Tularaemia and Australian wildlife

Fact Sheet

August 2024

Key points

- Tularaemia is a rare disease resulting from infection with the bacterium *Francisella tularensis.*
- Most infections are reported in the northern hemisphere, where this pathogen is commonly found in wildlife species, mainly rodents and rabbits.
- In Australia, only four confirmed or suspected cases have occurred in humans and the pathogen has been associated with common ringtail possums (*Pseudocheirus peregrinus*). It is thought that other native mammals may also carry the bacterium.
- *Francisella tularensis* can be transmitted to humans via contact with infected wildlife, via biting arthropods, inhalation, or contact with contaminated water.
- Tularaemia is a nationally notifiable disease in both animals and humans. You must notify animal health authorities if you suspect an animal has tularaemia (see *Surveillance and management* below). People in close contact with Australian wildlife should be aware of tularaemia and should take appropriate precautions.

Aetiology

Francisella tularensis is a Gram-negative, obligate intracellular bacterium first identified in the United States in 1911. There are several subspecies of varying virulence. There are several other species in the genus *Francisella*.

Francisella tularensis subsp. *tularensis* (Type A) causes life-threatening illness in humans (only found in North America); *F. tularensis* subsp. *holarctica* (Type B) results in less severe disease and is the subspecies associated with human cases, ringtail possums (and possibly other native mammals) in Australia. *Francisella tularensis* subsp*. mediasiatica* has similar virulence to *F. t. holarctica. Francisella t. novicida* is the least virulent subspecies.

One Health implications

Wildlife and the environment: *F. tularensis* subsp. *holarctica* has recently emerged as a zoonotic pathogen in Australian wildlife and the situation is not well-understood. Ringtail possums appear to be involved in the epidemiology of the disease but other Australian native mammals may also be involved. Tularaemia should be considered in any acute mortality events in wildlife, particularly in possums, and also rabbits, hares and rodents, which are host species overseas. There are very rare reports of the pathogen in Australia and there is no evidence of significant population level impacts from this disease in Australian wildlife.

Domestic animals: clinical disease can occur in cats, dogs, sheep and other domestic species overseas, but has not been reported in Australia.

Humans: the organism can cause serious disease in humans. The four confirmed or suspected human cases of *F. t. holarctica* in Australia have followed exposure to native mammals. Wildlife carers and those working closely with Australian wildlife should be aware of tularaemia and take appropriate hygiene and infectious control precautions. If bites or scratches occur, people are advised to seek medical advice from their local public health department.

Natural hosts

Outside Australia, tularaemia is primarily a disease of rabbits, hares and rodents [1]. *Francisella tularensis* has an extremely broad host range, and is reported from at least 190 species of mammals, 23 species of birds, three species of amphibians and 88 species of invertebrates.

In 2016, *F. tularensis* was detected for the first time in Australian animals, in common ringtail possums (*Pseudocheirus peregrinus*), that had died in two separate historical mortality events in NSW in 2002 and 2003 [2]. Two confirmed cases of tularaemia in humans in Tasmania in 2011, and two probable cases in humans in NSW in 2020 appeared to be associated with exposure to possums or other native mammals [3] (see *Occurrences in Australia*).

World distribution

Francisella tularensis subsp. *tularensis* is only found in North America; *F. t. holarctica* is found throughout the northern hemisphere and in Australia; *F. t. mediasiatica* is found in central Asia; *F.t. novicida* has been isolated only rarely in North America.

Occurrences in Australia

Although recent studies indicate the presence of *F. t. holarctica* in Australian wildlife both in Tasmania and on mainland Australia, there is limited information available. Further work is required to better understand possible native animal hosts, prevalence, transmission pathways and the impacts of infection on wildlife.

In separate events in 2011, *F. t. holarctica* biovar *japonica* was diagnosed (by PCR, supported by typical clinical presentation), in two women who were scratched or bitten by possums between Queenstown and Zeehan, Tas. In one case, contact was with a juvenile common ringtail possum; in the other case, the species of possum was not specified [4, 5]. Surveillance was conducted in 2011 in a five km radius of where the two human cases had been bitten. Over 40 samples, including carcasses, faeces and nesting material were examined with no evidence of exposure or infection with *F. tularensis* found.

In 2016, tularaemia was detected for the first time in Australian animals, following next generation molecular analysis of archived samples, collected from two separate clusters of mortalities of common ringtail possum deaths that had occurred in NSW in 2002 and 2003. Findings of *F. tularensis holarctica* were confirmed by PCR and were found to be genomically very similar to that found in the 2011 Tas human cases [2].

In 2020 two probable human cases occurred in NSW. One occurred after a woman was bitten and scratched by a ringtail possum [6] and the other is believed to have been acquired in a laboratory setting, with likely exposure during post-mortem examination of Australian wildlife which did not include a possum species [3, 6]. The implicated species of Australian animal in this case has not been identified.

A different species of *Francisella*, *F. hispanensis*, was isolated from a man in the NT in 2003 (this organism was previously classified as a *novicida*-like subspecies of *F. tularensis*) [7, 8]. A strain of *Francisella,* resembling *F. hispanensis* was implicated in disease in a woman in WA [9].

Epidemiology

Francisella tularensis is highly infectious and can be spread by several mechanisms:

- blood-feeding arthropods including ticks, biting insects and mosquitoes
- contact with blood or tissues of infected animals
- inhalation of aerosols or particles
- ingestion of contaminated water or meat [1].

It cannot be spread from person to person.

Francisella tularensis subsp. *tularensis* is the most virulent of the strains and causes pneumonia, septicaemia and death in 5-10% of untreated human cases. The infective dose is extremely low: 10 bacteria when injected subcutaneously and 25 via aerosol. Tularaemia is not transmissible from person to person [10]. In general, infection with *F. t. holarctica* causes less severe disease.

Signs usually appear 3-5 days after infection, but can occur as late as 14 days afterwards [3]. The course of the disease is two to ten days in susceptible species [1].

The organism can survive in water and mud for several months [10]. In the northern hemisphere, tularaemia in wildlife may occur as an acute mass mortality event, particularly in rabbits and hares, but it usually cycles at low levels in local wildlife populations.

There is very little information on the epidemiology of tularaemia in the Australian context. In other countries, tularaemia has emerged several times in non-endemic areas after the importation/ translocation of infected wildlife or changes in ecologic and climate conditions, or in settings of post-war social disruption.

Clinical signs

Signs in animals overseas can include sudden death, depression, fever, local inflammation or ulceration at the site of entry and enlargement of lymph nodes draining the affected area. Mass mortalities may be seen. The history of the cases diagnosed in archived ringtail possum samples included clusters of mortality and acute necrotizing enteritis or hepatitis [2].

Clinical signs in humans are variable and can range from localized infection (seen in Australian human cases) to life-threatening pneumonia and septicaemia (seen with strains occurring overseas) and are determined by the route of infection. Following an arthropod bite or other cutaneous exposure, an ulcer develops at the site of infection along with abscessation of draining lymph nodes. Consumption of contaminated water or meat leads to pharyngitis, tonsillitis and swelling of lymph

nodes in the neck. Inhalation of the organism results in an influenza-like illness with fever and pneumonia.

The two women from Tas were bitten and scratched by possums prior to developing ulcers at the site of injury and a prominent lymphadenitis. One of the women had swollen epitrochlear lymph nodes, fever, rigor, myalgia and night sweats, followed by axillary lymphadenopathy and a spontaneously discharging sinus of the epitrochlear node [4]. All human cases in Australia resolved following treatment.

Diagnosis

Tularaemia can be diagnosed at necropsy by making impression smears of liver, spleen, bone marrow, kidney or lung, which reveal large numbers of very small Gram negative organisms. Immunofluorescence, immunohistochemistry or PCR can confirm the organism. It can be cultured from heart blood, liver, spleen or bone marrow but is slow-growing and grows poorly on most bacterial culture media.

Serological tests such as tube agglutination, ELISA and Western blot can be used to detect antibodies in species that live long enough (see WHO 2007 [11]).

The inability to culture an organism on specialized media in the Tas cases was probably caused by prolonged antibiotic treatment. The combination of clinical, serologic, and molecular evidence strongly supported the diagnosis of infection with *F. t. holarctica* [4].

For more details on sample collection and submission see the WHA "National guidelines for sample submission tularaemia – diagnostic testing" [12].

Laboratory diagnostic specimens and procedures

Care should be taken when handling animals or carcasses with suspected tularaemia, as the organism can cause serious disease in humans. Good hygiene and infection control measures are required. See NSW DPI Bulletin https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/679619/CVO-Bulletin-vets-and-paravets-19-June-2020.pdf and WHA "National guidelines for sample submission tularaemia – diagnostic testing" https://wildlifehealthaustralia.com.au/Incidents/Incident-Information/tularaemia. A necropsy should be performed, and a complete set of tissues collected fresh and in formalin. Impression smears of affected organs can also be submitted. If there are any concerns about the ability to manage the carcass safely, the whole carcass should be sent, (chilled) to the state or territory diagnostic laboratory for testing. Contact the laboratory to provide advanced notice of the submission.

Because *F. tularensis* is highly contagious and zoonotic [1], necropsies of suspect cases and culture attempts should only be carried out in laboratories with physical containment level 3 facilities. *Francisella tularensis* subsp*. tularensis, holarctica* and *mediasiatica* are fastidious and require specialist media and *F. t. novicida* is non-fastidious. Freezing of tissues as soon as possible after death will also improve culture recovery rates [13, 14].

[1] In the USA, tularemia is considered a biodefense threat and therefore work with the agent is highly regulated.

Pathology

Acutely affected mammals are usually found dead, in good body condition, with pale foci of necrosis in the liver, bone marrow and spleen, which is generally enlarged. The lungs are usually congested and there may be fibrinous pneumonia and pleuritis. Foci of caseous necrosis are often present in lymph nodes particularly in the abdominal cavity. Multifocal necrosis is usually absent in affected birds, with splenic enlargement the only obvious lesion.

In chronic cases, granulomas can be found in the lymph nodes, liver, spleen, lungs and kidneys.

Microscopically acute cases have multifocal areas of coagulation necrosis in the spleen, liver, lymph nodes, bone marrow and lungs without the presence of neutrophils or macrophages. Lesions in chronic cases are granulomatous with areas of central necrosis surrounded by macrophages, epithelioid cells and giant cells [1, 15].

Differential diagnoses

Differential diagnoses include any diseases that cause necrotizing, suppurative or granulomatous lymphadenitis, multifocal hepatitis and splenitis, such as plague, pseudotuberculosis, mycobacterial infections, salmonellosis, Tyzzer's disease, and herpesvirus infections.

Treatment, prevention and control

Most infected people recover fully with the appropriate treatment, which includes suitable systemic antibiotics [1, 3, 4, 7].

Overseas, control of the disease has been attempted through culling of reservoir hosts and steps to reduce vector numbers, with the objective of lessening disease in people and livestock. There have been no considerations of disease control in Australian wildlife.

Overseas, prevention includes hygiene and infection control precautions, such as wearing appropriate personal protective equipment when handling potentially infected animals, thoroughly cooking meat, disinfecting water by boiling or chlorination and using insect repellents to decrease the probability of bites from potentially infected arthropods [1].

People in close contact with Australian wildlife, products and carcasses should be aware of tularaemia and should take appropriate hygiene and infectious control precautions. If bites, scratches or other injuries occur, people are advised to seek medical advice from their local public health department.

Research

Further work is needed to better understand the distribution, prevalence and epidemiology of tularaemia in the Australian context.

Surveillance and management

Tularaemia is a nationally notifiable disease (see www.agriculture.gov.au/biosecurity-trade/pests-diseases-weeds/animal/notifiable). By law you must notify animal health authorities in your jurisdiction if you know or suspect that an animal has a notifiable pest or disease. Refer to advice in

your jurisdiction (www.agriculture.gov.au/biosecurity-trade/pests-diseases-weeds/animal/state-notifiable) and on outbreak.gov.au on how to report. Tularaemia is also a nationally notifiable disease in humans, see https://www.health.gov.au/topics/communicable-diseases/nationally-notifiable-diseases.

Wildlife Health Australia administers Australia's general wildlife health surveillance system, in partnership with government and non-government agencies. Wildlife health data is collected into a national database, the electronic Wildlife Health Information System (eWHIS). Information is reported by a variety of sources including government agencies, zoo based wildlife hospitals, sentinel veterinary clinics, universities, wildlife rehabilitators, and a range of other organisations and individuals. Targeted surveillance data is also collected by WHA. See the WHA website for more information https://wildlifehealthaustralia.com.au/Our-Work/Surveillance and https://wildlifehealthaustralia.com.au/Our-Work/Surveillance/eWHIS-Wildlife-Health-Information-System.

We are interested in hearing from anyone with information on this condition in Australia, including laboratory reports, historical datasets or survey results that could be added to the National Wildlife Health Information System. Negative data are also valuable. If you can help, please contact us at admin@wildlifehealthaustralia.com.au.

Acknowledgements

We are grateful to the people who contributed to this Fact Sheet.

Wildlife Health Australia recognises the Traditional Custodians of Country throughout Australia. We respectfully acknowledge Aboriginal and Torres Strait Islander peoples' continuing connection to land, sea, wildlife and community. We pay our respects to them and their cultures, and to their Elders past and present.

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See also:

CDC www.cdc.gov/tularemia

CFSPH Factsheet: www.cfsph.iastate.edu/Factsheets/pdfs/tularemia.pdf and PowerPoint presentation: www.cfsph.iastate.edu/DiseaseInfo/ppt/Tularemia.ppt

To provide feedback on Fact Sheets

Wildlife Health Australia welcomes your feedback on Fact Sheets. Please email admin@wildlifehealthaustralia.com.au. We would also like to hear from you if you have a particular area of expertise and are interested in creating or updating a WHA Fact Sheet. A small amount of funding is available to facilitate this.

Disclaimer

Fact Sheet. Persons should accordingly make and rely on their own assessments and enquiries to verify the accuracy of the information provided.

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