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ARIZONA STATEWIDE ROCKY MOUNTAIN SPOTTED FEVER HANDBOOK AND RESPONSE PLAN

2/3/2015

Prepared by Arizona Department of Health Services in collaboration with Arizona Tribal and Inter Tribal Council of Arizona, Inc. Representatives

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Objectives

Rocky Mountain spotted fever (RMSF) is a public health threat in Arizona, specifically on tribal lands. The objectives of this handbook are to provide an epidemiological and historical background of RMSF in Arizona, present a sustainable framework for human case surveillance, and outline response strategies to protect tribal lands and work to eradicate the disease threat. Parts of this handbook and plan represent a compilation of RMSF best practices and recommendations that each tribal and local public health entity can pull from to develop their own protocols specific to their tribe or county. Through the development of this document ADHS hopes to achieve enhanced communication and collaboration between partners and stakeholders of RMSF in Arizona.

This handbook is divided into general sections as outlined above. The sections of the handbook and response plan are designed to provide an understanding of the past and present burden of RMSF in Arizona tribal lands and mechanisms by which the burden can be reduced. The surveillance and response activities outlined are to be carried out in collaboration with ADHS, IHS, tribal health departments, and local and federal agencies (e.g. CDC). Additionally, this handbook may be utilized by the tribes as a planning document in the case of a RMSF outbreak and for federal funding advocacy for Arizona RMSF prevention and control funding.

Materials referred to in the text will be presented at the end of the document in the Appendix.

ABBREVIATION	DEFINITION
ADHS	Arizona Department of Health Services
ASPHL	Arizona State Public Health Laboratory
CDC	Centers for Disease Control and Prevention
IHS	Indian Health Service
ITCA	Inter Tribal Council of Arizona, Inc.
RMSF	Rocky Mountain spotted fever

Epidemiology

BACKGROUND

Rocky Mountain spotted fever (RMSF) is the most severe tick-borne rickettsial illness in the United States. RMSF is caused by *Rickettsia rickettsii*, which is an obligate intracellular bacterium and a member of the Spotted Fever group *Rickettsia* (SFGR. RMSF was first reported in the late 1890's and is endemic to North and South America. The disease is potentially fatal, but can be prevented.

Overall, RMSF has been a reportable disease in the United States since the 1920's. Cases reported throughout the United States occur between May and August, with the peak activity occurring in June & July. The highest incidence rate is observed in individuals 55-64 year of age. According to CDC, five states (North Caroline, Oklahoma, Arkansas, Tennessee, and Missouri) account for over 60% of RMSF cases, with the primary vector being the American dog tick.

VECTOR

RMSF is spread by the bite of an infected tick. The most common tick vectors in the United States are *Dermacentor variabilis* (American dog tick) and *Dermacentor andersoni* (Rocky Mountain wood tick). These tick species are widely distributed throughout the eastern and northwestern states, respectively. The Rocky Mountain wood tick has been found in Northern Arizona and can potentially spread RMSF.

In Arizona, the primary tick vector of RMSF is the brown dog tick (*Rhipicephalus sanguineus*), which is the most widely distributed tick in the United States. An environmental investigation in the early 2000's which followed the emergence of RMSF in Arizona revealed a high prevalence of the *R. sanguineus* tick. The brown dog tick is a peridomestic species that lives in and around homes where dogs live.

There are ecologic needs for tick survival, including appropriate humidity, temperature, available hosts, and hiding locations for molting and egg laying. Most ticks have similar moisture and temperature requirements, but *R. sanguineus* has unique needs. The brown dog tick thrives in hot climates, but is vulnerable to colder temperatures, requires a dog to find a mate, needs three feedings to complete life cycle, and primarily feeds on dogs in all life stages. Humans and other species are considered incidental hosts. The brown dog tick can live indoors as long as there are dogs to feed on, and has places to hide such as walls, carpet, cracks and crevices. Outdoors, these ticks are excellent at hiding under old boards, along the sides of house, under porches, under trash piles, and on old mattresses and couches.

The life cycle of the brown dog tick can take as little as two months. One female tick can lay thousands of eggs. Interestingly, vertical transmission is possible, meaning that a female *R. sanguineus* tick infected with RMSF can lay infected eggs, which can contribute to disease transmission. The life cycle (see Figure 1 below) of the brown dog tick includes four stages: egg, larvae or "seed tick", nymph, and adult. Differences in size and color occur between each life stage. For example, a blood-feeding adult female can increase in size to 12 mm, and turns from brown to gray or olive as it becomes engorged. Once she is fully engorged, the female detaches and finds a sheltered place to lay her eggs. Eggs usually hatch within 3 to 8 weeks. The newly hatched larvae or "seed ticks", are light in color, have

six legs, and are about the size of a pinhead. After a feeding, the larva detaches, hides, and molts in to the nymph stage within several weeks. Nymphs and adults are brown and have eight legs. Immature brown dog ticks can survive for many months without feeding, and adults can survive more than a year. Usually, the brown dog tick's life cycle spans 2 years. However, if hosts are readily available, the tick's entire life cycle can take place within 2-4 months.

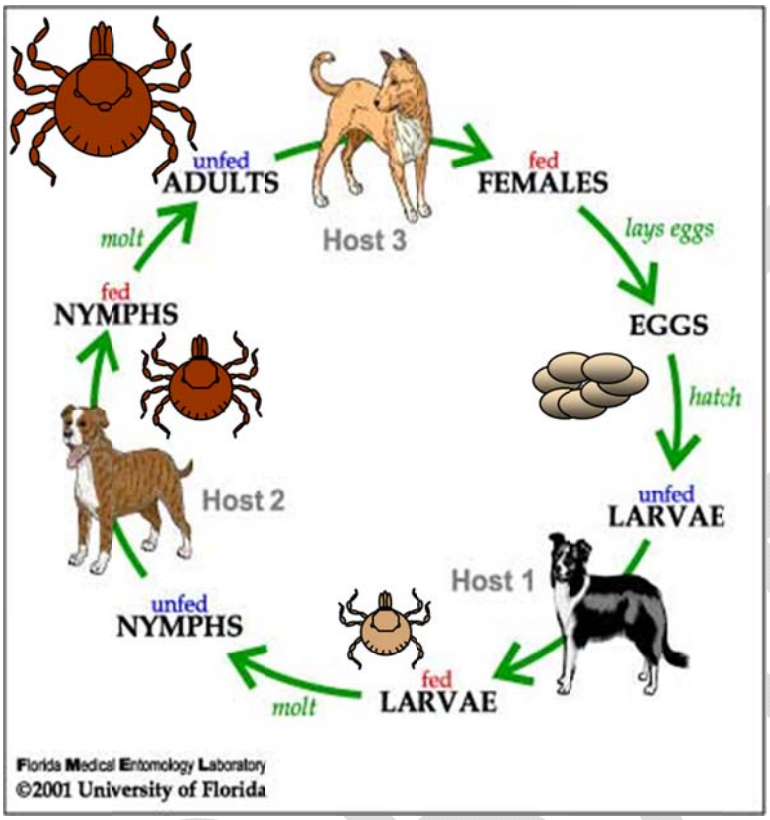


Figure 1: Life cycle of the brown dog tick (*Rhipicephalus sanguineus*)

The Role of Dogs in RMSF

Dogs cannot directly spread RMSF, but they are the preferred host. Free-roaming dogs play an important role in spreading ticks into nearby homes and yards. New puppies, especially sick ones, may increase the number of infected ticks due to the high likelihood of having circulating rickettsiae in their bloodstream. Dogs that are spayed or neuter have a lower likelihood of roaming and spreading infected ticks around the community.

Dogs are also affected by RMSF and can develop a similar illness as humans. Recovered dogs are immune to reinfection and have elevated antibodies (IgG) that can persist in their system for many years. The seropositivity of dogs for RMSF is often a strong indicator of human risk, and can act as a warning system for RMSF emergence in new areas. In communities where canine seropositivity is ≤5%, reports of human cases are unlikely. However, in areas with canine seropositivity of ≥50% human cases are often observed. The threshold for human cases is somewhere in between 5-50%, meaning that the risk of human cases is moderate. Knowledge of RMSF seroprevalence in dogs allows for a classification of areas into risk levels, which is vital for the development and implementation of public health prevention measures.

History of RMSF in Arizona

Historically, RMSF was rarely seen in Arizona. The first locally-acquired case of RMSF in Arizona was identified in 2003 in an Arizona resident with no travel history, who resided in a tribal community (Reservation #1) in the eastern part of the state. In the same year a pediatric case died of suspected sepsis following a febrile rash. This case was from the same tribal community as the first, and tested positive for the causative agent of RMSF, *Rickettsia rickettsii*. In 2005, Reservation #2's first human case was reported. Reservation #2 shares a large border with Reservation #1. Cases continued to be reported from these two reservations each year, and response efforts (e.g. community education, pesticide spraying, tick collaring dogs, etc.) were initiated by the tribal governments in coordination with other partners.

Between 2009 and 2012 four other reservations reported their first human cases of RMSF.

- 2009: Reservation #3, south-central Arizona;
- 2011: Reservation #4, southern Arizona;
- 2012: Reservation #5 and Reservation #6, both located in northern Arizona.

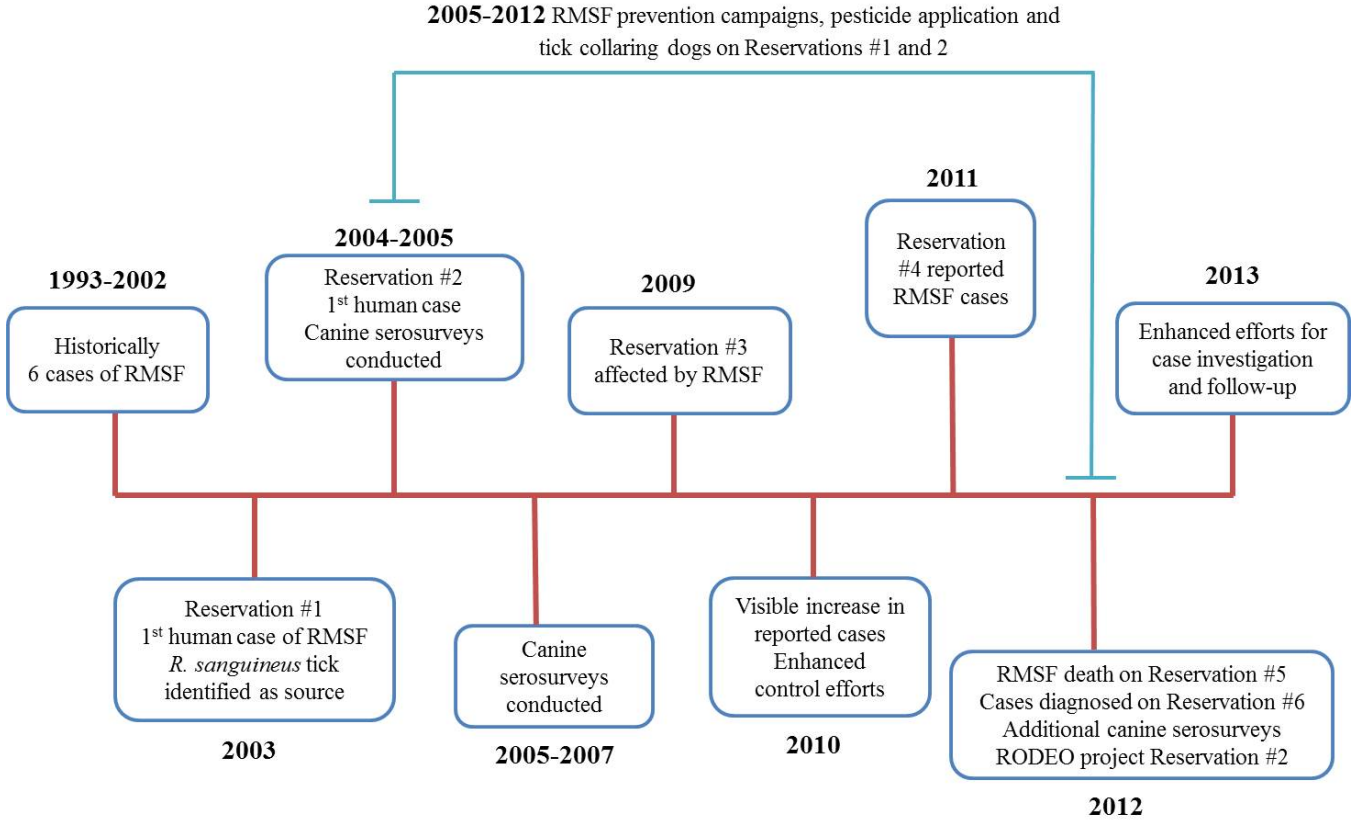


Figure 2: Timeline of RMSF emergence and activities in Arizona tribal lands

Throughout 2004-2012 canine serosurveys were conducted on each of the affected reservations to predict the human risk level for RMSF. Page 4 ("Role of dogs") discusses the relationship between canine seropositivity and human risk. The six affected tribal lands are considered to be RMSF endemic regions in Arizona, and have been classified into low, moderate, or high risk areas. The risk classification is determined based on the results from canine serosurveys, number of reported and confirmed human cases, and an observed presence of ticks in the yards, homes, on dogs, and free-roaming dogs throughout the community. These risk categories are based on investigations done in Arizona and are not validated elsewhere. Figure 4 illustrates the high, moderate, and low risk classifications.

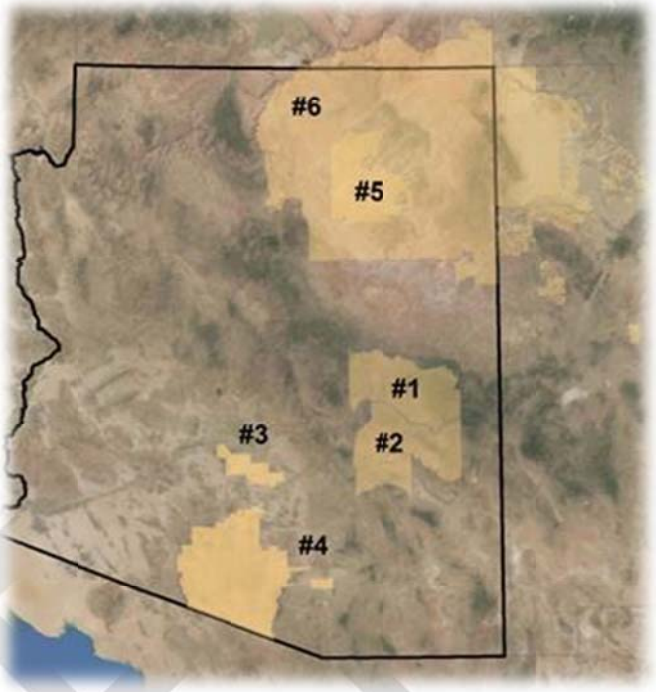


Figure 3: *Map of six RMSF affected tribal lands*

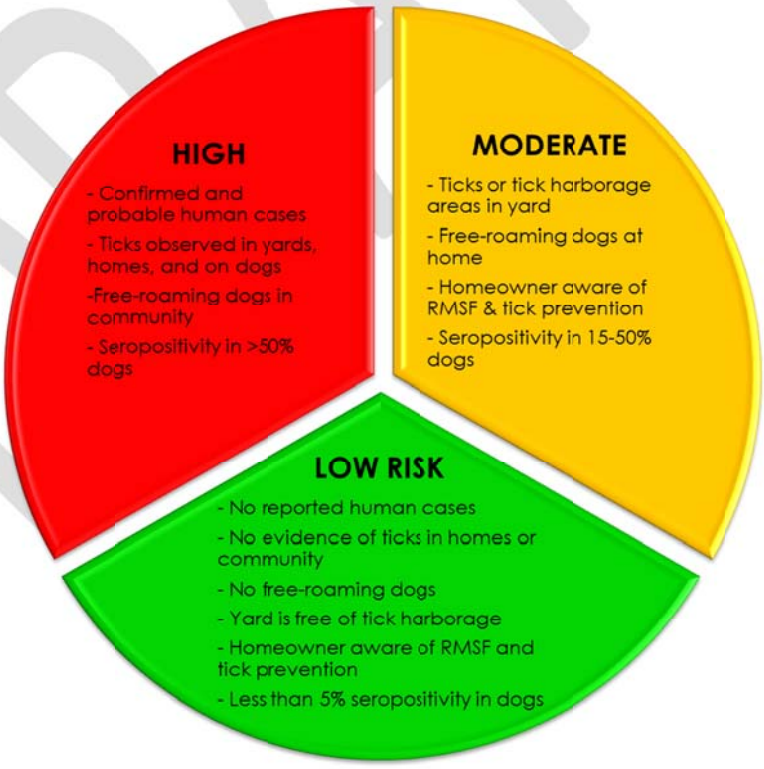


Figure 4: Human risk categories for RMSF endemic areas

CHARACTERISTICS OF RMSF IN AZ vs. U.S.

Although RMSF is widespread throughout the United States, several epidemiological and ecological features make RMSF unique in Arizona. Figure 5 illustrates a summary of these different features in comparison with the United States as a whole, which includes differences in the vectors, seasonality and populations affected. This section will describe those differences in detail.

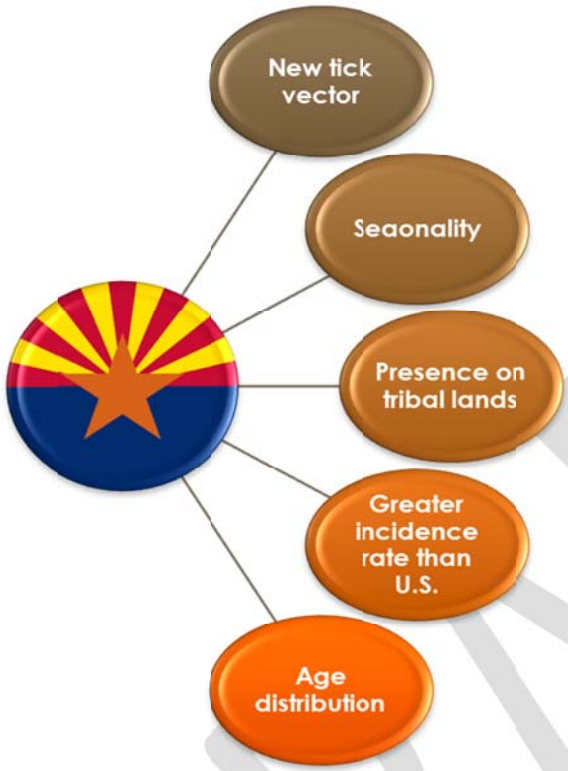


Figure 5: Diagram of features contributing to the uniqueness of RMSF in Arizona

NEW TICK VECTOR

The first feature contributing to the uniqueness of RMSF in Arizona is the tick vector. After the first human case of RMSF was identified, an investigation led to the discovery of *R. sanguineus* ticks, both in the environment and on free-roaming dogs on tribal lands. These findings provided evidence of a new tick vector for RMSF in the United States, and confirmation of the source of exposure for the human case. Brown dog ticks, as described earlier, are a peridomestic and hardy species, which are able to thrive in the environment found in Arizona tribal lands. Table 1 compares and contrasts RMSF in Arizona versus the United States.

SEASONALITY

Throughout the United States, ticks, and therefore tick-borne diseases are seasonally distributed. The peak of disease activity corresponds with the peak of tick activity. Peak activity for RMSF across the United States is often around July. However, in Arizona, there are two peaks for RMSF activity—May and August. Human cases are reported between May and November, with the majority reported in August and September. The two peaks for RMSF activity can be attributed to the warmer climate in Arizona, which allows for *R. sanguineus* ticks to go through two full life cycles. Longer seasonality means prolonged thriving time for the ticks in the environment. Our awareness of RMSF seasonality allows for more targeted and effective environmental prevention approaches.

INCIDENCE RATE & PRESENCE ON TRIBAL LANDS

The third and fourth features go hand-in-hand. Since 2003, when RMSF was first identified in Arizona, human cases have been found almost exclusively on tribal lands. Human cases of RMSF were originally identified on only one reservation, but activity has since spread to other reservations. In 2010-2011 the incidence rate of RMSF in Arizona was >200 times that of the national RMSF incidence rate. Epidemiological investigations and case interviews also led to the discovery that RMSF was acquired most commonly around the home (peridomestically). Furthermore, there were clusters of cases by community within the affected regions. In the

United States, due to the differences in primary vectors, RMSF is not acquired near the homes, but commonly in forest or wooded areas. These features allow for a greater incidence rate in Arizona than in other areas of the U.S.

AGE DISTRIBUTION

The incidence of RMSF in younger populations (<1-19 years) is significantly greater in Arizona than in the U.S. in general. In Arizona, ~45% of cases diagnosed are in children. In the United States, 45% of cases are in adults 50 years and older. This may be a result of the Arizona tick vector's association with dogs which could increase children's risk of exposure to ticks while outside playing with dogs. Another reason is that children may not notice a tick bite until the tick is attached and engorged with blood, thought adults commonly do not recall a tick bite either. Lastly, children have a lower level of immunity than adults and could be more susceptible to the severe symptoms of RMSF and require enhanced medical care.

	Arizona	United States
Tick vector	Brown dog tick	American dog tick
Seasonality	Two peaks (May & August)	One peak (June/July)
Area Acquired	Near the home	Forest/wood settings
Age Distribution	Younger (<18 years)	Older (55-65+ years)

Table 1: Differences in RMSF Epidemiology, Arizona vs. United States

CHAIN OF PREVENTION

An array of preventative efforts has occurred throughout the decade since the emergence of RMSF in Arizona. These include the establishment of animal control programs, tick collaring and pesticide spraying campaigns, and educational efforts towards health care professionals and community members throughout the tribes. However, a lack of consistent and sustainable access to financial resources, animal control programs, veterinary services, public health infrastructure, and integrated pest management techniques has caused the tick vector to flourish and continued reports of suspected human cases on affected reservations. These limitations have added to the environmental sustainability of the *R. sanguineus* tick, large populations of free-roaming dogs, and have posed challenges to the control and eradication of RMSF.

Based on knowledge of the history of RMSF in Arizona, and an understanding of its risk factors, two major goals for stopping the chain of RMSF transmission have been identified. Most importantly, there is a need to understand the current burden of RMSF in tribal communities in Arizona. This is a significant driver of resource allocation (e.g. financial). This will greatly assist in reaching the second goal, which is the prevention of deaths and overall RMSF cases. Figure 6 illustrates the chain of prevention and control response efforts.

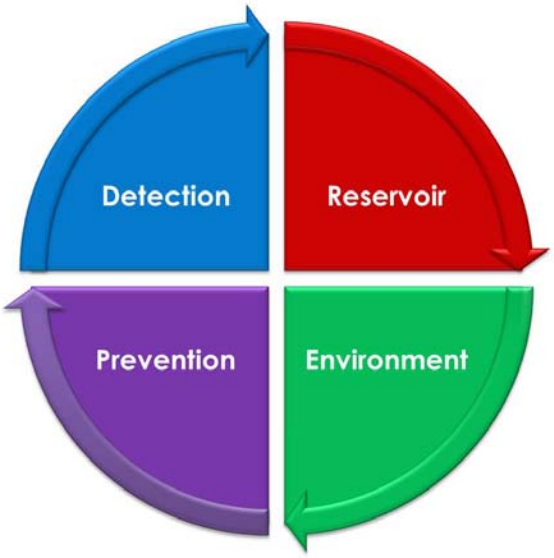


Figure 6: Stopping the chain of RMSF

1. **Reservoir** →dog and tick population.
2. **Environment** →solid waste removal, pesticide spraying, home assessments.
3. **Prevention** →community education (also incorporates environment and reservoir).
4. **Detection** →early diagnosis, treatment, and case investigations.

Clinical Diagnosis & Treatment

Symptoms & Description of Illness

Symptoms of RMSF usually occur 2-14 days after the bite on an infected tick. A tick bite is usually painless, and a person may not always remember being bitten. RMSF usually presents with non-specific symptoms, but can be a series illness resulting in fatality in the first 8 days if not diagnosed and treated appropriately. Illness is characterized by acute onset of fever, and may be accompanied by headache, malaise, myalgia, nausea/vomiting, or neurologic signs. It is important to note that RMSF may present very differently depending on the person. RMSF can be challenging to diagnose because the early symptoms are very general and resemble many other illnesses.

The majority of people with RMSF develop some type of rash during illness, however, the rash may not appear until 4-7 days following illness onset. Approximately 10% of RMSF cases do not develop a rash. The hallmark RMSF rash usually appears within 2-5 days after symptom onset as small, flat, non-itchy, pink macules on the wrists, forearms, and ankles. This rash might then spread to the truck of the body. About 35-60% of cases usually develop a red-purple spotted (petechial) rash around day 6 of illness. This type of rash often indicates progressive RMSF.

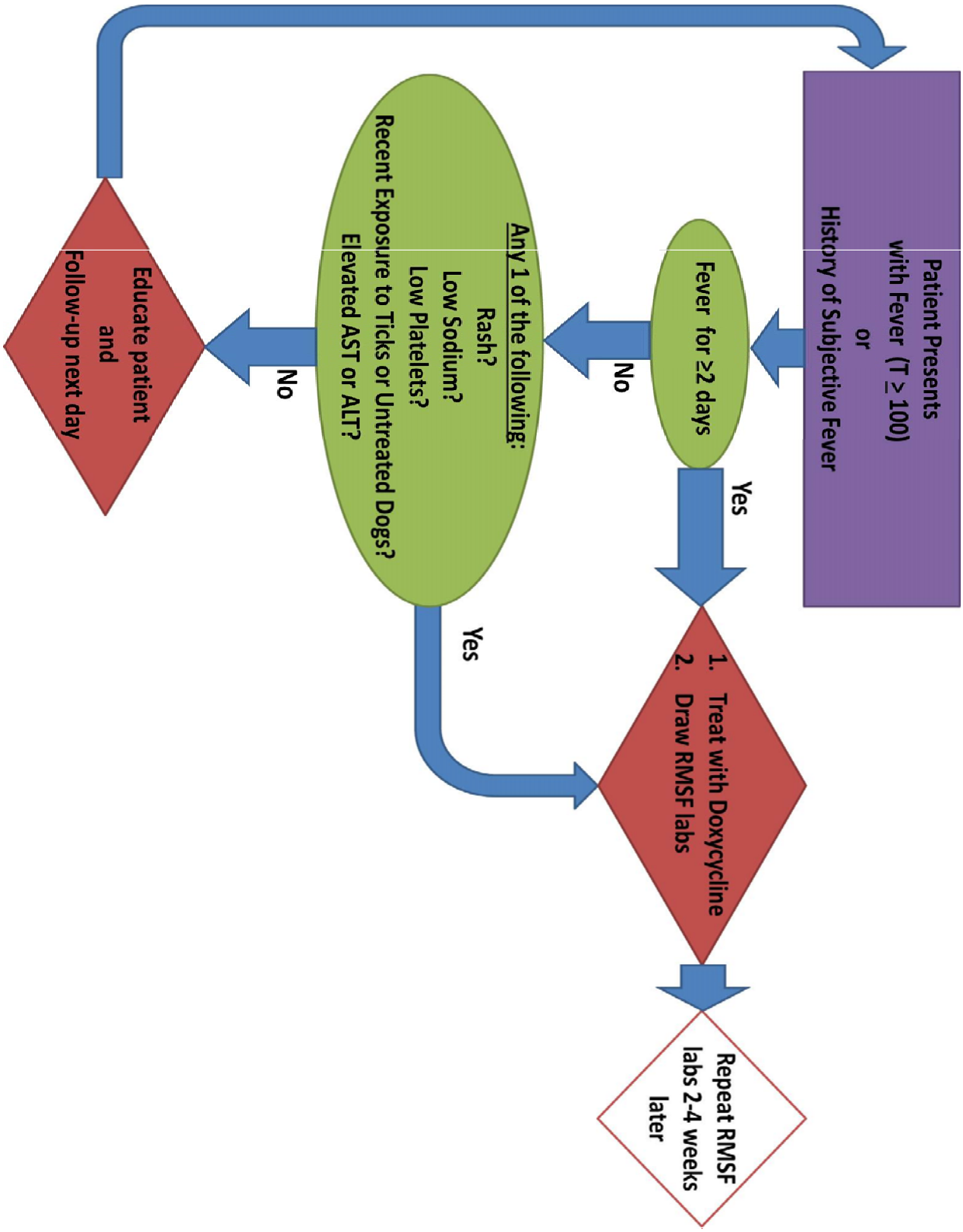
Laboratory findings indicative of RMSF include thrombocytopenia, anemia, leukopenia, and/or elevated liver enzymes. In the late stages of RMSF illness, a definitive rash usually develops, along with photophobia, confusion, ataxia, seizures, cough, dyspnea, arrhythmias, jaundice, and severe abdominal pain. Severe illness and prolonged hospitalizations can lead to vascular damage and long-term health problems. This is due to the mechanism by which *Rickettsia rickettsii* attacks the cells that line the blood vessels. The damage to blood vessels can result in a disease process called "vasculitis" and bleeding or clotting in the brain or other vital organs. It is this damage that is life-threatening, and leaves recovered patients with permanent long-term health problems.

Children with RMSF may experience nausea, vomiting, and loss of appetite. Compared to adults, children may be less likely to report a headache, but more likely to develop an early rash. Other frequently observed signs in children with RMSF are abdominal pain, altered mental status, and conjunctival infection. Occasionally, symptoms like cough, sore throat, and diarrhea may be seen and can lead to misdiagnosis. The most common differential diagnoses for RMSF, especially during initial presentation of symptoms, include viral illnesses, fever of undetermined cause, bacterial sepsis, upper or lower respiratory tract infections, or ear infections.

Diagnosis

RMSF can be diagnosed based on clinical signs and symptoms, and later be confirmed using laboratory tests. Treatment should never be delayed or withheld if laboratory results are pending or on the basis of an initial negative acute laboratory result. Review the clinical symptoms in the above section and the clinical algorithm (Figure 7) to determine if a patient is a suspect RMSF case.

Figure 7: RMSF Clinical Algorithm



Treatment

Doxycycline is the first line treatment for adults and children. It should immediately be initiated or prescribed whenever RMSF is suspected. Chloramphenicol is an alternative when contraindications to tetracyclines are present (e.g., child < 8 years of age, pregnancy, etc.). The use of antibiotics other than doxycycline has been associated with a higher risk of fatality.

The standard treatment with doxycycline is 7-14 days with dosage as follows:

Adults: 100mg every 12 hours (i.e. twice a day)
Children < 45kg or 100 pounds: 2.2 mg/kg body weight every 12 hours (i.e. twice a day)

Treat for at least 3 days until the fever subsides and until evidence of clinical improvement.

Treatment is most effective if doxycycline is started within the first 5 days of symptoms. Treatment should be initiated as soon as a case is suspected. Never delay treatment to wait for lab results. If the patient is treated within the first five days of the illness fever generally subsides within 24-72 hours. Failure to respond to doxycycline suggests that the patient's condition might not be due to RMSF. In these circumstances consider a differential diagnosis. Resistance to doxycycline or relapses in symptoms after the completion of the recommended course of treatment has not been documented.

RMSF Investigations

Algorithm

The RMSF clinical algorithm (see Figure 7 above) was developed by members on the first tribes affected by RMSF in collaboration with ADHS and CDC to assist in identifying early cases and prevent deaths. The algorithm has been widely used to assist tribal health departments and physicians on tribal lands in the assessment of suspect cases. The algorithm was created to have broad criteria, and be used for short-term purposes, while community prevention and control efforts were developed. However, as robust environmental control, prevention, community education, and surveillance efforts continue, future discussions may include a less comprehensive use of the algorithm. Currently, many of the affected tribal lands continue to use the algorithm to initiate the clinical suspicion of RMSF and warrant a case investigation.

Case Investigation Steps

RMSF is a nationally notifiable condition and should be reported within 5 working days to the tribal or local health jurisdiction. For tribal health departments an example of this may be a RMSF referral to a public health nurse from a doctor at the hospital. Keep in mind the Arizona Administrative Code (Title 9: Health Services), which requires healthcare providers to report cases of RMSF to tribal health departments, local county public health or ADHS. Communicable Disease Reporting Requirements provides an overview of reporting requirements and may be a useful website to reference.

Tribal or local county public health is responsible for conducting an investigation on any suspected RMSF cases. It is recommended that the investigator use the rickettsial disease investigation form (Appendix 1), but similar questionnaires developed by their health department can also be used.

The Arizona Department of Health Services uses an online database for reporting, investigating, and managing cases of communicable diseases, such as RMSF. This system is called MEDSIS, which stands for Medical Electronic Disease Surveillance Intelligence System. MEDSIS is a secure web-based, centralized, person-based disease surveillance system for Arizona. MEDSIS is a statewide system hosted and supported by ADHS for use by health care providers and institutions responsible for reporting communicable diseases, and for local health departments to conduct disease surveillance. MEDSIS allows cases to be reported in real-time and viewed by the respective local health department and ADHS.

Conducting a RMSF investigation is very simple. The following steps do not always have to be conducted in order, as long as important demographic, symptom, exposure, and laboratory information is collection.

1. Consult with physician who reported the suspect case of RMSF. Gather information from the medical records or laboratory reports.
    a. When did the symptoms start? What were the symptoms? Was an acute specimen drawn for RMSF? Was the patient hospitalized? Is there travel history? Is there tribal affiliation? Was doxycycline started?
2. Contact the patient to query them about the above information that may be missing. Ask about risk factors, dog ownership or contact, and any outdoor activities. Reinforce the need to stay on doxycycline for the entire course of treatment.

3. Schedule a convalescent blood specimen 2-4 weeks after the acute. A convalescent specimen may not be necessary, ONLY IF the patient does not reside in an endemic area in Arizona (one of the six affected tribal lands), and there is overwhelming clinical and laboratory evidence to rule out RMSF.
4. RMSF is not transmitted person-to-person or by dogs, but if potential exposure to ticks occurred around the residence it is recommended to ask if others in the home have felt ill or have taken part in similar high-risk activities (e.g. played with dogs).
5. Follow-up with the patient after the convalescent specimen regarding completion of doxycycline course and that symptoms have resolved.
6. Work with local animal control and environmental health partners. Conduct home or community based environmental control strategies, including dog collaring and pesticide spraying.
7. Educate the patient and the community, with assistance from community health representatives, about tick prevention and how to keep their family and dogs safe.
8. Review case investigation notes and complete reporting to ADHS using the online surveillance system. Close and classify case.

These are very general steps to investigating a suspected RMSF case, but it is essential that these steps are followed and MEDSIS is used as a tool to communicate case information to the state. Appendix 1 illustrates tips for RMSF case investigations that breaks the steps down into a flow chart and explains the key information needed for RMSF surveillance.

Case Classification

There are four case classifications available for RMSF in the state of Arizona: confirmed, probable, suspect, or not a case. Classification is determined based on clinical evidence, exposure history, and laboratory results. Clinical evidence includes "any reported fever and one or more of the following: rash, eschar, headache, myalgia, anemia, thrombocytopenia, or any hepatic transaminase elevation". Exposure is defined as having been in potential tick habitats within the past 14 days before onset of symptoms. Occupation should be recorded if relevant to exposure. A history of a tick bite is not required.

In addition to symptoms and clinical information, cases are also classified based on laboratory diagnostics. When assessing laboratory criteria, serology is the best diagnostic option, and is most widely used for detecting antibodies against RMSF. However, paired samples (acute and convalescent) are essential for confirmation because antibody responses are rarely detectable in acute samples.

- Remember; always give Doxycycline if RMSF is suspected!

- Polymerase chain reaction (PCR) or immunohistochemical (IHC) testing methods are appropriate only for cases of severe illness, or from post-mortem specimens before doxycycline has been given.
  - Biopsies of rash are appropriate when present, but again, rash may not be present until late in disease progression and should always be coupled with serology (negative PCR does not mean a non-case).

To consider a case confirmed there needs to be laboratory evidence as follows.

- Fourfold change in IgG antibody titer reactive with *Rickettsia rickettsii* or other spotted fever group antigen by indirect immunofluorescence assay (IFA) between paired serum specimens (one taken in the first week of illness and a second taken 2-4 weeks later), OR
  - Example: acute specimen is <1:64 and convalescent is 1:128

- Detection of *R. rickettsii* or other spotted fever group DNA in a specimen by PCR assay, OR
- Demonstration of spotted fever group antigen in a biopsy or autopsy specimen by IHC, OR
- Isolation of *R. rickettsii* or other spotted fever group rickettsia from a clinical specimen in cell culture.

To classify a case as probable there needs to be laboratory evidence as follows:

- Serology IgG or IgM antibody reactive with *R. rickettsii* or other spotted fever group antigen by IFA, enzyme-linked immunosorbent assay (ELISA), dot-ELISA, or latex agglutination.

In summary, serology is the most common diagnostic tests for RMSF to look for increasing levels of RMSF-specific antibodies. This suggests recent infection. Early in any tick-borne rickettsial disease, most of the acute tests will be negative. It typically takes 7-10 days after the start of symptoms for the body to make enough antibodies to reach detectable levels. Ideally, the first (acute) sample should be taken early (within the first week of symptoms) to provide a recent baseline antibody level and the second (convalescent) sample should be taken 2-4 weeks later after the body has had time for a full antibody response. Antibody levels may remain high for months following illness.

The above information explains in details the confirmatory and supportive laboratory criteria required to classify a case as confirmed or probable. Table 2 more generally defines each case classification category. Appendix 3 displays these case definitions as an info-graphic and may be more useful for classifying cases. Table 2 shows the cases definition in the color associated with the info-graphic (Appendix 3) as a reference.

CASE DEFINITION	DESCRIPTION
Confirmed	A clinically compatible case that meets clinical evidence criteria, and confirmatory laboratory criteria.
Probable	A clinically compatible case that meets clinical evidence criteria, and supportive laboratory criteria.
Suspect	A case with laboratory evidence of past or present infection but no clinical information available (e.g. a laboratory report). OR A case that meets the clinical criteria, but with a negative acute specimen results and missing convalescent testing.
Not a case	A case with no clinical information and negative laboratory results.

Table 2: Case Definitions for RMSF

Case Investigation Scenarios

A. Setting the Scene

A 5-year old child comes into a healthcare facility with high fever. The child has been sick for about 2 days. There does not seem to be a rash present or any severe body or muscle pain. The child sometimes plays outside with dogs, but the family cannot recall a tick bite. The child lives on tribal lands where Rocky Mountain spotted fever has been a continual concern.

Due to fever and potential tick exposure, a blood specimen is drawn to test for acute titers to RMSF. Doxycycline is prescribed. Other labs (blood cell count and chemistry panel) are drawn as well. Other symptoms that may have developed and general lab results come back to the healthcare facility and are entered into the patient's medical record. The child is sent home with doxycycline and soon feels better. When the test results come back from the first test, the result is negative (usually written as "not detected").

B. Scenario 1

- Public health nursing is unable to set up an appointment in 2-4 weeks for the child to come back for a convalescent blood draw to check RMSF titers.
- No case investigation is performed.
    - This involves collecting demographic information about the patient, determining when they started to feel sick and their symptoms, and recent activities leading to possible tick exposure.
    - Medical records should also be requested from the healthcare facility.
- No convalescent specimen is collected.
- The laboratory reports the first test result to ADHS. Because there is no symptom information or convalescent specimen, the ADHS RMSF Epidemiologist classifies it as "not a case".

C. Scenario 2

- Public health nursing sets up an appointment in 2-4 weeks for the child to come back for a convalescent blood draw to detect RMSF titers.
    - Convalescent titer reminder should be utilized (figure 8 below)
    - May also need to remind patient about convalescent titer via phone or patient's preferred method
- Public health nursing conducts a case investigation and reviews the child's symptoms, potential exposures, general laboratory results, and differentials.
    - If the case fits the RMSF algorithm, public health nursing opens a case in MEDSIS (Medical Electronic Disease Surveillance Intelligence System).
        - Be sure to check for a pre-existing case to avoid duplication.
    - Cases need to be reported to the state within 5 working days from the time RMSF is suspected.

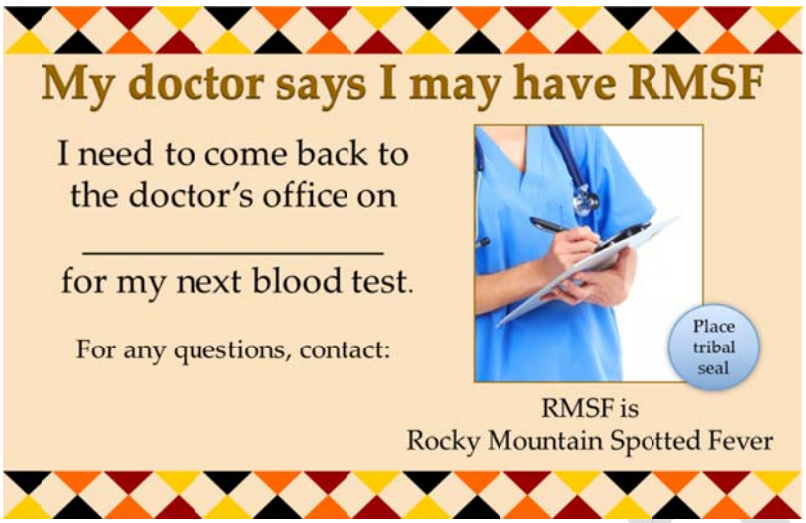


Figure 8: RMSF convalescent specimen reminder card

- In MEDSIS, public health nursing completes the DSO (disease specific observations) with symptom information and date of illness onset. Medical records and laboratory results are attached to the record for ADHS' RMSF Epidemiologist to review. Additional information, as needed, is entered in the case as a note.
- Public health nursing follows-up with the case for the convalescent RMSF titer that was scheduled.
- The newly collected convalescent specimen and the acute specimen are sent to the State's public health laboratory for paired sera testing.
  - Paired testing determines if it was a true positive case or true negative case.
- Public health nursing updates the investigation status, classifies the case, and submits to ADHS in MEDSIS.
- ADHS's RMSF Epidemiologist reviews the case, and with symptom information and results from acute and convalescent sera, classifies and reviews the case.

D. Discussion

Scenario 1 is not correct, but it is how the majority of RMSF cases in Arizona are currently reported. Follow-up for RMSF cases takes time and persistence. However, resources for case investigations are often limited, and it can be challenging to convince patients to return to the healthcare facility for a convalescent blood draw. In the short-term, this may seem like pressure is being placed on public health nursing resources. However, in the long-term, thorough case management and investigation is much more sustainable. It also results in a more complete picture of RMSF in Arizona.

For assistance in case investigation, please contact Hayley Yaglom at Hayley.Yaglom@azdhs.gov or 602-542-2521. For assistance with MEDSIS training, please contact the MEDSIS helpdesk at medsishelpdesk@siren.az.gov.

E. Consequences

- Without a case investigation and a convalescent specimen, public health, the healthcare facility, and the patient, never know if the illness was due to RMSF. Laboratory diagnostics can help determine if case are true cases OR if they are not cases.

- Potential RMSF cases could be missed, which influences surveillance and the assessment of disease burden and needed resources. As a direct result of the lack of confirmatory clinical and laboratory information, ADHS's yearly statistics may underestimate the true picture of RMSF in Arizona.
- Tribes, counties, the State, and the CDC are unable to report whether the enhanced education and prevention for RMSF has made a difference in reducing case numbers.

F. Summary

Remember, that all case investigation information needs to be relayed to ADHS through MEDSIS and to utilize Appendix 2 for guidance. ALL suspect patients need to be contacted for symptoms, possible exposures, and to return for a convalescent blood specimen. A single acute titer is NEVER enough to confirm a true RMSF case. Furthermore, acute titers are almost always negative. The acute specimen is only important to act as a comparison to the convalescent specimen. When no convalescent specimen is collected the case cannot be confirmed. Often, for this reason, there are a large number of cases that must be left classified as probable or suspect. This is a large surveillance barrier for RMSF in Arizona. Public health can only utilize the information that meets the specified public health surveillance definitions. Generating more accurate case counts for RMSF in Arizona is advantageous for all jurisdictions by demonstrating the true burden of RMSF cases in Arizona and allowing for the more appropriate allocation of resources.

RMSF Response

The following section comprehensively addresses five key aspects necessary for an effective RMSF response effort. The information included represents both the currently implemented strategies, and suggests further measures. The four key components are:

- **A.** Environmental Control & Surveillance
  - Development of programs for tick surveillance, risk assessment, and vector control and eradication
- **B.** Animal Control & Veterinary Programs
  - Development of comprehensive animal control programs
- **C.** Health Care
  - Addresses communication chain for suspect RMSF cases, clinical education, and transfer protocol.
- **D.** Community Outreach and Education
  - Development of a community outreach program, RMSF health education curriculum, and standardized use for RMSF educational materials
- **E.** Budget & Financing
  - Development of budget to support comprehensive RMSF control programs

Environmental Control & Surveillance

Overview

The life cycle, host preference, and behavioral patterns of the brown dog tick discussed earlier in this handbook, provide the building blocks for RMSF environmental control and surveillance activities. Targeted environmental activities should include tick control and prevention on dogs AND indoor and outdoor tick control.

Pet owner responsibility is essential to ensuring that dogs are kept free of ticks. However, many residents do not regularly treat their dogs for ticks. This may be due to a lack of financial resources, inability to catch the dog, not thinking tick treatment is important, or not treating dogs frequently enough to be effective. It is therefore prudent to have a public program in place to provide regular control of ticks on dogs. It's also crucial to provide vector control in and around homes.

Tick control services might include providing insecticidal products for free or at low-cost by going house-to-house, or by providing treatment at pet clinic events (e.g. rabies or spay/neuter clinics). Several topical treatments and tick collars are effective at controlling ticks on dogs. Services at the home-level should include outdoor and indoor tick control and treatment practices where infestation is indication.

Removing debris and solid waste is key to tick control, as the presence of these materials can create a habitat that supports tick survival around the home. If resources are available, assistance programs to help homeowners in the removal of debris and waste can be successful as minimizing this as a risk factor.

Risk Assessment

Assessing environmental risk factors for RMSF is essential to determining and implementing appropriate and effective tick control measures. Utilizing a questionnaire that incorporates

three main areas to assess risk: human (e.g. knowledge and awareness of RMSF), dog (e.g. observe dogs for ticks, including free roaming dogs), and living environment (e.g. assess home and surroundings for tick harborage) is beneficial for capturing comprehensive information. These factors also contribute to overall RMSF risk assessment for the affected tribal lands, as seen in Figure 4.

Surveillance Strategies

A. Canine Tick Load

Canine tick load is one surveillance method that can be used as an indicator of community-wide and area-specific tick issues. Assessment of canine tick load can provide an estimation of the baseline tick burden for a community. It also indicated which areas are more at risk for RMSF. Surveillance of canine tick load on its own can direct implementation of prevention efforts, or it can be used in combination with other factors to develop more comprehensive strategies.

The best method to assess the risk of impact of RMSF via canine tick load is by observing dogs selected at random throughout the community. Due to the lack of feasibility to sample all dogs, this random sampling with allow a more representative population to be assessed. It is important to consider seasonal differences and care status of the dog (e.g. presence of a tick collar, indoor/outdoor pet). These considerations will be beneficial for interpreting the information collected.

B. Environmental Tick Load

Environmental tick load is another surveillance strategy for RMSF risk assessment. There are three potential methods for environmental tick load analysis. These include:

a. using carbon dioxide tick traps, which involves dry ice emitting carbon dioxide to attract ticks
b. flagging, which involves gathering ticks on a flannel cloth, but does not work particularly well for *R. sanguineus* ticks
c. direct environmental inspection/observations.

These strategies can provide an estimate of tick load in a particular area of interest. The limitations to conducting environmental tick load assessments include limited laboratory capacity for tick counts and identification of species, and availability of resources (e.g. dry ice).. The best time to conduct these environmental assessments would be before tick season begins and during the peak tick activity periods in each of the areas of interest. This approach would provide a baseline environmental tick load, and would also allow for the assessment of environmental prevention efforts.

C. Canine Seroprevalence

As previously mentioned, investigating seroprevalence of RMSF in dogs can be useful in determining the risk to humans. Dogs that are seropositive provide evidence of either recent or previous exposure to infected *R. sanguineus* ticks. Therefore, canine seroprevalence may be a helpful indicator that infected ticks are somewhere in the surrounding environment. Although the Arizona RMSF tick vectors prefer dogs as a food source, nearby humans are often considered a sufficient meal.

The serosurvey should be conducted with the assistance of a veterinarian or veterinary technicians, and requires laboratory analysis of the blood specimens. There are no rapid clinical test kits available. In the development phase, it is important to consider the baseline seroprevalence, the frequency of sampling, method of sampling, and evaluation/use of data. Two potential methods of sampling are testing a representative sample of dogs by going door-to-door throughout the community, or by testing dogs seen at rabies vaccination clinics. Other options may be available, depending on the community. The sampling method employed should be determined based on community-specific factors. Demographics about the dog, including age and care status (e.g. indoor/outdoor, tick collar present), should be collected.

Seroprevalence investigations provide beneficial information, but there are also limitations. These include the need for laboratory capacity, limited funding, and the need for an experienced veterinarian. Canine seroprevalence should be considered in conjunction with canine tick load assessment, as a paired environmental RMSF surveillance strategy.

D. Prevalence of Rickettsial Infections in Ticks

Another strategy in determining community risk of RMSF is to test the brown dog ticks for the *R. rickettsii* bacteria. This indicates the prevalence of infected ticks in an area. . This method requires collected ticks to undergo laboratory analysis for presence of the bacteria. This strategy is typically utilized in an outbreak if RMSF emerged in a new location, whether on tribal lands or not or for cluster investigations to determine if infected ticks are present around a particular home or neighborhood. It is not recommended as a routine method for environmental surveillance. Tick rickettsial prevalence can be burdensome because a large number of tick samples are needed, funding sources are often limited, and laboratory capacity is required. Canine seroprevalence is more commonly used to determine RMSF activity than tick rickettsial prevalence.

It's best to pair tick rickettsial prevalence investigations with environmental tick load assessments. Keep in mind that monitoring climate trends and weather conditions can assist in understanding changes in tick population-levels and predicting tick activity.

E. Tick Control Measures

Community-level integrated tick management and control strategies are the most effective public health response to reduce RMSF. Several community-based collaborative methods have been successfully implemented on affected tribal lands since the mid 2000's. The most important involves direct tick control measures, such as pesticide application. When choosing a pesticide, there are factors to consider, such as equipment cost, pesticide cost, active ingredients, application rate, potential residual compounds, and efficacy. Additionally, training and certification may be mandatory for pesticide use and application. Brown dog ticks thrive in areas where there is a lot of solid waste and vegetation. Reduction of tick habitats outdoors requires removal of any vegetation and solid waste. Dog houses and outdoor solid waste piles, including tires, furniture, and bins should be routinely inspected for tick infestation. Some examples of best practices to prevent tick infestation indoors include general sanitation, clutter removal, and routine dog bed laundering. Indoor and outdoor tick control measures are essential to preventing the potential for human cases of RMSF. These control methods

can be most effective when tailored to specific environmental conditions and community needs.

Majority of the dog population on tribal lands are not maintained indoors and often roam freely around the community. Without adequate and consistent tick prevention, dogs are likely to be exposed to ticks in areas around their neighborhood and bring those ticks back near their homes. The best method to prevent RMSF in dogs and further tick exposure to humans is to prevent ticks from feeding and attaching to dogs. Also, it is best to use products that kill ticks, not just repel them. Regardless of whether a dog has ticks on its body or whether ticks are present in the surrounding yard, tick control products should be used, such as long-lasting tick collars, which are extremely beneficial towards preventing ticks on dogs. Some tick collars, including Bayer Seresto collars, last about 8 months. In these collars, there is a sustained release technology that allows continuous protection with two active ingredients working synergistically. The ingredients include imidacloprid, which is a very potent insecticide, and flumethrin, which is a highly effective acaricide. A topical or systemic tick-control treatment, such as permethrin, fipronil, seasonal dips, or collars impregnated with amitraz or propoxur (Zodiac collars) to prevent ticks is recommended. A spray treatment or dip may be necessary to kill ticks on dogs with severe infestations. In areas with high tick activity and human cases of RMSF, regular applications of acaricidal treatments to yards and outdoor dog kennels can reduce the number of ticks in a dog's environment. Lastly, ensuring the health of dogs in the community is another way to prevent risk of illness to humans. Often times, free-roaming dogs are not fixed and have a multitude of health concerns. In addition to tick prevention, maintenance of overall health is important. This can be accomplished through wellness, vaccination and spay/neuter clinics, often sponsored by RAVS (rural area veterinary services).

Best practices are to apply pesticides four times over the season where tick activity will peak and to ensure dogs are collared in the spring and fall to ensure protection throughout peak tick activity. In summary, the most effective strategy to control ticks in a tribal community is through an integrated approach. This includes the following:

- Use appropriate spot-on treatments, tick collars, sprays, or dips to control ticks on dogs. Remember to read the label.
- Apply appropriate pesticides to control ticks in yards. Follow the instructions carefully for the product chosen. Repeated applications may be necessary.
- Remove tick habitats on properties, including leaf litter and solid waste (e.g. old furniture, boards).

As described in the section above, development of a RMSF response plan requires comprehensive approaches to successfully implement surveillance, control and prevention efforts. These efforts also include collaboration and partnerships between multiple jurisdictions and stakeholders, such as tribal districts, CDC, ADHS, IHS, local county public health, ITCA, RAVS, National Animal Control Association, National Humane Society, Emergency Management, Community Housing, and Public Works. It may be necessary to evaluate and address targeted areas for RMSF response activities versus community-wide interventions if certain areas or districts of affected tribal lands fall into different risk categories. Also, keep in mind the wide range of needs for tribal

communities that have been affected by RMSF when determining prevention and education efforts.

Upon development of a response plan utilizing many of the strategies listed in this handbook, be sure to do the following things.

1) Discuss plan with stokeholds and finalize
2) Evaluate the type of equipment and resources needed
3) Inventory current supplies and place orders
4) Decide which RMSF education materials will be used
5) Disseminate RMSF information using flyers, PSA's, radio, and social media channels

Implementation of the plan involves continued and dedicated efforts, evaluation of surveillance investigations, and follow-up with areas that control strategies took place. Some specific examples of RMSF response activities include:

- Door-to-door campaign in targeted areas to assess knowledge of residents.
- Set-up mobile tick dip stations near target areas.
- Animal control can make an initial sweep of roaming dogs.
- Offer rabies vaccination clinics.
- Requesting permission to draw blood from dog for RMSF testing, collect demographic information on the dog, and place a tick collar on the dog.
- Animal control can conduct follow-up in target areas to check on sick dogs or look for free-roaming dogs.
- Evaluate results from RMSF testing to determine whether control measures need to be increased or simply maintained.
- Visit households were positive dog cases were identified.
- Continued monitoring for roaming and sick dogs.
- Evaluate surrounding of households to look for ticks or areas where ticks may be living.

Animal Control

In the past, there has been a lack of established animal control programs which has potentially contributed to the rapid spread of RMSF across the affected tribal lands. Some affected tribes had animal control programs and veterinary services, but others did not. Since RMSF emergence, animal control programs have developed. In addition to the need for financial resources, this section presents some concerns and recommendations in regards to maintaining an animal control program.

Decision needs to be made as to whether the animal control program will focus on public health or ordinance enforcement. The key difference is proactive prevention versus reactive action. Stopping the transmission of RMSF and other diseases can be accomplished through education and community outreach efforts first and public health enforcement of laws and ordinances second. Enforcement may deal with animal related issues and perhaps give minimal thoughts to public health. Combining both is the optimal approach.

Animal control programs should collaborate with tribal veterinarians and environment health representatives to accomplish prevention and control tasks at the reservoir and dog level. The animal control program should be tailored to the needs of the tribe, to

promote sustainability, in addition to providing and focusing on RMSF prevention efforts. Some important functions of an animal control program are to impound stray animals, assist in coordination of spay/neuter, wellness, and vaccination programs, and potentially be a continual resource for owned dogs in the community. The reality is that not all tribes can have an animal rescue facility for free-roaming dogs to be housed or dogs to be available for adoption. Therefore, outside animal rescue and veterinary facilities may need to be contacted for assistance. There may be dogs that need veterinary care, whether routine or advanced, or may need to be euthanized. Building a network with these types of entities and local public health will be very beneficial to accomplishing tribal animal control goals.

If a tribe has plans to develop their own animal control program, remember to consider the needs of the tribal members and leadership, necessary number of staff to run the facility, what services will be provided, budget and resources needed, and whether there will be a charge for services. Additionally, there may be existing tribal animal control laws and regulations that need to be enforced. Keep in mind that educating community members and dog owners is important to implement first before an ordinance is enforced.

In summary, animal control should be considered a public health issue rather than just a public safety issue. There is no perfect animal control program. Utilizing collars for short-term control are the safest and most effective single approach to tick prevention on dogs. Spay/neuter capabilities are the best long-term control mechanism for keeping dog populations within desirable and manageable levels. While it is best to have a comprehensive animal control program, any level of effort is beneficial to prevent RMSF in tribal communities and integral to saving lives.

Heath Care

While health care may not be considered as a response strategy, best practices are vital to detecting cases, preventing deaths, and understanding the current burden of RMSF on tribal lands. This section will discuss the key areas where physicians and public health nursing play a role, and the recommendations for maintaining their partnership. Case investigations and follow-up were discussed previously. The transfer protocol will also be discussed.

Health care providers are often the first individual that a suspect RMSF patient will encounter. It is therefore important that providers understand the clinical symptoms of RMSF, the RMSF clinical algorithm, how to diagnose, and treat RMSF. The goal is to reduce morbidity and prevent mortality caused by RMSF. The responsibility for training physicians can fall to tribal health departments, local public health, ADHS, or CDC. Establishment of protocols for diagnosing RMSF, laboratory testing, and reporting has been done by ADHS in conjunction with CDC expertise. As mentioned in the case investigation section, RMSF is a reportable disease, therefore laboratories and health care providers are mandated by the Arizona Administrative Code to notify local public health or ADHS.

In the tribal lands that had been declared as high risk, use of the RMSF clinical algorithm is mandatory. There are automatic notifications in certain emergency departments of hospitals when a person presents with fever. With the implementation of this algorithm, came the requirement to train physicians, public health nurses, and other health care staff. It may not be necessary to utilize the clinical algorithm in such a strict manner as previously had been done; however there should an appointment of an RMSF infection preventionist or public

health nurse that would be the primary point of contact for ADHS. This individual may be able to work with other providers and tribal health department to develop patient-targeted education if hospitalized and an incentive program for outpatients to return for convalescent blood sampling. Health care providers are responsible for coordinating specimen collection and shipment to a laboratory for RMSF testing.

A chain of command for referral cases and point of contact for follow-up should be established. Public health nursing is often responsible for receiving referrals from physicians and conducting home visits with patients and completing case investigations and follow-up. Health care providers should be in regular communication with the tribes to obtain information about risk status, in order to procure the highest level of clinical care.

RMSF Transfer Protocol

The purpose of the RMSF transfer protocol is two-fold. First, it aims to promote continuation of patient care and treatment from a tribal health care facility to non-tribal health care facility. The second objective to prevent case history and information gaps between the jurisdictions in a scenario where a patient is transferred to a hospital outside tribal lands. Once a patient is transferred to hospital outside tribal lands, responsibility temporarily falls into the local county public health's jurisdiction for investigation and follow-up. For example, a transfer if a tribal affiliated patient to Phoenix Children's Hospital would fall into Maricopa's jurisdiction.

Some of the tribes utilize the state infectious disease online reporting system, MEDSIS, but not all the tribes have access or having varying levels of access. Without this protocol, there may be no other way of the patient case information getting back to the tribe. The RMSF transfer protocol was piloted in 2012, and is currently implemented collaboratively within two tribal and corresponding county jurisdictions. The goal is for all tribes reporting suspect RMSF cases that are transferred out of tribal jurisdiction health care facilities to implement this protocol. This will also facilitate enhanced multijurisdictional communication and collaboration.

Implementation of the protocol requires a few simple steps. The recommendation is to designate one or two point of contacts at each tribal jurisdiction that will be responsible for initiating the protocol. Refer to figure 9 for the flow of patient information. The **green arrows** indicate how the information gets **passed on from** the tribal jurisdiction and the **red arrows** indicate the flow of information **back to** the tribal jurisdiction.

Step 1→ Tribal jurisdiction initiates protocol by notifying RMSF Epidemiologist at ADHS of suspect RMSF case that has been transferred. RMSF Epidemiologist needs the patient name, date of birth, date of symptom onset, tick exposure, symptoms and any laboratory results from tribal health care facility, date of transfer and name of hospital patient was transferred to. The following questions also need to be addressed.

1) Was the patient started on doxycycline at IHS or tribal health care facility?
2) Were RMSF labs drawn?

Any additional information is helpful, but not necessary.

Step 2→ RMSF Epidemiologist gathers the above information from the tribal jurisdiction and contacts the epidemiology staff at the appropriate county public health department. RMSF Epidemiologist opens a MEDSIS case.

Step 3→ County public health will contact the hospital that the patient was transferred to and obtain follow-up information on condition and diagnosis. This includes determining if the patient was continued on doxycycline at health facility in county jurisdiction and if RMSF was kept of the differentials list. County public health will also educate the physician as needed about RMSF.

Step 4→Information will be provided back up the chain from county public health to the RMSF Epidemiologist at ADHS to the tribal jurisdiction. Additional case information obtained will be entered into the MEDSIS case. When the patient is discharged from the non-tribal health care facility, responsibility for additional patient follow-up if necessary falls back into the tribal jurisdiction.

In order for this protocol to be successfully implemented, it also requires an educational component to physicians and infection preventionists about RMSF on tribal areas if they are unfamiliar and about the importance of using doxycycline to treat RMSF. Depending on the needs and audience, the role of educator can be filled by individuals from tribal jurisdictions, IHS, county public health, ADHS, and CDC. In severe cases, coordination of additional specimens for testing will be done by the RMSF Epidemiologist and appropriate corresponding jurisdiction. Lastly, the RMSF Epidemiologist will be responsible for maintaining a comprehensive record of all transfer cases across the state.

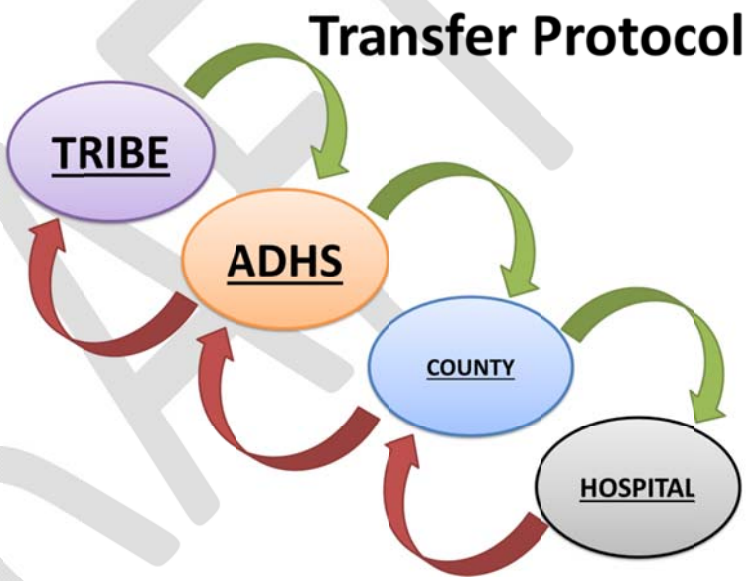


Figure 9: RMSF Transfer Protocol illustrating flow of patient case information

Community Outreach & Education

Control and prevention of RMSF at the environmental level is extremely important, however without RMSF-specific community education, acceptance of control efforts may be challenging. Furthermore, educational strategies can more widely reach all ages on the individual level. There are many ways to approach community outreach and education. There has already been communication and coordination between all partners for massive community outreach and education, including presentations and panel discussions. Additionally, affected tribes have shared educational materials and ideas with one another. This section will provide some l recommendations on how to get RMSF health education programs started and what information should be included.

Tribal health departments may want to consider dedicating specific staff to outreach and educational efforts, such as community health representatives or health educations. These

individuals can play a large role in discussing the risk factors and symptoms of RMSF, how to check for and remove a tick, and how to reduce the risk of ticks around homes to audiences. However the dedication of staff is not necessary, as public health officers, animal control officers, tribal veterinarians, and environmental health representatives can also provide assistance to increase awareness and knowledge of RMSF and related prevention activities. Working with these partners can help identify existing animal control policies and ordinances, as well as the most appropriate and effective method to communicate these to the community.

There are a variety of RMSF education materials that have been developed over the past several years, such as brochures, calendars and posters. Consider whether these have been useful or if there is a need to develop new materials. It is also important to consider whether materials need to be translated into other languages, specifically tribal languages. Many materials have been created electronically, which allows easier sharing between partners. The goal is the promotion consistent messaging statewide. Monthly workgroup and coalition calls allow exchange of ideas and materials.
Development of a comprehensive toolkit to disseminate to specific target audiences (e.g. general community, physicians, and veterinarians) may be extremely beneficial. This is because the key messages may differ depending on the audience. When RMSF first emerged, physicians on tribal lands were not aware of the illness and how to diagnose or treat. There have been many presentations to physicians about RMSF and also physician pocket cards available as a reminder of symptoms to treat with doxycycline. Nurses and physicians should continually be informed about the threat of RMSF and updates on cases, as well as educated on the use of the RMSF clinical algorithm.

Community-wide outreach and education can be accomplished through large presentations, posting flyers or posters, newspaper articles, social media and radio or television public service announcements. Individual efforts can be achieved through home site visits. During home RMSF risk assessments, the residents can be educated on tick habitats, solid waste removal, and how to care properly for any dogs they may have. The importance of tick collars and spaying and neutering dogs should be emphasized. These one-on-one interventions are especially important at homes or neighborhoods where there have been positive RMSF cases. Conducting school presentations are also recommended to make children aware of the risks and how to keep themselves safe and healthy, including what to do if they find a tick on themselves.

Financing & Budget **(Erica W. @ ITCA to add)**

Developing and strategizing a budget is an essential piece of the puzzle. It is recommended that RSMF prevention and control budgets be organized around six categories: 1) animal control, 2) tick control, 3) environmental surveillance, 4) community outreach/education, 5) public health surveillance, and 6) clinical education. These six categories have been addressed throughout this handbook and encompass comprehensive RMSF control efforts.

1) Animal Control costs for a one staff office including personnel cost, equipment and operating costs will be approximately $125,000 per year.
2) Tick Control will require granule and liquid pesticide, seresto dog collars, staff personnel and operating costs and community clean up. Treating 2,400 homes 12 times/year with granule pesticides will cost approximately $86,400 (supplies only). Treating 2,675 homes

4 times/year will cost approximately $118,000 (includes supplies, equipment and seasonal workers cost). Placing seresto dog collars, at $40 per collar for 5,300 dogs will cost $220,000 (supplies and seasonal workers). The removal of community debris and yard clean up to remove tick habitat will require the partnering with tribal housing authorities and other partners to use waste containers and transfer station. The removal of 191 tons will cost $155,000.

3) Environmental Surveillance would involve a determination of the canine and environmental tick loads. The tick count on dogs will require significant staff time. The environmental tick load count in addition to staff time will cost $75-100 for 10 CO2 tick trap supplies.
4) Community Outreach/Education costs will involve development and printing of community brochures, children tools such as coloring book calendars, postage, etc. A budget of $6,100 will cover 5,000 community brochures, 5,000 coloring book calendars, and necessary postage. Public Health Surveillance/Investigation would involve canine seroprevalance which has historically been performed with CDC assistance through Epi-Aid. Use of contracted veterinary services and private lab may be necessary with current cost unknown.
5) Clinical Education involves the education of clinical staff on RMSF treatment which is an on-going practice of CDC, ADHS and IHS so there should be no costs to the tribes. Potential possible funding sources includes tribal programs (including general funds), government or private grants (businesses, philanthropic organizations), emergency funds (ADHS, IHS, CDC), and CDC community transformation grants.

Overview:

		Year 1	Year 2	Year 3	Year 4	Year 5	Total
Grant funded		Collar and environmental controls in 600 Household community	Collar campaign, environmental treatment by request only	Collar campaign, environmental treatment by request only	Collar campaign, environmental treatment by request only	Collar campaign, environmental treatment by request only	**Total grant contribution**
	RMSF Supervisor	-	Collar and environmental control reservation wide				
	Spay/neuter	Full time Spay/Neuter	Full tme Spay/Neuter	Full time -	Part time -	- -	
	Collar	Seresto	Seresto	Seresto	Amitraz	Seresto	
	Estimated cost	$270,545	$543,161	$354,486	$343,236	$256,986	$1,768,415
Tribe Funded	ACOs	Staffing 2 ACOs	Staffing 2 ACOs	Staffing 2 ACOs	Staffing 2 ACOs	Staffing 2 ACOs	**Total tribe contribution**
	Spay/neuter	-	-	Spay/Neuter	Spay/Neuter	Spay/Neuter	
	Estimated cost	$105,000	$105,000	$130,000	$130,000	$130,000	$600,000

Table 3: Sample budget for a 5-year RMSF prevention plan, example for a 3,000 household reservation/community

Summary

In summary, RMSF control and prevention efforts cannot occur successfully without collaborative partnerships. Everyone has a role, with tribal entities acting as the lead agencies (Figure 10).

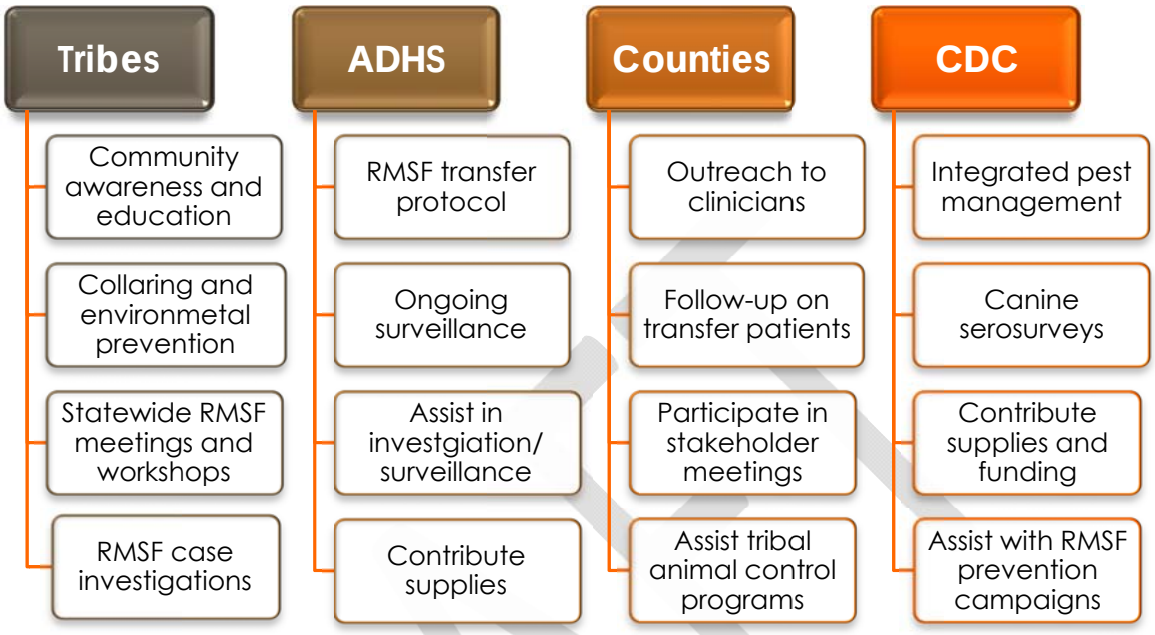


Figure10: Diagram summarizing some of the roles each partner can play.
Please note: ITCA (e.g. advocacy, funding, and assistance with prevention campaigns) & IHS (e.g. quarterly meetings, multitude of environmental and health care roles) not shown.

Future of RMSF in Arizona

Looking into the future, we can set some small attainable goals to help achieve the big picture objective.

- Continue coalition and response efforts on affected tribal lands
- Sharing or experiences and outreach between tribes
- Maintain stronger surveillance methods and case investigations on tribal lands
- Hold an annual statewide workshop/meeting to bring all partners together
- Hold bi-annual calls at the beginning and end of tick season with all partners
- Strength animal control and environmental control programs
- Expand educational opportunities for the community on RMSF and dog health
- Expand transfer protocol to other IHS and tribal facilities
- Evaluate need for comprehensive use of clinical RMSF algorithm
- Conduct canine serosurveys on affected tribal lands to assess current risk

In the span of just over 10 years, RMSF has emerged in and spread from Northern to Southern Arizona, threatening the health of tribal communities. Although significant effort was put forth by the affected tribes, state and federal partners, the incidence of RMSF continued to increase around 2011-2013. Many partners strongly state that RMSF designated funding has not only been inadequate, but sporadic. Our collaborative efforts, with the lead of ITCA, have reached beyond the local level to address policy matters, legislation, and advocacy work. These aspects will hopefully lead to future funding. In late 2014, the National Congress of American Indians passed a resolution to support RMSF prevention and control in Arizona. Appendix 5 shows the full signed resolution. It is clear that a sufficiently funded and sustainable integrated approach is the key to eradicating RMSF in Arizona tribal lands.

APPENDICES

APPENDIX 1

DEPARTMENT OF HEALTH & HUMAN SERVICES
Centers for Disease Control and Prevention (CDC)
Atlanta, Georgia 30333

Tick-Borne Rickettsial Disease Case Report

Use for: Spotted fever rickettsiosis (SFR) including Rocky Mountain spotted fever (RMSF), Ehrlichiosis (*E. chaffeensis*, *E. ewingii*, & undet.), and Anaplasmosis (*A. phagocytophilum* & undet.).
Visit http://www.cdc.gov and use "Search" for complete Case Definition(s) or visit the disease web site(s) for a fillable/downloadable PDF version of this Case Report.

CDC

Form Approved
OMB 0920-0009

CDC# ____ (1-4)

Patient's name: _____
Address: _____ (number, street)
City: _____

Date submitted: __ __ / __ __ / __ __ __ __ (mm/dd/yyyy) (5-6) (7-8) (9-12)
Physician's name: _____ Phone no.: _____

NETSS ID No.: (if reported) _____ Case ID (13-18) — _____ Site (19-21) — _____ State (22-23)

1. State of residence: Postal abrv: ____ (24-25)

2. County of residence: (26-50) _____
History of travel outside county of residence within 30 days of onset of symptoms?: 1 ☐ YES 2 ☐ NO 9 ☐ Unk

3. Zip code: (51-59) _____ - _____

4. Sex: (60) 1 ☐ Male 9 ☐ Unk 2 ☐ Female

5. Date of birth: __ __ / __ __ / __ __ __ __ (mm/dd/yyyy) (61-62) (63-64) (65-68)

6. Race: (69)
1 ☐ White
2 ☐ Black
3 ☐ American Indian Alaskan Native
4 ☐ Asian
5 ☐ Pacific Islander
9 ☐ Not specified

7. Hispanic ethnicity: (70) 1 ☐ Yes 2 ☐ No 9 ☐ Unk

8. Indicate Disease (Presumed) To Be Reported: (71)
1 ☐ SFR (including RMSF)
2 ☐ Ehrlichiosis - *E. chaffeensis*
3 ☐ Anaplasmosis - *A. phagocytophilum*
4 ☐ Ehrlichiosis - *E. ewingii*
5 ☐ Ehrlichiosis/Anaplasmosis - Undetermined

9. Was a clinically compatible illness present? If there is no presence of clinical illness, then this is not a case. (72)
Clinical evidence - fever and one or more of the following: rash (primarily SFR), headache, myalgia, anemia, leukopenia (Ehrlich. & Anaplas.), thrombocytopenia, or elevated hepatic transaminases. 1 ☐ YES 2 ☐ NO 9 ☐ Unk
Eschar (aka tache noire) or black, necrotic area around site of known/possible tick bite present? 1 ☐ YES 2 ☐ NO 9 ☐ Unk

10. Date of Onset of Symptoms: __ __ / __ __ / __ __ __ __ (mm/dd/yyyy) (73-80)

11. Was an underlying immunosuppressive condition present? (81)
1 ☐ YES 2 ☐ NO 9 ☐ Unk
Specify condition(s): _____

12. Specify any life-threatening complications in the clinical course of illness: (82)
1 ☐ Adult respiratory distress syndrome (ARDS)
2 ☐ Disseminated intravascular coagulopathy (DIC)
3 ☐ Meningitis/encephalitis
4 ☐ Renal failure
8 ☐ Other: _____
9 ☐ None

13. Was the patient hospitalized because of this illness? (83) (If yes, date)
1 ☐ YES 2 ☐ NO 9 ☐ Unk __ __ / __ __ / __ __ __ __ (mm/dd/yyyy) (84-85) (86-87) (88-91)

14. Did the patient die because of this illness? (92) (If yes, date)
1 ☐ YES 2 ☐ NO 9 ☐ Unk __ __ / __ __ / __ __ __ __ (mm/dd/yyyy) (93-94) (95-96) (97-100)

15. Name of laboratory: _____ **City:** _____ **State:** __ __ **Zip:** __ __ __ __ __ - __ __ __ __

Below, indicate Y (Yes) or N (No), ONLY if the test or procedure was performed. Lack of selection indicates that the test or procedure was not performed.

16. Serologic Tests	Serology 1 COLLECTION DATE (mm/dd/yyyy) __ __ / __ __ / __ __ __ __ (101-2) (103-4) (105-8) Titer	Positive?	Serology 2* COLLECTION DATE (mm/dd/yyyy) __ __ / __ __ / __ __ __ __ (109-10) (111-12) (113-16) Titer	Positive?
IFA - IgG	(_____)	1 ☐ YES 2 ☐ NO (117)	(_____)	1 ☐ YES 2 ☐ NO (118)
IFA - IgM	(_____)	1 ☐ YES 2 ☐ NO (119)	(_____)	1 ☐ YES 2 ☐ NO (120)
Other test: _____ (121-130)	(_____)	1 ☐ YES 2 ☐ NO (131)	(_____)	1 ☐ YES 2 ☐ NO (132)

* Was there a fourfold change in antibody titer between the two serum specimens? 1 ☐ YES 2 ☐ NO (137)

17. Other Diagnostic Test? (Use # 16, S1 for collection date)	Positive?
PCR	1 ☐ YES 2 ☐ NO (133)
Morulae visualization*	1 ☐ YES 2 ☐ NO (134)
Immunostain	1 ☐ YES 2 ☐ NO (135)
Culture	1 ☐ YES 2 ☐ NO (136)

* Visualization of morulae not applicable for SFR.

18. Classify case BASED ON the CDC case definition (see criteria below): (138)
1 ☐ SFR (including RMSF)
2 ☐ Ehrlichiosis - *E. chaffeensis*
3 ☐ Anaplasmosis - *A. phagocytophilum*
4 ☐ Ehrlichiosis - *E. ewingii*
5 ☐ Ehrlichiosis/Anaplasmosis - Undetermined
_____ (139-148)

(149) 1 ☐ CONFIRMED 2 ☐ PROBABLE

State Health Department Official who reviewed this report:
Name: _____
Title: _____ Date: __ __ / __ __ / __ __ __ __ (mm/dd/yyyy)

COMMENTS:

Confirmed SFR (including RMSF): A clinically compatible case with evidence of a fourfold change in IgG antibody titer reactive with *Rickettsia rickettsii* or other SFR antigens by IFA between paired serum specimens, one taken during the first week of illness and a second 2-4 weeks later, **OR** detection of *R. rickettsial* or other SFR DNA in a clinical specimen via amplification of a specific target by PCR assay, **OR** demonstration of SFR antigen in a biopsy/autopsy specimen by IHC, **OR** isolation of *R. rickettsia* or other SFR species from a clinical specimen in cell culture.

Probable SFR (including RMSF): A clinically compatible case with evidence of elevated IgG or IgM antibody reactive with *R. rickettsii* or other SFR antigens by IFA, enzyme-linked immunosorbent assay (ELISA), dot-ELISA, or latex agglutination (CDC uses an IFA IgG cutoff of ≥1:64 and does not use IgM test results as independent diagnostic support criteria.).

Note: Current commercially available ELISA tests cannot evaluate changes in antibody titer. IgM tests may be unreliable because they lack specificity. IgM antibody may persist for lengthy periods of time. When sera demonstrate elevated antibody responses to multiple infectious agents among rickettsial species, and between ehrlichial and anaplasmal species, the greater antibody response is generally directed at the actual agent involved.

Confirmed Ehrlichiosis/Anaplasmosis: A clinically compatible case with evidence of a fourfold change in IgG antibody titer reactive with *Ehrlichia chaffeensis or Anaplasma phagocytophilum* antigen by IFA between paired serum specimens (one taken during the first week of illness and a second 2-4 weeks later) **OR** detection of *E. chaffeensis* or *A. phagocytophilum* DNA in a clinical specimen via amplification of a specific target by PCR assay, **OR** demonstration of ehrlichial or anaplasmal antigen in a biospy/autopsy specimen by IHC, **OR** isolation of *E. chaffeensis* or *A. phagocytophilum* from a clinical specimen in cell culture.

Probable Ehrlichiosis/Anaplasmosis: A clinically compatible case with evidence of elevated IgG or IgM antibody reactive with *E. chaffeensis* or *A. phagocytophilum* antigen by IFA, enzyme-linked immunosorbent assay (ELISA), dot-ELISA, or assays in other formats (CDC uses an IFA IgG cutoff of ≥1:64 and does not use IgM test results as independent diagnostic support criteria.), **OR** identification of morulae in the cytoplasm of monocytes or macrophages (Ehrlichiosis) or in the cytoplasm of neutrophils or eosinophils (Anaplasmosis) by microscopic examination.

RMSF Case Definitions

Bureau of Epidemiology and Disease Control
Office of Infectious Disease Services

Fever >100 degrees OR history of subjective fever
AND
At least 1 of the following:

Rash, eschar, headache, joint or muscle pain, anemia, leukopenia, thrombocytopenia, OR elevated liver enzyme

Yes

Laboratory results

- Single specimen with elevated IgG or IgM antibodies → **PROBABLE**
- Negative acute and missing convalescent specimen → **SUSPECT**
- 4-fold change in IgG antibodies between acute and convalescent titers
  OR
  PCR detection
  OR
  IHC detection in tissue biopsy
  OR
  Isolation in cell culture → **CONFIRMED**

No or Unknown

Laboratory results

- Negative or Unable to Obtain → **NOT A CASE**
- Single specimen with elevated IgG or IgM antibodies → **SUSPECT**

January 2015

Arizona Department of Health Services

Tips for RMSF Case Investigation

Bureau of Epidemiology and Disease Control
Office of Infectious Disease Services

STEP 1

Review RMSF algorithm

STEP 2

Draw acute RMSF specimen
Give Doxycycline!

→ Schedule follow-up for patient for convalescent RMSF specimen in 2-4 weeks

STEP 3

Enter case into MEDSIS

→ Complete mandatory fields
(e.g. demographics, onset date, lab results)

STEP 4

Complete DSO	Add a note	Attach a document
Clinically compatible illness (YES/NO) Symptom onset date Hospitalized (YES/NO)	Symptoms (rash, headache, joint or muscle pain, abnormal labs) Recent rick exposure or risk of exposure? Transfer case? Hospital name	Medical records Laboratory results (e.g. RMSF, CBC/CHEMISTRY, other diagnostics)

STEP 5

Follow-up with patient
Collect convalescent

→ Enter convalescent lab result into MEDISIS case

STEP 6

Update status in case management section
(If convalescent cannot be obtained after 60 days, mark case as lost to follow-up)

→ Classify MEDSIS case
Close and submit to ADHS

Arizona Department of Health Services

January 2015

APPENDIX 4

EXECUTIVE COMMITTEE

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Brian Cladoosby
Swinomish Indian Tribal Community

FIRST VICE-PRESIDENT
Randy Noka
Narragansett Tribe

RECORDING SECRETARY
Robert Shepherd
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Ron Richardson
Haliwa-Saponi Indian Tribe

SOUTHERN PLAINS
Stephen Smith
Kiowa Tribe of Oklahoma

SOUTHWEST
Manuel Heart
Ute Mountain Ute Tribe

WESTERN
Arlan Melendez
Reno Sparks Indian Colony

EXECUTIVE DIRECTOR
Jacqueline Johnson Pata
Tlingit

NCAI HEADQUARTERS
1516 P Street, N.W.
Washington, DC 20005
202.466.7767
202.466.7797 fax
www.ncai.org

NATIONAL CONGRESS OF AMERICAN INDIANS

The National Congress of American Indians
Resolution #ATL-14-034

TITLE: Rocky Mountain Spotted Fever Prevention and Control

WHEREAS, we, the members of the National Congress of American Indians of the United States, invoking the divine blessing of the Creator upon our efforts and purposes, in order to preserve for ourselves and our descendants the inherent sovereign rights of our Indian nations, rights secured under Indian treaties and agreements with the United States, and all other rights and benefits to which we are entitled under the laws and Constitution of the United States, to enlighten the public toward a better understanding of the Indian people, to preserve Indian cultural values, and otherwise promote the health, safety and welfare of the Indian people, do hereby establish and submit the following resolution; and

WHEREAS, the National Congress of American Indians (NCAI) was established in 1944 and is the oldest and largest national organization of American Indian and Alaska Native tribal governments; and

WHEREAS, Rocky Mountain spotted fever (RMSF) is a severe and potentially fatal tick-borne bacterial disease and patients with severe infection may be left with permanent long-term health problems such as profound neurological deficits, damage to internal organs, or may die; and

WHEREAS, in Arizona, since 2003, over 250 human cases and 20 deaths from RMSF have been reported, almost all are Tribal members and Arizona now has one of the highest incidence rates for RMSF and in some Tribal communities, rates of RMSF are more than 300 times the national average; and

WHEREAS, the affected Tribes have worked together with federal and state partners to address RMSF in their communities through a Statewide Rocky Mountain Spotted Fever coalition to exchange best practices, share resources and support each other's efforts to control and prevent RMSF; and

WHEREAS, the solution for controlling RMSF is simple and can be achieved through use of properly timed environmental pesticides, sustained treatment of community dogs for ticks, and development of robust tribal animal control programs; and

WHERAS, an effective program has been developed, piloted and evaluated in one affected community through a joint effort between the Tribe, Centers for Disease Control and Prevention (CDC), Indian Health Services (IHS), Arizona Department of Health Services, Inter Tribal Council of Arizona, Tribal Epidemiology Center and other agencies and this program has been adopted to a degree possible by other affected Tribes.

NOW THEREFORE BE IT RESOLVED, Rocky Mountain Spotted Fever (RMSF) is a critical health concern that needs to be addressed; and

BE IT FURTHER RESOLVED, as a high priority health issue, adequate funding is immediately needed to implement comprehensive RMSF control programs for a minimum of five years on all affected tribal lands; and

BE IT FURTHER RESOLVED, that Tribes need access to the same funding sources available to states to address insect and animal borne infectious diseases; and

BE IT FURTHER RESOLVED, that the Indian Health Service (IHS), Centers for Disease Control and Prevention (CDC), Bureau of Indian Affairs (BIA), and other relevant agencies should coordinate efforts to ensure that adequate resources are made available to prevent and control RMSF; and

BE IT FINALLY RESOLVED, that this resolution shall be the policy of NCAI until it is withdrawn or modified by subsequent resolution.

CERTIFICATION

The foregoing resolution was adopted by the General Assembly at the 2014 Annual Session of the National Congress of American Indians, held at the Hyatt Regency Atlanta, October 26-31, 2014 in Atlanta, Georgia, with a quorum present.

Brian Cladoosby
President

ATTEST:

Robert Shepherd
Recording Secretary