Journal of Infection and Public Health 13 (2020) 544–551

Contents lists available at ScienceDirect

Journal of Infection and Public Health

journal homepage: http://www.elsevier.com/locate/jiph

Spatial, temporal, and occupational risks of Q fever infection in South Australia, 2007–2017

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ARTICLE INFO

Article history:
Received 4 July 2019
Received in revised form
20 September 2019
Accepted 3 October 2019

Keywords:
Q fever
Spatial
Occupational
Livestock
South Australia
One Health

ABSTRACT

Background: The burden of Q fever on at risk population groups in Australia is substantial, despite the availability of a vaccine. Our objectives were to: (a) describe the epidemiology of notified Q fever cases in South Australia (SA), (b) identify if Q fever infection is associated with occupational exposure, and (c) detect the possible spatial and temporal association of Q fever with livestock density.
Methods: Laboratory confirmed Q fever notifications from January 2007 to December 2017 were obtained from the SA Health Department. Q fever notification rates and incidence rate ratios were calculated for gender, notification year, age group, occupation category, and primary exposure suburb. Spatial mapping and analysis of Q fever notifications was undertaken using livestock data, and abattoirs and saleyards located in SA.
Results: During the study period 167 Q fever cases were notified. Males predominated (72%), with higher rates observed in the 21–40 year age group (1.52/100,000), and eight cases (5%) reported prior Q fever vaccination. Most frequently listed occupation categories were livestock farmers (35%), and abattoir workers (20%), but in 15% of cases, there was no known occupational risk. Highest notifications (22%) were recorded in the suburb containing an abattoir. The number of goats, cattle and sheep was not associated with Q fever notifications.
Conclusions: Q fever predominance among males in their twenties and thirties may indicate vaccination under-coverage among the young workforce possibly due to high turnover of workers. Q fever among those vaccinated raises concerns about vaccine efficacy or potential waning immunity. Our findings are consistent with previous studies highlighting abattoir workers as a high-risk occupational group because of its transient workforce, and low vaccination coverage. Q fever notifications in SA may be unrelated with spatial livestock density. Further One Health research involving veterinary, public health and environmental data is required.

Introduction

Q fever infection is transmissible from animals to humans, and it exists in many countries, particularly amongst certain occupational groups who have contact with animals and animal products [1,2]. *Coxiella burnetii*, the causative bacterium, is present in a range of reservoirs, particularly goats, cattle and sheep [3]. Infected animals shed the bacteria in their urine, faeces, and in larger quantities in birth products [4]. Soon after shedding, the bacterium becomes aerosolized in the environment and may infect humans through inhalation of contaminated dust and aerosols [3,5]. In humans Q fever infection commonly manifests as a self-limiting febrile illness, but may remain sub-clinical as well [2]. Asymptomatic infections pose diagnostic challenges to clinicians and could be a major driver of Q fever underreporting with its higher probability in low incidence geographical regions [6,7]. It has been estimated that for every Q fever case, two further cases are likely to be underreported [8].

Unlike the United States (U.S.), and the United Kingdom where the annual reported incidence of Q fever is low (0.04–0.24/100,000) [8,9], the reported incidence in Australia is higher (1.50–4.90/100,000) [10]. Higher incidence is in part because

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https://doi.org/10.1016/j.jiph.2019.10.002

of increased notifications among persons who come in contact with livestock through their occupations, and is associated with significant workplace compensation claims [11,12]. In recognition of Q fever as an emerging public health problem, the Australian Government has been conducting Q fever surveillance through mandatory reporting since 1977 [13]. The government also funded vaccination nationally through the National Q Fever Management Program (NQFMP) from 2001 to 2006 [14]. The NQFMP was effective in reducing Q fever incidence by 20–50% until 2009 when the incidence had started to rise again. This rebounding incidence highlights the changing epidemiology of Q fever as reported in several Australian studies with more cases reported among farmers post-NQFMP compared to abattoir workers pre-NQFMP [15,16].

The complex epidemiology of Q fever underscores that multi-sectoral strategies may be required to control its transmission. A One Health approach engages cross-sectoral collaboration, data sharing and intelligence exchange among public health and animal health authorities and provides an effective means for Q fever control and prevention [17]. Such an approach was adopted in the Netherlands to deal with a community Q fever outbreak affecting more than 4000 people [18,19]. Veterinary control measures included bulk milk tank monitoring, small ruminant mandatory vaccination, pregnant animal culling and prohibition of farm expansion [19]. However, veterinary control measures per se were thought to be insufficient in preventing human cases, and like the NQFMP a subsidized vaccination program was nationally funded for high risk populations [18].

In Australia, there are limited studies concerning the epidemiology of Q fever. Amongst those published, studies are from areas with high Q fever incidence [1,14–16,20], and few studies in areas with low reported incidence [10,21,22]. On the contrary, there has been no published epidemiological reviews concerning Q fever infection in SA. Investigating occupational risks of Q fever, and relationship with Q fever notifications and livestock density in Australia is also limited. This study aims to describe the epidemiology of notified Q fever cases in SA, to explore the association of Q fever infection with occupational exposure, and their spatial and temporal correlation with livestock density from 2007 to 2017. Combined, this information will provide evidence for public health and animal health authorities for their coordinated actions to protect the vulnerable groups from Q fever infection utilizing a One Health approach.

Methods

Q fever notification data

Laboratory confirmed Q fever notification data in SA from 1 January 2007 to 31 December 2017 were obtained from the Communicable Disease Control Branch (CDCB), SA Health Department. We obtained information on date of illness onset, age, gender, hospitalization, vaccination status, postcode, residential suburb, primary exposure (PE) suburb, and occupation.

To estimate the burden in SA, Q fever notified cases per 100,000 population was calculated using 2016 and 2011 Australian census population estimates [23]. Age specific population estimates, yearly total populations, and suburban populations were sourced from Australian Bureau of Statistics census reports. Given the low number of notifications in SA over the study period, we calculated state level Q fever incidence rates, and later incidence rates by PE suburbs. Incidence Rate Ratios (IRRs) for Q fever notifications were calculated for selected sub-groups defined by gender, year of notification and age group. In our study occupations were classified into eight broad categories modified from an Australian study [1] and from nationally derived occupation classifications [24] (Table 2, Supplementary Table S1).

Livestock density

On 1st January each year, livestock count is recorded as the number of animals on farms by property identification codes (PIC), which is a mandatory registry code in SA containing information on the property, animal species, and the number of livestock [25]. Using PIC data we obtained the number of goats, cattle, and sheep for the study period. However, as SA does not have an animal surveillance system, Q fever infection in animals is unknown. There are 57 PIC zones and 10 PIC regions in SA, with PIC regions several times larger than zones containing one to nine PIC zone(s) (Fig. 1). In order to visually inspect the relationship between livestock numbers and human Q fever incidence per 100,000 population, we plotted Q fever incidence against goat, cattle, and sheep populations. Pearson's correlation was used to examine the association between annual livestock population and yearly Q fever incidence.

The average density of livestock species per square kilometre for each PIC zone across the 11 year study period was calculated using ArcGIS. In addition, in order to examine the pattern of overall livestock density, an 11-year combined goat, cattle, and sheep density per square kilometre was calculated.

Spatial mapping of Q fever cases

In all analyses, we included PE suburb because this is the most likely place where the person was exposed. Information on PE suburb is obtained from the medical notification or from interviews with the case by CDCB. Location of exposure includes the case's workplace or their residential suburb. If there is no information on exposure, the place of exposure is listed as the case's residential suburb. For this study period >90% of cases were interviewed with exposure information provided.

In order to examine the association between Q fever and livestock density, spatial join was performed on PE suburbs to PIC zones using ArcGIS. PE suburbs that fell completely within a PIC zone were assigned to the respective PIC zone number. However, PE suburbs which fell over one adjacent PIC zones were manually assigned to a PIC zone that contained the majority of the respective PE suburbs. Q fever notifications were mapped with livestock density for goats, cattle and sheep per PIC zone, for each year and for the overall study period. A total of 18 (11%) cases were excluded from spatial mapping because their associated PE suburb was recorded as interstate, overseas or unknown.

Q fever notifications were also mapped against the location of SA abattoirs and saleyards as potential places of exposure. Abattoirs are where slaughtering of livestock is carried out, while saleyards are livestock markets where trading takes place in the form of auctions [26]. Information on location, XY coordinates and postcodes for each abattoir and saleyards was sourced from the Aussie Farms Repository [26]. All were assigned to a PIC zone as per the method described for spatially assigning Q fever notifications from PE suburbs to PIC zones. This information was added to the maps as a separate layer in ArcGIS.

Risk occupations/regions for Q fever in SA

Poisson regression was used to calculate IRRs to compare Q fever incidence between selected occupation categories and SA regional PE suburbs with 95% confidence intervals (CI) and P values.

Statistical analyses were conducted using Stata version 15. Geographic mapping was applied using ESRI's ArcGIS version 10.5.1.

Results

Q fever notification data

There were 167 Q fever cases notified in SA between January 2007 and December 2017. Across the 11-year study period, annual

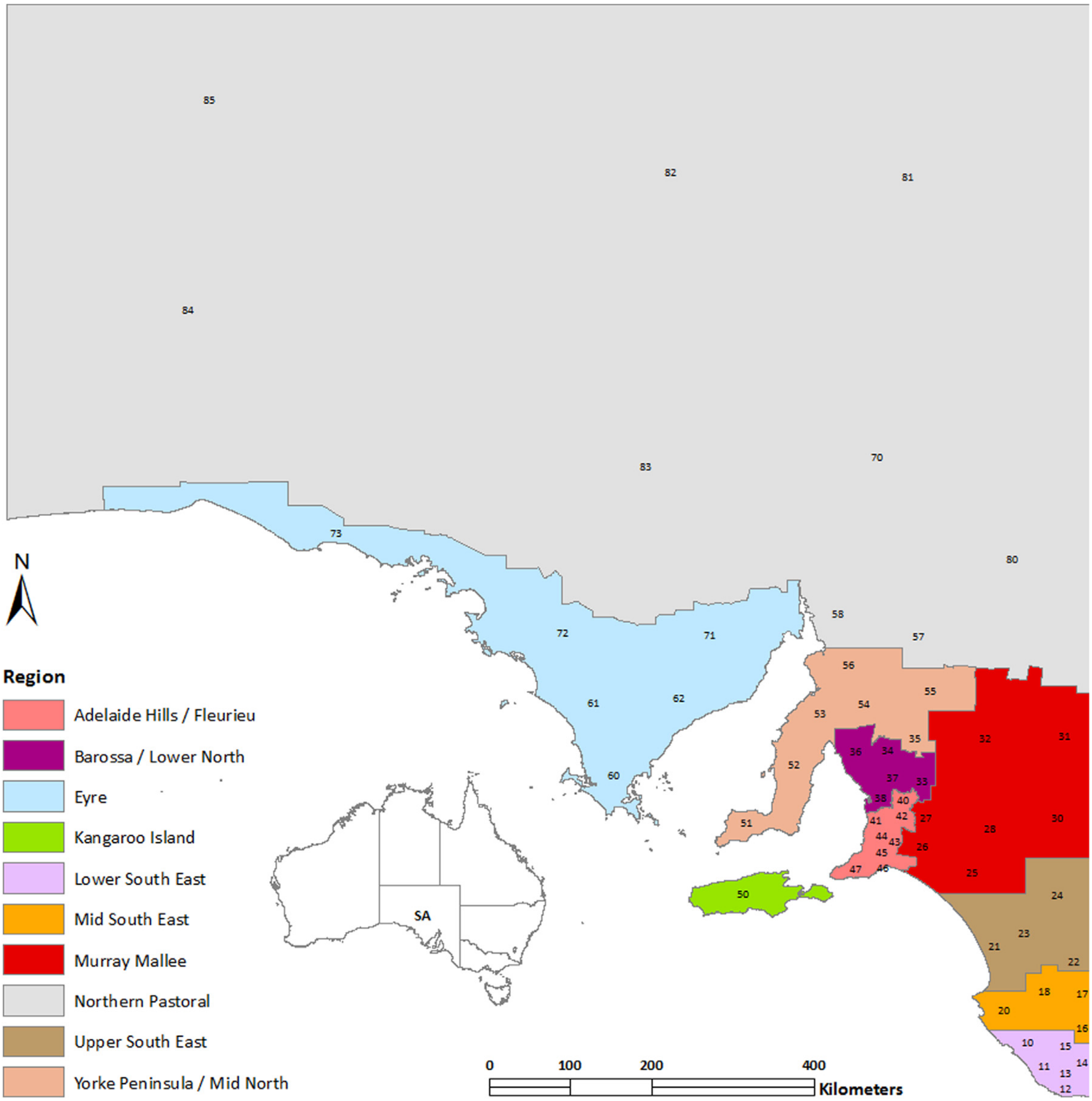

Fig. 1. Reference PIC regions, South Australia. Numbers indicate property identification code (PIC) zones. South Australia location is indicated as SA in the inset Australia map.

Q fever cases ranged from eight to 28, with the highest number reported in 2016. The mean annual notification rate was 0.92 per 100,000 population, with notification rates peaking at 1.63/100,000 in 2016 (Fig. 2). Cases associated with seasonality was not detected.

Of the 167 Q fever cases, 120 (72%) were male, and 70 (42%) were in the 21–40 year age group (Table 1). Q fever notification rates were almost three times higher among males (IRR 2.61, 95% CI 1.86–3.65) compared to females (Table 1). As opposed to the highest reported age group of 21–40 year-olds, Q fever incidence was 72% lower among persons >60 years (IRR 0.28, 95% CI 0.17–0.48). Of the 167 cases, eight (5%) reported prior Q fever vaccination. Just under half of all cases required hospitalization. Within occupational categories, the proportion of hospitalization ranged from 20% (healthcare workers) to 78% (transport workers) (Table 2). However, occupational category was not associated with cases being hospitalized, (Fisher's Exact $P = 0.156$).

Five PE suburbs had the highest number of Q fever notifications and accounted for 59 (35%) cases (Table 1). Two of these PE suburbs were in the Murray Mallee region, and three in the Northern Pastoral region. The PE suburb with the highest number of Q fever cases was from the Murray Mallee region and accounted for 22% of the total cases at a rate of 23.70/100,000 (Table 1). When PE suburbs were assigned to PIC zones, the top five PIC zones with the highest number of Q fever notifications accounted for 78 (47%) cases. Of these, 50 (64%) were reported from the Murray Mallee region containing two of the five PIC zones.

Primary exposure of cases occurred at work (49%), residence (38%), travel (4%), and for 9% it was unknown. The five major occupation categories were farmers who had contact with livestock, abattoir workers, no risk occupation, unknown occupation, and tradespersons or transport workers (Table 2).

Livestock density

Although cattle and sheep populations have increased proportionately, goat populations have shown a disproportionate increase over the study period, particularly since 2014 (Fig. 3). Annual goat, cattle and sheep counts were highly correlated with each other ($P < 0.001$), but none of them, or the total livestock population were associated with annual Q fever incidence in humans ($P \geq 0.370$).

Table 1
Characteristics of Q fever cases, South Australia, 2007–2017.

Characteristics	N (%[a])	Rate/100,000 person-years at risk	IRR (95% CI)[b]	*P* value
Gender				
Female	47 (28)	0.51	Ref.	–
Male	120 (72)	1.33	2.61 (1.86–3.65)	<0.001
Year of notification (2-year)[c]				
2007–2008	41 (25)	1.30	Ref.	–
2009–2010	20 (12)	0.62	0.48 (0.28–0.81)	0.007
2011–2012	18 (11)	0.55	0.42 (0.24–0.73)	0.002
2013–2014	27 (16)	0.80	0.62 (0.38–1.01)	0.054
2015–2016	41 (25)	1.20	0.93 (0.60-1.43)	0.728
2017	20 (12)	1.16	0.89 (0.52–1.53)	0.683
Age group				
0–20 years	13 (8)	0.30	0.20 (0.11–0.36)	<0.001
21–40 years[d]	70 (42)	1.52	Ref.	–
41–60 years	66 (40)	1.36	0.89 (0.64–1.25)	0.517
61 years or older	18 (11)	0.43	0.28 (0.17–0.48)	<0.001
Occupation category				
Farmer/contact with livestock	59 (35)	35.67	4.61 (2.89–7.36)	<0.001
Abattoir worker	34 (20)	17.57	2.27 (1.36–3.81)	0.002
No risk occupation[e]	25 (15)	7.73	Ref.	–
Tradesperson	9 (5)	7.83	1.01 (0.47–2.17)	0.974
Transport worker	9 (5)	5.87	0.76 (0.35–1.63)	0.479
Healthcare worker	5 (3)	5.56	0.72 (0.28–1.88)	0.501
Contact with animals other than livestock	3 (2)	53.90	6.97 (2.10–23.08)	0.001
Primary exposure suburb				
Murray Mallee regional suburb in PIC 27[f]	37 (22)	23.70	Ref.	–
Murray Mallee regional suburb in PIC 32	10 (6)	33.66	1.42 (0.71–2.86)	0.325
Northern Pastoral regional suburb in PIC 57	4 (2)	24.39	1.03 (0.37–2.89)	0.956
Northern Pastoral regional suburb in PIC 58	4 (2)	5.21	0.22 (0.08–0.62)	0.004
Northern Pastoral regional suburb in PIC 70	4 (2)	94.01	3.97 (1.41–11.13)	0.009

Notes: IRR, incidence rate ratio; CI, confidence interval; Ref., reference group for Poisson regression analysis.

[a] Percentages may not add up to 100 due to rounding. Person-years at risk was calculated by summing yearly total population for the respective sub-groups of each of the listed variables in SA across 11 study years.

[b] These are unadjusted IRRs, as population at risk estimates for subgroups defined by all five factors simultaneously were not able to be obtained from the available data.

[c] Year of notification was collapsed into 2-year intervals for a more stable model.

[d] The highest number of Q fever cases belong to this age group.

[e] We wanted to quantify the risks of Q fever in other occupations relative to this category.

[f] The highest number of Q fever notifications was reported from this suburb.

Table 2
Q fever notification by occupation, South Australia, 2007–2017.

Occupation categories	Number (%[a])	Hospitalized (%[b])	Reported occupations from notification data
Farmer/contact with livestock	59 (35)	26 (44)	Beef cattle farmer; dairy farmer; farmers and farm managers; farm hands; grazier; livestock farmers; mixed crop and livestock farmers; primary products inspector; shearer; sheep farmer; skilled agricultural workers; veterinarian; wool classer
Abattoir worker	34 (20)	11 (32)	Abattoir worker; boner; butcher; cleaner in meatworks; lecturer at TAFE, attends abattoirs and butchers to lecture[c]; meat and fish process workers; meatworks labourer; meat tradespersons; packer; slaughter person; slicer
No risk occupation[d]	25 (15)	12 (48)	Child care worker; community worker; construction project manager; importer/exporter; kitchenhand; other advanced clerical and service workers; performing arts support workers; sales consultant; school teachers; supervisor transport and despatching clerks
Unknown occupation[e]	23 (14)	16 (70)	Home duties; other; retired; unemployed
Tradesperson	9 (5)	3 (33)	Builder; construction tradespersons; electrical and electronics tradesperson; motor mechanic; tiler
Transport worker	9 (5)	7 (78)	Delivery driver; road and rail transport drivers; truck drivers
Healthcare worker	5 (3)	1 (20)	Enrolled nurses; medical laboratory technical officer; medical technical officer
Contact with animals[f] other than livestock	3 (2)	1 (33)	Park ranger; veterinary students

[a] Percentages may not add up to 100 due to rounding. Percent contribution in parenthesis is relative to the column total i.e., 167 cases.

[b] Percent contribution in parenthesis is relative to the row total i.e., number of cases in that occupation category.

[c] The likely exposure occurred at his workplace and therefore classified under abattoir worker.

[d] The occupation per se is not known to be a risk factor for Q fever and obtained dataset does not have specific detail on exposures.

[e] A primary occupation is not known and examples listed here are the occupation descriptions as recorded in the obtained dataset without specific detail on exposures.

[f] Important ones are dogs, cats, kangaroos and bandicoots.

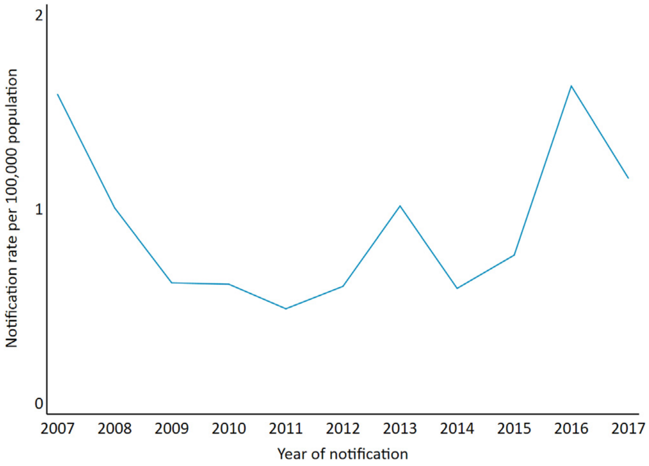

Fig. 2. Q fever notification rates by year of notification, South Australia, 2007–2017.

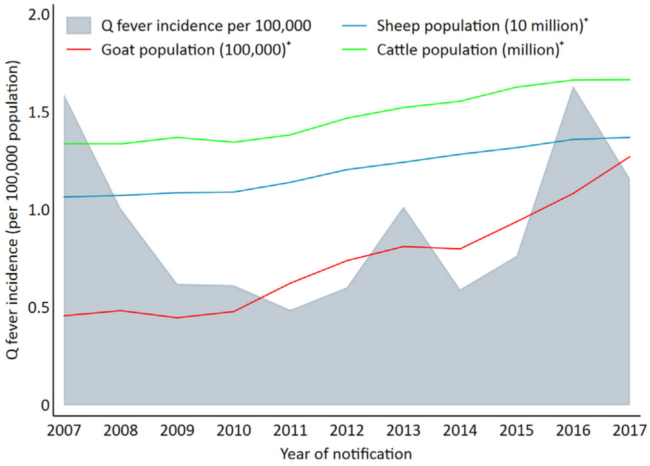

Fig. 3. Q fever incidence by livestock numbers, South Australia, 2007–2017. **+**Species denominators are different because of the relative differences in their annual population size.

The highest annual (Supplementary Fig. S1–6) and overall study period (Fig. 4) goat, cattle, and sheep density was respectively observed in Adelaide Hills/Fleurieu regional PIC, Lower South East regional PIC, and Mid-South East regional PIC. In comparison, the lowest annual goat and sheep density was observed in two Northern Pastoral regional PICs (Supplementary Fig. S1–6). However, the lowest annual cattle density was observed in Northern Pastoral regional PICs during 2007–2012 (Supplementary Fig. S1–3), and in the Eyre regional PIC during 2013–2017 (Supplementary Fig. S4–6).

Spatial mapping of Q fever cases

Spatial distribution was undertaken for 149 (89%) cases because for remaining cases the PE suburb was interstate, overseas or unknown. The highest number of Q fever notifications from one PIC was reported from the Murray Mallee region across all study years (Supplementary Fig. S1, S3–6), except the Barossa/Lower North in 2008 and 2010 (Supplementary Fig. S1 and S2), and the Lower South East in 2009 (Supplementary Fig. S2). Overall, the highest Q fever cases (n = 39) in one PIC occurred in the Murray Mallee region while the lowest was recorded in the Northern Pastoral region (Fig. 4).

The location of 40 meat abattoirs and four saleyards were plotted by their XY coordinates (Fig. 4 and Supplementary Fig. S1–6). The top three PIC regions with the highest number of abattoirs were Barossa/Lower North, Adelaide Hills/Fleurieu, and the Murray Mallee region. Of the 149 cases, 107 (72%) were reported from PE suburbs in regional PICs having at least one abattoir located in it. Of the four saleyards, two were located in Adelaide Hills/Fleurieu region, and one each in Lower South East and Barossa/Lower North region (Fig. 4 and Supplementary Fig. S1–6).

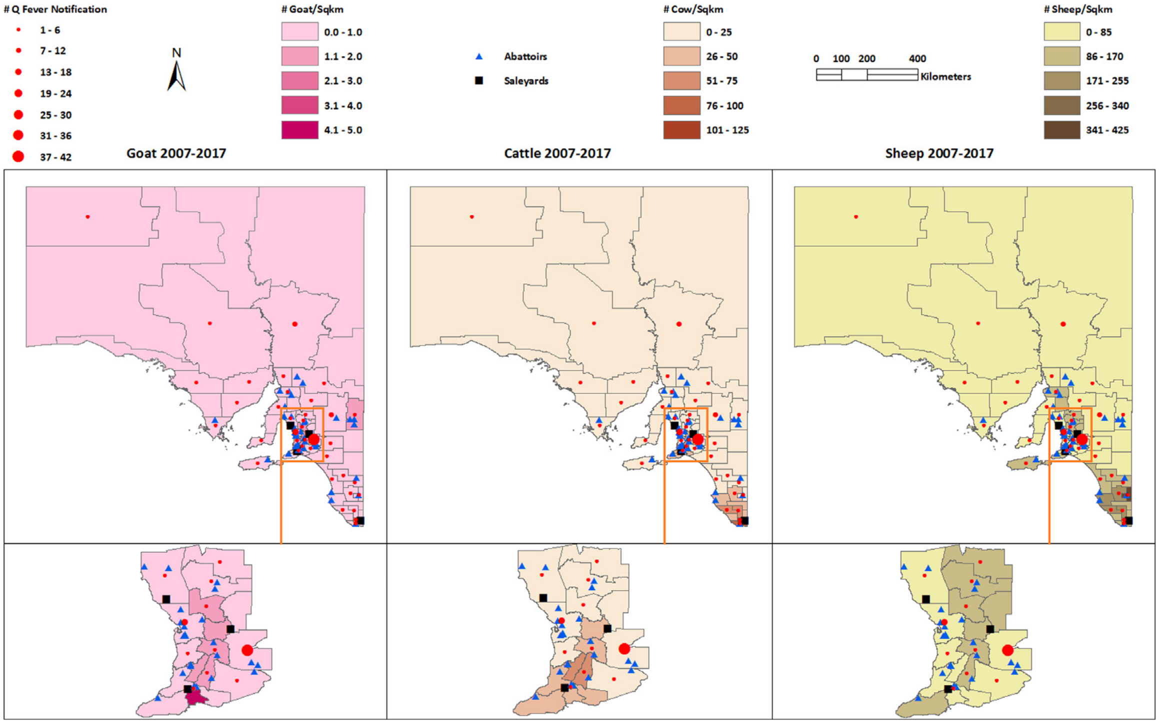

Fig. 4. Spatial relationship of Q fever notifications and livestock densities; location of abattoirs and saleyards, South Australia, 2007–2017.

Risk occupations/regions for Q fever in SA

Compared to Q fever cases who had 'no risk occupation', disease incidence was two times higher among abattoir workers (IRR 2.27, 95% CI 1.36–3.81), seven times higher among persons who had contact with animals other than livestock such as park rangers and veterinary students (IRR 6.97, 95% CI 2.10–23.08), and almost five times higher among farmers or persons who had contact with livestock (IRR 4.61, 95% CI 2.89–7.36) (Table 1). One Northern Pastoral regional suburb had four times the risk of Q fever (IRR 3.97, 95% CI 1.41–11.13), while another suburb in that region had 80% lower risk (IRR 0.22, 95% CI 0.08–0.62) compared to the reference Murray Mallee regional suburb (Table 1).

Discussion

This comprehensive epidemiological study explored the relationship between Q fever notification data and livestock data in SA, the state that has the third highest notification rates nationally [10]. We were also able to quantify occupational risks of Q fever.

Even though male preponderance in Q fever cases is consistent with other published studies [1,8,11,14,27,28], the age group with the highest incidence of Q fever notifications in our study was young adults in their twenties and thirties, compared to older adults reported elsewhere in Australia and in the U.S. [1,8]. Although the decrease in Q fever notifications among young adults between 2001 and 2010 is considered to be due to the direct effect of targeted vaccination through the NQFMP [15], our findings have several interpretations. One reason could be that Q fever vaccination coverage rate among young adults in SA is generally low, particularly among transient abattoir workers who are financially challenged and may not afford the cost of vaccination [29]. Evidence also suggests that transient workers are often involved in slaughtering of feral goats [29], which could potentially increase their risks of Q fever.

Contrary to initiatives from WorkSafe Victoria of enforcing mandatory vaccination for all abattoir workers [30], one study reported that SA meat processors generally do not offer routine vaccination to their employees [29]. We found that 95% of Q fever notifications in SA were not vaccinated indicating poor coverage among at-risk populations. Therefore, it is prudent to prioritize abattoir workers for targeted vaccination. Five of the eight cases who developed disease after Q fever vaccination had their vaccination status validated, and the time interval between vaccination and disease onset ranged from 83 days to 15 years post vaccination. This raises concerns about Q fever vaccine efficacy. Q fever vaccine Q-VAX® is manufactured by Seqirus Australia from inactivated *C. burnetii* Phase I Henzerling strain that offers cell mediated immunity [31]. It was proposed that vaccination related immunity lasts for at least five years [32]. However, two cases who developed Q fever within three years post vaccination suggests possible waning immunity or failure of a primary immune response to the vaccine. Revaccination is contraindicated because of the risk of hypersensitivity to the vaccine in those previously exposed to the organism [31].

Increased number of Q fever cases in SA reporting contact with livestock is consistent with published Australian and international literature [11,15,28,33]. This could be in part because of the lower than expected vaccination coverage among farmers during the second phase of NQFMP which attracted less subsidy than the first phase [5]. In addition to farmers and abattoir workers, unvaccinated veterinary students and park rangers that constituted the occupational group "contact with animals other than livestock" in our study possessed higher than expected risk of Q fever. This elevated risk should not be overlooked based on the number of notified cases during the study period, the finite population at risk and the calculated rates of Q fever also deserve careful consideration. Although Q fever vaccination is a prerequisite for students enrolled in veterinary degrees in Australia [34], and vaccination is currently recommended for park rangers [32], the three cases were not vaccinated. This situation warrants exploration of existing Q fever vaccination policy and practice, particularly related to at-risk groups who are currently recommended to be vaccinated such as abattoir workers, farmers, shearers, veterinary students, veterinarians and wildlife workers [32].

Even though evidence suggests that NQFMP was effective [14], the unexpected increase in Q fever notifications in SA in 2016 underscores the need for further epidemiological investigation. Contrary to an international study that found a relationship between the number of sheep flocks and Q fever [27], our study identified that livestock species, or total livestock populations, were not statistically associated with Q fever notifications in humans. Furthermore, the Murray Mallee regional suburb had the highest recorded Q fever notifications, but its associated livestock density was not high. However, the respective PIC zone contained an SA abattoir [35], which could potentially highlight the added risk of Q fever among abattoir workers.

Historical high incidence, transient workforce, relative unvaccinated status, and poor industry attention suggest that abattoir workers are still one of the highest at-risk occupational groups for Q fever infection. This supports the findings in our study, coupled with evidence that the majority of cases were reported from PIC zones with abattoirs. Although higher rates of Q fever notifications were reported from one Northern Pastoral regional suburb, its small population size deserves consideration. In contrast, the Murray Mallee regional suburb had a 37 times larger population with the highest notification numbers, as well as the location of several abattoirs. We suggest that the Murray Mallee region needs continued vigilance by state government and meat industry, and that mandatory vaccination is required for all abattoir workers in SA. However, for averting the economic and social implications of Q fever on a sustainable scale, commitment from government and industry should extend to fund vaccination of at-risk occupations, particularly farmers and park rangers, and ensure that all veterinary students are vaccinated prior to working with animals.

One of the key limitations of this study is the low number of notifications reported over the study period, which was further reduced by the exclusion of 18 cases from analyses. Underreporting of Q fever may have contributed to lower notification rates resulting in limited epidemiological analysis and interpretation. We were unable to produce adjusted rate ratios and we cannot rule out that there may be confounding in the calculated IRRs. The other major limitation was that the occupations reported for cases notified to CDCB did not align with the ABS categories for occupation. Although we endeavoured to include all related occupations and population size, under or over representation is a possibility. We also assumed that the worker population for each occupation category remained constant for the duration of the study period.

Although in Queensland Q fever notifications may have a seasonal pattern [20] which has also been shown in the U.S. [8] and Netherlands [28], our findings do not hold that postulation in SA, which is consistent with published literature on national level data in Australia [13]. However, in the large Q fever outbreak that occurred in the Netherlands, there was an association between environmental conditions such as *C. burnetii* airborne concentration and vegetation density, and disease notification [28,36,37]. Therefore, one future direction may include analysis of Q fever notifications in an interdisciplinary approach using veterinary data on bulk tank milk sample, and vaginal or environmental swabs for *C. burnetii*; meteorological data including relative humidity, temperature, and wind speed and direction; atmospheric dispersion modelling; and spatial covariates from the adjacent states of SA.

Conclusions

Q fever prevention requires a coordinated approach from all levels, including government and industry. Public health programs like NQFMP should be adopted nationally and at state levels periodically, and in collaboration with industries. In order to maximize program success, state level challenges and opportunities deserve contextual priority when conceiving public health programs. Our finding of no association between spatial livestock density and Q fever notifications does not restrict replication of such analysis in other high incidence Australian states and countries, as this will contribute evidence to the epidemiology of Q fever not only in Australia, but also worldwide. One Health research using data from several disciplines including public health, veterinary, and environmental is required before drawing any premature conclusion that Q fever is not associated with livestock density.

Author contributions

MRR, AM, HM and PB conceptualized and designed the study. MRR completed data analysis and drafted the manuscript. AM, HM and PB reviewed the manuscript. AM, HM and PB supervised the research.

Funding

No funding sources.

Competing interests

None declared.

Ethical approval

This research was approved by the SA Department for Health and Wellbeing Human Research Ethics Committee, HREC reference number: HREC/18/SAH/47 and endorsed by the University of Adelaide ethics committee.

Acknowledgements

We acknowledge the Communicable Disease Control Branch, Department for Health and Wellbeing, and the Department of Primary Industries and Regions, South Australia. Md R. Rahaman is also grateful to Dr Dorothy Turner, GIS course coordinator, the University of Adelaide for her assistance while he undertook the "Introduction to GIS" course. Additionally, the authors wish to thank Jana Maria Bednarz from Adelaide Health Technology Assessment for her statistical assistance. Md R. Rahman is supported by the Adelaide Scholarships International (ASI) scholarship of the University of Adelaide.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.jiph.2019.10.002.

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