Q-Fever: guidance for preparing planning approvals

EPA VICTORIA | Environment Protection Authority Victoria

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This publication provides information and guidance for planners assessing, and proponents seeking approval for developments, where public health risks of Q-Fever must be considered.

What is Q-Fever?

Q-Fever is a zoonotic disease (spread from animals to humans) caused by the bacterial organism *Coxiella burnetii*. Ruminant livestock (e.g. cattle, sheep, goats, alpaca/llama, deer) are the main reservoirs for infection in humans. *C. burnetti* has also been identified in a range of domestic and wild animals including Australian native wildlife, rodents, wild dogs, foxes and camels. Q-Fever is largely asymptomatic in livestock, although an increase in abortions may occur over several years. There is no widely available animal vaccine for managing or controlling Q-Fever in livestock. Q-Fever bacteria are extremely hardy, as they can form spore-like particles (SLPs) that can survive for long periods in soil and other materials. Q-Fever bacteria are very infective as the probabilities of a single viable *C. burnetii* causing infection and illness in humans are 44 per cent and 12 per cent respectively.

Coxiella burnetii

The size of *Coxiella burnetii* varies (0.2–1.0 μm) as it occurs as small or large cells depending on the stage of its developmental cycle and as SLPs (Gürtler et al 2014).

C. burnetii is extremely infectious, with1–10 viable organisms enough to cause infection in humans by inhalation (Brooke et al 2013). *Coxiella burnetii* SLPs can remain infectious for more than 40 months even under unfavourable external conditions (Gürtler et al 2014). *C. burnetii* is an obligate parasite; this means that it needs a host to replicate.

At least 50 per cent of infected humans are asymptomatic. After an incubation period (3–30 days), unspecific symptoms such as fever, sweating, nausea, headaches, vomiting and diarrhea can occur, with extreme fatigue seen in 5–20 per cent of cases. Pneumonia occurs in 1–2 per cent of acutely affected patients. Around 5–15 per cent of acute cases become chronic (Gürtler et al. 2014).

C. burnetii can be excreted in the faeces, urine and milk. High amounts can be found in birthing products such as the placenta and the newborn animal (Rousset et al 2009).

Inhalation of contaminated aerosol or dust is the main human exposure pathway (Eastwood et al 2018). Other pathways include:

- direct contact, such as human to human, animal to human and tick faeces to humans; tick faeces can be highly infectious, with one gram of tick faeces containing around 10^9 *C. burnetii* bacteria
- direct and indirect contact, with contaminated tissue, such as sheep placenta, or goat manure (Delsing et al 2010); in placental tissue of infected animals, concentrations of up to 10^9 bacteria per gram of tissue can be reached (Honarmand 2012)
- exposure to contaminated straw, enclosures, or dust (van Woerden et al 2004)
- contact with contaminated work clothes (CDC 2013).

How is Q-Fever managed in Victoria?

Government agencies, businesses, landholders and farm owners have a shared responsibility in protecting both their staff and the public from Q-Fever. For businesses and individuals, this responsibility includes addressing Q-Fever as part of their general environmental duty (GED) to minimise risks of harm to human health and the environment from their activities. The GED is the key compliance obligation under the *Environment Protection Amendment Act 2018* which is intended to come into effect on 1 July 2021.

Q-Fever in humans is also a notifiable condition in Victoria. On notification of a case, the Department of Health and Human Services (DHHS) will interview the testing medical practitioner and the case to determine the source of the illness. If the case is a worker who has been exposed, Worksafe Victoria is notified. If a case is infected due to an animal exposure related to a farm, Agriculture Victoria may be informed, particularly if more than one case is linked to a common agricultural source. If the source cannot be identified, or for outbreaks of disease, EPA's Environmental Public Health Unit will be asked to provide support and advice on pollution and waste-related impacts on human health.

Victoria's approach to managing Q-Fever follows a One Health model which promotes a cross-sector collaboration among multiple stakeholders as described below (Rahaman et al 2019).

Relevant roles and responsibilities

Person/Organisation	Roles/Responsibilities
Site operator/manager	• Implement best practice to ensure staff and public health are protected from Q-Fever. • Prevent emissions from activities that may adversely affect public health. • Abide by works approval, licence and/or planning permit conditions. • Have a Q-Fever management plan in place.
WorkSafe Victoria	• Ensure occupational health and safety risks of Q-Fever to workers and site visitors are properly managed. This may include risk control measures for employees, contractors and visitors to a site (e.g. pre-screening and vaccination). • Advise employers about preventing Q-Fever transmission in the workplace. • Respond to occupational Q-Fever incidents (e.g. if an employee who contracts Q-Fever requires hospitalisation). • Regulate licenced premises.
Environment Protection Authority Victoria (EPA)	• Advise on the Q-Fever risk from pollution and waste. • Assess and approve works approval applications for livestock facilities involving > 5,000 animals. • Grant licences for abattoirs, food processing plants and composting facilities, with necessary conditions. • Act in its capacity as a referral authority in accordance with Clause 52 & 55 of the *Planning and Environment Act 1987.* • Support and comment on Environmental Effects Statements where Q-Fever health risks must be considered. • Investigate waste and pollution impacts from agricultural activities.
Councils (local government)	• Siting of feedlots. • Assess planning applications for developments where there is a Q-Fever risk. • Investigate nuisances from agricultural activities. • Enforcement of ongoing EPA works approval conditions where there is no EPA licence requirement. This enforcement is transferred to the planning permit after approved works have been completed to EPA's satisfaction.
Department of Health and Human Services (DHHS)	• Lead the investigation and response to notified Victorian human cases and outbreaks of Q-Fever. • Manage the surveillance and epidemiology of human Q-Fever cases in Victoria. • Contribute to managing public health risks from Q-Fever cases, outbreaks and their consequences in Victoria. • Review EPA-referred assessments of significant works approval applications with recommendations to EPA on the public health risks of the application.
Agriculture Victoria/Office of the Chief Veterinary Officer	• Advise on intensive animal industry practices which may also minimise human health risks of Q-Fever. This includes deciding whether a proposed intensive animal industry can operate safely from a biosecurity perspective. • Review/comment on a biosecurity management plan for a given proposal.

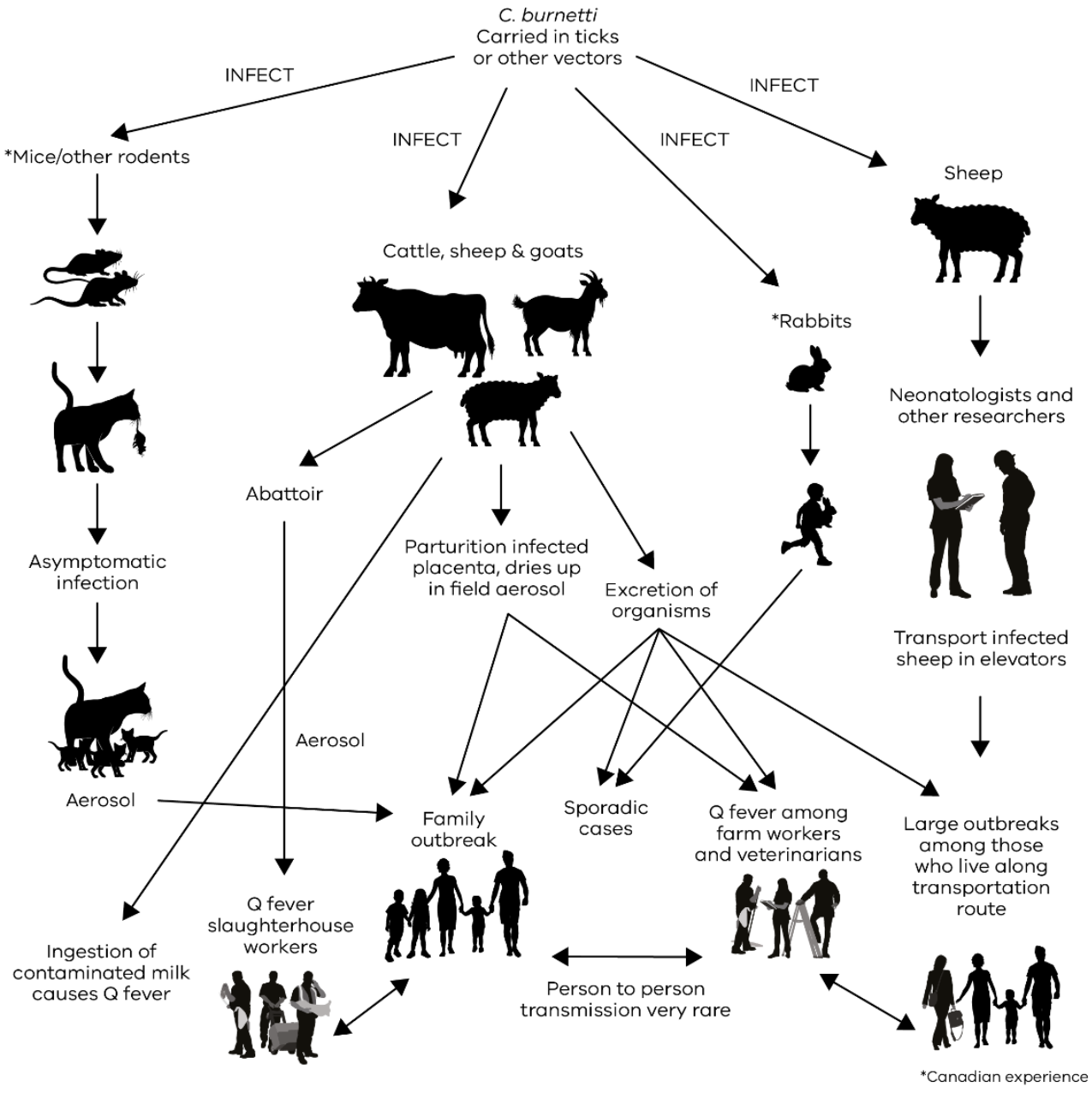
Questions and answers about Q-Fever

Question	Answer
Where is it found?	Q-Fever is caused by *Coxiella burnetti* bacteria and has been identified in a range of animal species. It is most common in cattle, sheep and goats. The bacteria are most prevalent in animal products including birthing tissues such as placenta, blood, urine, faeces, bedding and soils contaminated by these wastes. *Coxiella burnetii* can survive in the environment for long periods in materials such as wool (up to 9 months) and fresh meat (> 1 month). *Coxiella burnetii* spore-like-particles can also remain stable in soil.
Incubation period	In humans, the incubation period (the time between exposure to the bacteria and symptoms starting) is highly variable, but typically 3–30 days.
How can I be exposed?	• High risk workplaces, such as abattoirs, knackeries, tanneries, dairy/animal farms, saleyards or other dust-prone areas where soil may have been contaminated by infected animals. • Animal products and wastes; contact with contaminated straw, wool or hides; contact with contaminated clothing of workers, including secondary contact outside the workplace (e.g. someone washing a high-risk worker's clothing). • Windborne exposure to contaminated waste / dust / dirt due to poor waste management practices (e.g. inadequately composted infective waste such as animal carcasses; straw and birthing materials in composted soil which is subsequently spread across fields to improve crop yield). Farmland close to residential communities are considered high-risk sources. • People may become infected by contamination of skin abrasions or splashes in the eyes, but most commonly by inhaling organisms in contaminated aerosols (e.g. fine mists, droplets or dust from soil or straw) from high risk tissues (e.g. placenta, birth fluids, urine). • Inhaling contaminated dust, when climate and environmental conditions are conducive; this dust may be carried downwind for a considerable distance from the source. Potential public transmission pathways for dust or aerosols will depend on the site activities and proximity to sensitive land uses (e.g. nursing homes, kindergartens, schools, hospitals). Some studies suggest *Coxiella burnetti* may spread up to 5 km from an infected source in rural areas, compared to 2 km in urban areas. This is likely to change depending on other variables such as wind speed and topography.
What are the health effects and symptoms	At least 50 per cent of human Q-Fever infections are asymptomatic (show no symptoms). For those who do experience symptoms, the onset of Q-Fever infection is often acute, characterised by an influenza-like illness including fever, chills, sweats, progressing to a severe headache (often behind the eyes), weakness, loss of appetite, muscle aches and cough. Pneumonia can occur. Acute infectious that have not been appropriately treated (including asymptomatic infections) can result in a Q-Fever chronic fatigue-like syndrome years or even decades later. Severe infections can also lead to more serious issues such as liver failure and heart valve infections.
Vaccination	A vaccine is available for humans but is only licensed for adults aged 16 years and over. There is no known widespread animal vaccine available in Australia.
Prevalence	Q-Fever is endemic in rural Australia, particularly in northern Australia. It is estimated that up to 7 per cent of Victoria's livestock carries Q-Fever bacteria, *Coxiella burnetii.* DHHS reported a human Q-Fever notification rate of 0.5 cases per 100,000 population in 2018, with an average of 40 cases per year reported between 2015 and 2019.
At risk groups	High-risk occupations: Abattoir and meat processing workers, dairy farmers, veterinarians, those working with livestock, sheep shearers, knackery and tannery workers, animal shooters, and others exposed to animals giving birth. It is recommended that staff in these occupations be vaccinated against Q-Fever. Risks to the public are higher when the following factors increase: • Size of facility and number of animals involved. • Birthing activity at a site such as intensive dairy farming. • Type of livestock; goats and sheep may be a higher risk than cattle (Clark & Soares Magalhães 2018). • Proximity to sensitive land uses and unvaccinated individuals. • Wind speed and direction. • Local topography, rainfall, vegetation cover which may contribute to the overall "dustiness" of an area.

Prevention

Complexities of Q-Fever prevention

Potential transmission routes outlined in the diagrams below show the potential complexities of Q-Fever exposure/transfer, whether by zoonotic (animal to human), animal to animal, or consumption of infected milk. Each transmission or combination of likely transmissions present further investigations to identify and prevent exposures, to protect human health.



Possible transmission routes of Q-Fever (adapted from Marmion 1999).

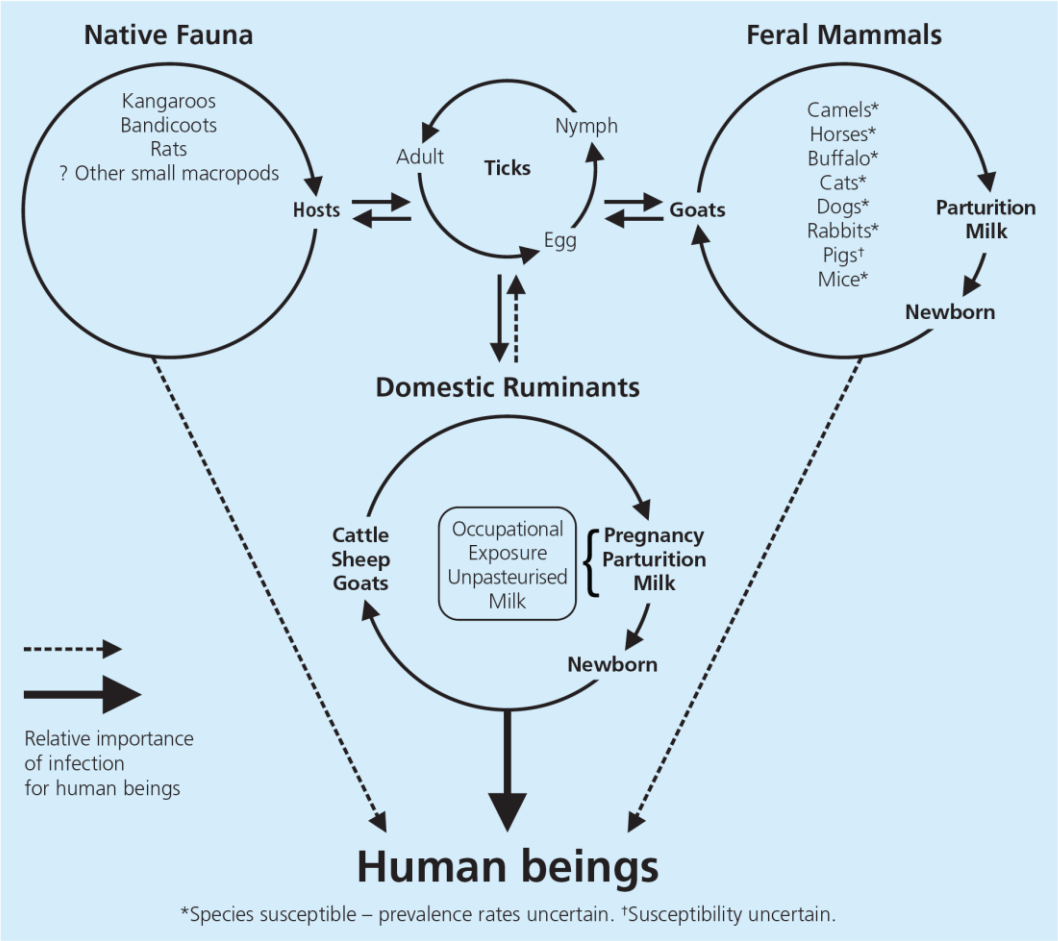


Figure courtesy of Prof Barrie Marmion – personal communication.

(CSL Biotherapies 2009)

Various prevention and risk control measures can reduce offsite human health impacts of Q-Fever, including:

- adequate onsite biosecurity management such as the safe disposal of placentas
- quarantine of infected animals and appropriate disposal of their waste
- prevention of dust formation and aerosolisation,
- adequate composting of waste.

Following the guidelines *Designing, constructing and operating composting facilities (2017)* (publication 1588.1) and Australian Standard 4454 *Composts, soil conditioners and mulches (Standards Australia 2012)* may destroy *Coxiella burnetii* in infected wastes.

Other measures which may prevent or minimise the risks from Q-Fever transmission include:

- vaccination of staff/visitors at high risk facilities
- limiting non-immune / susceptible persons' access to high-risk facilities
- vaccination of members of public likely to be affected, if > 15 years of age
- vegetation barriers
- wastewater management
- additional biosecurity measures, such as truck/vehicle wash, handwash facilities, sanitation and security controls onsite
- planning measures such as the application of separation distances between high-risk facilities and nearby/susceptible communities.

Planning referrals

EPA should consider the risk of Q-Fever when assessing an application involving animals. This may include intensive animal production, a sale yard, or a site to be used as a short-term holding facility for animals, such as an abattoir.

Referrals to EPA may be in the context of a statutory requirement, such as under Section 55 of the *Planning and Environment Act 1987* for an intensive animal production or holding system. The following applications meet the threshold for such referrals for consideration of a works approval in accordance with the Environment Protection (Scheduled Premises) Regulations 2017:

- B01 – Animal industries; if > 5000 animals, these need a works approval, but typically no licence.
- B02 – Livestock saleyards or holding pens; these may need a works approval but typically no licence.
- D01 – Abattoirs; these may need a works approval and may require a licence in certain circumstances.

Referrals may also be made to EPA outside of statutory requirements. For example, under Section 52 of the *Planning and Environment Act 1987,* applications which do not meet the threshold for an EPA works approval can be referred if the responsible authority seeks EPA's views.

Since the integration of an environmental public health unit at EPA in late 2016, works approval applications are not typically referred to DHHS, unless they are significant. As per section 19B(9) of the *Environment Protection Act 1970*, a significant works approval application is a works approval application that:

- poses public health risks that cannot be adequately assessed and mitigated using the current Victorian policy framework and suite of relevant guidance as documented in the EPA publication 1658 (as updated), and
- the Chief Environmental Scientist, in consultation with the Chief Health Officer, believes that EPA is unable to assess the public health risks and mitigation measures.

Any authority assessing an application for an intensive animal production or holding system must consider the following:

- amount and nature of livestock to be at a site for a given time
- activities to occur (e.g. births at a dairy farm)
- proximity to sensitive receptors (e.g. residential homes, schools, hospitals)
- management regime and controls in place to prevent harm to human health and the environment, in line with the duty holder's general environmental duty
- typical wind speeds and directions and the likely amount of dust created by the site and released beyond its boundaries.

Siting, design and operational management of proposed developments will help minimise offsite emissions and human health risks from exposure to Q-Fever-causing bacteria. Assessments should focus on appropriate management of animal wastes, as well as a contingency plan for worst-case scenarios and unforeseen events, such as storms.

An EPA referral response addressing Q-Fever risks may ask the proponent to manage offsite amenity and health impacts (primarily dust) and provide an Environment Management Plan to specifically address waste management and biosecurity issues.

How EPA assesses works approval and licence applications

Works approval applications for developments or proposed activities where Q-Fever is a risk should include site-specific holistic measures to manage and prevent adverse human health effects from Q-Fever. Such measures will depend on the nature of operations proposed, with risks of offsite exposures to Q-Fever bacteria increasing for outdoor activities. For example, goat and sheep farms, especially where many births are likely to occur, are more likely to have offsite emissions compared to indoor activities such as knackeries.

Works approval and licence applications should include a Q-Fever risk management plan which must have the following:

- Details of type(s) of activities/processes/animals involved and expected numbers at a given time at the proposed site.
- Separation distance of the proposed site to the nearest sensitive receptor(s), waterway(s) and water supply catchments.

- An explanation of how offsite emissions will be managed to prevent potential exposure to Q-Fever bacteria, including the use of mitigation measures and controls. This explanation should also consider influencing factors such as typical wind speeds in the area.
- A robust onsite biosecurity management plan.

Even in lower risk scenarios such as an abattoir or knackery, a site-specific Q-Fever risk management plan should always be included in any relevant development application, to account for other influences that could facilitate Q-Fever outbreaks, such as wind direction and speed.

EPA Transformation and new legislation

The *Environment Protection Amendment Act 2018* is intended to take effect on 1 July 2021. This Act will introduce a three-tiered permissioning scheme where a works approval will become a development licence and, a licence becomes an operating licence. This guidance will be updated to reflect the new legislation in 2021.

Separation distance

When a separation distance to a sensitive receptor is likely to be inadequate, a human health risk assessment may be required to show there will be no adverse effects to public health. This assessment may include identifying potential bacteria sources, and outlining control measures and management practices to minimise/eliminate exposure/transmission.

The guideline

EPA's *Recommended separation distances for industrial residual air emissions – guideline* (1518, 2013; 'EPA 1518') recommends minimum separation distances between industrial and sensitive land uses. These distances are based on amenity impacts such as offsite residual odour and dust emissions. When this guideline was published in 2013, it did not specifically consider Q-Fever risk. However, contaminated dust can be a vehicle for migration of Q-Fever bacteria, *Coxiella burnetti.*

EPA 1518 recommends a 500 m separation distance for a stock saleyard (> 500 animals) and 5 km for a dairy feedlot should apply. EPA 1518 does not recommend a separation distance for other livestock industries. Such industries need to be assessed on a case by case basis, considering risk factors including extent of birthing activity, type and amount of livestock at the site at a given time, proximity to waterways and sensitive receptors, wind speed and direction, local topography, rainfall, and vegetative cover.

Section 9 of EPA 1518 allows the proponent to seek a variation from a recommended separation distance. Here, they must show that this variation is appropriate, using supporting evidence which is based on both:

- a site-specific environmental risk assessment
- use of air dispersion modelling protocols, as set out in the State Environmental Protection Policy (Air Quality Management).

Case studies

These case studies demonstrate the importance of using separation distances with a mix of other management approaches to reduce the risk of Q-Fever outbreaks.

- Outbreak in a town (population size approximately 88,000) in the Netherlands (Ladbury et al 2015). A goat farm with increasing levels of abortions in the animal herd was considered the most likely source of 347 human cases. The study found that those living within 1 km of the farm were at a higher risk of being infected than those living 5–10 km away. This was due to airborne transmission from the farm. A similar outbreak a year earlier showed that people living within 2 km of the infected goat farm were reported to be at the highest risk of contracting Q-Fever due to wind-borne dispersal, with minimal risk beyond 5 km (Schimmer et al 2010).
- A West Midlands UK study found *Coxiella burnetii* travelled up to 18 km due to gale force winds (Hawker et al 1998).
- A Q-Fever outbreak at a sheep saleyard in South Australia (O'Connor et al 2015) was due to windy conditions during the outbreak which was conducive to airborne dispersal of contaminated dust. 22 reported cases from a total of 25 were from people who had attended the saleyard on the same day. Findings suggested a point-source exposure due to infected sheep entering the saleyard on, or just prior to the sale day. The infected sheep contaminated dust in the saleyard, which then spread across the saleyard in windy conditions.

- In 2012–2014, a Victorian Q-Fever outbreak was linked to an intensive goat and sheep dairy farm (Bond et al 2016). The number of human infections involved were mostly occupational (17 employees and one family member confirmed with Q-Fever over a 28-month period) presumably due to a low population density surrounding the farm, with the closest town, of less than 1000 residents, being more than10 km away. Employees mostly occupied farmhouses closest to the farm. The incidence of human cases was reduced over time by human vaccinations and environmental biosecurity measures. Infection remained endemic in the goat herd and a challenge to manage without source control.
- In 2007-2012, large outbreaks in The Netherlands were attributed to infected intensive goat farms located in the same areas that human cases were confirmed (Vellema & van den Brom 2014).

These case studies are examples of high-risk scenarios, with people living close to the source of Q-Fever bacteria. A higher risk zone is apparent within 2,000 metres of some intensive animal activities, such as dairy ruminant farming (goats and sheep) with a lower risk zone apparent within 5,000 metres of such activities.

Wind speed and dust

- Wind has been implicated as a factor in the spread of Q-Fever in studies from animal-related sources (Clark & Soares Magalhães 2018). A dispersion model developed by researchers in the Netherlands showed that wind speeds exceeding threshold values of 2 m/s near goat dairy farms were associated with outbreaks (van Leuken et al 2015).
- Airborne *C. burnetii* transmitted by manure spreading has also been implicated as a risk factor for human outbreaks (Hermans et al 2014).

Onsite biosecurity management

A typical biosecurity management plan for the abatement of offsite Q-Fever risks should include, but not be limited to:

- An emergency animal disease response.
- A solid and liquid waste management policy including a maintenance and cleaning protocol when handling livestock.
- Dust control measures and management including regular perimeter and onsite monitoring of dust/air, aerosols/particles, products and milk.
- Restricted site access to the public.
- A worker and visitor Q-Fever vaccination program and an associated Occupational Health and Safety policy which records the vaccination status of all employees and requires review of visitor vaccination status/records.
- Procedures outlining acceptance of only healthy animals (when possible to identify), with pregnant or recently birthed/aborted stock not to be accepted by saleyards.
- Segregation of infected animals, with bio-exclusion management practices to also ensure indoor birthing and safe disposal of birthing material, manure and animal bedding, to contain the release of Q-Fever.
- Optimum hygiene practices including onsite laundering of workers' clothing/boots/uniforms.
- Minimisation of windborne dispersal of animal wastes and contaminated soils from the site, by planting vegetation around the perimeter of the property.

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