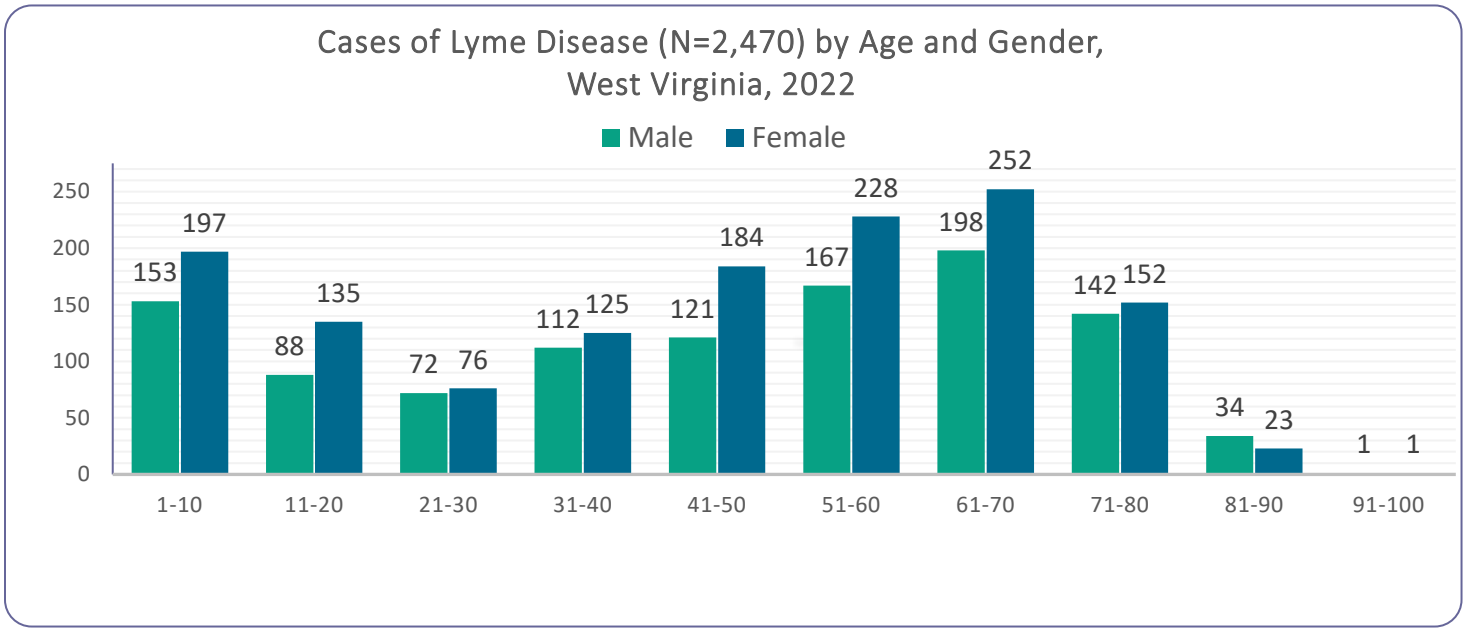

Figure 6. Cases of Lyme Disease by Age and Gender, West Virginia MMWR 2022.

Syndromic Surveillance data, shown in Figure 7, demonstrates the increase in tick bite exposure visits by the population from September 1st to November 30th, 2021 compared to September 1st to November 30th, 2022. These fall season maps show where people are being exposed to *Ixodes scapularis*, which is the only human blood feeding tick active in September, October, and November. The counties with high tick bite exposure are also the same counties with high densities of *Ixodes scapularis,* the tick vector for Lyme disease, and the high incidence of Lyme disease (Fig. 5). Conversely, the counties in West Virginia with low Lyme disease incidence also have low exposure to *Ixodes scapularis*. There are more encounters with the Lyme disease tick vector in regions where the tick is established. For more information on vector density and disease rates, see the West Virginia Vector Surveillance Report.

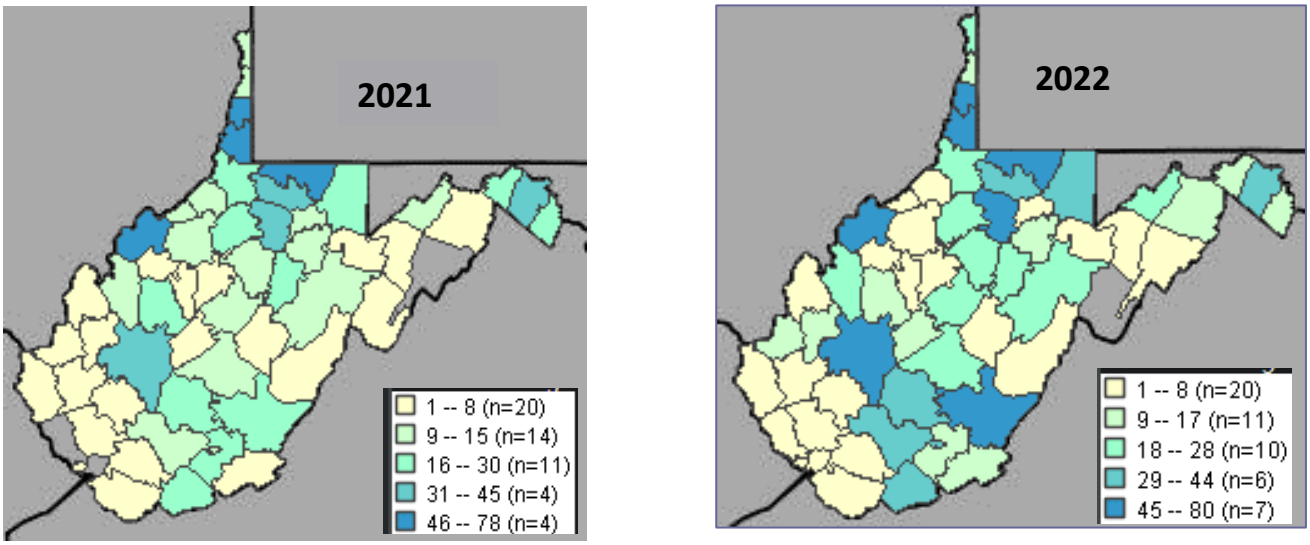

Figure 7. The distribution of tick bite exposure emergency departments and urgent care visits from September 1st to November 30th in both 2021 and 2022. County counts are based on the hospital location where a patient sought treatment.

Discussion

Though the vectors for Powassan virus (*I. cookei* and *I. scapularis*) have been identified in the state, there were no reports of Powassan virus during the study period or to date in West Virginia. The first human babesiosis case in West Virginia was reported in 2017, one case was reported in 2018, and no other cases have been reported since.

The overall reported number of TBDs increased from 1,788 in 2021 to 2,501 in 2022 (Table 3); the number of counties that reported at least one TBD rose from the same 53 counties in both 2019 and 2020, to all 55 counties in the state (Table 4). Reported Lyme disease cases have increased 280.5% during the past five MMWR years, from 648 in 2017 to 2,470 in 2022. West Virginia became a high incidence state in 2017 and is now the 4th highest incidence state in the nation. In 2022, West Virginia's average incidence rate was 137.7 cases per 100,000 persons compared to 99.7 in 2021. West Virginia is seeing a steady increase in incidence of Lyme disease each year.

Tickborne rickettsial diseases (anaplasmosis, ehrlichiosis, and SFGR) often have high hospitalization rates among cases; 83% (n=5) of anaplasmosis cases and 42% (n=5) of ehrlichiosis cases during MMWR Year 2022 were hospitalized. 27 % of SFGR cases (n=3) reported in 2022 required hospitalization.

West Virginia is in a unique geographical position for TBD exposure. It borders three states also classified as high incidence states for Lyme disease: Maryland, Pennsylvania, and Virginia rank in the top 14 states that account for nearly 95% of Lyme disease cases. West Virginia also borders Tennessee, Virginia, and North Carolina which contain hotspots for SFGR. The Asian longhorned tick (*Haemaphysalis longicornis*) was first collected in West Virginia in 2010 and originally misidentified as the rabbit tick, *Haemaphysalis leporispalustris*. It is a new tick to the US overall (2017) and is still being researched by scientists. While it has not been known to cause disease in humans in the US, studies have shown that it carries the potential to transmit carry *Rickettsia rickettsii*, the pathogen responsible for Rocky Mountain spotted fever. Quality surveillance allows for monitoring of changes in TBD incidence and identification of emerging TBDs at the local, state, and national level. Therefore, it is important to obtain timely and accurate data, including travel history, during TBD case investigations.

There are limitations to TBD surveillance. First, underreporting of TBDs in West Virginia, and other high incidence states, is likely. Cases may not seek medical attention unless symptoms or clinical manifestations of disease become severe and cannot be resolved without treatment. Misdiagnosis of disease is possible due to inaccurate laboratory test results and/or provider diagnostic error. For example, the ideal laboratory test for confirmation of SFGR requires both an acute and convalescent sample 4 weeks apart. There were 54 cases of spotted fever that were deemed suspect or not a case due to inadequate laboratory testing ordered by healthcare providers or lack of clinical information obtained. There is also the possibility of case misclassification. For example, case ascertainment for most TBD require clinical, laboratory, and, sometimes, epidemiologic evidence. If information is missing, a true case may be classified as either "suspect," or "not a case." In 2022, in addition to the SFGR cases, there were four suspect ehrlichiosis cases and one suspect anaplasmosis case that were not included in the analyses of this summary. Also, surveillance data often captures only the county of residence or facility where treatment was sought, and not necessarily county of exposure. This highlights the importance of obtaining quality laboratory, clinical, and epidemiologic information to ensure that appropriate surveillance is being conducted.

Prevention of tickborne diseases focuses primarily on avoiding tick bites. CDC's recommendations for the prevention of TBDs are located on the CDC website at www.cdc.gov/ticks/avoid/on_people.html. Because ticks are active in warmer months, it is also important to make the public aware of the risk of becoming infected with any TBD from late spring to early fall.

2022 Other Zoonotic Diseases Surveillance Summary

Introduction

While mosquito borne and tickborne diseases account for most zoonotic diseases reported in West Virginia, other diseases can be transmitted from animals to humans without arthropod vectors. Table 5 lists diseases and conditions that are transmitted by animals under surveillance in West Virginia. While Q fever and tularemia can be transmitted by ticks, they are more commonly transmitted by other animals.

Table 5. Lists of diseases, the associated pathogen(s), and host species.

Disease	Pathogen	Host(s)
Anthrax	*Bacillus anthracis*	Cattle, sheep, and goats
Brucellosis	*Brucella* spp.	Sheep, goats, cattle, deer, elk, pigs, and dogs
Hantavirus pulmonary syndrome	Hantavirus	Wild rodents (deer mice)
Leptospirosis	*Leptospira interrogans*	Cattle, pigs, horses, dogs, rodents, and wild animals
MERS (Middle East Respiratory Syndrome)	MERS coronavirus	Camels and bats
Monkeypox (M pox)	Orthopoxvirus	Rodents, prairie dogs, Gambian giant rat, and rabbits
Plague	*Yersinia pestis*	Fleas and rodents
Psittacosis	*Chlamydophila psittaci*	Parrots, parakeets, macaws, turkeys, and ducks
Q fever	*Coxiella burnetii*	Cattle, sheep, ticks, and goats
Rabies[1]	Rabies lyssavirus	Mammals
SARS (Sudden Acute Respiratory Syndrome)	SARS coronavirus	Bats (likely)
Tularemia	*Francisella tularensis*	Hard ticks, rabbits, hares, and rodents
Viral hemorrhagic fever	Marburg virus, Lassa virus, Ebola virus, Crimean-Congo virus, Rift Valley Fever, and Yellow Fever	Bats, primates, ticks, mosquitoes, and rodents

[1]The Bureau for Public Health has an annual rabies report that can be accessed at our webpage under data and surveillance: https://oeps.wv.gov/rabies/pages/default.aspx

Results

There was one confirmed case of Q fever (Putnam County) reported during MMWR year 2022.

Discussion

Zoonotic diseases in West Virginia can be transmitted by a variety of animals and by a variety of different routes. Some zoonotic diseases are only found outside the United States and require travel to endemic areas for a person to become infected.

In West Virginia, most zoonotic diseases that are not arthropod-transmitted result from contact with domestic animals such as livestock and dogs. High-risk groups for both diseases include farm workers, veterinarians, and meat processing workers since their professions put them in close contact with animal products (e.g., unpasteurized milk) and animal body fluids (e.g., birth products, feces). Inhalation of the bacteria that cause brucellosis and Q fever may also lead to infection.

Most of the "other" zoonotic diseases listed on Table 5 are reportable within 24 hours or immediately since these diseases can result in severe morbidity and even mortality (e.g., rabies, hantavirus) and are considered bioterrorism agents (e.g., anthrax, Q fever). For information about "other" zoonotic diseases reportable in West Virginia, visit: oeps.wv.gov/zoonotic/pages/default.aspx.