Q fever notifications in Queensland, 2016

Communicable Diseases Branch

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Contents

Summary

Over the last three decades (1987–2016), a total of 6,888 confirmed Q fever cases were notified in Queensland.

The first peak of notification occurred in 1993 (405 cases, 13.0/100,000/year). A second peak of notification occurred in 2001 (442 cases, 12.2/100,000/year), followed by a substantial decline in notifications reaching a nadir in 2009 (131 cases, 3.0/100,000/year). Since 2009, there has been a gradual increase in notification rates, reaching 5.3/100,000/year in 2015 (251 cases) and 4.8/100,000/year in 2016 (231 cases).

Between 2012 and 2016, the notification rate was three times higher in males (7.3/100,000/year) than in females (2.5/100,000/year). Notification rates varied substantially across Queensland, with the highest rates in the South West (98.6/100,000/year) and Central West (71.4/100,000/year) areas, and the lowest rates in the North West (0.0/100,000/year) and the Metro North areas (1.0/100,000/year).

Over the period 2012–2016, around one-third of notified Q fever cases reported being in Q fever at-risk occupations (including farmers, graziers, and abattoir workers). Over half of Q fever cases were hospitalised.

Of 1,041 cases with enhanced surveillance data (2012–2016):

- 61% (634 cases) reported any exposure to animals, animal products, or animal waste, with the most common activities being working with animal manure/fertiliser (31%), and assisting/observing an animal birth (20%);
- 90% (926 cases) reported any exposure to a risk environment, with the most common activities being exposed to dust from paddocks/animal yards (66%), and living/working within 300 metres of a bush/scrub/forest area (64%);
- 7% (77 cases) reported no exposure to risk factors included in data collection;
- The most common reservoirs of Q fever infecting agent in Queensland appear to be cattle and kangaroos.

Introduction

Q (for query) fever was first described in 1937 by Dr Edward Derrick in Queensland.[1] The disease is caused by the bacterium *Coxiella burnetii*, which was first identified around the same time by both Cox[2] in the US and Burnet[3] in Australia. The organism is commonly carried by cattle, sheep, and goats,[4] but is also found in companion animals (e.g. domestic dogs and cats)[5,6], and native and feral wildlife.[7]

Humans are usually infected *C. burnetii* by inhalation of droplets/dust contaminated by birth fluids, faeces, or urine from infected animals.[8] Person-to-person transmission of infection is rare.[4] Q fever can be treated effectively with antibiotics once the diagnosis is made.

Eighty years since the first reporting of the disease, nearly half of notified Q fever cases in Australia still occur in Queensland.

This report has two aims:

- To explore the trends in Q fever notifications over the last three decades (1987–2016);
- To understand demographic characteristics and potential sources of infection among notified Q fever cases in recent years (2012–2016).

Notification data

Standardised Q fever notification data were collected in Queensland between 1 January 1987 and 31 December 2016. Q fever notification rates were calculated per 100,000 population by year, age, sex, Indigenous status, and geographic location. Enhanced surveillance data were collected to provide additional information, including occupations, awareness of Q fever vaccine, hospitalisation, and potential sources of infection (in terms of exposures to animals/animal products/animal waste; exposures to a risk environment). We reported the enhanced surveillance data over the period 2012-2016 for which around 90% of notified Q fever cases were followed up with such data.

Q fever case definition

A confirmed Q fever case was based on the following national case definition:

Confirmed Q fever case

A confirmed case requires either:

1. Laboratory definitive evidence

OR

2. Laboratory suggestive evidence AND clinical evidence.

Laboratory definitive evidence

1. Detection of *Coxiella burnetii* by nucleic acid testing

OR

2. Seroconversion or significant increase in antibody level to Phase II antigen in paired sera tested in parallel in absence of recent Q fever vaccination

OR

3. Detection of *C. burnetii* by culture (note this practice should be strongly discouraged except where appropriate facilities and training exist.)

Laboratory suggestive evidence

Detection of specific IgM in the absence of recent Q fever vaccination.

Clinical evidence

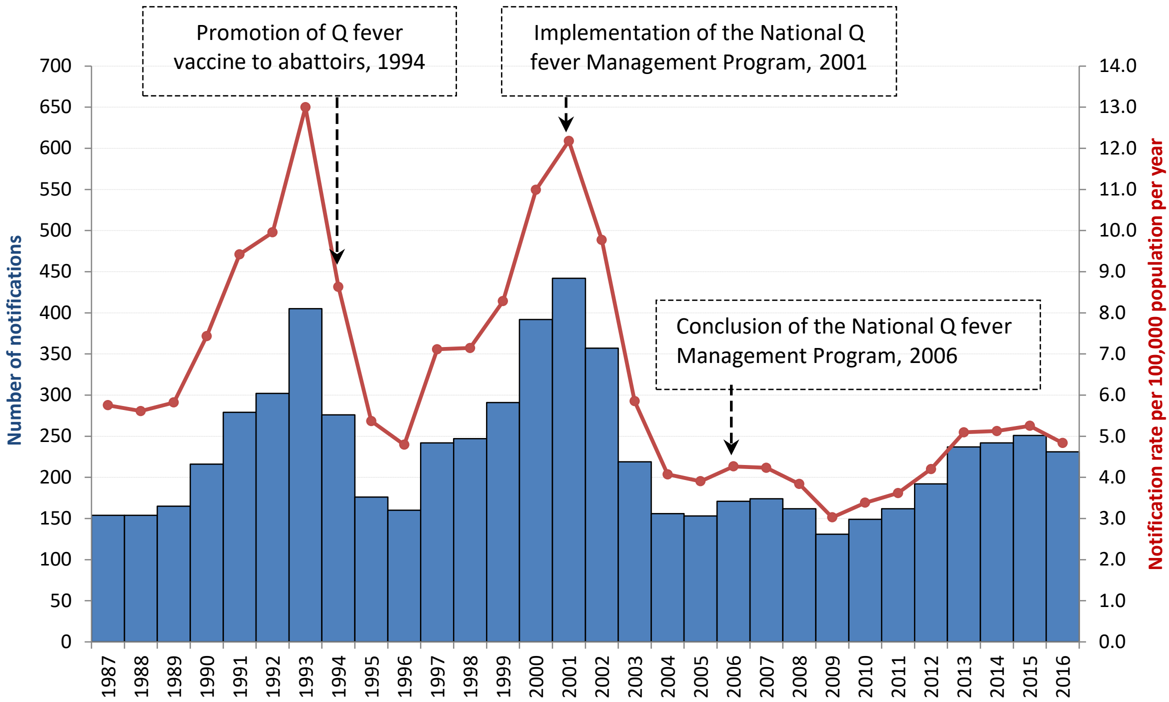
A clinically compatible disease.

Results

Trends in Q fever notifications in Queensland, 1987–2016

Over the period 1987–2016 (Figure 1), a total of 6,888 confirmed Q fever cases were notified in Queensland. During this period, the highest number of Q fever notifications in Queensland was reported in 2001 (442 cases) and the lowest number in 2009 (131 cases). The first peak in the notification rate (13.0/100,000/year) occurred in 1993, one year prior to the promotion of Q fever vaccine in abattoirs by the vaccine manufacturer (CSL)[9]. A second peak in the notification rate (12.2/100,000/year) occurred in 2001. This was followed by a substantial decline in notification rates, reaching a nadir in 2009 (3.0/100,000/year). This occurred in the context of implementation of the National Q Fever Management Program (NQFMP) during 2001–2006. Since 2009, there has been a gradual increase in notification rates, reaching 5.3/100,000/year (251 cases) in 2015 and 4.8/100,000/year (231 cases) in 2016.

Figure 1: Notifications of Q fever in Queensland, 1987–2016



Q fever notifications by age, sex, and Indigenous status, Queensland, 2012–2016

Of 1,153 Q fever cases notified during 2012–2016, 860 (75%) were male (Table 1). The notification rate in males was almost three times higher than that in females (7.3 vs 2.5/100,000/year). People aged 45–59 years had a higher notification rate compared with other age groups (Table 1).

Table 1: Notifications of Q fever by age and sex, 2012–2016, Queensland

Age group (Years)	Male		Female	
	Number	Notification rate* (95% CI)	Number	Notification rate* (95% CI)
00–14	26	1.1 (0.7-1.6)	16	0.7 (0.4-1.2)
15–29	154	6.2 (5.3-7.2)	34	1.4 (1.0-2.0)
30–44	214	8.9 (7.7-10.1)	61	2.5 (1.9-3.2)
45–59	266	11.9 (10.5-13.4)	112	4.9 (4.0-5.9)
60–74	167	10.6 (9.0-12.3)	60	3.8 (2.9-4.9)
75+	33	5.6 (3.8-7.8)	10	1.3 (0.6-2.4)
Total	**860**	**7.3 (6.9-7.9)**	**293**	**2.5 (2.2-2.8)**

* Per 100,000 population per year.

Indigenous status was reported for 949 (82%) Q fever cases (49 Indigenous, 900 non-Indigenous). The average annual notification rate in Indigenous people was 4.8/100,000/year (95% CI: 3.6-6.4), comparable with the rate in non-Indigenous people (4.0/100,000/year, 95% CI: 3.8-4.3).

Q fever notifications by geographic area, Queensland, 2012–2016

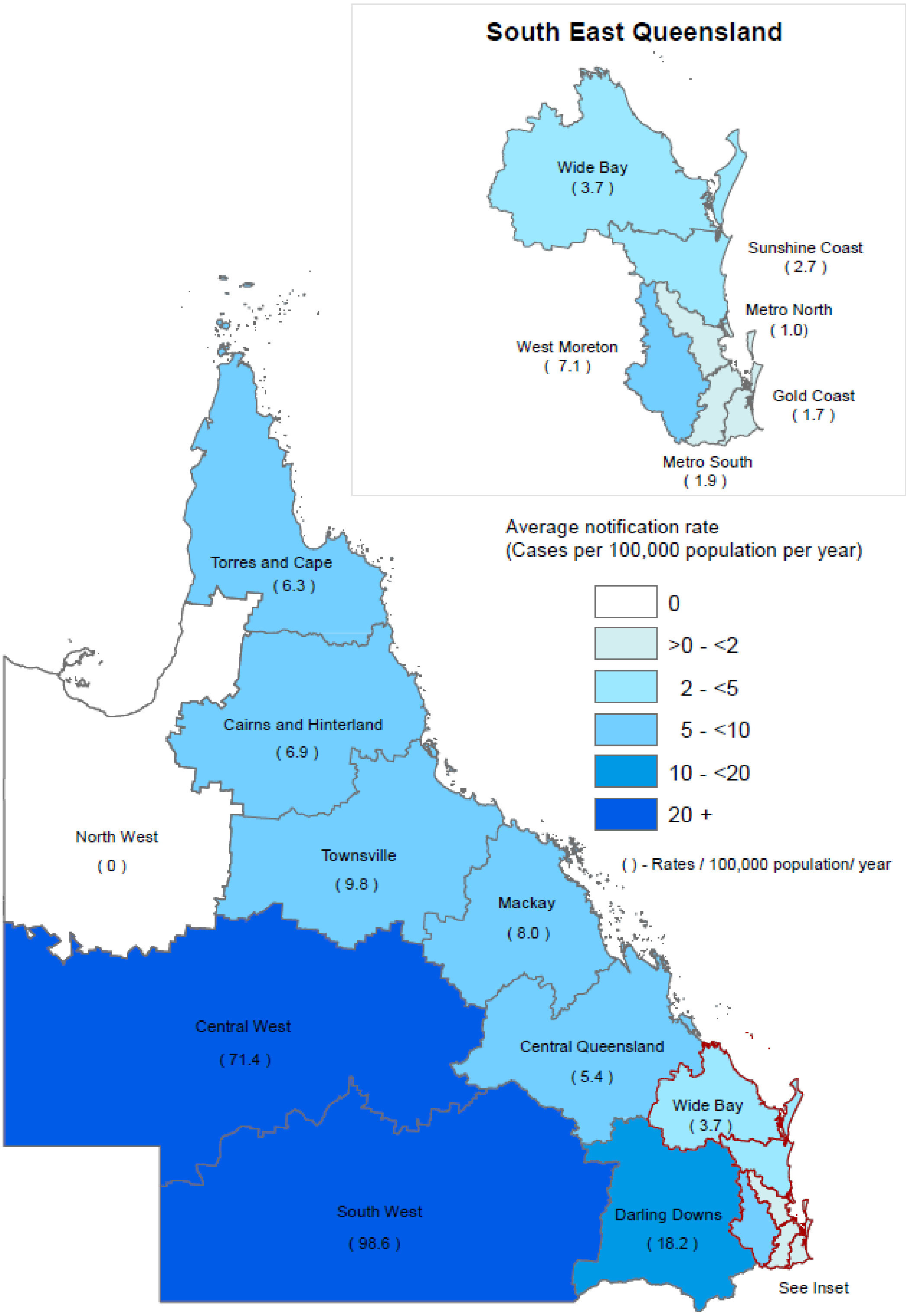
Over the period 2012–2016, the largest number of Q fever notifications were from the Darling Downs HHS area (251 cases, 22% of the total cases), followed by the South West HHS area (131 cases, 11%), and the Townsville HHS area (117, 10%) (Table 2). Notification rates varied substantially across HHS areas (Figure 2), with the highest rates from the South West HHS area (98.6/100,000/year) and the Central West HHS area (71.4/100,000/ year), and the lowest rates from the North West HHS area (0.0/100,000/year) and the Metro North HHS area (1.0/100,000/year).

Table 2: Notifications of Q fever by Hospital and Health Service (HHS) of residence, 2012–2016, Queensland

HHS of residence	No. of notifications	Notification rate* (95% CI)
Torres and Cape	8	6.3 (2.7-12.3)
Cairns and Hinterland	85	6.9 (5.5-8.5)
North West	0	0.0
Townsville	117	9.8 (8.1-11.7)
Mackay	72	8.0 (6.2-10.0)
Central West	44	71.4 (51.9-95.9)
Central Queensland	61	5.4 (4.2-7.0)
Wide Bay	39	3.7 (2.6-5.1)
South West	131	98.6 (82.4-117.0)
Darling Downs	251	18.2 (16.0-20.6)
Sunshine Coast	52	2.7 (2.0-3.6)
Metro North	49	1.0 (0.8-1.4)
Metro South	103	1.9 (1.6-2.3)
West Moreton	93	7.1 (5.7-8.7)
Gold Coast	48	1.7 (1.3-2.3)
Queensland	**1,153**	**4.9** (4.6-5.2)

* Per 100,000 population per year

Figure 2: Average annual notification rates of Q fever by Hospital and Health Service of residence in Queensland, 2012–2016



Occupations and awareness of Q fever risk and vaccine in notified Q fever cases, 2012–2016

Of 1,153 Q fever cases notified over the period 2012–2016, 1,041 (90%) had been followed up to collect enhanced surveillance data.

Of these 1,041 cases, 802 (77%) had data on occupations, of which 293 (37%) reported being in Q fever at-risk occupations (Table 3). The most common at-risk occupations included livestock/dairy farmer/worker(66 cases), farmer/farm worker(unspecified, 63 cases), grazier (40 cases), and abattoir/meatworks worker (33 cases).

Table 3: Notified Q fever cases in at-risk occupations, 2012–2016

Occupation	Number	Percent
Occupation with direct contact of animals, animal products, or animal waste		
Livestock/dairy farmer/worker	66	22.5%
Grazier	40	13.7%
Abattoir/meatworks worker	33	11.3%
Sheep shearer/wool handler	8	2.7%
Veterinary personnel	6	2.0%
Driver of trucks transporting livestock/meat	6	2.0%
Butcher	5	1.7%
Kangaroo shooter	5	1.7%
Animal breeder	3	1.0%
Others*	14	4.8%
Occupation with exposure to a risk environment		0.0%
Farmer/farm worker (unspecified)	63	21.5%
Gardener/landscaper	11	3.8%
Agriculture farmer/worker	10	3.4%
Lawn mower	7	2.4%
Earth mover	5	1.7%
Others#	11	3.8%
Total	**293**	**100.0%**

* Other reported occupations included animal trainer, farrier, worker of animal rescue centre, tradesperson of animals, contractor of livestock farm, worker of pet food processing, worker of tannery, and wildlife carer.
# Other reported occupations included ranger of park/forest, driller, contractor of farm, arborist, geophysical surveyor, and environmental scientist.

Of these 1,041 Q fever cases, 227 (21.8%) thought that they were at risk of Q fever, and 418 (40.2%) were aware of Q fever vaccine.

For those 293 cases in Q fever at-risk occupations, 113 (38.6%) thought they may have been at risk of Q fever and 162 (55.3%) were aware of Q fever vaccine.

Exposures to risk factors in notified Q fever cases, 2012–2016

Of 1,041 cases with enhanced surveillance data, 964 (92.6%) reported any exposure to risk factors listed in Table 4; the remaining 77 (7.4%) cases reported no exposure to risk factors included in data collection.

Regarding the two categories of risk factors, 634 (60.9%) cases reported any exposure to animals, animal products, or animal waste, with the most common activities being working with animal manure/fertiliser (31.1%) and assisting/observing an animal birth (19.8%); 926 (90.0%) cases reported any exposure to a risk environment, with the most common activities being exposure to dust from paddocks/animal yards (65.7%) and living/working within 300 metres of a bush/scrub/forest area (63.8%).

Cases reporting exposures to both categories of risk factors accounted for 57.3% (596/1,041) of all cases; 3.7% (38/1,041) reported exposures to animals/animal products/animal waste only; and 31.7% (330/1,041) reported exposures to a risk environment only.

Table 4: Exposures to risk factors in notified Q fever cases in Queensland, 2012–2016

Exposure to risk factors*	Number	Percent
Any exposure to animals/animal products/animal waste	**634**	**60.9%**
Worked with animal manure/fertiliser	324	31.1%
Assisted or observed an animal birth	206	19.8%
Worked with straw or animal bedding	201	19.3%
Involvement in shooting/hunting	155 (77#)	14.9%
Involvement in slaughtering, skinning, or meat processing	154 (44#)	14.8%
Attended a saleyard or animal show	128	12.3%
Worked with wool/shearing/wool processing	83	8.0%
Worked at an abattoir	68	6.5%
Consumed unpasteurised milk or milk products	55	5.3%
Visitor to an abattoir	23	2.2%
Contractor to an abattoir	9	0.9%
Any exposure to a risk environment	**926**	**90.0%**
Exposure to dust from paddocks or animal yards	684	65.7%
Lived/worked within 300 metres of a bush/scrub/forest area	664	63.8%
Lived/worked within 1 km of an abattoir/animal grazing area/saleyards	590	56.7%
Exposure to trucks for transporting sheep, cattle or goats	505	48.5%
Lived on a farm	465	44.7%
Visited a farm	320	30.7%
Laundered clothes from someone who works with animals	254	24.4%
Any exposure to risk factors	**964**	**92.6%**
Total number of cases with data on exposure to risk factors	**1,041**	

* Multiple exposures could be reported by individual Q fever cases.
# Number of cases reporting relevant risk exposures where kangaroos were involved.

Contact with different types of animals and ticks is shown in Table 5. The most common animals involved were dogs (61.9%), cattle (53.2%), and kangaroos (38.7%).

Table 5: Q fever cases (N=1,041) reporting contact with livestock, companion animals, feral animals, wild animals, and ticks

Animal	Number	Per cent*
Dogs	644	61.9%
Cattle	554	53.2%
Kangaroos	403	38.7%
Cats	315	30.3%
Sheep	194	18.6%
Ticks	180	17.3%
Small marsupials (e.g. bandicoots)	171	16.4%
Feral pigs	158	15.2%
Domestic goats	109	10.5%
Domestic pigs	75	7.2%
Feral goats	71	6.8%

* The sum of percentages was over 100% as individual Q fever cases could report contact with multiple animals/ticks.

Of the 206 cases reporting assisting/observing an animal birth (Table 4), the most common animals involved were cattle (140, 68.0%), followed by goats/sheep (27, 13.1%), dogs (11, 5.3%), cats (7, 3.4%), horses (2, 1.0%), a wallaby (1, 0.5%), and a pig (1, 0.5%).

Hospitalisations

Of 1,041 Q fever cases, 569 (54.7%) reported being hospitalised; 494 of those hospitalised reported the length of hospital stay, with a median of 5 days (range, 1-46 days).

Discussion

Recent trends in Q fever notifications in Queensland clearly demonstrate the impact of Q fever vaccination programs on occurrence of the disease.

During 2001–2006, a National Q Fever Management Program was implemented in Australia.[9] The program provided subsidised Q fever vaccine to at-risk groups, including abattoir workers/contractors, sheep shearers, and sheep/dairy/beef cattle farmers (including their employees and family members). The program was concluded in late 2006. Over the same period and beyond, there was a substantial drop in annual notifications of Q fever in Queensland, from 442 cases in 2001 to 131 cases in 2009, a 70% reduction in annual notifications. This provides ecological evidence that subsidised Q fever vaccination targeting high risk occupations is effective in reducing cases of Q fever. The gradual increase in annual notifications of Q fever since 2009 coincided with cessation of subsidy for the vaccine, and may indicate reduced uptake of Q fever vaccine among at-risk groups.

Most notified Q fever cases in Australia have been reported in Queensland and New South Wales, accounting for 47% and 39% of national notifications, respectively

(2012–2016 data).[10] Concentration of Q fever cases in these two states reflects large numbers of cattle and sheep raised. As at June 2015, of 27.4 million head of cattle in Australia, 11.3 million (41%) were located in Queensland, and 5.6 million (20%) were located in New South Wales;[11] of 70.9 million head of sheep, 26.6 million (38%) were located in New South Wales, 2.2 million (3%) were located in Queensland.[12] Australia has a relatively small flock of goats. Given that cattle, sheep, and goats are primary reservoirs of *C. burnetii*, prevention strategies should focus on provision of Q fever vaccine to people who work directly with those animals, animal products, and animal waste, as well as effective environment management (e.g. appropriate treatment and use of animal manure) to minimise spread of *C. burnetii* to the broader community.

Queensland notification data indicate around one-third of notified Q fever cases are likely to have contracted the infection through their occupational exposures to animals, animal products, animal waste, or a *C. burnetii* contaminated environment. Of those in at-risk occupations, 61% reported as being farmers/farm workers (of livestock, dairy, and agriculture), and 11% as being workers of abattoirs/meatworks. A similar distribution of these two categories of high risk occupations among occupationally acquired Q fever cases has been reported in New South Wales.[13] It is important that any notification of Q fever case from an at-risk workplace/occupation setting should trigger an investigation into further Q fever cases due to possible co-exposure to a same source of infection, and a review of vaccination status of all workers. This work needs to be carried out in collaboration between the employer, the workplace health and safety regulator, and the relevant public health authority.

Review of exposure history for notified Q fever cases revealed the three most common risk-associated moments related to acquisition of the infection:

First, working with animal manure/fertiliser: 31% of notified Q fever cases reported such exposure within one month prior to the onset of disease. Land-applied goat manure was considered an important source of human infection for the world's largest Q fever outbreak in The Netherlands over the period 2007–2010,[14] resulting in over 4,000 Q fever cases (including 28 deaths reported).[15,16] The outbreak was linked to intense dairy goat farming situated in and around densely populated areas. This unprecedented Q fever outbreak clearly demonstrates that *C. burnetii* contaminated animal manure not only puts people who work with it at direct risk of Q fever, but also poses a significant, extensive risk to members of the wider community, if applied to land as fertiliser without appropriate treatment. As part of control mechanisms for the outbreaks in The Netherlands[14] and Victoria,[17] it was recommended that 1) manure should be composted or stored for 3 months before using it as fertiliser; 2) manure should be covered during storage and transport; and 3) manure should be under-ploughed immediately when spreading on farming land.

Second, assisting/observing an animal birth: 20% of notified Q fever cases reported such exposure, with the most common animals involved being cattle, and less frequently involved animals goats/sheep, dogs, and cats. It is well recognised that animal birth products (e.g. birth fluids, placental tissue, aborted/stillborn animals) contain extremely high concentration of *C. burnetii* and provide high microbial shedding.[8] There have been reported Q fever outbreaks among veterinary personnel linked to undergoing caesarean sections for a cat[5] and a dog[18], and an outbreak among farm workers related to environmental exposure to placental material from cattle.[19] The high proportion of contact with dogs and cats among notified Q fever cases may reflect the high proportion of ownership with such companion animals in the general population. However, the increased risk of infection appears to be associated with exposure to dog/cat birthing. Apart from vaccination and compliance of standard precautions for infection control among those working with animal birthing, there is a need for appropriate management of animal placentas/aborted foetuses to minimise environment contamination and human exposure. Measures include 1) preventing animals from eating placentas by immediate removal; 2) disposal of placental tissue/aborted animals by deep burial; and 3) avoiding use of animal placentas in compost.[20,21]

Third, exposure to dust form paddocks or animal yards: 66% of notified Q fever cases reported this type of environmental exposure. *C. burnetii* is an effective infecting agent and can survive in harsh environment (e.g. UV light, desiccation, elevated temperatures) for many months.[22] A previous study showed a *C. burnetii* detection rate of 5% among dust samples collected over 30 locations ranging from urban to rural areas in Queensland, indicating existence of the organism in the wider environment.[23] Wind and dry conditions may facilitate spread of *C. burnetii* contaminated dust for several kilometres.[4] It appears that living or working in the proximity of existing paddocks/animal yards indicates an elevated risk of contracting Q fever due to exposure to contaminated dust with a relatively higher microbial load of *C. burnetii*.

Our data shed light on the potentially important role of kangaroos in transmission of *C. burnetii* to humans. Of 1,041 notified Q fever cases with enhanced surveillance data, 403 (39%) reported contact with kangaroos, more specifically, 77 (7%) involved in kangaroo shooting/hunting, and 44 (4%) involved in slaughtering/skinning/meat processing of kangaroos. However, only 5 cases reported as a professional kangaroo shooter. This indicates most exposures to kangaroos among Q fever cases in Queensland might be through non-occupational activities (e.g. recreational hunting). Potter et al reported that seroprevalence of *C. burnetii* antibodies among western grey kangaroos in Western Australia was 24%, and 4% of these kangaroos had active shedding of organisms in excreta.[24] Recently, two reported Q fever cases from New South Wales were considered to have acquired their infection from kangaroos, possibly through direct contact with joeys (juvenile kangaroos using the mother's pouch) and kangaroos, and inhalation of dust contaminated with kangaroo faeces during lawn mowing.[25] It appears that kangaroos are the most important reservoir in wildlife contributing to human Q fever cases in Queensland.

Review of Q fever notifications in Queensland reveals that one-third of Q fever cases reported occupational exposures to animals/animal products/animal waste/contaminated environment, while the remaining two-thirds of cases are likely to have been infected by non-occupational exposures. The most common reservoirs of *C. burnetii* in Queensland appear to be cattle and kangaroos. These findings highlight the importance of providing Q fever vaccination for at-risk occupational groups, as well as minimising potential sources of infection through effective environmental and animal management (e.g. appropriate manure treatment and placenta disposal), to achieve sustained prevention and control of Q fever.

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