February 2025

Spotted Fever Group Rickettsiosis (SFGR)

Surveillance and Investigation Protocol

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I. ABOUT THE DISEASE

Rocky Mountain spotted fever (RMSF) and other spotted fever group rickettsioses (SFGR) are tickborne pathogens caused by bacteria in the *Rickettsia* genus. This disease is known to be transmitted to humans by *Dermacentor variabilis*, also known as the American dog tick or wood tick (CDC 2019a). Other ticks that are known to transmit these pathogens include *Dermacentor andersoni* (Rocky Mountain wood tick), *Rhipicephalus sanguineus* (brown dog tick) (CDC 2019a), *Amblyomma maculatum* (Gulf Coast tick) (CDC 2019b), and *Amblyomma americanum* (lone star tick) (Goddard 2003; Cohen *et al.* 2009). SFGRs are reportable within one week to the local health department where the case resides.

A. Clinical Presentation

Rocky Mountain Spotted Fever (RMSF)

Clinical symptoms begin to arise 2-14 days after the tick bite. Symptoms include a sudden onset of fever and headache with other symptoms of muscle pain, nausea, vomiting, abdominal pain, rash and edema around the eyes and back of hands in the first four days of illness. Also, a fever of approximately 40˚C persists until the end of the second week of illness. A generalized early stage macular rash appears 2-4 days after the onset of fever, and first appears around the wrists, forearms and ankles and spreads to the trunk and sometimes the palms of hands and soles of feet. *Rickettsia rickettsii* infects vascular endothelial cells, and less commonly, underlying smooth muscle cells of small and medium blood vessels. Infection with *Rickettsia rickettsii* leads to systemic vasculitis that manifests externally as the characteristic petechial skin lesions. A late stage petechial rash does not appear until day 5-6 of illness with every attempt to be made to treat the patient before the onset of this rash. Some type of rash appears in about 90% of cases (CDC 2019a). Pathogen-mediated injury to the vascular endothelium results in increased capillary permeability, microhemorrhage, and platelet consumption. Severe late-stage manifestations of RMSF include cutaneous necrosis, meningoencephalitis, acute renal failure, acute respiratory distress syndrome, shock, arrhythmia, and seizure are consequences of microvascular leakage.

***Rickettsia parkeri* Rickettsiosis**

Compared with RMSF, *Rickettsia parkeri* rickettsiosis is less severe (Biggs *et al.* 2016). Symptoms develop a median of 5 days (range: 2-10 days) after the bite of an infected tick. The first manifestation in nearly all patients is an inoculation eschar (a dark, scabbed plaque overlying a shallow ulcer, typically 0.5 – 2 cm in diameter), which generally is nonpruritic, nontender or mildly

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tender, and surrounded by an indurated, erythematous halo and occasionally a few petechiae. Fever typically develops within a few days of the eschar. Shortly after the onset of fever, a nonpruritic maculopapular or vesiculopapular rash commonly develops on the trunk and extremities. Other symptoms include myalgia and headache. Gastrointestinal manifestations, such as nausea and vomiting, are rare. No severe manifestations or deaths have been reported from *Rickettsia parkeri* infection.

B. Etiologic Agent

Rickettsiae are obligate intracellular, Gram-negative coccobacilli (Nathavitharana and Mitty 2015). Members of the genus *Rickettsia* are divided into four main groups: the spotted fever group, typhus group, transitional group, and ancestral group. The spotted fever group, including *Rickettisa rickettsii* and *Rickettsia parkeri*, are mainly associated with ticks, while the typhus group and transitional group are associated with other arthropods, such as lice, fleas, and mites.

C. Reservoir

Tickborne rickettsial pathogens are maintained in natural enzootic transmission cycles involving vertebrates and their tick vectors. Table 1 lists the *Rickettsia* spp. (pathogenic and non-pathogenic) detected in tick species from West Virginia and neighboring states. Based upon a review of published tick surveillance studies, *Rickettsia rickettsii* is seldom detected in ticks from the Mid-Atlantic region. Due to immunological cross-reactivity amongst members of the SFGR, early studies based upon immunochemistry may be suspect.

Rickettsial organisms maintain themselves in ticks through transovarial and transstadial transmission (Wright *et al.* 2015; Harris *et al*. 2017; Lee *et al*. 2019). Infected tick larvae and nymphs transmit rickettsiae to susceptible rodents, such as meadow voles and deer mice, when the ticks emerge to blood feed in the spring. Conversely, ticks feeding on infected hosts can also acquire the rickettsiae during the brief time period when the bacteria are present in the vertebrate's blood

Table 1: *Rickettsia* spp. infection in tick species – Delaware (DE), Georgia (GA), Kentucky (KY), Maryland (MD), North Carolina (NC), Ohio (OH), Pennsylvania (PA), South Carolina (SC), Tennessee (TN), Virginia (VA), West Virginia (WV)

	Rickettsia rickettsii	*Rickettsia parkeri*	*Rickettsia amblyommatis*	*Rickettsia montanensis*	*Rickettsia bellii*
Dermacentor variabilis	KY (2014-2016), MD (2009) OH (1975, 1976), OH (1981-2006), OH (1984-1989)	KY (2007,2008), NC (2009-2013), VA (2012)	GA (2006), KY (2014-2016), NC (2009-2013), TN (2007, 2008, 2012), VA (2012, 2014, 2015)	DE (2006), GA (2006, 2015, 2017), KY (2007, 2008, 2014-2016), MD (2002), NC (2009-2013), OH (1975, 1976, 1981), OH (1984-1989, 2006), TN (2007-2008, 2012), VA (2010-2012, 2014, 2015), WV (2014, 2019)	GA (2003-2005, 2013, 2017), KY (2014-2016), NC (2009-2013), OH (1981,2006), PA (2014-2015), VA (2014-2015)
Amblyomma americanum	NC (2011)	GA (2019), TN (2007), VA (2012)	GA (2006), MD (2008, 2009, 2012), NC (2005), OH (2000-2010), SC (1981, 2006), TN (2007, 2008), VA (2010-2012), WV (2014, 2019)	GA (2006), TN (2007, 2008)	
Amblyomma maculatum		GA (2007), KY (2003, 2005-2009, 2015-2017), MD, NC (2009, 2010), SC (2007), TN (2012-2014), VA (2010-2012)			
Rhipicephalus sanguineus		VA (2012)			
Haemaphysalis leporispalustris		VA (2012)			

D. Incubation Period

Symptoms for RMSF typically begin 2-14 days after being bitten from an infected tick. The symptoms for SFGR appear 2-10 days after being bitten by an infected tick.

E. Mode of Transmission

Rickettsia rickettsii and other rickettsial diseases are predominantly transmitted to humans through tick bites. Infected ticks must remain attached to the host for period of time (reactivation phenomenon) before rickettsial transmission can occur. This delay in transmission is because *Rickettsia rickettsii* seem to be in an avirulent stage in the unfed tick. The rickettsiae become virulent only after a prolonged attachment of the tick to its host or following ingestion of blood by the infected tick. *Rickettsia rickettsii* can also be transmitted from human to human through blood transfusions (Wells *et al.* 1978). Although organ transplant acquired RMSF/SFGR has not been documented, transmission of other tickborne rickettsia infections through solid organ transplant is possible (Sachdev *et al.* 2014).

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F. Period of Communicability

Ticks remain infected for life, approximately 18 months. Transmission between people is limited to blood transfusions.

II. DISEASE CONTROL AND PREVENTION

A. Disease Control Objectives

1. Reduce severe complications of disease by educating healthcare providers about the occurrence of SFGR and the importance of beginning early antibiotic treatment based on clinical symptoms and patient history.

B. Disease Prevention Objectives

1. Reduce the risk of disease during tick season by educating the public to:
   a. Use personal protective measures when visiting tick habitats.
   b. Keep pets free of ticks.
   c. Perform tick checks following visits to tick habitats.
   d. Promptly and correctly remove ticks found on the body.

C. Disease Prevention and Control

Transmission of *R. rickettsii* and other tickborne diseases can be prevented. Avoid contact with ticks by avoiding bushy areas with high levels of leaf litter and tall grass, and by walking in the center of trails. Also, using insect repellants that contain 20-30% DEET (N, N-diethyl-m-toluamide) on clothing and exposed skin or products that contain 0.5% permethrin on clothing can prevent tick bites. Finally, finding and removing ticks after exposure can prevent tick bites. These include showering or bathing, conducting full-body tick checks, and inspecting pets and gear after returning from a tick-infested area. Children should be checked for ticks by checking under their arms, around and in ears, inside the belly button, behind the knees, between the legs, around the waist, and in their hair. Clothing should be placed in a dryer on high heat for one hour to exterminate any remaining ticks (CDC 2019).

D. Treatment

Treatment for RMSF and other forms of rickettsia should be started prior to laboratory verification, due to the increased risk of long-term sequelae or fatality with delays in treatment. Doxycycline is the first-line treatment for adults and children of all ages, and the duration of

treatment is usually 5-7 days in length. Adults should receive 100 mg every 12 hours and children under 45kg (100lbs) should receive 2.2 mg/kg body weight twice daily (Chapman *et al.* 2006). Chloramphenicol is the only alternative drug used to treat RMSF in cases in which the patient has a severe hypersensitivity to doxycycline (Biggs *et al.* 2016). Epidemiological studies suggest that those patients treated with chloramphenicol are at higher risk for death than those patients who are treated with tetracycline-class antibiotics (Biggs *et al.* 2016; Holman *et al.* 2001).

III. DISEASE INVESTIGATION

A. Case Definition and Case Classification

The following section is from the CDC; read information below in the case classification section regarding clinical and laboratory evidence necessary to classify cases (CDC 2020).

Background

Spotted fever group rickettsioses (SFGR), which captures cases of Rocky Mountain spotted fever (RMSF), *Rickettsia parkeri* rickettsiosis, Pacific Coast tick fever (caused by infection with *Rickettsia* species 364D), and others, are a group of diseases caused by spotted fever group rickettsiae. These pathogens cause acute febrile illnesses, with headache, malaise, thrombocytopenia, rash, and occasionally eschars (dark necrotic scabs at the site of tick or mite bite). Rocky Mountain spotted fever, caused by *R. rickettsii*, is well recognized as the most severe rickettsial illness.

Currently, only 3% of SFGR cases are reported as confirmed, with most probable cases supported by a single serology titer. Antibodies to SFGR can rise in the first week of illness and stay elevated for months to years following infection. Data suggest that the prevalence of IgG antibodies reactive to SFGR in asymptomatic individuals may be more common than previously thought. The use of a single elevated IgG titer result for diagnosis may produce a skewed understanding of SFGR epidemiology and national disease burden.

Clinical Criteria

Fever as reported by the patient or a healthcare provider **and** one or more of the following: rash, eschar, headache, myalgia, anemia, thrombocytopenia, or any hepatic transaminase elevation.

Laboratory/Imaging Criteria

For the purposes of surveillance:

- Confirmatory Laboratory Evidence:

- Detection of SFGR nucleic acid in a clinical specimen via amplification of a *Rickettsia* genus- or species-specific target by Polymerase Chain Reaction (PCR) assay,
  OR
- Serological evidence of a fourfold increase in IgG-specific antibody titer reactive with SFGR antigen by indirect immunofluorescence antibody assays (IFA) between paired serum specimens (one taken in the first two weeks after illness onset and a second taken two to ten weeks after acute specimen collection), *
  OR
- Demonstration of SFGR antigen in a biopsy or autopsy specimen by immunohistochemical methods (IHC),
  OR
- Isolation of SFGR from a clinical specimen in cell culture and molecular confirmation (e.g., PCR or sequence).

- Presumptive Laboratory Evidence:
  - Serologic evidence of elevated IgG antibody at a titer ≥1:128 reactive with SFGR antigen by IFA in a sample taken within 60 days of illness onset.**
- Supportive Laboratory Evidence:
  - Serologic evidence of elevated IgG antibody at a titer <1:128 reactive with SFGR antigen by IFA in a sample taken within 60 days of illness onset.

*A four-fold rise in titer should not be excluded (as confirmatory laboratory criteria) if the acute and convalescent specimens are collected within two weeks of one another.
**This includes paired serum specimens without evidence of fourfold rise in titer, but with at least one single titer≥1:128 in IgG-specific antibody titers reactive with SFGR antigen by IFA.

Epidemiologic Linkage

None.

Vital Records Criteria

None.

Other Classification Criteria

A person previously reported as a probable or confirmed case-patient may be counted as a new case-patient when there is an episode of new clinically compatible illness with confirmatory laboratory evidence.

Case Classifications

Suspect

A case with confirmatory or presumptive laboratory evidence of infection with no clinical information available,

OR

A clinically compatible case (meets clinical criteria) that has supportive laboratory evidence.

Probable

A clinically compatible case (meets clinical criteria) that has presumptive laboratory evidence.

Confirmed

A clinically compatible case (meets clinical criteria) that is laboratory confirmed.

B. Reporting Timeframe to Public Health

West Virginia Code 64CSR7 requires healthcare providers and laboratories to report SFGR (including RMSF) within one week of notification.

C. Outbreak Recognition

There is a low likelihood of outbreaks occurring due to SFGR; however, outbreaks of SFGR could potentially occur by transfusion of contaminated blood products. Patients who develop SFGR within one month of blood transfusion should be reported to the Division of Communicable Disease Epidemiology (DCDE).

D. Healthcare Provider Responsibilities

1. Report cases of spotted fever rickettsioses (including RMSF) to the local health department within one week of diagnosis. Include copies of all laboratory reports (including complete blood count and metabolic panels).
2. Specimen collection timing is critical for diagnosis using serological testing, as most patients lack diagnostic antibody levels during the first week of clinical illness. For confirmation through serological testing, paired sera (2-4 weeks apart) are required; single positive specimens are presumptive evidence of infection.

3. Spotted fever group rickettsioses (including RMSF) is also confirmed through molecular detection of SFGR nucleic acid or demonstration of SFGR antigen in a biopsy or autopsy specimen by immunohistochemical methods.

E. Laboratory Responsibilities

1. Report positive test results for SFGRs to the local health department within 1 week.

F. Local Health Responsibilities

1. Conduct an appropriate case investigation.
   a. Contact the health care provider that either reported the case or ordered the laboratory testing to obtain the clinical information on the West Virginia Electronic Disease Surveillance System (WVEDSS) form.
   b. If needed, contact the patient to obtain information regarding tick exposure and/or travel history.
   c. Educate the patient and the patient's family on RMSF and SGFR prevention.
   d. In conjunction with state public health entomologist, conduct active tick surveillance at patient's residence or site of tick exposure.
   e. Report all case data using WVEDSS.
2. Educate the public about RMSF and other spotted fever rickettsioses, specifically regarding the mode of tick transmission and use of personal protection. Prevention messages for these diseases are also effective for other tick-borne illnesses.
3. Educate providers and laboratories to report cases of RMSF and other spotted fever rickettsioses to the local health department in the patient's county of residence within 1 week of diagnoses.

G. State Health Responsibilities

1. Educate the public about SGFRs specifically, on the mode of tick transmission and personal protection. 90% of cases of SFGR occur between April and September, and the risk of tick bite increases with individuals that live close to wooded areas (Usatine *et al.* 2010). Due to this, increased public education should be performed during these months and to those individuals with a higher risk of tick bites.
2. Educate providers and laboratories to report cases of RMSF and SFGR to the local health department in the patient's county of residence within one week of diagnosis.
3. In conjunction with local health department, conduct active tick surveillance at patient's residence or site of tick exposure.

4. Conduct tick surveillance when and where ticks are most active.
5. Monitor pathogenic *Rickettsia* spp. infection rate in tick population.

IV. DISEASE SURVEILLANCE

A. Public Health Significance

Rocky Mountain spotted fever has been a nationally recognized and reportable infectious disease since the 1920s (CDC 2019a). Despite its name, RMSF cases have been reported throughout the entirety of the United States, with over 50% of cases being reported in 5 specific states (as of 2019): North Carolina, Tennessee, Arkansas, Missouri, and Virginia (CDC 2019a). A notable regional increase in the reported SFGR occurred in Arizona during 2003-2013. Over this period, approximately 300 cases of RMSF and 20 deaths were reported from American Indian reservations in Arizona (AZDHS 2015). The highest incidences of reported RMSF have occurred in males and individuals that are 40 years old or older. However, higher mortality and morbidity are found amongst children under 10, individuals with compromised immunity, and people that are delayed treatment (CDC 2019a). Despite this, severity of this disease is significantly reduced with early detection and antibiotic treatment (CDC 2019a). Also, there are numerous methods to avoid contact with ticks (CDC 2019a). The principal ticks that carry RMSF and other rickettsial diseases include the American dog tick or wood tick (*Dermacentor variabilis*), the brown dog tick (*Rhipicephalus sanguineus*), the Gulf Coast tick (*Ambylomma maculatum*), Rocky Mountain wood tick (*Dermacentor andersoni)* (CDC 2019a, b), and lone star tick (*Amblyomma americanum*) (Goddard 2003; Cohen *et al.* 2009).

B. Disease Surveillance Objectives

1. To identify and monitor the epidemiological characteristics of SFGR in West Virginia, including the geographic distribution of cases.

C. Surveillance Indicators

1. Proportion of probable or confirmed cases where the case was completed and submitted to DIDE within 30 days of initial report date.
2. Proportion of probable or confirmed cases with onset date complete.
3. Proportion of probable or confirmed cases with county of residence complete.
4. Proportion of probable or confirmed cases with travel history documented.
5. Proportion of cases based upon confirmatory laboratory evidence.

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