



衛生防護中心
Centre for Health Protection

Scientific Committee on Vector-borne Diseases

Epidemiology, Prevention and Control of Spotted Fever in Hong Kong

Purpose

This paper reviews the latest global and local epidemiology of tick-borne spotted fever and examines the prevention and control measures in Hong Kong.

The causative agent and vector

2. Spotted fever is a worldwide distributed tick-borne rickettsial disease caused by more than one species of *Rickettsia* that are broadly grouped under the heading “Spotted Fever group *Rickettsia* (SFGR)”¹. SFGR bacteria are Gram-negative aerobic coccobacilli belonging to the family Rickettsiaceae and are obligatory intracellular parasites that infect the endothelial cells of blood vessels. They replicate by binary fission inside the host cells, and result in heavy damage and hence vasculitis. Some commonly known members of the SFGR are listed in Table 1. The most extensively studied member in the SFGR is *R. rickettsii*, which causes the famous Rocky Mountain spotted fever (RMSF)^{2, 3}. The tick vectors, clinical presentations, case fatality rate, complications, and long term sequelae are different for these different SFGR infections⁴.



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Table 1. Spotted fever *Rickettsia* transmitted by ticks¹

Disease	Species	Geographic Distribution	Clinical Symptoms
Rickettsiosis	<i>Rickettsia aeschlimannii</i>	Africa, Mediterranean region	Fever, eschar, maculopapular rash
African tick- bite fever	<i>Rickettsia africae</i>	Sub-Saharan Africa, West Indies	Fever, eschar, maculopapular rash

Disease	Species	Geographic Distribution	Clinical Symptoms
Queensland tick typhus	<i>Rickettsia australis</i>	Australia, Tasmania	Fever, eschar, regional adenopathy, rash on extremities
Mediterranean spotted fever or Boutonnoise fever	<i>Rickettsia conorii</i>	Mediterranean region and Africa to Indian subcontinent	Fever, eschar (usually single), regional adenopathy, maculopapular rash on extremities
Far eastern spotted fever	<i>Rickettsia heilongjiangensis</i>	Northern China, Eastern Asia	Fever, eschar, maculopapular rash, regional adenopathy
Aneruptive fever	<i>Rickettsia helvetica</i>	Central and northern Europe	Fever, headache, myalgia
Flinders Island spotted fever, Thai tick typhus	<i>Rickettsia honei</i>	Australia, Thailand	Mild spotted fever, eschar and adenopathy are rare
Japanese spotted fever	<i>Rickettsia japonica</i>	Japan	Fever, eschar, regional adenopathy, rash on extremities
Australian spotted fever	<i>Rickettsia marmionii</i> subspecies	Australia	Fever, eschar, maculopapular or vesicular rash, adenopathy
Rickettsia massiliae rickettsioses	<i>Rickettsia massiliae</i>	France, Greece, Spain, Portugal, Switzerland, Sicily, Central Africa and Mali	Fever, maculopapular rash, necrotic eschar
Rickettsia parkeri rickettsioses	<i>Rickettsia parkeri</i>	Eastern and southern U.S., particularly along the coast	Fever, headache, eschar, variable rash
Rocky Mountain spotted fever, febre maculosa, São Paulo exanthematic typhus, Minas Gerais exanthematic typhus, Brazillian spotted fever	<i>Rickettsia rickettsii</i>	North, Central and South America	Fever, headache, abdominal pain, maculopapular rash progressing into papular or petechial rash (generally originating on extremities)
North Asian tick typhus, Siberian tick typhus	<i>Rickettsia sibirica</i>	Broadly distributed through north Asia	Fever, eschar, regional adenopathy, maculopapular rash
Lymphangitis associated rickettsiosis	<i>Rickettsia sibirica mongolotimonae</i>	Southern France, Portugal, China, Sub-saharan Africa	Fever, multiple eschars, regional adenopathy and lymphangitis, maculopapular rash
Tick-borne lymphadenopathy (TIBOLA), Dermacentor-borne necrosis and lymphadenopathy (DEBONEL)	<i>Rickettsia slovaca</i>	Southern and eastern Europe, Asia	Necrosis erythema, cervical lymphadenopathy and enlarged lymph nodes, rare maculopapular rash
364D rickettsiosis	<i>Rickettsia</i> species 364D	Northern California, Pacific Coast of U.S.	Fever, eschar

3. Ticks live in moist and humid environments, particularly in or near wooded or grassy areas and they feed on mammals, birds, reptiles, and amphibians^{5,6}. They go through four life stages: egg, six-legged larva, eight-legged nymph, and eight-legged adult. Ticks wait for their hosts by “questing” on the tips of grasses and shrubs of well used paths. When a host, including

human, brushes the vegetation on which a tick is waiting, the tick climbs onto the host. Some ticks will look for area with thinner skin for attachment. Ticks must eat blood at every stage to survive.

4. Different members of the SFGR are transmitted by different hard-bodied (ixodid) ticks⁷. For example, the RMSF is transmitted by *Dermacentor variabilis* (American dog tick), *Dermacentor andersoni* (Rocky Mountain wood tick), *Rhipicephalus sanguineus* (brown dog tick), and *Amblyomma cajennense* (cayenne tick)^{8, 9}. *R. conorii* is transmitted by *R. sanguineus* (brown dog tick), while *R. africae* is transmitted by the highly aggressive *A. hebraeum* ticks and by *A. variegatum*⁴. The vector for *R. australi* is *Ixodes holocyclus*. Japanese spotted fever, caused by *R. japonica*, is transmitted by *Ixodes ovatus*, *Dermacentor taiwanensis*, *Haemaphysalis longicornis*, and *Haemaphysalis flava*. Many of the SFGR tick vectors are also the vectors of other tick-borne disease. For example, *A. variegatum* and *R. sanguineus* are also the vectors of Crimean Congo Hemorrhagic Fever.

5. Infection of ticks with SFGR occur when bacteria free ticks feed on rickettsemic hosts¹⁰. An uninfected tick can also be infected when co-feeding with an infected tick on the same host. SFGR bacteria infect more than one tissue of the tick, including mid-gut, salivary gland, and ovaries¹¹. As such, the bacteria can be maintained by both transovarial (from an infected female tick to her progeny) and transstadial transmissions (between developmental life stages)¹². Ticks are both the reservoir and vector of SFGR bacteria.

Mode of transmission

6. The epidemiology of spotted fever is related to the seasonal activities of the vectors and the human behaviour that place persons at risk of tick attachment and then infection. Spotted fever usually occurs during warmer months. People with exposure to vegetated area, such as hiking trails, camping sites, and even gardens, are at risk of contracting the infection.

7. Tick feeds by inserting its feeding tube into the skin and some species also secrete a cement-like substance for anchoring⁶. Tick secretes saliva with anticoagulant and anesthetic properties. Humans are accidental hosts and are infected when SFGR bacteria from the infected salivary gland passing along with the saliva enter the dermis of the skin⁴. In addition to tick bite, contacting with tick tissues or fluids, inhalation of contaminated aerosol, and blood transfusion, are also possible route of transmission.

Clinical Presentation, Diagnosis and Patient Management

8. Infections caused by different SFGR vary in their clinical severity¹³. RMSF followed by Mediterranean spotted fever are the most severe ones, and those caused by *R. slovaca* and *R. aeschlimannii* are never reported to be fatal⁴. Japanese spotted fever was thought to be mild but there is growing recognition of severe cases^{4, 14}. Nonetheless, it is recommended that all suspected patients should be treated as if they have RMSF¹.

9. Incubation period is commonly 6 to 10 days. Early signs and symptoms are notoriously nonspecific and different for different SFGR infections (Table 1)⁸. Initial symptoms include sudden onset of fever, malaise, headache, accompanied by myalgia, anorexia, nausea, vomiting, abdominal pain, and photophobia^{8, 12}. The classic clinical triad of fever, headache, and rash may not be seen in all patients^{2, 15}. Eschar (or tache noire), a dark, scab like plaque overlying a shallow ulcer with surrounding erythema or scaling, at the site of tick bite is a classical and common symptom in many SFGR infections. However, an eschar is usually absent in RMSF, but multiple eschars may be noted in African tick bite fever⁴. Intraocular inflammation has been reported to be the main manifestation of Mediterranean spotted fever¹⁶. While a rash might be absent or atypical in up to 20% of RMSF cases, it usually appears 2 to 4 days after fever onset⁸. IgM and IgG are not usually detectable in the first week of illness (7 to 15 days and 7 to 10 days after disease onset for Mediterranean spotted fever and RMSF respectively)¹⁷.

10. In severe cases of spotted fever, patients might present with prolonged fever, renal failure, disseminated intravascular coagulopathy (DIC), hemophagocytic syndrome, meningoencephalitis, and acute respiratory distress syndrome⁸. Glucose-6-phosphatedehydrogenase (G6PD) deficiency is known to associate with fulminant cases of RMSF and Mediterranean spotted fever^{2, 4, 8, 12, 18-22}. For RMSF, untreated and treated case fatality rate can be up to 20% and 5% respectively^{4, 8}; for Mediterranean spotted fever, the untreated case fatality rate is 4%⁴. Long term sequelae such as partial paralysis of the lower extremities; gangrene requiring amputation of fingers, toes, arms, or legs; hearing loss; blindness; loss of bowel or bladder control; movement disorders; and speech disorders may be observed in RMSF patients recovering from life-threatening cases⁸.

11. The greatest challenge to clinicians is diagnosing spotted fever, based on clinical signs and symptoms, in the early clinical course, when antibiotic therapy is most effective^{8, 23}. Additional information such as recent tick exposure, specific recreational (e.g. hiking) or occupational exposures to tick-infested habitats (e.g. densely vegetated area), recent travel to endemic area during the incubation period, and symptomatic contacts / pets can help making a diagnosis for early treatment. However, as tick bite is typically painless, and bite from tick at its earlier stage (e.g. nymph is 1-2 mm in size) is

hard to get noticed, the absence of a definitive tick bite history should not exclude a diagnosis of spotted fever^{8, 15}. *Dermacentor* ticks prefer to bite on the head, neck, or the upper trunk, so the eschar might be hidden by hair and the patient may be unaware of the tick bite²⁴.

12. Laboratory diagnosis for spotted fever is retrospective and serves to validate the accuracy of the clinical diagnosis⁸. It also allows understanding the epidemiology and public health impact of spotted fever. Treatment decisions should be based on epidemiological and clinical clues and should never be delayed while waiting for laboratory confirmation. Laboratory diagnosis of spotted fever is by demonstrating a four-fold rise in antibody titre against the spotted fever group antigen by immunofluorescence test, or by demonstrating the presence of the genome of SFGR in the blood specimen by polymerase chain reaction. The latter test is more definitive and is required in case there is cross reaction to antigens of other rickettsial diseases. However the application of this test is limited by the fact that rickettsemia only occurs in a relatively narrow time window during the acute phase and that the number of rickettsiae circulating in the blood is low¹².

13. Doxycycline is the treatment of choice for both adults and children as recommended by the Centers for Disease Control and Prevention and American Academy of Pediatrics Committee on Infectious Disease, unless otherwise contraindicated^{8, 25}. However there were case reports of possible cases of doxycycline resistant strains of *R. africae* that respond to ciprofloxacin instead²⁶. Early empirical treatment is recommended for suspected case because delayed treatment (after day 5 of onset in RMSF) may lead to severe disease (e.g. skin necrosis and gangrene in RMSF patients) and fatal outcome^{4, 8, 15}.

Overseas epidemiology

14. Spotted fever cases occur worldwide²⁷. A recent study of ill returnees after international travel indicated that, among those who developed rickettsial disease, spotted fever comprised of 82.5% of the cases²⁸. Most cases were associated with travel to sub-Saharan Africa (87.6%), with South Africa (n = 135), Zimbabwe (n = 13), and Tanzania (n = 7) being the 3 most commonly reported countries of exposure. Separate studies suggested that >99% of spotted fever cases diagnosed in international travellers to sub-Saharan Africa were caused by *R. africae*^{29, 30}.

15. RMSF has been a reportable disease in the United States since the 1920's and then nationally notifiable since 1944^{31, 32}. The Centers for Disease Control and Prevention (CDC) regularly reviews and publishes the statistics and epidemiology findings³³⁻⁴⁰. Overall, there was an increasing trend from 1920's to present. Periods of increased incidence can be seen between 1930

and 1950 and 1968 through 1990. In the last decade, there has been a more dramatic increase in incidence of RMSF increasing from 1.9 cases per million persons in 2000 to an all-time high of 8.4 cases per million persons in 2008. On the other hand, case fatality rate had an overall decreasing trend from 28% case fatality in 1944 to <1% case fatality beginning in 2001. However, such observed increase in incidence and decrease in case fatality rate may be due to changes in diagnostic and surveillance practices, such as a new RMSF surveillance case definition in 2004, that resulted in an increase in the number of probable cases that were diagnosed with single serologic assays⁴¹. Incidence increased with age. Race-specific incidence rate was higher among American Indians, probably due to an emerging RMSF focus in Arizona⁴²⁻⁴⁴. Seasonally, most cases are reported between May and August.

16. RMSF cases have been reported throughout most of the contiguous United States, but five states (North Carolina, Oklahoma, Arkansas, Tennessee, and Missouri) accounted for over 60% of RMSF cases³¹. Between 2003 and 2010, RMSF cases begun to emerge in an area in eastern Arizona in which no RMSF case was seen before. Approximately 10% of these 140 cases died. Instead of the primary vectors in other states (American dog tick and Rocky Mountain wood tick), the tick responsible for RMSF transmission in this area is the brown dog tick, found on dogs and around people's homes. Most of these cases occurred within communities with a large number of free-roaming dogs.

17. However recently it was shown that RMSF cases reported in some parts of the United States may be caused by other antigenically related SFGR (such as *R. parkeri* and *R. amblyommii*) as a result of cross-reactivity among SFGR antibodies, as indicated by an absence of *R. rickettsii* in ticks collected in Tennessee, which historically reports one of the highest incidence rates for RMSF in the United States⁴⁵⁻⁵³. To better reflect the scope of cases being reported, as of January 1, 2010, the name of the reporting category was changed to "Spotted Fever Rickettsiosis (including Rocky Mountain spotted fever)"⁵⁴.

18. Spotted fever is not a reportable infection in Canada, and an increase in the number of spotted fever cases was not observed in the last decade, when an upsurge of cases was observed in the United States⁵⁵. American dog tick and Rocky Mountain wood tick are common throughout Canada. Spotted fever cases were also reported in Mexico, Costa Rica, and Panama²⁷.

19. In south America, RMSF has been extensively described in Brazil, where *R. rickettsii* has been associated of with various synonymous diseases termed Sao Paulo exanthematic typhus, Minas Gerais exanthematic typhus, and Brazillian spotted fever since the early 1930s^{27, 56, 57}. Cases have been reported in several states, particularly in the southeast region of the country, including

Minas Gerais, São Paulo, Rio de Janeiro, and Espirito Santo, where most cases occur between July and December. The case fatality rate was reportedly quite high at 30%. Spotted fever cases caused by *R. parkeri*, *R. africae*, and *R. sibirica* may occur in Brazil as well, as indicated by the reporting of eschar associated rickettsial disease that occurred after a tick bite^{58, 59}. Spotted fever cases were also reported in Argentina, Colombia, and Peru⁶⁰⁻⁶⁵.

20. Mediterranean spotted fever is endemic in southern Europe and cases have also been sporadically reported in northern and central Europe²⁷. For example, the annual incidence rate was 9.8 cases per 100,000 persons in Portugal, where the disease was reportable and had the highest of the rates of all Mediterranean countries. Cases were encountered in late spring and summer. It was thought to be the only causative agent of spotted fever in the region. Increasingly, spotted fever cases caused by other SFGR were reported in different regions of Europe⁶⁶⁻⁷⁴.

21. Mediterranean spotted fever is endemic in northern Africa²⁷. The first case was reported in Tunisia in 1910⁷⁵. In Algeria, most cases were encountered in summer, between July and October. Particularly between 2000 and 2006, there was an increase in number of cases, and this may be attributable to the increased tendency of the brown dog tick to bite human, as indicated by the presence of multiple eschars. In Morocco, in addition to Mediterranean spotted fever, cases due to *R. aeschlimannii* were also reported⁷⁶. African tick-bite fever, caused by *R. africae*, is the most prevalent SFGR in the Sub-Saharan Africa, including Ethiopia, Kenya, Cameroon, Zimbabwe and South Africa^{27, 77-79}. The vector *A. herbraeum* readily bites any humans that enter their biotope from the ground up, resulting in eschars on the lower limbs. Multiple eschars are typical of African tick-bite fever. Cases are usually associated with visiting game reserves or participating in outdoor activities such as running, trekking and hiking in forested areas, usually inhabited by *Amblyomma* ticks.

22. Israeli spotted fever, caused by *R. conorii* subsp. *israelensis*, is endemic in Israel⁸⁰. In 2004, the incidence is 0.29 per 100,000 persons (20 cases). Children below the age of 10 are most at risk. Most cases occurred between June and October. No eschar is present in most Israeli spotted fever cases and this adds to the difficulty of making a diagnosis.

23. In northern China, the prevalent SFGR is *R. sibirica*, which causes North Asian tick typhus²⁷. This disease is usually mild and is seldom associated with severe complications. A new SFGR, *R. heilongjiangensis*, was isolated in the Heilongjiang Province of China in 1982. The infection is later coined Far Eastern spotted fever and is relatively mild. Spotted fever is not a nationally notifiable disease in China. North Asian tick typhus cases were also reported in former USSR, but the infection is called Siberian tick typhus here²⁷. More than 80% of the cases were observed in Altai (Western Siberia) and

Krasnoyarsk regions, with a seasonal peak during spring and summer months. An increase of the number of cases has been observed since 1979. In Japan, *R. japonica* had been the only known causative agent of spotted fever, but later on case due to *R. heilongjiangensis* was also reported^{81, 82}. Cases were endemic to warm areas bordering the Pacific Ocean and occurred from April to October¹⁴. Working in the fields seemed to be a risk factor⁸³. Spotted fever case was not reported in South Korea until a Japanese spotted fever case was reported in 2006^{84, 85}. In Sri Lanka, seroepidemiology study, defining case with a single titre over 1/128 as positive case, indicated that spotted fever was also endemic and related to work in tea and rubber plantations⁸⁶. Spotted fever also occurred in Southeast Asia countries such as Cambodia, Laos, Malaysia, Myanmar, and Thailand⁸⁷⁻⁹⁰.

24. In Australia, two SFGR were endemic and these include the *R. australis* causing Queensland tick typhus, and the “marmionii” strain of *R. honei* causing Flinders Island spotted fever^{27, 91-94}. Queensland tick typhus cases occurred only on the eastern seaboard of mainland Australia, mainly between June and November. Flinders Island spotted fever occurred in southeastern Australia, mainly in summer (December and January).

Local epidemiology

25. In Hong Kong, spotted fever was a communicable disease of topical public health concern and medical practitioners were encouraged to voluntarily report cases to the Department of Health. Since July 2008, spotted fever has been made a statutory notifiable disease and is classified as a subtype under Typhus and Other Rickettsial Diseases under the Prevention and Control of Disease Ordinance (Cap 599). From 2008 to 2012, Centre for Health Protection (CHP) recorded a total of 87 cases, and the annual number of cases was shown in Figure 1. There is no discernible secular trend. The number of cases each year ranged from 10 to 22 cases. There were fewer cases in the colder months from February to May (Figure 2).

Figure 1. Annual number of cases of spotted fever reported to the Centre for Health Protection, 2008 to 2012.

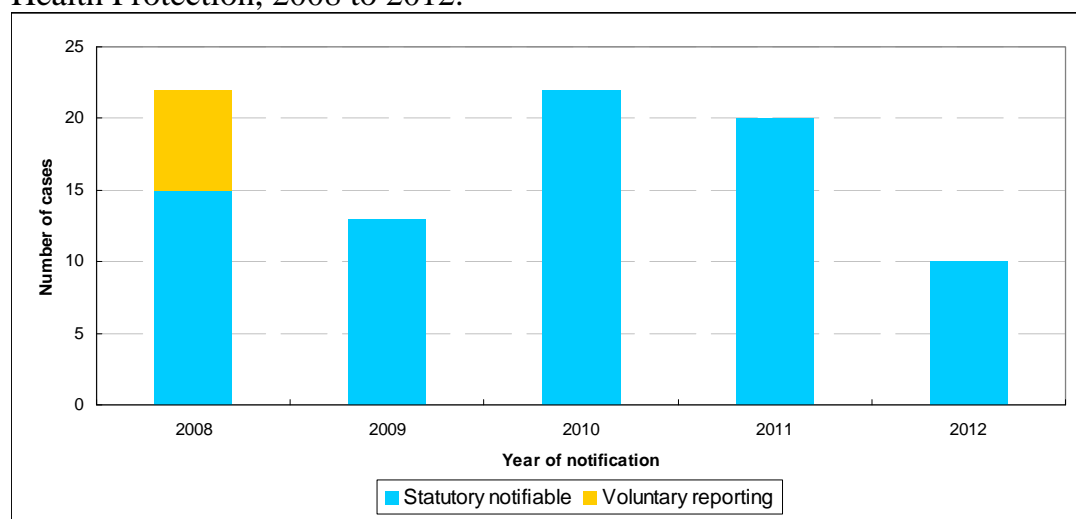
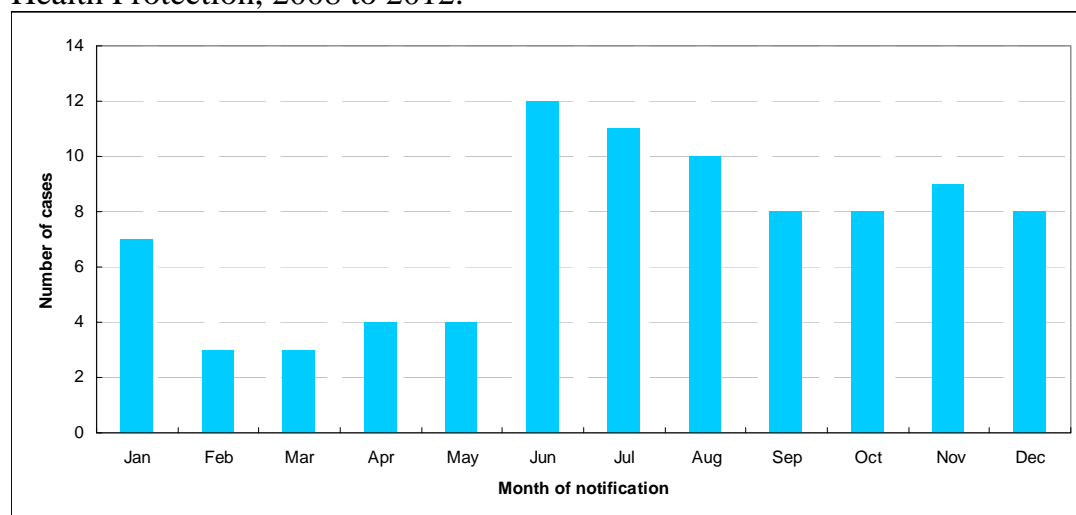


Figure 2. Monthly number of cases of spotted fever notified to the Centre for Health Protection, 2008 to 2012.



26. Except for three cases, the majority (97%) of the cases were local cases. One of the imported cases affected a 20-year-old lady who visited a national park in Thailand. The other two imported cases were epidemiologically linked cases affected a father and his daughter who both visited game reserve areas in South Africa.

27. The epidemiology of the local cases is as follows. The male-to-female ratio was 0.95:1. The affected persons were aged from 4 to 87 years, with a median of 56 years. Clinical presentations include: fever (84 cases, 100%), rash (74 cases, 88%), headache (25 cases, 30%), deranged liver function test (24 cases, 29%), myalgia (16 cases, 19%), lymphadenopathy (1 case, 1%). Eschar was noted in 12 patients (14%) and 26 patients (31%) recalled a history of arthropod bite during the incubation period. Except for one patient who was admitted for the treatment of other underlying condition,

all other patients were hospitalised due to spotted fever, with a median length of stay of 8 days. Except for the three severe cases described below, all cases were mild. One 62-year-old female patient developed septic shock and recovered subsequently. One 82-year-old female patient suffered from encephalitis and required intensive care. She was further complicated by hospital acquired pneumonia and later succumbed. One 79-year-old male patient also required intensive care due to multi-organ failure. He later recovered.

28. Most of the cases (69 cases, 82%) who contracted the disease locally reported a history of exposure to vegetated areas. Among these 69 cases, 45 of them reported an exposure history of hiking or camping, 15 reported an exposure to vegetated area near residential areas, eight cases reported a possible occupational exposure, and two cases reported exposure to parks. Epidemiological investigation revealed that there were two local clusters of spotted fever cases. One affected two female patients who were hiking collaterals of a hiking group. The other cluster affected a pair of brother and sister who hiked together.

29. The Public Health Laboratory Services Branch of CHP reported that, among 25 serologically positive serum samples, four were PCR-positive and subsequently identified to be *R. japonica* by DNA sequencing⁹⁵. *R. japonica* has also been detected from ticks harvested by the Agriculture, Fisheries and Conservation Department (AFCD) in relation to human cases. These seem to suggest that *R. japonica* could be one of the prevalent agents for spotted fever in Hong Kong.

Prevention and control measures in Hong Kong

30. To prevent and control spotted fever, a coordinated approach encompassing environmental hygiene; personal protection; health education; and disease surveillance, investigation, and control have been adopted in Hong Kong.

Environmental hygiene

31. If applicable, leaf litter, tall grasses, and bushes around homes and at campsites should be cleaned⁹⁶. If removal of vegetation is not possible, insecticide can be applied.

32. Since rodents can serve as the hosts for the immature stages of ticks²⁷, proper rodent control measures at rural places frequented by visitors, such as hiking trails and villages (and their peripheries) would help to prevent spotted fever in these areas⁹⁷. The most fundamental and effective way of rodent prevention and control is to eliminate the food, harbourage and passages for the pest⁹⁸. This can be achieved via proper handling of refuse, storage of food, and keeping of articles. Blockage / elimination of rodent passages

through installation of gratings, wire mesh or metal plates etc are structural rodent-proofing measures essential for successful rodent disinfection with rodenticides or trapping.

Personal protection

33. There is no licensed vaccine available for spotted fever. As such, avoiding tick bites and promptly removing attached ticks remain the best personal protection measures⁸. If applicable, one should limit their exposure to tick-infested habitats, including wooded or bushy areas with high grass and leaf litter^{5, 99}. Brushing against tall grass and other vegetation should be avoided, and one should walk along the centre of the cleared trails. Sitting, lying, or putting personal belongings in damp grass or on damp logs should be avoided¹⁰⁰. This is particularly important during seasonal periods of tick activity during the warmer months. Protective clothing, such as hat, long-sleeved shirts, pants, socks, and closed-toe shoes are helpful in blocking ticks from reaching the skin and attaching. Light coloured clothing is preferable because it is easier to see ticks against a lighter background. Dogs are known as “transport hosts” for bringing ticks into contact with human¹⁰¹. Pet owners should check their pets for ticks daily¹⁰². Feeding and touching stray animals should also be avoided¹⁰⁰.

34. Repellents are also useful for preventing tick bite, but it is very important to always follow product instruction¹⁰³. Over-application should be avoided. Used on exposed skin and clothing, repellents that contain 20% or more DEET (N, N-diethyl-m-toluamide) can provide protection that lasts for hours^{5, 99}. The American Academy of Pediatrics recommends that repellents should contain no more than 30% DEET when used on children¹⁰⁴. Parents should apply the repellent to their child, avoiding hands, eyes, and mouth, for example, by spraying first on their hands and then rubbing it on child’s face. Repellents are also not recommended for children younger than 2 months.

35. Repellents containing permethrin kill ticks on contact. Clothing and gears such as boots, pants, socks, and tents treated with it remain protective through several washings⁹⁹. Permethrin should not be applied directly to skin, and should be applied in a well ventilated area⁸. Treated clothing should be allowed to dry completely before being worn.

36. Frequent self-checking for ticks may help to prevent ticks from transmitting SFGR to oneself as it takes several hours for ticks to begin injecting pathogens after attachment⁸. After exposure to potentially tick-infested habitats, clothing should be checked for ticks to avoid carrying them indoor⁵. Drying clothes in a dryer for an hour is effective for killing ticks. Showering within two hours after exposure is also helpful for both washing off unattached ticks and residual repellent. A full body check of these parts of the body with a mirror is also recommended: under the arms, in and around the ears, inside belly button, back of the knees, in and around the hair, between the legs, and around the waist.

37. In case an attached tick is found, it should be removed as soon as possible to reduce the risk of infection, as there is a delay in hours between tick bite and the transmission of SFGR from the infected tick¹². The tick can be removed by grasping it with tweezers, as close to the skin as possible, and pulling it straight out with steady, even pressure¹⁰⁵. The tick should not be twisted or jerked to avoid breaking of the mouth parts. The tick also should not be removed with bare hand, nor should the tick be crushed, as fluids containing SFGR might be present in the tick's body and at the wound site. After removing the tick, the hands and the bite area should be cleaned with rubbing alcohol, an iodine scrub, or soap and water. If one develops rash or fever within several weeks of tick biting, consult a doctor and tell the doctor about any related exposure history.

Health education

38. Health education is regularly done by the CHP and Food and Environmental Hygiene Department (FEHD). Health information related to prevention of spotted fever is available in the CHP website¹⁰⁶. Health education to patients and their contacts is provided by the CHP upon notification of spotted fever case. FEHD also published occupational health and safety guideline for their frontline pest control operators, who are at risk of contracting spotted fever during their daily operation^{107, 108}.

39. Every year, FEHD will hold a territory-wide interdepartmental anti-rodent campaign to enhance the public alert on rodent prevention, and to enlist support from the community in controlling rodents^{97, 109}. A spectrum of publicity instruments were used for public education including display of banners and posters, distribution of leaflets, talks, exhibitions, broadcasting of TV announcement of public interest and organizing health education activities at public markets.

Disease surveillance, investigation, and control

40. In Hong Kong, surveillance of spotted fever has been enhanced by listing it as a statutory notifiable disease since July 2008. All registered medical practitioners are required to report suspected or confirmed cases to the CHP for investigation and public health control measures. Cases are defined as persons with compatible clinical features and laboratory confirmation. CHP continues to monitor the epidemiology of the disease and the disease information and health advices are uploaded to CHP's website regularly.

41. After receiving notification of spotted fever, the CHP will carry out investigation to collect epidemiological information about their exposure history. Travel collaterals and household members are contacted and put under medical surveillance. Health education is also used as a tool to alert the parties concerned on the prevention and control of the disease, and they are advised to report to CHP and seek early medical advice if they develop symptoms. CHP will also collaborate with the Pest Control Advisory Section (PCAS) of FEHD

and AFCD for prompt vector and host survey at around the patients' homes and their vicinity, workplaces, and other places they have visited to determine the source of infection. PCAS will inform and advise the district pest control staff of FEHD and parties concerned to strengthen rodent prevention / control work and conduct tick disinfection at locations visited by the patients. AFCD will enhance stray animal control work at these locations.

Conclusion

42. Spotted fever is a worldwide distributed rickettsial disease caused by more than one SFGR bacteria. Ticks are both the reservoir and vector. Depending on the causative agent, severe and fatal cases can occur. Early diagnosis and treatment can save lives, and doxycycline is the antibiotic of choice, even for children. In Hong Kong, the number of cases each year ranged from 10 to 22 cases, with fewer cases in the colder months from February to May. Given the fatality of untreated case, the disease remains a potential threat to the public health of Hong Kong. Various government departments and the community should continue to participate in the coordinated effort of environmental hygiene; personal protection; health education; and disease surveillance, investigation, and control in order to achieve the prevention and control of the disease in Hong Kong.

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April 2013

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