WEST VIRGINIA
ANNUAL ZOONOTIC DISEASE SURVEILLANCE REPORT

2021

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Division of Infectious Disease Epidemiology
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Contents

Methods

Surveillance and Case Ascertainment Methods

During the study period (2021 MMWR Year), passive surveillance was conducted for mosquito-borne diseases (MBDs), tickborne diseases (TBDs), and zoonotic diseases (ZDs) in West Virginia. West Virginia Code §16-3-1 and 64CSR7 establish infectious disease reporting requirements for health care providers and laboratories. Local health departments (LHDs) conducted initial case investigations after receiving case reports or positive laboratory results for reportable MBDs, TBDs, and ZDs. Cases were reported from LHDs to the State using the West Virginia Electronic Disease Surveillance System (WVEDSS).

Cases were reviewed by the Zoonotic Disease Program in the West Virginia Department of Health and Human Resources (DHHR), Bureau for Public Health's Office of Epidemiology and Prevention Services - 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 DHHR to the Centers for Disease Control and Prevention (CDC) via the National Electronic Disease Surveillance System (NEDSS).

Surveillance was also conducted using syndromic surveillance. Syndromic surveillance tracks the number of patients seeking care in emergency departments (ED) and urgent care centers (UCC) with specific symptoms or concerns—before a diagnosis is confirmed. By utilizing the NEDSS program's cloud-based BioSense platform, a secure integrated electronic health information system with standardized analytic tools and processes, we can view ED and UCC visits due to "tick bite exposure."

Data Extraction and Analyses

Surveillance data for confirmed and probable cases of each MBD, TBD, and ZD for MMWR Year 2021 were exported from WVEDSS to an Excel database for analyses. Syndromic surveillance data were analyzed in the BioSense Electronic Notification of Community-based Epidemics (ESSENCE) program. County- and state-level census data for 2021 were obtained from the most recent, 2020, United States Census Bureau at: data.census.gov/profile/West_Virginia?g=040XX00US54.

2021 Mosquito-borne Disease Surveillance Summary

Introduction

MBDs, most of which are viruses, are transmitted through the bite of infected mosquitoes. Surveillance for these diseases in West Virginia focuses on four endemic mosquito-transmitted diseases—La Crosse encephalitis (LAC), West Nile virus (WNV), St. Louis encephalitis virus (SLEV), and eastern equine encephalitis virus (EEEV)—and travel-associated, or imported diseases, such as chikungunya, dengue fever, malaria, and Zika virus (ZIKV). Historically, LAC has been the MBD 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 infected persons who develop symptoms. 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.

Mosquito surveillance is important to understanding the geographic and temporal distribution of these vectors, the diseases they might transmit to humans, and when and where human cases of mosquito-borne disease might occur, based on the arboviral infection rate in the mosquitoes. Mosquito surveillance is conducted in selected counties across the state from summer through fall. Environmental surveillance for MBDs monitors local disease activity in non-human species. Horses can become infected with WNV and EEEV. Birds can be infected with SLEV, WNV, and EEEV. Mosquitoes, dead birds, and horses have all been used to detect and monitor WNV and other arboviral disease activity in West Virginia. Additional information on ecological assessments of MBDs and TBDs is available in the West Virginia Mosquito and Tick Surveillance Reports (https://oeps.wv.gov/arboviral/pages/tbd.aspx#data). This surveillance summary describes human cases of MBDs in West Virginia during 2021.

Results

Human Surveillance

Table 1 provides a comparison of human cases of MBDs reported in West Virginia from 2016 to 2021. In 2021, one probable case of MBD was reported, LAC.

The probable case of LAC was reported from Fayette County (Fig. 1). The case was a neuroinvasive case. The case was a six-year-old female. Illness onset month for this LAC case was July. The case was febrile and hospitalized because of illness. In addition to fever, this neuroinvasive case presented with encephalitis and headache.

Table 1. Human cases of mosquito-borne disease in West Virginia from 2016 to 2021

Disease	# (%) of Cases† (2016)	# (%) of Cases† (2017)	# (%) of Cases† (2018)	# (%) of Cases† (2019)	# (%) of Cases† (2020)	# (%) of Cases† (2021)
LAC	8 (38.1)	4 (50)	6 (50)	3 (30)	7 (100)	1 (100)
WNV	1 (4.8)	1 (12.5)	2 (16.7)	0 (0)	0 (0)	0 (0)
Malaria	2 (28.6)	1 (4.8)	2 (25)	3 (25)	2 (20)	0 (0)
Dengue	0 (0)	0 (0)	1 (8.3)	5 (50)	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	11(52.4)	1* (12.5)	0 (0)	0 (0)	0 (0)	0 (0)
Total	22 (100)	7 (100)	11(100)	11 (100)	9 (100)	1 (100)

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

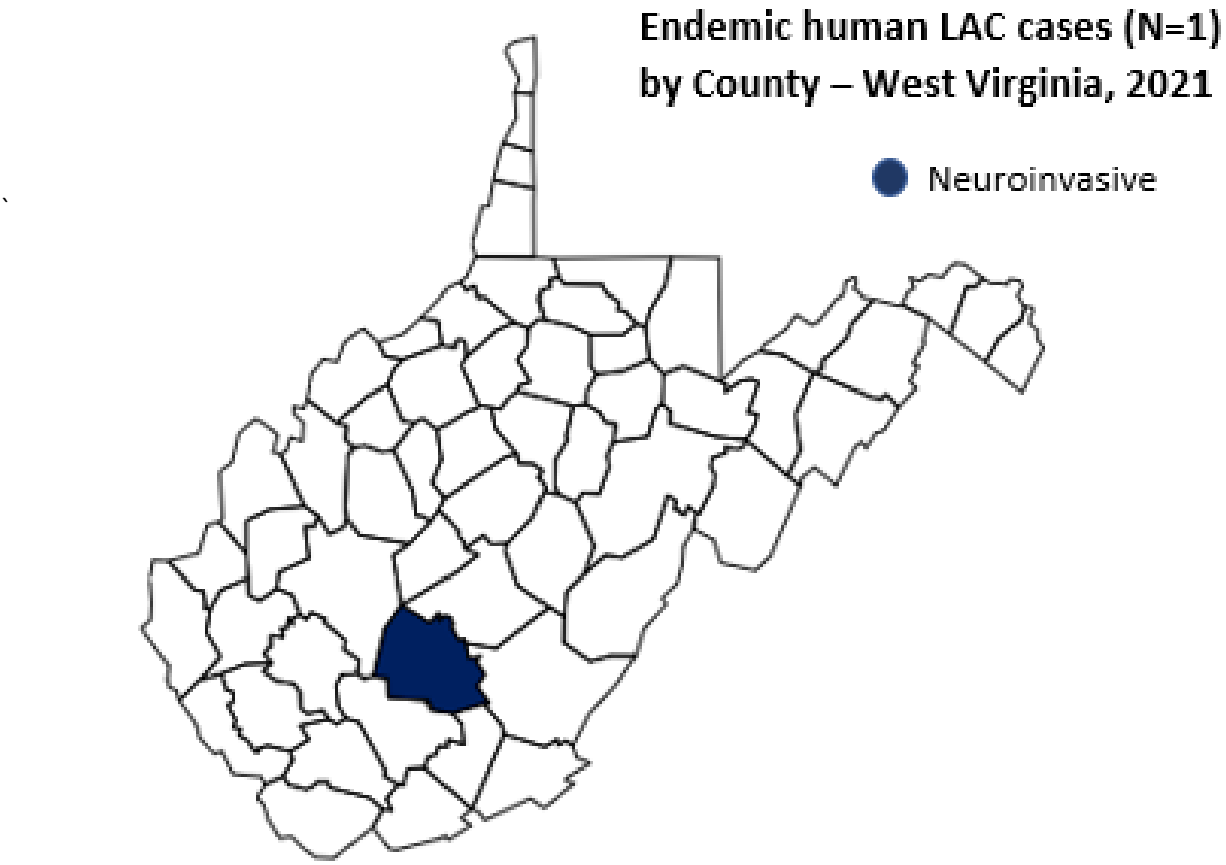

Figure 1. Distribution of human endemic mosquito-borne cases reported in West Virginia in 2021.

Discussion

The incidence of local MBDs was less for West Virginia in 2021 than in 2020. LAC cases followed the epidemiologic trends previously seen in West Virginia with cases in children under 15 years of age and reported from southern counties.

No imported MBD cases occurred in 2021; however, it is important that West Virginia residents who travel internationally be mindful of MBDs endemic in their destination country. CDC's Traveler's Health website is a good resource for this information and is available 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 (OEPS) MBDs webpage: oeps.wv.gov/arboviral/Pages/mbd.aspx.

2021 Tickborne Disease Surveillance Summary

Introduction

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 health care providers can prevent complications from these diseases and decrease morbidity and mortality. Most TBDs, including those listed in Table 2, are reportable to DHHR from health care providers and laboratories. The purpose of this summary is to describe the epidemiology of TBDs reported in West Virginia during 2021.

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

Tickborne Disease[a]	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

Human Surveillance

In 2021, 1,817 confirmed and probable TBD cases were reported from all 55 counties in West Virginia. Diseases reported included anaplasmosis, ehrlichiosis, Lyme disease, spotted fever group rickettsioses (SFGR) which includes Rocky Mountain Spotted Fever (RMSF), and tularemia (Figure 2, Table 3). No Powassan virus or babesiosis cases were reported.

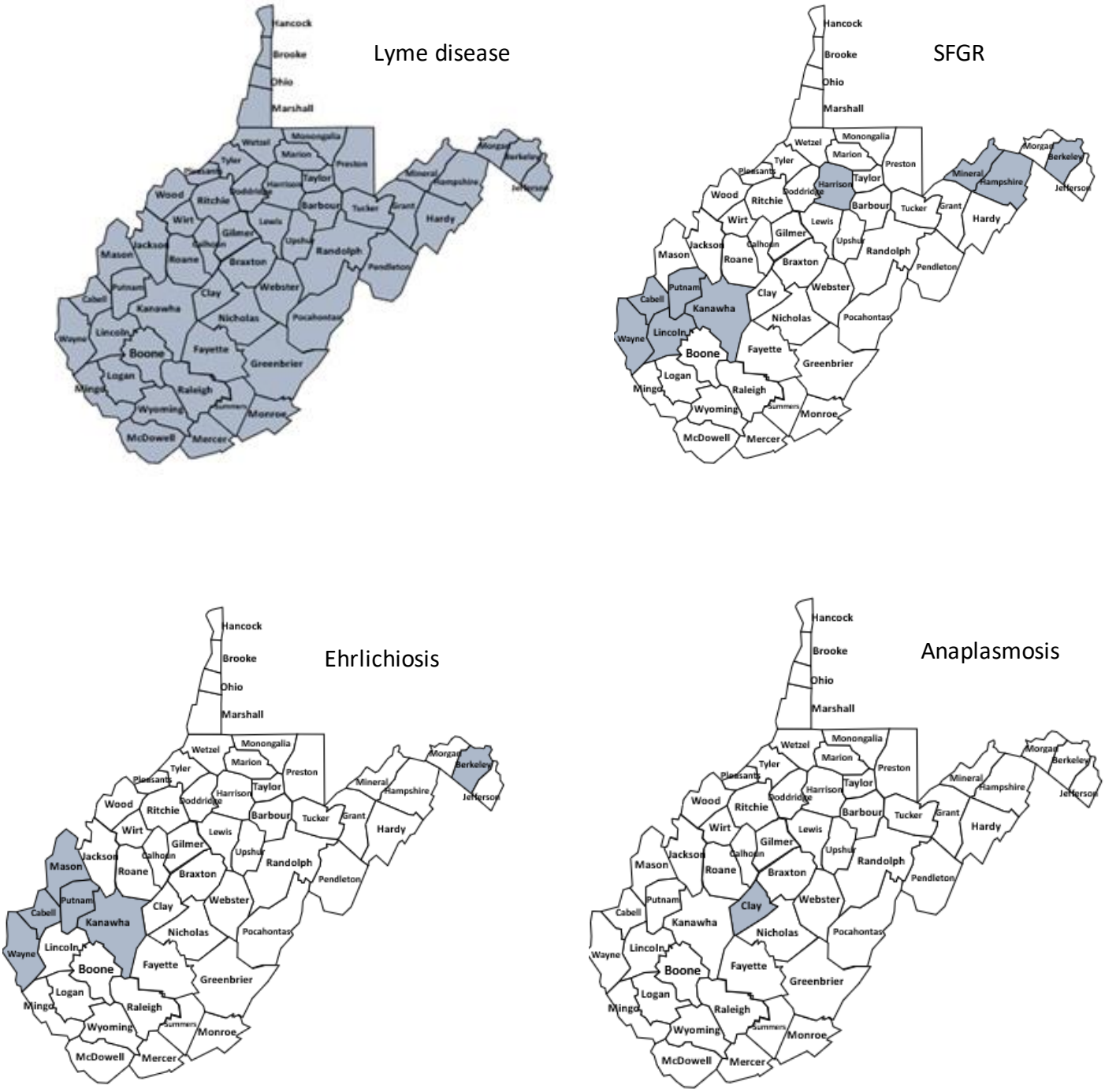

Figure 2. County-level distribution of Lyme disease, anaplasmosis, ehrlichiosis, and SFGR cases – West Virginia, 2021

Table 3. Frequency of TBDs reported in West Virginia from 2016–2021.

Disease Name	# of 2016 cases	# of 2017 cases	# of 2018 cases	# of 2019 cases	# of 2020 cases	# of 2021 cases
Anaplasmosis	0	2	0	3	2	1
Babesiosis	0	1	1	0	0	0
Ehrlichiosis	6	6	4	10	3	16
RMSF/SFGR	14	17	20	26	5	12
Lyme disease	368	648	671	898	1065	1788
TOTAL CASES	**388**	**675**	**697**	**937**	**1075**	**1817**

Table 4. Frequency of counties reporting TBDs in West Virginia from 2016–2021.

Disease Name	Counties with cases (2016)	Counties with cases (2017)	Counties with cases (2018)	Counties with cases (2019)	Counties with cases (2020)	Counties with cases (2021)
Anaplasmosis	0	2	0	3	2	1
Babesiosis	0	1	1	0	0	0
Ehrlichiosis	5	6	4	8	3	6
RMSF/SFGR	10	14	12	13	4	9
Lyme disease	42	45	49	52	52	55
***TOTAL COUNTIES**	**42**	**43**	**47**	**52**	**54**	**55**

*Note: Counties are mutually exclusive and are not double counted in the total.

A total of 16 ehrlichiosis cases (12 confirmed and four probable) were reported from Berkeley, Cabell, Kanawha, Mason, Putnam, and Wayne counties during MMWR Year 2021. Twelve of the 16 cases reported hospitalization. Their ages ranged from 32 to 84 years of age. All cases (n = 16) presented with fever. Of the 16 cases, 11 also presented with malaise (69%), 11 with headache (69%), eight with myalgia (50%), six with nausea (37.5%), four with rash (25%), three with meningitis (19%), and three with vomiting (19%). Laboratory results also showed that 12 (75%) presented with thrombocytopenia, nine (56%) with elevated hepatic enzymes, nine with leukopenia (56%), and three were noted to have presented with anemia (19%).

One probable anaplasmosis case, a 52-year-old male, was reported in MMWR year 2021 from Clay County. The patient in this case was hospitalized for six days. Reported symptoms were fever, headache, myalgia, and malaise.

There were 12 SFGR cases (all probable) reported during MMWR Year 2021, from nine counties: Berkeley, Cabell, Hampshire, Harrison, Kanawha (2), Lincoln (3), Mineral, Putnam, and Wayne counties. The majority of cases (n= 9, 75%) were male. Cases ranged in age from 23 to 70 years; three cases reported hospitalization. The symptoms that commonly presented were fever (n=11, 92%), malaise (n=8, 67%), myalgia (n=8, 67%), headache (n=5, 42%), rash (n=4, 33%), nausea (n=4, 33%), and vomiting (n=4, 33%).

Lyme disease cases increased during MMWR Year 2021 with 1788 cases reported (1,425 confirmed and 363 probable) compared to 1,065 cases (889 confirmed and 176 probable) reported in the previous year. Lyme disease cases accounted for 98 percent of all TBD cases reported (1,788 of 1,817 cases) which is consistent with the past couple of years. The number of counties reporting at least one case increased slightly from MMWR year 2020, from 53 to 55 counties. Twelve counties reported greater than 50 cases;

Kanawha (n=111), Marion (n=137), Marshall (n=102), Monongalia (n=126), and Preston (n=97) reported the most cases.

Lyme Disease Incidence Rates by County

West Virginia, 2021

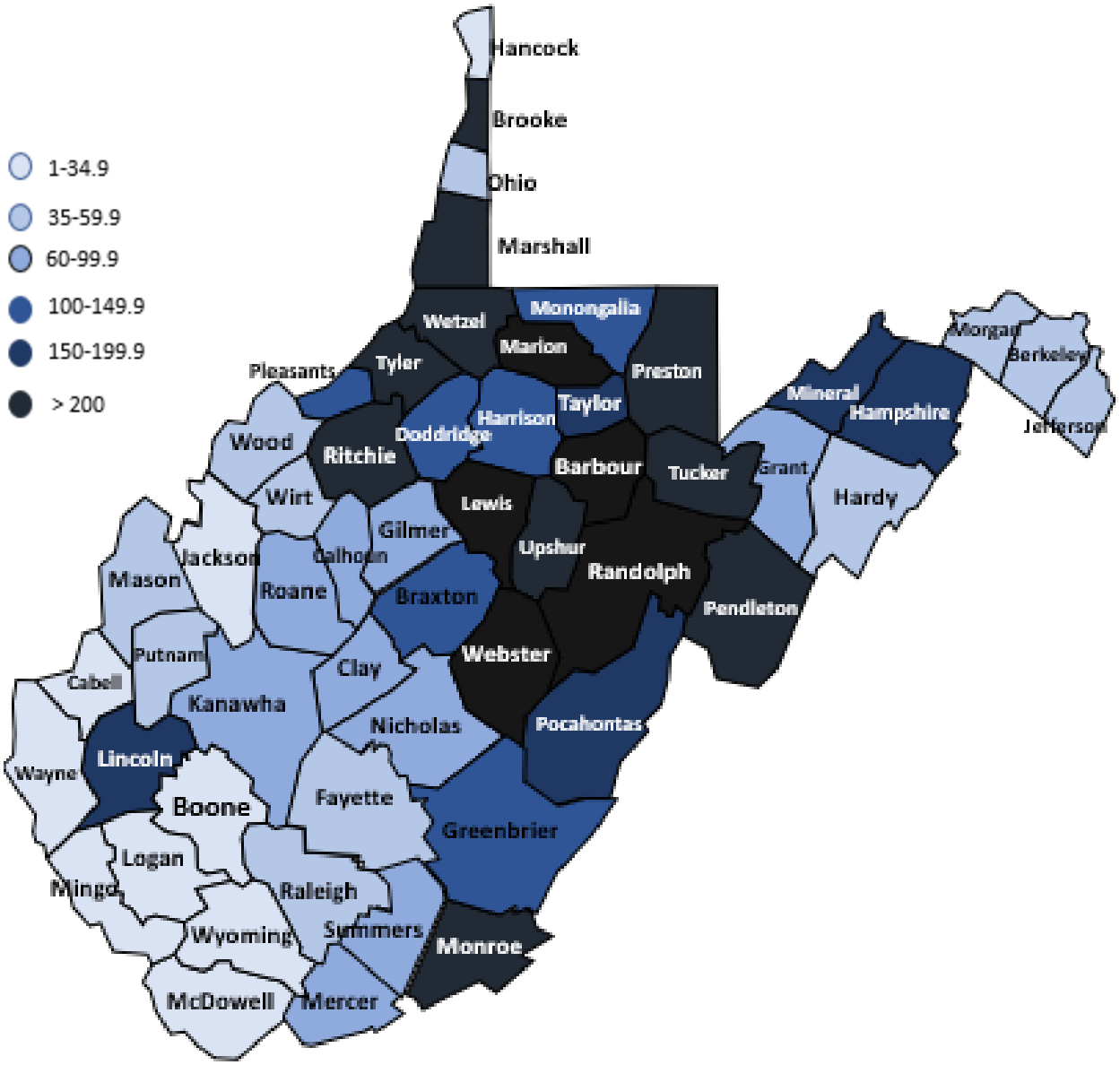

Figure 3. County level incidence rate of Lyme disease cases per 100,000 residents – West Virginia, MMWR Year 2021

Confirmed and probable Lyme disease cases ranged in age from one to 92 years; the highest proportion of cases were reported in the one to 10 age range (n=361, 20%) with the age range of 61 to 70 years old

(n=307, 17%) following closely (Figure 4). When looking at the relative frequency of reported symptoms, erythema migrans was the most commonly reported symptom (49%), while arthritis was the second most reported symptom (34%) (Figure 5).

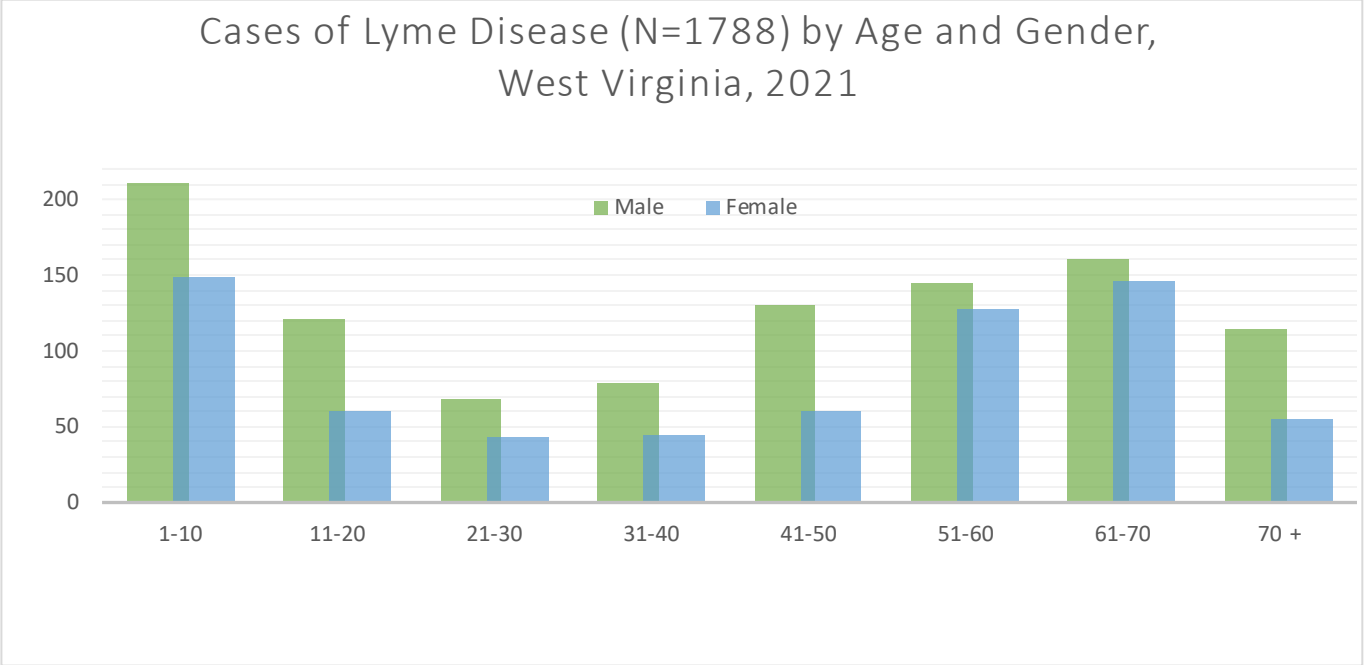

Figure 4. Frequency of Lyme disease cases by age and gender – West Virginia, MMWR Year 2021

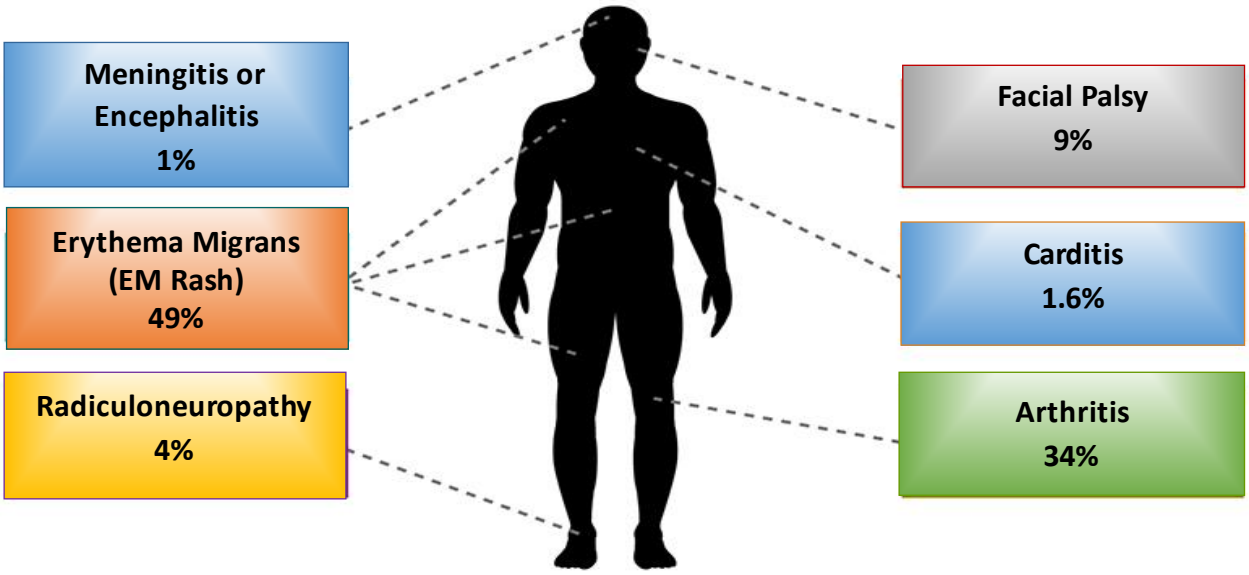

Figure 5. Frequency of clinical features of Lyme Disease among confirmed and probable cases – West Virginia, MMWR Year 2021.

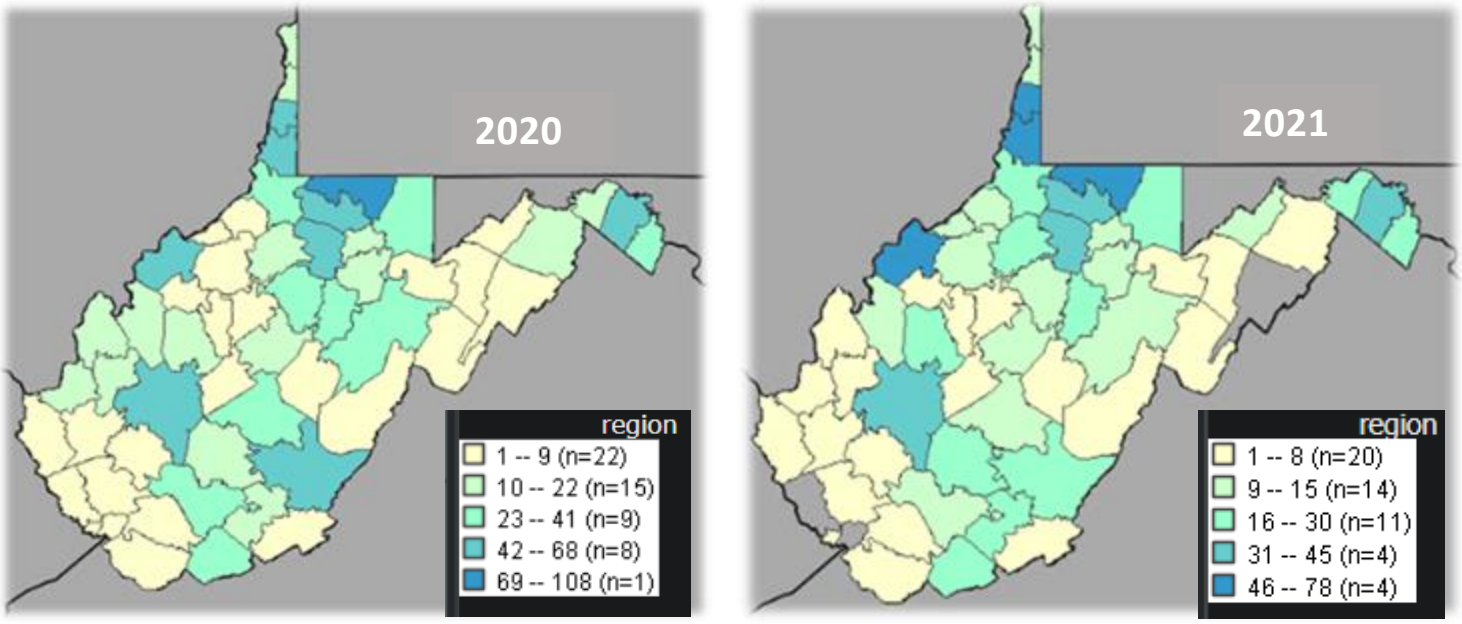

Figure 6. The distribution of tick bite exposure emergency departments and urgent care visits from September to November in both 2020 and 2021
*Data based on the hospital location where a patient sought treatment

Syndromic surveillance data, shown in Figure 6, demonstrates the increase in tick bite exposure (TBE) visits by the population from 2020 to 2021. These late 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 TBE 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. 3). Conversely, the counties in southwestern 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. Exposure to *Ixodes scapularis* is also extending to new regions.

Discussion

Lyme disease accounted for most TBD cases (Table 3) as seen in previous years. Though the vectors of Powassan encephalitis (*I. cookei* and *I. scapularis*) have been identified in the state, there were no reports of Powassan encephalitis during the 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 cases have been reported since.

The overall reported number of TBDs increased from 1075 in 2020 to 1788 in 2021 (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 361 percent during the past five MMWR years, from 388 in 2016 to 1788 in 2021. West Virginia became a high incidence state in 2017 based on having a three-year average incidence of greater than 10 cases per 100,000 persons. In 2021, West Virginia's average incidence rate in 2021 was 100.14 cases per 100,000 persons compared to 59.37 cases per 100,000 persons in 2020. 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; 100% (n=1) of anaplasmosis cases and 75% (n=12) of ehrlichiosis cases during MMWR Year 2021 were hospitalized. 25 % of SFGR cases (n=3) reported in 2021 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 about 95 percent] of Lyme disease cases. West Virginia also is in proximity to Tennessee 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 United States overall (2017) and is still being researched by scientists. While it has not been known to cause disease in humans in the United States, studies have shown that it carries the potential to transmit carry *Rickettsia rickettsii*, the pathogen responsible for RMSF. Quality surveillance allows for monitoring of changes in TBD incidence and the 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 four weeks apart. There were 52 cases of spotted fever that were deemed suspect or not a case due to inadequate laboratory testing ordered by health care providers or lack of clinical information obtained. There is also the possibility of case misclassification. For example, case ascertainment for Lyme disease requires clinical, laboratory, and, sometimes, epidemiologic evidence. If information is missing, a true case may be classified as either "suspect," or "not a case." In 2021, in addition to the SFGR cases, there were 167 suspect cases of Lyme disease, two 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 TBDs focuses primarily on avoiding tick bites. CDC recommendations for the prevention of TBDs are located 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.

2021 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 rats, 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 tularenis*	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: oeps.wv.gov/rabies/pages/default.aspx.

Results

There was one confirmed case of Q fever (Calhoun County) reported during MMWR year 2021 (Fig. 6). The case was a 68-year-old male who presented with endocarditis, fever, malaise, and elevated liver enzymes.

There were two cases of Tularemia (Kanawha and Logan counties), one confirmed and one probable, reported in 2021 (Fig. 6). One was a 20-year-old female who presented with fever and sepsis. The other case was a 31-year-old female who presented with fever and acute hypoxemic respiratory failure. The patient then became septic and developed organ failure before passing away.

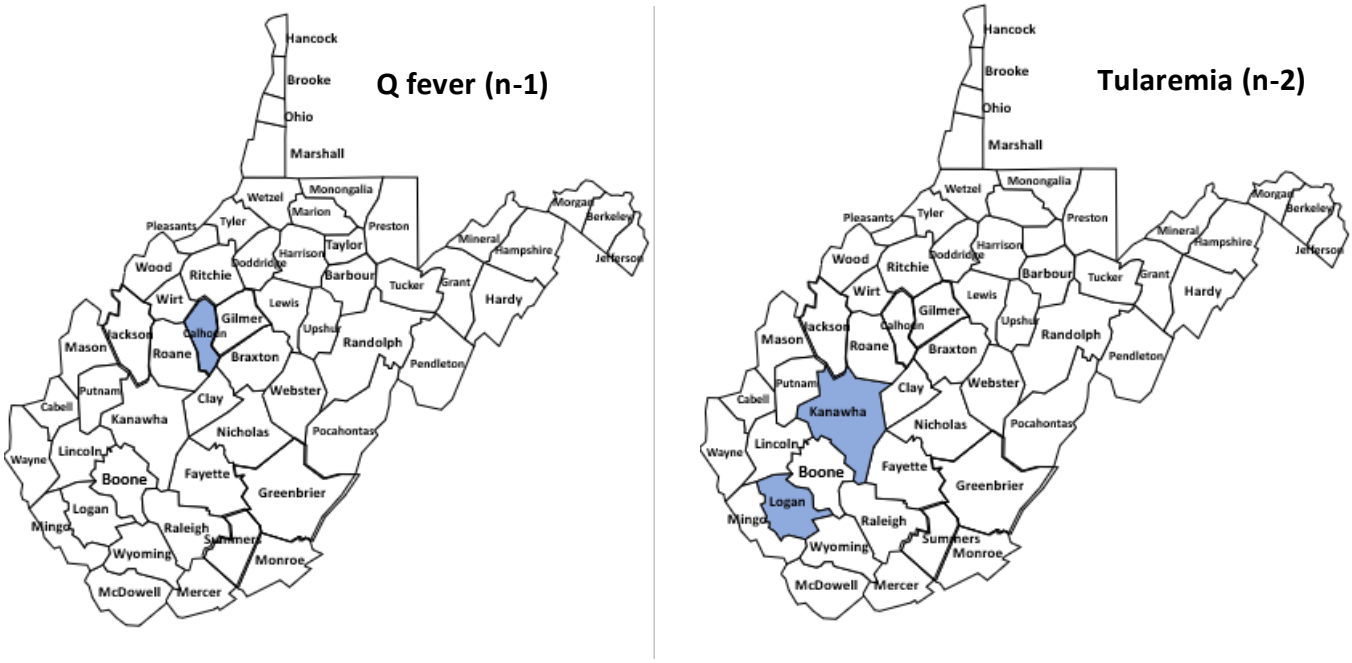

Figure 8. County-level distribution Q fever and Tularemia cases – West Virginia, 2021

Discussion

Zoonotic diseases in West Virginia can be transmitted by a variety of animals and by a variety of different routes. Some zoonotic diseases require travel to specific areas of the world for a person to become infected, while others may require exposure to bodily fluids or a bite from a specific animal host.

In West Virginia, most zoonotic diseases 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). Some "other" reportable zoonotic diseases are considered travel associated. These zoonotic diseases are not endemic to West Virginia but occur when a person is infected during travel to an area where the disease is transmitted (e.g., viral hemorrhagic fever, MERS-CoV). For information about "other" zoonotic diseases reportable in West Virginia, visit: oeps.wv.gov/zoonotic/pages/default.aspx.