West Virginia Tickborne Disease Surveillance Summary, 2012

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 in rickettsial diseases), while other TBDs produce highly variable symptoms (as in Lyme disease)[1,2]. Early recognition and treatment of TBDs by healthcare providers is important to 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 2012.

Table 1. Possible tickborne diseases by causative agent based on vectors found in West Virginia[3].

Tickborne Disease[a]	Agent	Tick Vector(s) in West Virginia
Anaplasmosis	*Anaplasma phagocytophilum*	Black-legged tick (*Ixodes scapularis*)[b]
Babesiosis	*Babesia microti* and other *Babesia* spp.	Black-legged tick (*Ixodes scapularis*)
Ehrlichiosis	*Ehrlichia chaffeensis* and *Ehrlichia ewingii*	Lone star tick (*Amblyomma americanum)*
Lyme disease	*Borrelia burgdorferi*	Black-legged tick (*Ixodes scapularis*)
Powassan encephalitis	Powassan virus	Groundhog tick (*Ixodes cookei*)[c] Black-legged 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)*
Tularemia	*Francisella tularensis*	American Dog tick (*Dermacentor variabilis*) Lone star tick (*Amblyomma americanum*)

[a] Other tickborne diseases, 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.

Methods

Surveillance and Case Ascertainment Methods

During the study period (2012 MMWR week 1 to MMWVR 52), passive surveillance was conducted for TBDs in West Virginia. West Virginia State Code 16-3-1 and 64CSR7 establishes infectious disease reporting requirements for healthcare providers and laboratories. Local health departments

conducted initial case investigations after receiving a case report or positive laboratory results for a reportable TBD. Cases were reported from local health departments to the state health department electronically using the West Virginia Electronic Disease Surveillance System (WVEDSS).

Cases reported by local health departments during the study period were reviewed by the state health department before a final case classification status was assigned. All case classifications were determined using the "2012 Nationally Notifiable Diseases and Conditions and Current Case Definitions[4]." Once final case status was determined, cases were reported by the state health department to the Centers for Disease Control and Prevention (CDC) via the National Electronic Telecommunications System for Surveillance (NETSS).

Data Extraction and Analyses

Demographic and clinical information about suspect, probable, and confirmed cases of each TBD were exported from WVEDSS to an Excel database for each TBD listed in Table 1. For the purposes of this study, only probable and confirmed cases with report dates from MMWR week 1 to MMWR week 52 were included in analyses. County- and state-level census estimates were obtained through the U.S. Census Bureau for 2012 at http://www.census.gov/popest/data/cities/totals/2012/index.html. Charts were created using Microsoft Excel 2010.

Active Tick Surveillance

In cooperation with the National Park Service, biweekly tick surveys were conducted in Harper's Ferry National Historic Park (Jefferson County) and New River Gorge River (Fayette, Raleigh, and Summers Counties). Tick drag surveys were also conducted in Cooper's Rock State Forest (Monongalia and Preston Counties), Tomlinson Run State Park (Hancock County), North Bend State Park (Doddridge County), and Blackwater Falls State Park (Tucker County). Sporadic tick surveys were conducted in Kanawha County.

Surveyors used the standard tick drag methods to collect specimens[5]. A tick drag cloth was dragged along the forest ground and examined every 20 meters for 100 meters. The route was then examined in the reverse direction. Ticks found on the cloth were removed, preserved in 70% ethanol, and returned to the lab for species identification, sex determination, and pathogen screening. The Army Institute of Public Health (Aberdeen, MD) tested the ticks collected for *Anaplasma phagocytophilum*, and *Borrelia burgdorferi* using polymerase chain reaction (PCR).

Results

In 2012, there were 101 probable and confirmed TBD cases reported. Conditions reported included anaplasmosis, ehrlichiosis, Rocky Mountain spotted fever (RMSF), and Lyme disease. Table 2 summarizes the data for 2012. No cases of babesiosis, Powassan virus, or tularemia were reported during this period.

Table 2. Summary of reporting statistics for TBDs reported in West Virginia in 2012.

Disease Name	Total number of cases reported for 2012 (%)	Number of counties with confirmed or probable cases	Incidence per 100,000
Anaplasmosis/ Ehrlichiosis	2 (2.0)	2	0.11
RMSF	2 (2.0)	2	0.11
Lyme disease	97 (96.0)	9	5.22

Anaplasmosis/Ehrlichiosis
Two probable cases of anaplasmosis/ehrlichiosis were reported during the MWWR year 2012. Cases were reported from Berkeley and Monongalia Counties. The cases were two males; one was 9 and other was 19 years of age. One was hospitalized, and no deaths were reported.

Rocky Mountain spotted fever
Two probable cases of RMSF were reported in 2012; one in Cabell County and one in Hardy County. Both cases were males; one was 35 and the other was 53 years of age. Neither hospitalization nor deaths were reported for these cases.

Lyme disease
There were 97 confirmed and probable Lyme disease cases reported in West Virginia during MMWR year 2012 accounting for 96.0% (97/101) of all TBD cases reported during this period. Cases of Lyme disease were reported from nine counties across the state (Figure 1). Jefferson and Morgan and Counties, located in the Eastern Panhandle, had the highest proportion of cases with 45 (46.3%) and 27 (27.84%) cases, respectively. Berkeley, Hampshire, Jefferson, and Morgan Counties all had incidence rates greater than 20 per 100,000 people (based on population estimates for each county). All other counties with cases had incidence rates below 10 per 100,000 people.

The highest proportion of Lyme disease cases reported illness onset during the warm weather months (Figure 2); 69 (84.2%) cases reported illness onset dates from May to September. Among females, the highest incidence occurred in the 31-40 age group; the highest incidence among males occurred in the 11-20 age group. No deaths were reported as a result of illness.

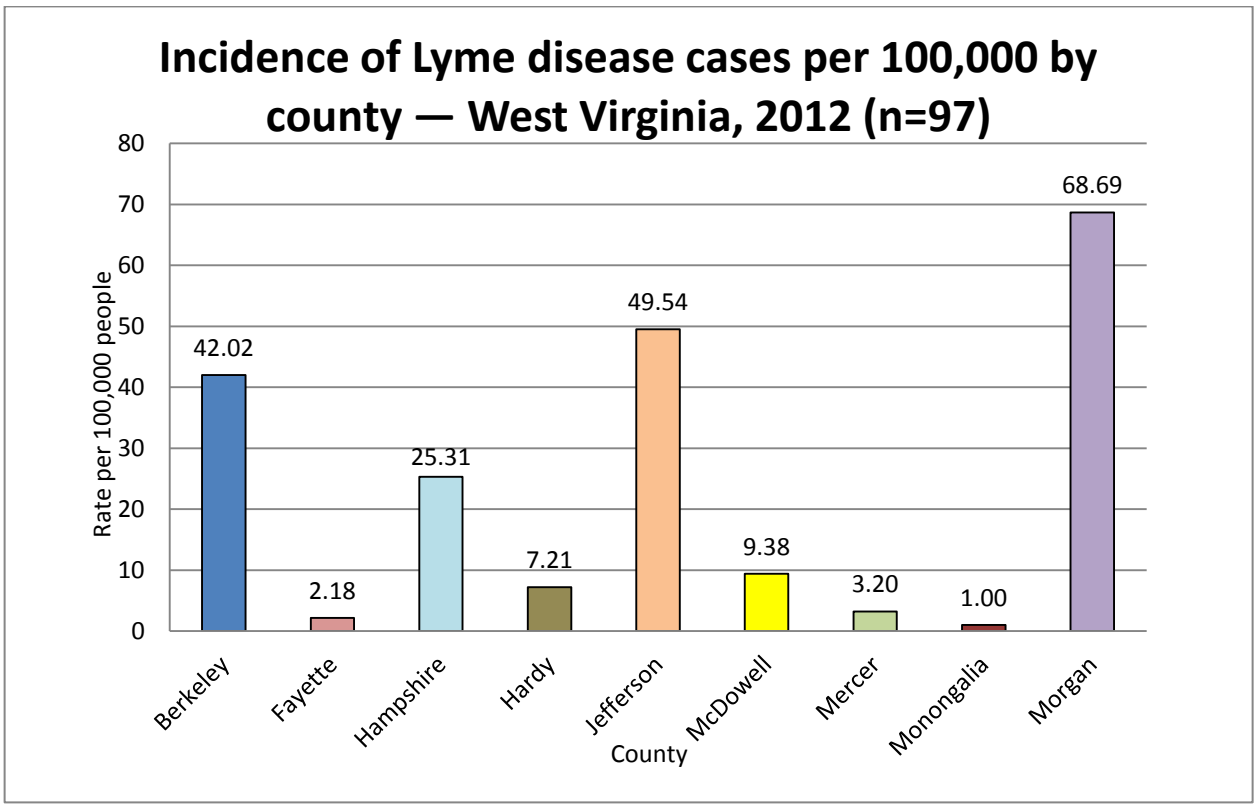

Figure 1. Incidence of Lyme disease cases by county. Estimates are based on 2012 census data for each county.

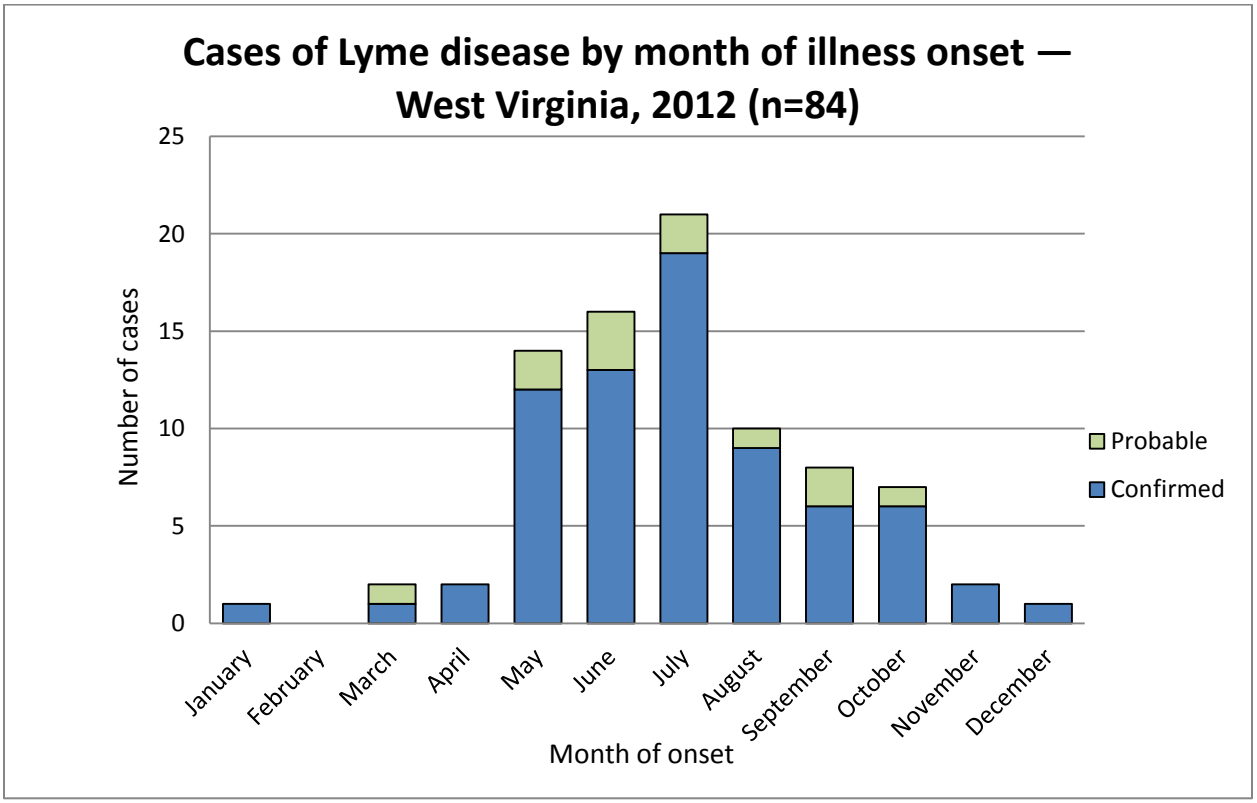

Figure 2. Month of illness onset for probable and confirmed cases of Lyme disease. Date of illness onset was missing for thirteen cases.

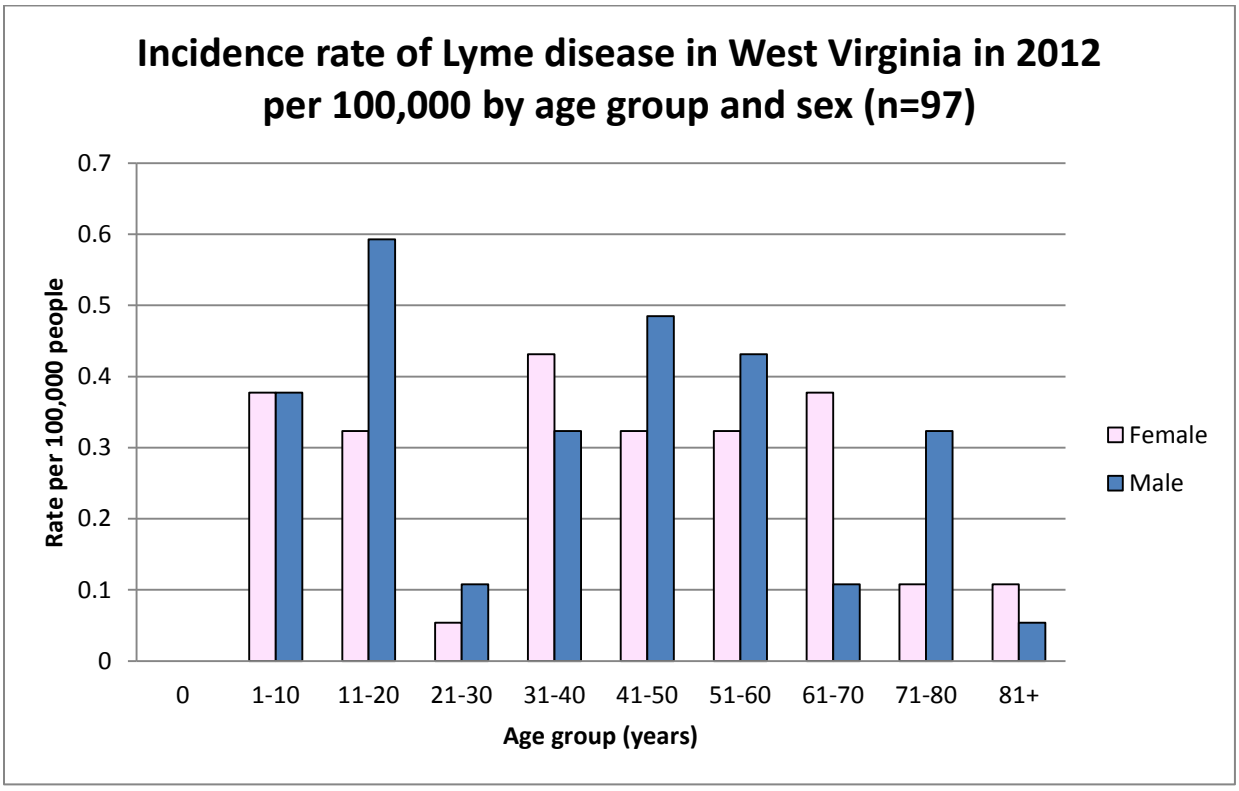

Figure 3. Incidence of Lyme disease by age group and sex.

Tick Surveillance

Twenty-six blacklegged ticks were found in Harper's Ferry National Park. Four (15%) of the blacklegged ticks from Harper's Ferry were positive for *Borrelia burgdorferi*. Two (8%) of the blacklegged ticks from Harper's Ferry were infected with *Anaplasma phagocytophilum*. None of the blacklegged ticks were co-infected with both *Borrelia burgdorferi* and *Anaplasma phagocytophilum*. Blacklegged tick was identified in counties previously unrecorded for the species.

A single female black-legged tick was found in New River Gorge National River (Fayette County). This specimen represents the first blacklegged tick recovered from Fayette County. A single female blacklegged tick was recovered from Tomlinson Run State Park in Hancock County and a single blacklegged tick nymph was recovered from Cooper's Rock State Forest in Preston County. Since these specimens represent new county records for blacklegged tick, they have been retained as physical county records of species occurrence and they were not subjugated to the destructive processes used in human pathogen screening.

Blacklegged tick populations have also been discovered in new counties in West Virginia. Unlike single specimen records (which could represent a tick being accidentally transported to the locality by a visiting host), a population record implies a large number of tick vectors in the locality capable of sustaining itself. Multiple specimens representing different life stages have consistently been recovered from a single location in Charleston, Kanawha County, West Virginia during late spring and fall 2012. The six nymphs collected at this site during a single collecting date would fulfill the population (critical mass) establishment criteria proposed by Dennis et al.[5]. Fortunately, none of the

ticks tested from this population were infected with *Borrelia burgdorferi* or *Anaplasma phagocytophilum*.

Additional tick species and tick-transmitted pathogens have been recovered through active tick surveillance. For example, a single American dog tick female collected from New River Gorge National River at the end of May was positive for *Rickettsia montanensis*.

Discussion

Four TBDs were reported in West Virginia during 2012: anaplasmosis, ehrlichiosis, Lyme disease, and Rocky Mountain spotted fever. Lyme disease accounted for the majority of TBD cases (Table 2). Though the vectors of tularemia (*D. variabilis* and *A. americanum*) and Powassan encephalitis (*I. cookei* and *I. scapularis*) have been identified in the state, there were no reports during the time period. Additionally, there have been no reports of either disease in the past five years (Powassan virus has never been identified in humans in West Virginia).

Babesiosis, a TBD caused by *Babesia* spp. bacteria and transmitted by *Ixodes scapularis,* is on the rise in the United States. This emerging TBD primarily occurs in the northeast and Midwest; yet, there is cause for concern given that the tick vector for the disease is present in West Virginia. Eighteen states reported babesiosis in 2011, including Maryland with four cases[6]. Most babesiosis cases had symptom onset in June, July, and August, similar to what is seen for Lyme disease cases. Given that both babesiosis and Lyme disease are transmitted by the same tick vector, babesiosis could occur in West Virginia. CDC provides additional information about babesiosis on its website: http://www.cdc.gov/parasites/babesiosis/.

In 2010, an evaluation was done in West Virginia to determine which counties would be considered "endemic" for Lyme disease based on 2007-2009 surveillance data. An endemic county is "…one in which at least two confirmed cases have been acquired in the county or in which established populations of a known tick vector are infected with *B. burgdorferi*." Results were based on confirmed cases with documented EM, known exposure within West Virginia, and met laboratory criteria based on the national case definition of Lyme disease. Using these criteria, three counties were determined to be endemic counties: Berkeley, Jefferson, and Morgan Counties. From analysis of 2010 and 2012 Lyme disease case reports, Hampshire County meets the same criteria for being classified as an endemic county; two cases in 2010 and one case in 2012 met the clinical, exposure, and laboratory criteria for the county to be considered endemic (Appendix A). Hampshire County is considered an endemic county as of 2013.

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 2012, there were 5 "suspected" cases of Lyme disease and one "suspected" case of anaplasmosis/ehrlichiosis 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. Lastly, there are limited resources for tick surveillance efforts. It would be difficult to survey all 55 counties in West Virginia for ticks.

As TBDs remain an important concern in West Virginia, surveillance is essential to understanding the distribution and incidence of these diseases. Although the incidence of some TBDs is currently low in West Virginia, human cases of TBDs may increase in the near future due to climate change, increased human sprawl into forest habitat where tick vectors reside, and increased population of tick hosts (like the white-tailed deer)[8]. 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 during TBD case investigations.

Due to the low number of cases for RMSF, ehrlichiosis, and anaplasmosis in West Virginia, targeted recommendations cannot be made for preventing these diseases. However, there were some trends noted among Lyme disease cases. The majority of Lyme disease cases (90/97) occurred in "endemic" counties from the Eastern Panhandle, accounting for 92.8% of confirmed and probable cases reported. Males were more likely overall to be infected with Lyme disease, particularly, between the ages of 11-20 years. Therefore, Lyme disease prevention efforts should be targeted towards residents of (and visitors to) the Eastern Panhandle, males, and young adults in general.

Records of blacklegged tick in Preston, Hancock, Fayette, and Kanawha Counties represent an expansion of the previously recorded distribution of this species in West Virginia. Blacklegged tick occurring in Preston County is not entirely surprising. The blacklegged tick has been previously recovered from Jefferson, Berkeley, and Morgan Counties in the eastern panhandle[5,6,7]. The occurrence of blacklegged tick in Hancock County is also expected surprising. The blacklegged tick has been found in the northern panhandle and neighboring counties in western Pennsylvania and northeastern Ohio[5,7,8].

The presence of blacklegged tick in Kanawha and Fayette Counties in south-central West Virginia represents a significant deviation from known established blacklegged tick populations. Some studies did not find blacklegged tick in central West Virginia[9-12]. However, populations of black-legged tick could occur in other parts of the state beyond the eastern panhandle[5,7,10,11,13] .

Although blacklegged tick has been found in Kanawha County, these ticks were not infected with *B. burgdorferi* or *Anaplasma phagcytophilum*. According to the 'dilution effect hypothesis,' blacklegged ticks would show lower infection in environments with high host species diversity. Since most host species are incompetent Lyme disease reservoirs, infection in the blacklegged tick population in large, host species rich habitats would be 'diluted.' Conversely, small forest fragments have lower host species diversity and disturbance-tolerant reservoir species, such as the white-footed mouse (*Peromyscus leucopus*), would be very abundant (Nupp & Swihart 2000). Since white-footed mice are competent mammalian reservoirs for *B. burgdorferi*[14] and *A. phagocytophilum*[15], infection would magnify in the tick population in the small forest fragments found in West Virginia's eastern panhandle.

Rickettsia montanensis has not previously been recorded from West Virginia. *Rickettsia montanensis* has been found in American dog ticks from neighboring states, such as Ohio[16], Maryland[17] and North Carolina[18]. This is a member of the spotted-fever rickettsioses group non-pathogenic in mammalian cells[19] and therefore, not presumed to be infectious in humans.

Prevention of tickborne illnesses focuses primarily on avoiding tick bites. A tickborne illness prevention checklist can be found at http://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. The Division of Infectious Disease Epidemiology (DIDE) sends out a yearly health advisory to provide important information about the start of TBD season. A link to the 2012 health advisory can be found at (http://www.dhhr.wv.gov/oeps/disease/Documents/WV%20HAN%20Advisory%2044.pdf).

Box 1. CDC recommended steps for tick bite prevention[19].

- Be extra vigilant in warmer months (April-September) when ticks are most active.
- Avoid wooded and bushy areas with high grass and leaf litter.
- Walk in the center of trails.
- 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.
- Find and remove ticks from your body. Bathe or shower as soon as possible after coming indoors to easily find ticks that may be 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 returning 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 their legs, around the waist, and especially in their hair.
- Examine gear and pets. Ticks can ride into the home on clothing and pets. Tumble clothes in a dryer on high heat for an hour to kill ticks that may be attached.

To assist with surveillance and diagnosis of RMSF, testing can be coordinated through the Division of Infectious Disease Epidemiology by calling 1-800-423-1271.

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Appendix A: Counties in West Virginia considered endemic for Lyme disease.