

Summary of Your Disease

Transmission

Rocky Mountain Spotted Fever (RMSF) is caused by the bacteria *Rickettsia rickettsia*. RMSF is transmitted by the bite of an infected tick or by contamination of the skin with tick blood or feces. In the U.S., RMSF is vectored by the American dog tick or the lone-star tick primarily. RMSF cannot be transmitted person-to-person. Infection typically occurs with exposure to tick-infested habitats or tick-infested pets. Tick-infested habitats can include wooded, shrubby, or grassy areas. RMSF infections are most prevalent when ticks are most active; this happens when the ground temperatures reach approximately 40°F.

Biology of the Vector

All life stages of the tick species that transmit Rocky Mountain Spotted Fever (RMSF) blood feed. This allows the tick to acquire or transmit RMSF at every stage of life. RMSF is not transmitted through vertical transmission, so ticks are not born with the bacteria *Rickettsia rickettsia*; they must acquire the bacteria from an infected host. The most important life stage of the tick for transmitting RMSF is the nymphal stage. This is due to the size and season of peak feeding. Nymphs are smaller than adult ticks, which makes them more difficult to notice. This results in the nymphs having longer feeding times on the host, allowing them to transmit RMSF. Peak feeding times for nymphs occur in the late spring and early summer. This season coincides with when human outdoor activities also peak (Institute of Medicine, 2011).

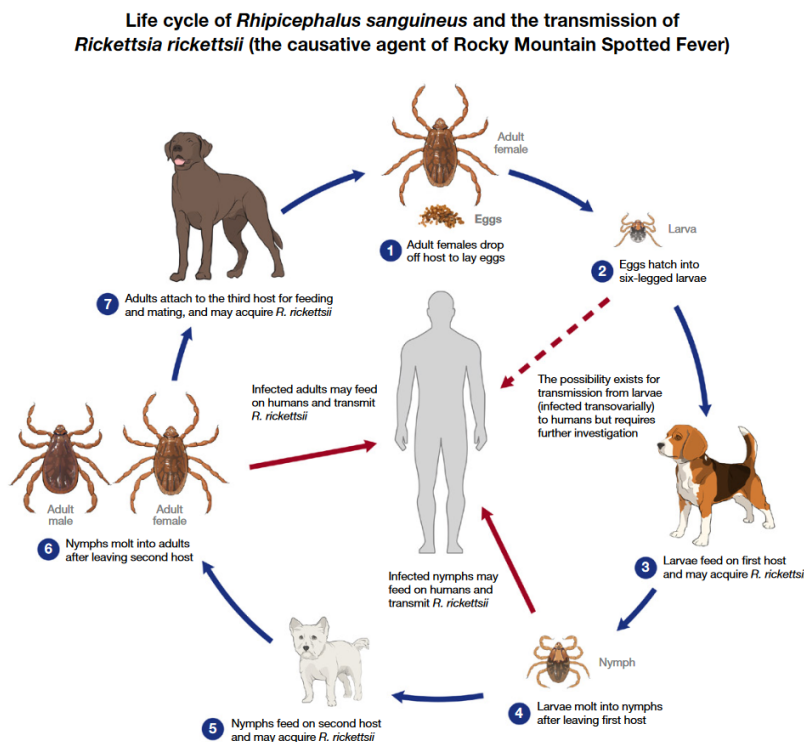


Figure 1. Diagram of Transmission Cycle of Rocky Mountain Spotted Fever

Signs and Symptoms

The initial signs and symptoms of Rocky Mountain Spotted Fever (RMSF) include fever, headache, rash, nausea, vomiting, and myalgia (muscle aches and pains). Even though 90% of patients eventually develop a rash, less than 50% develop a rash as an initial symptom (Pace, 2020). Later complications that can develop with RMSF include pulmonary hemorrhage and edema (fluid buildup), acute respiratory distress syndrome, myocarditis (inflammation of the heart muscle), acute renal (kidney) failure, and cerebral edema. Symptoms can appear 3 to 14 days after the bite of an infected tick, however they usually appear in 5 to 7 days after infection.

Diagnosis

Rocky Mountain Spotted Fever (RMSF) is difficult to diagnose because of the non-specific signs and symptoms in the early stages of disease. These non-specific symptoms resemble many other common illnesses and diseases. Diagnosis usually involves gathering a thorough patient history including recent tick bites, exposure to areas where ticks are found, and a recent travel history. Many patients may not remember being bitten by a tick so asking about recent travel to areas where ticks are common or RMSF is endemic is very important for diagnosis. A laboratory diagnosis for RMSF can be obtained through the standard serologic test of indirect immunofluorescence antibody (IFA) assay for immunoglobulin G (IgG) using the *R. rickettsia* antigen. If RMSF is suspected, treatment will not be delayed while waiting for a laboratory confirmation.

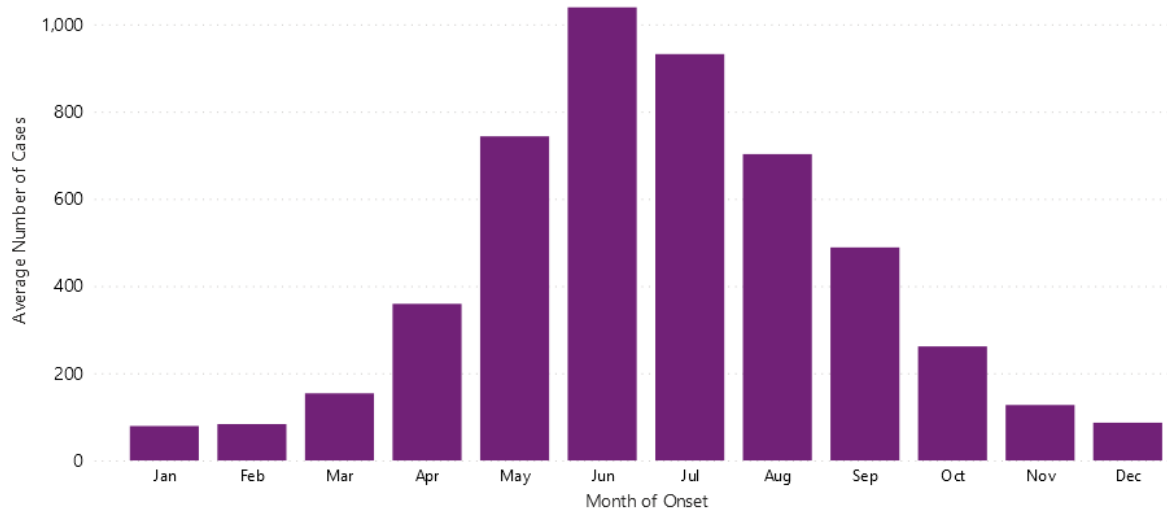
Treatment

The most important part of treatment for Rocky Mountains Spotted Fever (RMSF) is early treatment. RMSF is treated with the antibiotic doxycycline (Gottlieb, 2018). Early treatment is the most influential factor on survival. This antibiotic is not usually used on young children, due to dental staining, or in pregnant women because of risks of teratogenicity. However, data suggests that the short treatment with doxycycline is a low risk for treatment for RMSF (Pace, 2020). The only other effective antibiotic against RMSF is chloramphenicol. This antibiotic has a higher mortality rate and less availability, so it is not used frequently.

Epidemiology

The most lethal tickborne disease in the U.S. is Rocky Mountain Spotted Fever (RMSF) (Pace, 2020). The mortality rate is between 5% and 10%. Most cases occur in adults ages 40+, however the highest mortality rate is in children younger than 10 (Pace, 2020). The reported incidence of RMSF is approximately 6,000 cases per year (Pace, 2020). RMSF was originally discovered in the Rocky Mountains, however the geographic distribution of RMSF is primarily in the Southeastern and Southcentral states (Gottlieb, 2018). Most infections occur between March and September when ticks are most active and when humans are most likely to be in tick-infested areas (Gottlieb, 2018).

Average number of reported cases of spotted fever rickettsiosis, by month of onset—United States, 2015–2019



(Epidemiology and Statistics, CDC)

Prevention

Currently, there is no effective vaccine available to prevent Rocky Mountain Spotted Fever (RMSF). Methods to prevent tick bites include staying on paths and trails, tucking pants into socks or shoes, wearing long-sleeved shirts, and applying repellents with DEET to skin surfaces. If bitten by tick, the tick should be removed carefully with small forceps without crushing the tick. Crushing the tick could result in disease transmission.

Current Vector Control Techniques

A variety of tick control measures are available; however, the most widespread tick control technique is the widespread use of acaricides (tick killing insecticides) (Ghosh, 2007). An insecticidal dog collar, in Sonora, Mexico, is combined with long-lasting insecticidal wall treatments to reduce indoor tick populations. Another tick removal device is called the Tick Tubes. Tick Tubes are placed in mice breeding habitats where mice use it as part of their nest; the Tick Tube will cause any live ticks to detach and die. The Tick Tube is biodegradable and low risk for environmental contamination.

A current vector control techniques for ticks is the Integrated Tick Management (ITM) approach. ITM is composed of 4 components: public education and public relations, inspection and surveillance, disease testing, and control measures. The control measures include landscape management and habitat management which reduce and remove tick habitats. This is done by removing tick harboring areas and trimming tall grass and overhanging shrubs. A residual application is also used in conjunction with host-targeted devices and techniques. The residual application targets larval, nymphal, and adult ticks. These techniques use safe insecticides and are delivered by hand-held equipment, such as a backpack sprayer.

Technical Concerns

A major technical concern is that there are no vaccines available to prevent Rocky Mountain Spotted Fever (RMSF). This is due to the limited understanding of the protective host response and the *Rickettsia rickettsia* antigens involved in stimulating protective immunity (RMSF: Deadly, but Preventable, 2019). The limited understanding makes the development of the vaccine very complicated. Currently, the most effective strategy to prevent RMSF is using preventive measures. Another technical concern for RMSF is differential diagnosis. The disease Ehrlichiosis presents itself with similar symptoms to RMSF, apart from the rash. Both diseases have the same distribution and are transmitted by the same tick species (Animalu, 2021). Specialized confirmatory laboratory tests can confirm which disease is present in the patient.

Economic, Sociological, Political Concerns

Many people who are aware of the existence of the Rocky Mountain Spotted Fever (RMSF) are unaware of RMSF symptoms and prevention strategies. Lower socioeconomic individuals are even less likely to have heard about RMSF, the symptoms, and prevention strategies. This lack of knowledge about RMSF leads in increased exposure to ticks and more RMSF cases (Reyes-Castro, 2021).

Vector and Disease Control Recommendation

The recommendation for controlling the infection of Rocky Mountain Spotted Fever (RMSF) includes the use acaricides (tick killing insecticides), tick repellent, and protective equipment when in tick infested areas. Using these tools to prevent tick bites will reduce the chance of being infected with the bacteria *Rickettsia rickettsia*. In addition to applying these acaricides and tick repellents, people should do an inspection of their body to ensure no ticks are on their body or clothing when they enter their homes.

Acaricides, such as Permethrin, can be applied to clothing, boots, and camping gear. When the tick encounters the Permethrin, their nervous system will be over-excited and cause the tick to become paralyzed, fall off, and most likely die. Permethrin can provide lasting protection on clothing for several washes. Environmental Protection Agency (EPA) registered tick repellants include DEET, picaridin, and Oil of Lemon Eucalyptus (Preventing Tick Bites, 2020). Protective equipment includes wearing long-sleeve shirts, long-pants, and tall socks to avoid ticks gaining contact with the skin.

The advantages of acaricides, tick repellents, and protective equipment are that individuals can control when and how to use their preventative measures. These strategies are dependent on the individual's use of the strategies and not the environment they are entering. Acaricides, tick repellents, and protective equipment are easily available in many stores across the world; so, access to these resources is not a major barrier to most people.

One disadvantage of Acaricides, such as Permethrin, and tick repellents is their ability to cause skin irritations, such as irritant contact dermatitis, or trigger allergic reactions. These potential complications make this disease control strategy inaccessible to some people. Another potential disadvantage of acaricide use is acaricide resistance. Acaricide resistance in cattle populations has been observed in South America (Brazil), Central America (Mexico), and Asia (India) (Dzemo, 2022).

Bibliography

The "Rocky Mountains Spotted Fever" article provided by the Nursing Reference Center Plus provides an overview of the Rocky Mountain Spotted Fever (RMSF) disease. It describes the etiology, risk factors, signs and symptoms, assessment and diagnosis of the disease, and treatment goals of the disease. This article also provides useful information about red flags for diagnosing RMSF. This article is very valuable for information from the healthcare perspective. I will use this resource to develop the disease summary document for the Rocky Mountain Spotted Fever.

The "Evaluation and Management of Rocky Mountain Spotted Fever in the Emergency Department: a Review of Literature" discusses the difficulties emergency departments face in correctly diagnosing Rocky Mountain Spotted Fever (RMSF). The literature review discusses RMSF disease epidemiology, anatomy and pathophysiology, history and physical examination, laboratory testing, and treatment. The exploration of these disease factors explain why it is so difficult to diagnose RMSF. This literature review was conducted with the use of 85 references. I will use this resource to explore the pathophysiology and treatment of Rocky Mountain Spotted Fever.

The "Tickborne Disease: Diagnosis and Management" article provides information on diagnosing several tick vectored diseases including Rocky Mountain Spotted Fever (RMSF). A graphic is included that shows the distribution of reported cases of RMSF across the United States. This article also discusses tick analysis, removal, and prevention methods. A handout for tick protection was also created by the authors of this article. This article will be used to provide resources to cross reference the description and progression of the disease described in other articles and will provide some common tick management strategies that are implemented.

The article "Modeling of Control Efforts against *Rhipicephalus sanguineus*, the Vector of Rocky Mountain Spotted Fever in Sonora Mexico" describes current vector control strategies that are being implemented in Sonora, Mexico. This study investigates the combination of insecticidal dog collars and long-lasting insecticidal wall treatments to suppress indoor tick populations. I will use this article to learn more about vector control strategies that are being implemented and developed to control the transmission of Rocky Mountain Spotted Fever.

The "Upcoming and Future Strategies of Tick Control: A Review" article discusses current and future tick control strategies including tick vaccines, developing transgenic animals resistant to ticks (transgenic, meaning the animal contains DNA from another organism that has been introduced artificially), and creating newer generations of acaricides (acaricides, meaning pesticides used to kill ticks and mites). This review will be very useful for learning about current and potential vector control strategies. This article will help me develop my control plan for tick control to prevent the transmission of Rocky Mountain Spotted Fever.

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