WEST VIRGINIA
2017 ZOONOTIC DISEASE SURVEILLANCE REPORT

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Introduction

Mosquito-borne diseases, most of which are viruses, are transmitted through the bite of infected mosquitoes. Surveillance for these diseases in West Virginia focuses on four endemic arboviruses—La Crosse encephalitis virus (LAC), West Nile virus (WNV), St. Louis encephalitis virus (SLE), and eastern equine encephalitis virus (EEE)—and travel-associated diseases such as chikungunya, dengue fever, malaria, and Zika virus (ZIKV). Historically, LAC has been the mosquito-borne disease of most concern in West Virginia, with up to 40 human cases reported in previous years.

Most people who become infected with endemic with arboviral infections 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.

Environmental surveillance for arboviral diseases monitors local activity in non-human species. Mosquito surveillance is important to understanding the distribution of these vectors and the diseases that they may transmit to humans. Mosquito surveillance is conducted in selected counties across the state from late spring through fall. Horses can become infected with arboviruses resulting in clinical illness. Mosquitoes, dead birds and horses have all been used to help identify WNV and other arboviral disease activity in West Virginia. This surveillance summary describes human cases of mosquito-borne disease in West Virginia in 2017.

Methods

Patients with a positive laboratory test result for a mosquito-borne disease were entered into the West Virginia Electronic Disease Surveillance System (WVEDSS) for additional follow-up by the local health department (LHD) where the patient resides, including an environmental assessment of case sites. All reported human cases were classified according to the national case definition for each mosquito-borne disease (wwwn.cdc.gov/nndss/script/casedefDefault.aspx). Only confirmed and probable cases were included for analysis. For dengue fever and other arboviral diseases (except ZIKV), the 2015 case definitions were used to ascertain case status. For malaria, the 2014 case definition was used, and for ZIKV, the 2016 case definition was used. Confirmed and probable arbovirus cases were reported to the Centers for Disease Control and Prevention (CDC) through ArboNET. Surveillance reports were shared with public health partners throughout active mosquito/mosquito-borne disease season from July to November 2017, to provide data on vectorborne disease activity around the State. To obtain case counts and basic descriptive epidemiologic characteristics of cases, records were exported from WVEDSS for all mosquito-borne disease cases within Morbidity and Mortality Weekly Report (MMWR) Year 2017. Data were summarized using Microsoft Excel.

Enhanced passive surveillance methods were utilized to help detect human cases of mosquito-borne arbovirus infection. These methods included 1) statewide health alerts to physicians, 2) a hospital laboratory letter, 3) an email memo to LHDs with important arboviral disease information, and 4) dissemination of equine testing and dead bird surveillance information sheets to veterinarians. During 2017, mosquito-borne disease testing of human specimens occurred through hospital and commercial laboratories. The West Virginia Office of Laboratory Services (WVOLS) performed WNV, SLE, LAC, ZIKV testing.

Results

Human Surveillance

Table 1 provides a comparison of human cases of mosquito-borne diseases reported in West Virginia from 2013 to 2017. In 2017, eight cases of mosquito-borne diseases were reported. One probable case of WNV was reported from Cabell County in August. The case was a 69-year-old male. Four probable cases of LAC were reported from three counties: Kanawha, Raleigh, and Summers (Figure 1). All were neuroinvasive cases. Two of the cases were male, and two cases were female. The median age was ten years (mean= 10.8 years; range= 8-15 years). Illness onset for LAC cases began in July (n=2) and August (n=2). All cases were hospitalized as a result of illness. No cases of dengue fever were reported in 2017. Two travel-associated malaria cases were reported. The first case was a female from Monongalia County who traveled to Ghana. The second case was a male from Pendleton County who traveled to Kenya.

Table 1. Human cases of mosquito-borne disease in West Virginia from 2013 to 2017.

Disease	# (%) of Cases† (2013)	# (%) of Cases† (2014)	# (%) of Cases† (2015)	# (%) of Cases† (2016)	# (%) of Cases† (2017)
LAC	11 (69)	2 (28.6)	4(57.1)	8 (38.1)	4(50)
WNV	1 (6)	0 (0)	0(0)	1 (4.8)	1 (12.5)
Malaria	2 (12.5)	2 (28.6)	2(28.6)	1 (4.8)	2 (25)
Dengue	2 (12.5)	1 (14.3)	1(14.3)	0 (0)	0 (0)
EEE	0 (0)	0 (0)	0(0)	0 (0)	0 (0)
SLE	0 (0)	0 (0)	0(0)	0 (0)	0 (0)
Chikungunya	0 (0)	2 (28.6)	2(28.6)	0 (0)	0 (0)
ZIKV	-	-	-	11(52.4)	1* (12.5)
Total	16 (100)	7 (100)	7(100)	21 (100)	8 (100)

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

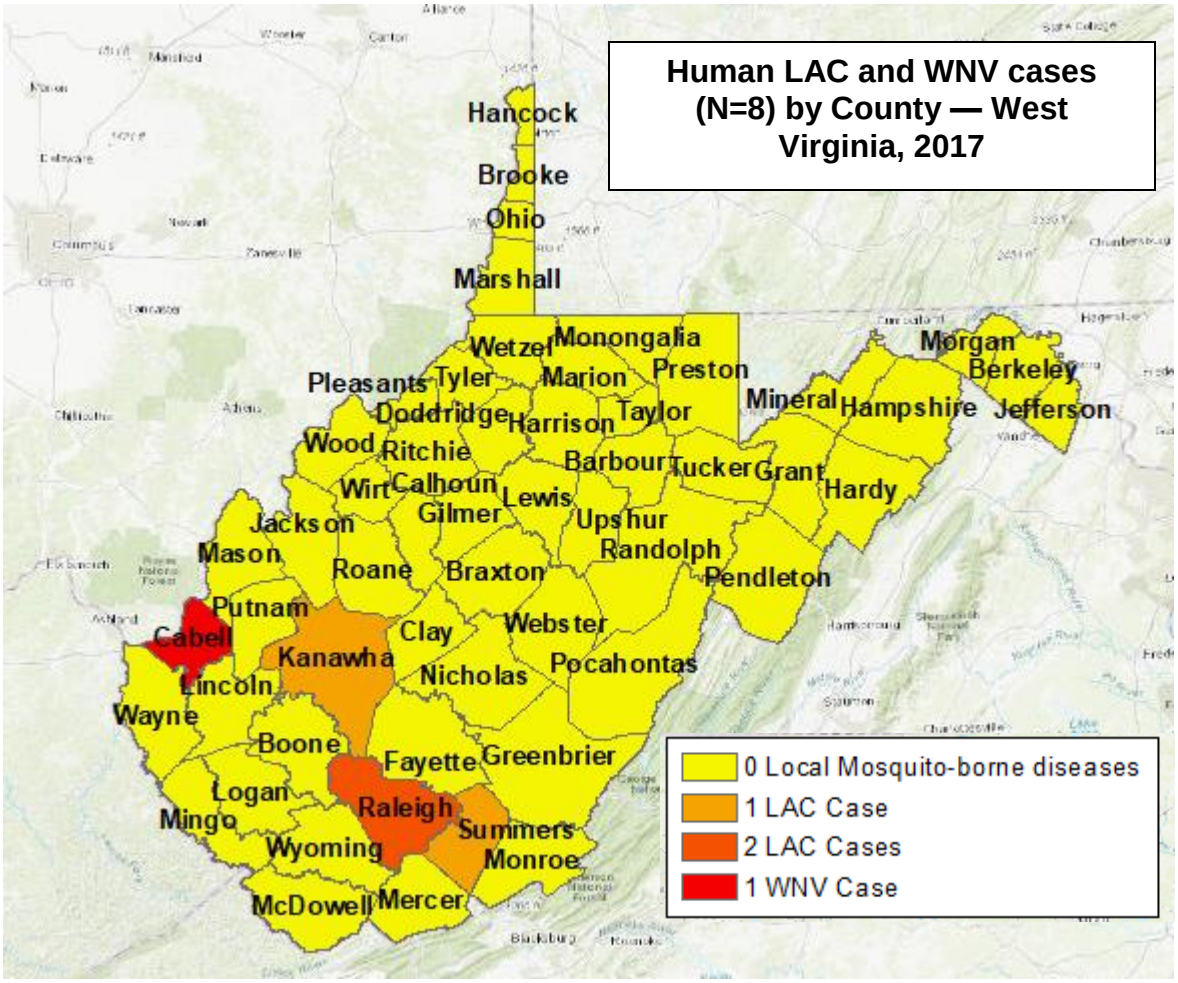

Figure 1. Distribution of human locally transmitted mosquito-borne cases reported in West Virginia in 2017.

Discussion

The incidence of local mosquito-borne disease infections was low in West Virginia in 2017 with only four LAC cases reported (0.22 per 100,000 people) and one WNV case reported. LAC cases followed the epidemiologic trends previously seen in West Virginia: children under 15 years of age and in the majority (75%) of the cases reported in southern counties.

Three imported mosquito-borne disease cases occurred in 2017, accounting for 37.5% of all mosquito-borne cases reported in the state. It is important that residents from West Virginia who travel internationally be mindful of mosquito-borne diseases endemic in their destinations. CDC's website for travelers' health is a good resource for this information: //wwwnc.cdc.gov/travel. Links to CDC pages as well as public health literature on mosquito-borne disease can be found on the West Virginia Department of Health and Human Resources (DHHR), Bureau for Public Health, Division of Infectious Disease Epidemiology (DIDE) Mosquito-borne Disease webpage: www.dhhr.wv.gov/oeps/disease/Zoonosis/Mosquito/.

Reducing the risk of mosquito-borne disease means reducing the risk of being bitten by mosquitoes:

- Be aware of the times of day when mosquitoes are most active. For many mosquitoes, peak hours are dusk and dawn. The LAC-transmitting mosquitoes are active during the day.
- Wear protective clothing such as long sleeves, pants, and socks. Use insect repellant that contains DEET, picardin, IR3535, or oil of lemon eucalyptus on exposed skin and clothing when outdoors.
- Ensure that window and door screens are intact to keep mosquitoes outside of homes. Remove breeding sites around the home (e.g. any containers that can accumulate water).
- Check with your healthcare provider when traveling abroad to learn about mosquito-borne diseases found in that area of the world.

DHHR's Zoonotic Disease Group sincerely thanks the many public health partners who contributed to mosquito-borne disease surveillance across the State. Your efforts have provided important information presented in this summary.

Introduction

Tickborne diseases (TBDs) are diseases transmitted by the bite from an infected tick vector. In West Virginia, tick vectors responsible for disease transmission have been identified for at least six TBDs (Table 1). 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 in Lyme disease).[1] 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 1, are reportable to public health authorities in West Virginia from healthcare providers and laboratories. The purpose of this summary is to describe the epidemiology of TBDs reported in West Virginia in 2017.

Table 1. 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*)
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.

Methods

Surveillance and Case Ascertainment Methods

During the study period (2017 MMWR Year), passive surveillance was conducted for TBDs in West Virginia. West Virginia State Code 16-3-1 and 64CSR7 establish infectious disease reporting requirements for healthcare providers and laboratories. LHDs conducted initial case investigations after receiving a case report or positive laboratory results for a reportable TBD. Cases were reported from LHDs to the State Health Department using the WVEDSS.

Cases were reviewed by the Zoonotic Disease Program in the DIDE before a final case classification status was assigned. All case classifications were determined using the most current case definition for each disease or condition. Once a final case status was determined, cases were reported by the State Health Department to the CDC via the National Electronic Telecommunications System for Surveillance (NEDSS).

Data Extraction and Analyses

Surveillance data for confirmed and cases of each TBD for MMWR Year 2017 was exported from WVEDSS to an Excel database for analyses. County- and State-level census estimates for 2017 were obtained from the U.S. Census Bureau.

Results

Human Surveillance

In 2017, 675 confirmed and probable TBD cases were reported from 47 counties in West Virginia. Conditions reported included anaplasmosis, babesiosis, ehrlichiosis, Lyme disease, and spotted fever group rickettsioses (SFGRs) (Figure 1, Table 2). No Powassan virus cases were reported.

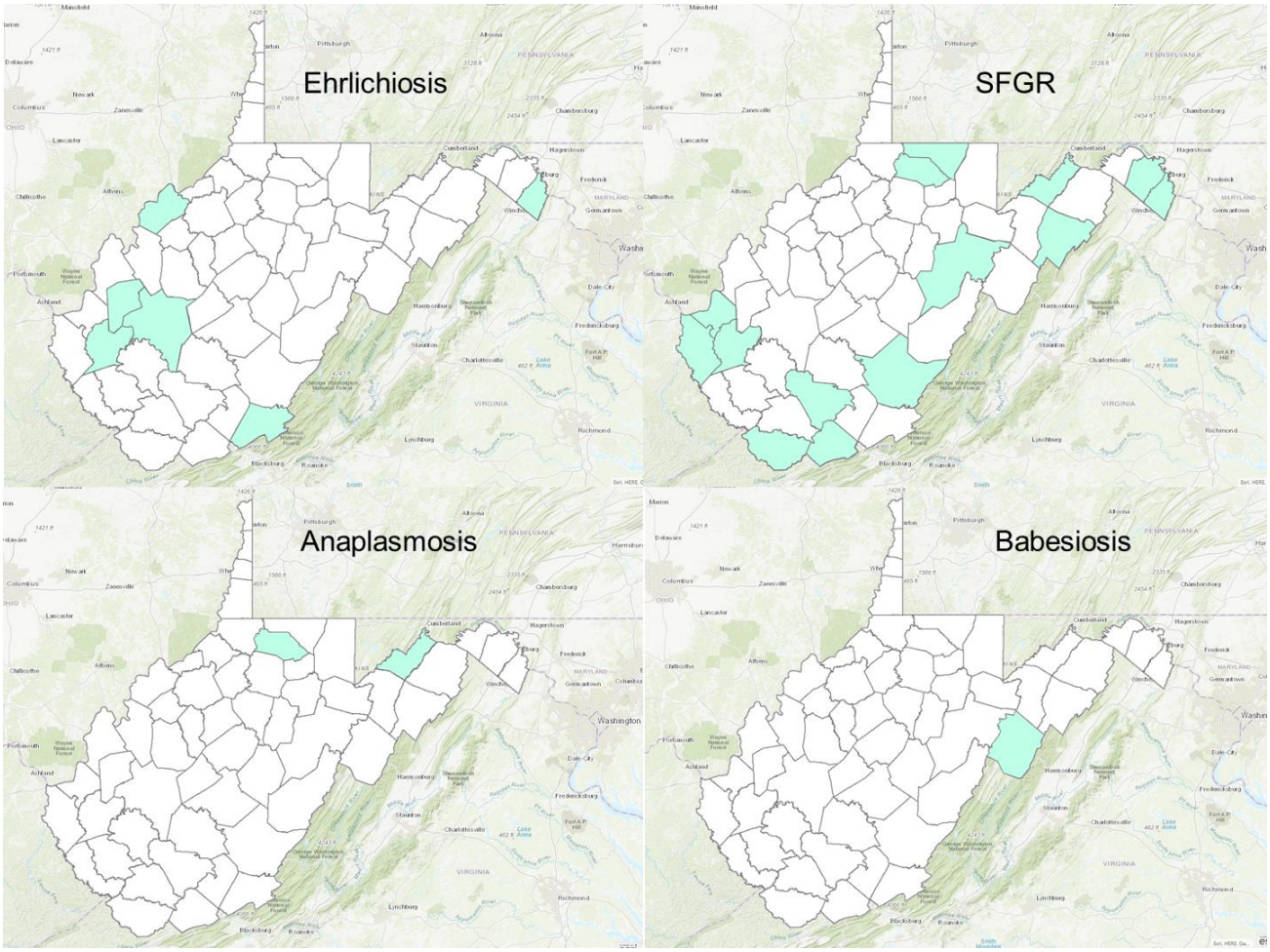

Figure 1. County-level distribution of ehrlichiosis, SFGRs, anaplasmosis, and babesiosis cases – West Virginia, 2017.

Table 2. Frequency of TBDs reported in West Virginia from 2014-2017.

Disease Name	# of 2014 cases	# of 2015 cases	# of 2016 cases	# of 2017 cases
Anaplasmosis	2	2	0	2
Babesiosis	0	0	0	1
Ehrlichiosis	2	5	6	6
Anaplasmosis/ Ehrlichiosis undetermined	0	1	0	1
RMSF/SGFR	5	9	14	17
Lyme disease	136	289	368	648
TOTAL	**145**	**304**	**388**	**675**

Table 3. Frequency of counties reporting TBDs in West Virginia from 2014-2017

Disease Name	Counties with cases (2014)	Counties with cases (2015)	Counties with cases (2016)	Counties with cases (2017)
Anaplasmosis	2	0	0	2
Babesiosis	0	0	0	1
Ehrlichiosis	3	4	5	6
Anaplasmosis/ Ehrlichiosis undetermined	0	1	0	1
RMSF/SGFR	5	7	10	14
Lyme disease	24	37	42	45
TOTAL	**24**	**38**	**43**	**47**

Two probable anaplasmosis cases were reported from Roane and Marion counties during MMWR Year 2017. Six ehrlichiosis cases (one confirmed and five probable) were reported from Marion and Roane counties during MWWR Year 2017. Both cases were male. One case reported hospitalization. Six ehrlichiosis cases (four confirmed and two probable) were reported from Jefferson, Kanawha, Lincoln, Monroe, Putnam, and Wood counties. Two cases were female, and four were male. Their ages ranged from 26 to 74 years of age. Five cases reported hospitalization. A 13-year-old female anaplasmosis/ehrlichiosis undetermined case was reported from Putnam County.

Eighteen probable spotted fever group rickettsioses cases were reported during MMWR Year 2017 from 14 counties: Berkeley, Cabell, Greenbrier, Hardy, Jefferson, Lincoln, Marion, McDowell, Mercer, Mineral, Monongalia, Raleigh, Randolph, and Wayne counties. Ten cases were female, and eight were male. Their ages ranged from 8 to 73 years of age. Three cases reported hospitalization. One female babesiosis case (the first in West Virginia) was reported from Pendleton County. This case reported hospitalization.

Lyme disease cases greatly increased during MMWR Year 2017 with 648 confirmed and probable cases reported (503 confirmed and 145 probable). Lyme disease cases accounted for 95.9% of all tickborne disease cases reported (648 of 676 cases). Forty-five counties reported at least one case, and 17 counties reported greater than 20 cases. Berkeley (n=64), Hancock (n=53), Hampshire (n=36), Jefferson (n=30), and Morgan (n=29) reported the most cases.

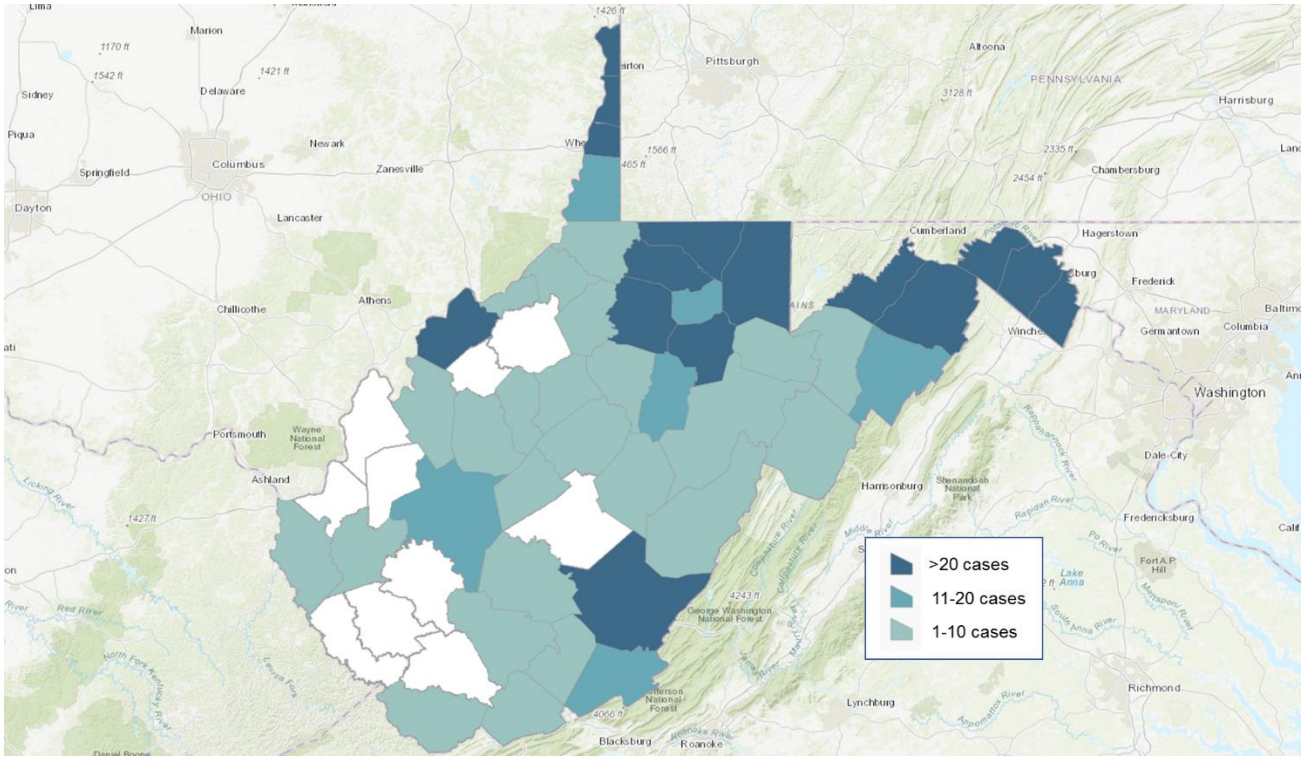

Figure 2. Human Lyme disease cases – West Virginia, MMWR Year 2017. Counties shown in dark blue reported more Lyme disease cases. Counties in white did not have any Lyme disease cases reported.

Confirmed and probable Lyme disease cases ranged in age from 1 to 92 years. The highest proportion of female cases were reported in the 51-60 age range. The highest proportion of males were reported in the 1-10 age range (Figure 3).

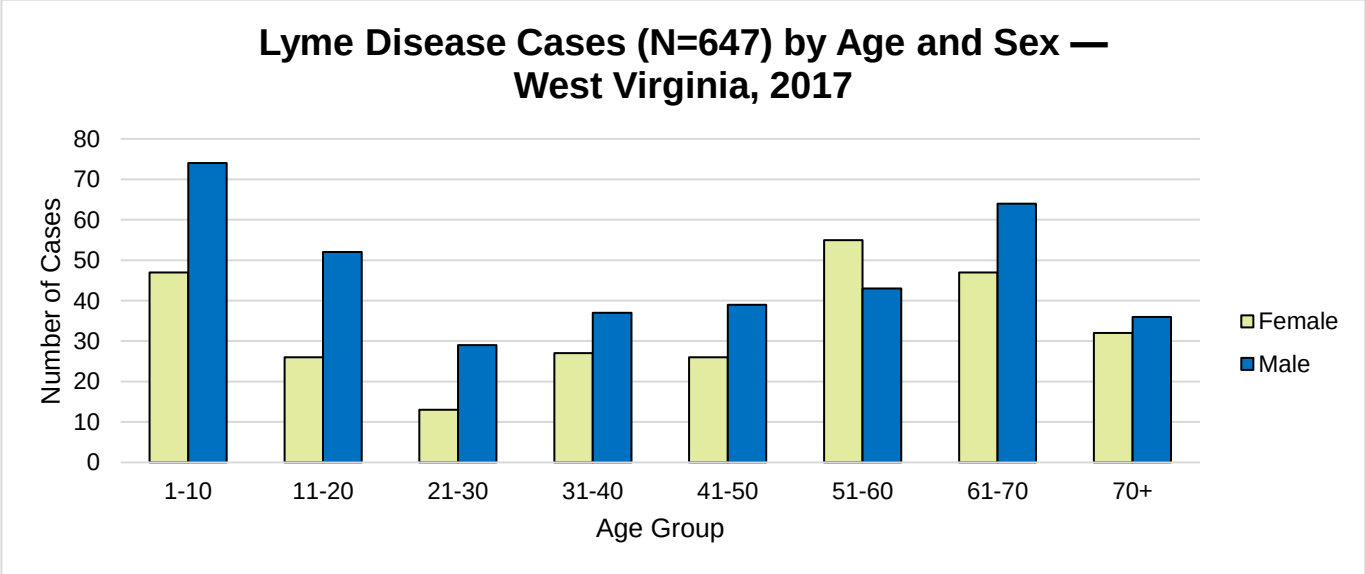

Figure 3. Frequency of Lyme disease cases by age and gender, West Virginia, MMWR Year 2017. Gender was missing for one case.

Discussion

Lyme disease accounted for the majority of TBD cases (Table 2) as has been documented in previous years. Though the vectors of Powassan encephalitis (*I. cookei* and *I. scapularis*) have been identified in the State, there were no reports during the period. Powassan virus has never been identified in humans in West Virginia. 2017 was the first time that babesiosis case was reported in West Virginia.

The reported number of TBDs increased from 388 in 2016 to 675 in 2017 (Table 2); the number of counties that reported at least one TBD increased from 43 counties in 2016 to 47 counties in 2017. Reported Lyme disease cases have greatly increased over the past three years from 289 in 2015 to 648 in 2017. West Virginia became a high incidence State in 2017 from having a three-year average incidence of greater than ten cases per 100,000 persons.

Tickborne rickettsial diseases (anaplasmosis, ehrlichiosis, and SFGR) often have high hospitalization rates among cases. This was indicated by 80% of confirmed and probable ehrlichiosis cases reported during MMWR Year 2017 being hospitalized.

West Virginia borders three states with high incidence of TBDs. Maryland, Pennsylvania, and Virginia rank in the top 14 states that account for about 95% of Lyme disease cases reported annually. Quality surveillance allows for monitoring of changes in the occurrence of TBDs 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 the current report. First, underreporting of TBDs in West Virginia 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. 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 2017, there were 100 “suspected” cases of Lyme disease, seven suspected SFGR cases, five ehrlichiosis, one babesiosis, and one suspected anaplasmosis/ehrlichiosis cases that were not included in the analyses of this summary. This highlights the importance of obtaining quality laboratory, clinical, and epidemiologic information to ensure that appropriate surveillance is being conducted.

Prevention of tickborne illnesses focuses primarily on avoiding tick bites. A tickborne illness prevention checklist can be found on the DIDE website at: www.dhhr.wv.gov/oeps/disease/Zoonosis/Tick/Documents/Tick%20Bite%20Prevention%20Checklist.pdf. In addition, CDC provides recommendation for the prevention of TBDs, adapted in Box 1. Because ticks are more 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.

Below are CDC's recommended steps for tick bite prevention:

- Be extra vigilant in warmer months (April-September) when ticks and people are most active.
- Avoid wooded and bushy areas with high grass and leaf litter.
- Walk in the center of trails.
- Use repellents that contain 20 to 30% DEET on exposed skin and clothing for protection that lasts up to several hours. Always follow product instructions. Parents should apply this product to their children, avoiding hands, eyes, and mouth.
- Use products that contain permethrin on clothing. Treat clothing and gear, such as boots, pants, socks and tents with products containing 0.5% permethrin. It remains protective through several washings. Pre-treated clothing is available and may be protective longer.
- Repel ticks with DEET or permethrin. Use repellents that contain 20% or more DEET on exposed skin for protection that will last several hours. Use products that contain permethrin on clothing. Treat clothing and gear, such as boots, pants, socks, and tents.
- Bathe or shower as soon as possible after coming indoors (preferably within two hours) to wash off and more easily find ticks that are crawling on you.
- Conduct a full-body tick check using a hand-held or full-length mirror to view all parts of your body upon return from tick-infested areas. Parents should check their children for ticks under the arms, in and around the ears, inside the belly button, behind the knees, between the legs, around the waist, and especially in their hair.
- Examine gear and pets. Ticks can ride into the home on clothing and pets, then attach to a person later, so carefully examine pets, coats, and day packs.
- Tumble clothes in a dryer on high heat for an hour to kill remaining ticks. Some research suggests that shorter drying times may also be effective, particularly if the clothing is not wet.

DHHR's Zoonotic Disease Group sincerely thanks the many public health partners who contributed to mosquito-borne disease surveillance across the State. Your efforts have provided important information presented in this summary.

Introduction

While mosquito- and tickborne diseases account for the majority of zoonotic diseases reported in West Virginia, there are other diseases that can be transmitted from animals to humans without these vectors. Table 1 shows a list of diseases and conditions under surveillance in West Virginia that are transmitted by other animals. Q fever and tularemia can be transmitted by ticks but are more commonly transmitted by other animals.

Table 1. 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	MERS coronavirus	Camels and bats
Monkeypox	Monkeypox virus	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	
SARS	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]WVBPH has an annual rabies report that can be accessed at: [LINK TO RABIES REPORT WOULD GO HERE.

Methods

Human Surveillance

During the study period (MMWR Year 2017), passive surveillance was conducted for reportable zoonotic diseases in West Virginia. West Virginia State Code 16-3-1 and 64CSR7 establish infectious disease reporting requirements for healthcare providers and laboratories. LHDs conducted initial case investigations after receiving a case report or positive laboratory results for a reportable zoonotic disease. Cases were reported by LHDs to the DIDE program staff electronically using the WVEDSS. Program leads reviewed each investigation before a final case classification status was assigned. All case classifications were determined using the most current case definition for each disease or condition.

Results

One confirmed brucellosis case was reported during MMWR year 2017. The case was a female from Berkeley County who reported consumption of raw milk from cattle and raw cheese from goats. The case was hospitalized due to illness. Three probable Q fever cases were reported during MMWR year 2017. Two male cases were reported from Putnam and Randolph counties, and one female case as reported from Cabell County. Two were hospitalized due to illness; both had reported exposure to livestock.

Discussion

Zoonotic diseases in West Virginia can come from a variety of animals and are based on the type and location of exposure to pathogen zoonotic agents. Some zoonotic pathogens require travel to specific areas of the world for a person to become infected, while others require exposure to bodily fluids or a bite from a specific animal host.

In West Virginia, most of the non-mosquito-borne and non-tickborne infections come 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 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 2 are reportable within 24 hours or immediately since these diseases can result in severe morbidity and even mortality (e.g. rabies, hantavirus) and can be considered bioterrorism agents (e.g. anthrax, Q fever). Some “other” zoonotic diseases are not endemic to West Virginia and would only be reported if a case travels to an area where the disease was being transmitted (e.g. viral hemorrhagic fever, MERS-CoV). For information about “other” zoonotic diseases reportable in West Virginia, visit: www.dhhr.wv.gov/oeps/disease/Zoonosis/other/Pages/default.aspx.