



Australian beef industry worker's knowledge, attitudes and practices regarding Q fever: A pilot study



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ABSTRACT

Background: Q fever is a vaccine-preventable zoonotic infection with potentially severe health outcomes and high economic costs that affects agricultural workers, including beef and cattle industry workers, however this population historically have sub-optimal vaccine uptake.

Objective: To gather quantitative and qualitative pilot data from Australian beef industry workers on their knowledge, attitudes and practices around Q fever and Q fever vaccination.

Methods: A mixed methods approach was used to ascertain the Q fever disease risk perception and vaccination behavior of a purposive convenience sample of beef industry workers attending an industry expo in Rockhampton, Queensland, Australia between May 7th and 9th, 2018.

Results: The quantitative survey response rate was 83% (n = 86). More than 70% of respondents reported exposure to known Q fever risk factors. Eighty six percent were aware of Q fever, the self-reported uptake of Q fever vaccine was 27% and 9% reported undertaking testing which showed evidence of previous infection. Five main themes emerged from the qualitative data: "Finding the time" among other life priorities to attend a doctor for a vaccine; "Employer responsibility" to provide the vaccine; "My doctor knows me" and could suggest Q fever vaccination; "Assigning Risk" across a range of attitudes, including thinking it would not happen to them, 'fatalism', and knowing the danger but taking the risk anyway; and "The Need for Outreach" vaccine delivery services in their communities.

Significance: These data suggest that a coordinated public health approach to testing and vaccine provision, coupled with an awareness campaign among regional doctors to prompt them to routinely ask patients about their Q fever risk and vaccination history, should form part of a broad approach to Q fever control and prevention.

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1. Background

Q fever is a zoonotic disease caused by the obligate intracellular bacteria, *Coxiella burnetii*. First described in Australia, and subsequently identified in domestic ruminant herds worldwide [1], humans working in primary industries dealing with goats, sheep and cattle are occupationally at-risk for Q fever infection, which is usually acquired through inhalation of aerosolized bacteria [2]. In Australia and many other countries where Q fever is an important zoonotic disease, cattle are a known source of human infection

[3]. Other animals are known to shed *C. burnetii*, including domestic mammals, reptiles, invertebrates (most commonly ticks) and birds, with the bacteria capable of surviving for long periods in the environment, making it susceptible to being aerosolized by wind or agricultural practice [2,4].

In Australia, Health authorities must be notified of all confirmed human Q fever infection, with a national reported infection rate of 2.0 per 100,000 per year in 2014 [5]. The state of Queensland is the second largest landmass in Australia (1,727,000 km², or 666,798 mi²), with a vibrant agricultural sector and the highest reported Q fever infection with a rate of 6.3 per 100,000 population per year for 1991–2014 [4,5]. Within Queensland, the Central West region (396,650 km², or 153,147 mi²) historically has a higher notification rate of up to 16.3 per 100,000 in 2006 [6].

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While a nationally funded program for Q fever vaccination was previously available, this program ceased in 2006 [6]. The vaccine is currently only available for purchase through the private market [7]. The vaccine is a purified suspension of killed *Coxiella burnetii*, administered in a single dose. Previous Q Fever infection is a contraindication for vaccine administration due to the likelihood of an adverse reaction due to hypersensitivity to the organism, and serology and skin tests must be performed and proven negative prior to vaccination. Therefore, Q Fever vaccination requires at least two visits to a vaccine provider [8]. The few studies examining Q fever vaccination among Australian farmers suggest uptake of around 43% during the publicly funded program [6]. Qualitative data from the state of New South Wales suggest variable Q fever knowledge among farmers and their attending General Practitioners, time constraints, and cost and vaccine access difficulties all contribute to low vaccine uptake in this group [9]. Given the public health implications of Q fever in rural communities, particularly Central and Central West Queensland where reported infection rates are comparatively high, understanding beef industry workers' knowledge, attitudes and practices around Q fever and vaccination is crucial to inform well-targeted programs as part of a broader One Health approach to control and prevention [10].

Conducting such research is challenging in this region due to the isolation of the farmers most at risk. It is not uncommon for farming families in this and other similar regions in Australia to drive hundreds of kilometers to access their General Practitioner and other health services. Therefore, to gather pilot data, a community gathering was selected to access farmers in this region. Australia's Beef Expo is held in the regional center of Rockhampton, Queensland every three years, attracting people working in the beef industry from Queensland and further afield in Australia [11]. The 2018 expo ran from 7 to 9 May and presented an excellent opportunity to gather data about Q fever awareness and practices from Australian beef industry workers, particularly farmers in the Central and Central West regions of Queensland. Quantitative and qualitative pilot data were sought from beef industry workers on their knowledge, attitudes and practices around Q fever and Q fever vaccination.

2. Methods

A mixed methods approach, utilizing a survey, qualitative interviews and comprehensive field notes taken while engaging with beef industry workers attending the expo was used.

2.1. Sampling frame

Researchers attended a stall in the main hall of the expo which was provided by Queensland Health. The stall included information about many preventive health programs available to rural and remote families in the region, with researchers approaching expo attendees passing through the hall prior to them being given any information available at the stall. Potential participants were asked if they would like to complete the anonymous survey, which was either self-administered or administered with assistance from the researchers if requested. Participants were given information on Q fever after completion of the survey and/or interview if they requested it. Survey participation resulted in a large number of conversations being initiated between participants and researchers, the de-identified specifics of which were recorded immediately afterward in detailed field notes. Field notes are a valid source of qualitative data and their use is well-established in qualitative inquiry [12]. Participants were also invited to take part in a formal recorded qualitative interview.

2.2. Quantitative survey

The survey covered three main domains: Q fever knowledge and relevant personal practices, Q fever risk perception, and vaccination behavior. The knowledge and practice section used a combination of three- and five-point likert scales and was developed based on a standard case report form [13] used by public health units investigating reported Q fever cases consisting of items covering behavioral risk factors and potential infection sources identified through local studies [14]. The Q fever risk perception and vaccination behavior sections asked participants to select options which most closely described their position on Q fever vaccination and were developed using the Precaution Adoption Process Model of health behavior [15,16], which has been used previously to elicit disease risk and vaccination behavior in other populations [17,18]. The Precaution Adoption Process Model explains the stages through which people move when taking precautionary measures against risk. The model comprises of seven stages: 1) Unawareness of the issue ("I've never heard of Q Fever vaccine"), 2) Unengaged with the issue ("I've heard about the Q fever vaccine, but haven't thought about getting it"), 3) Undecided (I've heard about Q fever vaccine, but am undecided whether to get it"), 4) Decided not to act ("I thought about getting the Q fever vaccine and decided not to"), 5) Decided to act ("I've heard about the Q fever vaccine and plan to get it, but haven't yet"), 6/7) Acting/Maintaining ("I have had the Q fever vaccine and/or have had the pre-requisite skin test"). Demographic data such as residential and occupation post-code, plus distance to access the closest town were also collected. Simple descriptive analyses were completed for each item in the survey.

2.3. Qualitative data

Qualitative data was sought to provide insights that might not be apparent from quantitative data alone. A semi-structured qualitative interview schedule was developed by the research group, based on the key research questions of beef industry workers' knowledge of Q fever and their vaccination practices in the region, and guided by previous studies in other regions [9]. The open-ended interview questions asked worker's thoughts on Q fever, and their lived experience, or the experience of those they knew with either Q fever disease or vaccination, which were audio-recorded and transcribed. The details of informal conversations arising with survey respondents which centered on Q fever awareness, attitudes and vaccination practices were also recorded in detailed de-identified field notes, although these conversations were not formally audio-recorded. These detailed field notes and the transcriptions of the formal interviews were then subjected to an inductive thematic analysis [19]. Primary analysis was undertaken by one author (KW) and then the data set and emergent themes were discussed and refined with members of the research team most closely involved with data collection and who work in the Central and Central West Queensland regions (JW and GK).

2.4. Ethical approval

This study was approved by Central Queensland Hospital and Health Service Human Research Ethics Committee (approval number HREC/18/QCQ/11). As the survey and informal conversations were anonymous, consent was considered inherent in agreeing to complete the survey. For those who agreed to take part in a formal audio-recorded interview, a written participant information statement was provided to the interviewee and a consent form signed.

3. Results

3.1. Quantitative survey

Of the 104 people approached and invited to participate, 86 agreed (response rate 83%). Just over half of the respondents were female (55%), and a similar proportion (53%) reported working in a post code within the Central and Central West Queensland regions. The remaining 43% reported working in postcodes in other areas of Queensland, or other Australian states. Among all of the survey participants, the mean distance reported to drive to access their General Practitioner (GP) was 57 km and ranged from 0 to 275 km. The most commonly reported occupations were Farm Worker (33%), followed by Stockyard Worker (11%), and Grazier (cattle farmer/rancher) (9%). Twelve percent identified as working in two or more cattle-related occupations and there was high variability in the “other” category. This included agricultural or veterinary students, retirees living on a property, detectives in the Stock Squad investigating cattle theft and a shipboard stockman (Table 1). Greater than 70% of respondents reported exposure to the risk factors of: living on a farm, exposure to dust from paddocks, living within 1 km of a sale yard or animal grazing area, attending sale yards or animal shows, and handling fertilizer or manure (Table 2). The mean number of high-risk activities undertaken by individual respondents was 6.6 (range 0–11), with the majority of respondents (57%) reporting that they regularly undertook between seven and ten activities identified as being of high Q fever risk.

Eighty six percent (n = 74) said they had heard of Q fever, 9% (n = 8) said they had been diagnosed with Q fever in the past, and 42% (n = 36) reported they knew someone who had. The self-reported uptake of Q fever vaccine was 26% (n = 22), with another 9% (n = 8) reporting that they had been tested and told they did not need the vaccine.

The largest group of unvaccinated respondents (32% of the total group, (n = 28)) located themselves in stages 1 and 2 of the Precaution Adoption Process Model (PAPM), demonstrating a low level of engagement with the subject among roughly 1/3 of the respondents (Fig. 1). Reasons for participants locating themselves in stage 5 of the PAPM (“Thought about vaccine, plan to”) were mainly “I

Table 1
Survey respondent demographics.

Question	Result n (%)
Male	39 (45)
Female	47 (55)
Age	Mean: 51 years Range: 18–81 years
Work in Post Code in Central or Central West Queensland	46 (54)
Work in Post Code outside Central or Central West Queensland	39 (45)
Did not answer	1 (1)
Live in Post Code in Central or Central West Queensland	45 (52)
Live in Post Code outside Central or Central West Queensland	38 (44)
Did not answer	3 (4)
Distance to GP	Mean: 53 km Range: 0–275 km
Occupation	
Stockyard worker	9 (11)
Farm worker	28 (33)
Vet Worker	2 (2)
Grazier	8 (9)
Two or more cattle-related occupations	10 (12)
Other	28 (33)
Did not answer	1 (1)

Table 2
Survey respondents' Q fever exposure risk.

Question	Result n (%)*
Exposure to dust from paddocks	68 (79)
Works with animal manure or fertilizer	63 (73)
Lives on a farm	62 (72)
Attends sale yards or animal shows	62 (72)
Lives within 1 km of sale yard or animal grazing area	61 (71)
Lives/works within 300 m of bush or scrub	58 (67)
Regular exposure to trucks transporting cattle, sheep or goats	51 (59)
Launders clothes for someone who works with animals	48 (56)
Assists/observes cat or dog births	40 (47)
Any involvement with slaughtering, skinning or meat processing	40 (47)
Consumes unpasteurized milk	16 (19)

* Participants could select more than one.

just haven't got around to it yet”- type answers. One respondent specifically said that it was hard to get to the doctor, others queried vaccine availability at their local clinic and one reported pregnancy as an issue.

Approximately half of respondents disagreed with the statement that it was difficult for them to get to the GP for vaccine due to distance (52%, (n = 45)). Slightly more respondents disagreed with the statement that it is difficult to be vaccinated because of the need for two visits to the GP (the first for testing for previous infection - a contraindication for receiving the vaccine - and the second to receive the vaccine, subject to the test results) (36% (n = 31), versus 28% (n = 24) who agreed). Fifteen percent (n = 13) agreed that cost made them hesitate (the rest saying they neither agree nor disagree (24%), disagree (43%), or didn't know or didn't answer (24%)), with note that the cost of the vaccine was not included in the survey. Forty four percent (n = 38) agreed the vaccine was safe and 57% (n = 49) agreed it would protect them from Q fever.

The majority of respondents identified farm workers (n = 59, 69%), abattoir workers (n = 71, 83%), stockyard workers (n = 66, 77%) and cattle transport workers (n = 58, 67%) as being at higher risk than other Australians for contracting Q fever. While 78% (n = 67) knew that contact with birth tissues was a risk factor. Importantly, 20% (n = 17) did not know whether such contact presented a risk or not.

3.2. Qualitative data

Data used for qualitative analysis included three formal audio-recorded interviews, as well as de-identified field notes from 16 informal conversations with survey respondents. Fifteen of these conversations were with cattle farmers, but there were also noted conversations with an abattoir worker, an agricultural engineer, a feed lot owner and a veterinary worker. Five emergent themes were identified: “Finding the Time”; “Employer responsibility”, “Assigning and dealing with risk”; “My doctor knows me”; and “The need for outreach”.

3.2.1. “Finding the Time”

All of the farmers made mention of having to make the time or make the opportunity to go and have the requisite tests and then the Q fever vaccine. When prompted for more detail, some spoke of “just never getting around to it”, others spoke of priorities. Examples of their responses include:

“it's hard enough for us to get off the farm, and we're 10 min out of town”.

[Cattle Farmers, Southern Victoria]

and,

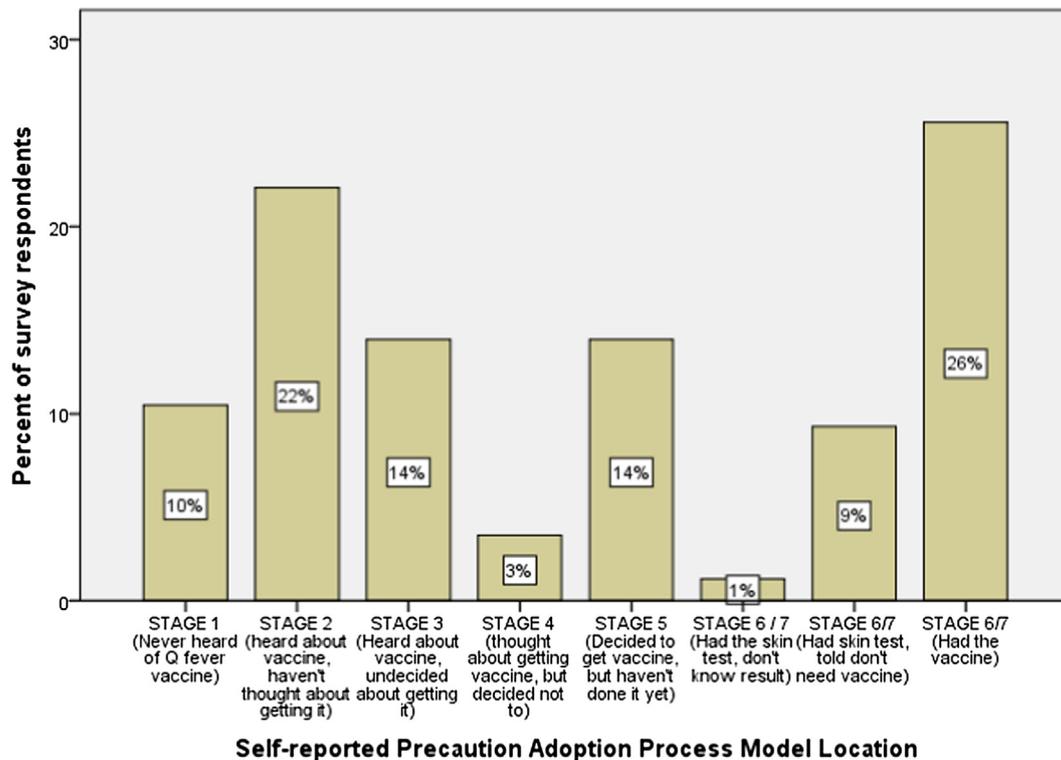


Fig. 1. Australian Beef industry workers' self-reported location on the Precaution Adoption Process Model of health behaviour regarding vaccinating against Q Fever.

"Even just to visit to the doctor for anything is, you know, it's... you put it off and put it off and put it off. You know what it's like, 'cause it's... you have to make an appointment."

[Cattle Farmer, Central Queensland]

The general feeling was that they were busy, as there are other priorities; Finding the opportunity to leave the farm and drive sometimes considerable distances into town to get the tests and then return a week later for the vaccine if needed, was problematic:

"I think the necessity to have the test and then follow up, because most people have got one window of time and that's it"

[Cattle Farmer, Central Queensland]

3.2.2. "Employer responsibility"

In contrast to the self-employed farmers, the abattoir and veterinary workers, plus some beef farmers who themselves employed staff, saw it as an occupational health and safety issue and reported that the vaccine is automatically offered in some occupational settings. There were numerous mentions of abattoir worker's compulsory Q fever vaccines. Some spoke of their responsibility as employers and others of the responsibility of their employers. One man spoke of how his experience in being diagnosed with Q fever led to workplace changes by his employer:

"What happened was, when I fell over in a heap the management group that take care of this said, and because, you know, there was a lot of issues, they said 'right, everyone's going to get a needle'... I triggered a complete change of their idea about Q fever"

[Cattle farmer, Central Queensland]

3.2.3. "Assigning and dealing with risk"

There were a range of viewpoints and approaches to assigning risk to Q fever in their occupations, ranging from the fatalistic approach,

"I'm 65, I figure if I'm going to get it, I would've had it by now"

[Farmer, Northern NSW]

to being aware of it but being prepared to take the risk,

"Sometimes you just risk it"

[Agriculture student, Central Queensland]

to feeling it can't happen to them,

Q: So, what was it that stopped you [getting the vaccine]?

A: Um, probably "it can't happen to me"

[Cattle farmer, Central Queensland]

One of the interviewees felt that there was something of a practical fatalism among her community, which related back to the first theme of "Finding the time":

"I don't think they can afford to be worried about it. I think it's a case of, you know, there's not a lot I can do about it unless I make this effort to make these two windows of time."

[Cattle farmer, Central Queensland]

It emerged that those with the keenest perception of risk were those who had personal experience with the disease. There were numerous anecdotes of people becoming very ill with Q fever or knowing someone who had. All spoke of the profound impact the illness had on their ability to work.

"I reckon it affected me my whole life"

[Retired meatworks engineer, Queensland]

"I think he probably went back to work much earlier than he should've... and I think he relapses from time to time"

[Cattle farmer, Central Queensland]

"It really hurts. If you get sick it's not cool. So, like if you can do anything... It's just it's not a cool thing to have... It's like,

you're really fit and healthy, but this is not cool. It's not a cold, it's not influenza, it is a proper full-on bloody fever. It hurts."

[Cattle farmer, Central Queensland]

3.2.4. "My doctor knows me"

The concept of feeling most comfortable with one's own GP who knew their medical history emerged. Some participants reported that GPs in local towns were not qualified to administer Q fever vaccines, forcing people to drive further afield to access the vaccines. Others suggested that if rural beef industry workers are visiting their GP for an unrelated matter, perhaps the GP could prompt whether their patient was aware of Q fever, and ascertain their need for vaccination:

"Or just mention it, say "what are you doing?", "oh, I'm working with cattle". And if your GP, 'cause you know yourself, once you get a GP that you're happy with you stick with them."

[Cattle farmer, Central Queensland]

3.2.5. "The need for outreach"

A number of older people mentioned an outreach program run many years ago and the consensus seemed to be that this was a good idea, although the logistical difficulty this would entail was acknowledged by some:

"I remember years ago that there was.. I think it was the Lions club organised diabetes awareness... people seemed to gather. It might've been a show day or something, but people seemed to gather and take the tests for that."

[Cattle farmer, Central Queensland]

and,

"I have in the past thought it would be good for some of the rural organisations to organise vaccination at conferences, but that was impossible to do because you have to have a test first."

[Cattle farmer, Central Queensland]

4. Discussion

This pilot study provided further insight into Australian beef industry workers' awareness of and attitudes toward Q fever and Q fever vaccine. Among this purposively sampled group at a Beef Expo 35% located themselves at stages 6 and 7 of the Precaution Adoption Process Model of health behavior (PAPM), reporting that they had decided to vaccinate and had taken steps to do so. Only 26% had received a vaccine, with a further 9% having sought the pre-requisite testing that demonstrated previous infection contraindicating vaccination. This is despite more than 70% of the participants reporting exposure to risk factors associated with Q fever infection. Given the isolation in which many of the study participants live and work, it would be logical to assume barriers to vaccination would be distance-related. However, just over half of this group reported that getting to their GP for the vaccine was not an issue for them, and the requisite two visits for testing and then vaccination was not reported as an issue by most respondents. Similarly, cost was not reported as a barrier by most of these people. Forty six percent of the sample located themselves at early, pre-decision stages of the PAPM: Ten percent had never heard of the vaccine, while 36% had heard about the vaccine but either hadn't thought about getting it or were undecided. A further 14% had decided they wanted to get vaccinated but hadn't yet taken steps to do so (PAPM stage 5). Given that half of the people surveyed knew about the vaccine but hadn't taken steps to vaccinate themselves, it is important to understand the barriers these people face to acting on their knowledge.

This appears to be hinted at in the qualitative data: From conversations with the participants, the concept of having to find a "window" of time to get tested and vaccinated appears to be a key issue for these farmers and is supported by a previous qualitative study exploring farmer's Q fever prevention approaches in New South Wales which reported that time was a factor for farmers in that study [9]. Previous research suggests that the ability of rural and remote Australians to access health care is a complex, multi-faceted issue which forms part of a broader problem of health disparity between rural and metropolitan-dwelling Australians [20]. Further study is needed to understand why finding this "window" is such an issue for farmers, and exactly what this "window" would look like to them – what their daily/weekly/monthly life looks like in terms of time availability, how they would go about identifying a time to organise vaccination, how they would prioritise that with other competing concerns, and any underlying factors driving this apparent lack of time/opportunity and prioritization. This issue of priorities may also explain the way in which risk was assigned and acted on, particularly by those who had no first-hand knowledge of the disease, although, again, this requires further exploration.

While some occupational groups within the beef industry such as abattoir workers have access to Q fever vaccination and testing through employer-provided programs, for farmers the onus is primarily on the individual to organize and pay for Q fever vaccination. The previous nationally funded Q fever program saw vaccine uptake as high as 43% in some regions [6], and the participants of the present study mentioned previous regional outreach programs that assisted with access to testing and vaccination services, a finding echoed in previous studies [9]. High Q fever vaccine uptake among people working in agriculture-related industries is a worthy goal: the economic burden of a Q fever outbreak has been shown to be high both in terms of production loss and disability-adjusted life years for those affected [21]. Similarly, an economic evaluation of increasing vaccine uptake among Australian meat and agriculture industry workers found it to be highly cost-effective [22].

A coordinated public health approach to providing vaccine and testing coupled with an awareness campaign among regional GPs to prompt them to routinely ask their patients about their Q fever risk and vaccination history, could go some way towards helping farmers make the "window" of time they say they need to get vaccinated for Q fever. Encouraging GPs practicing in rural areas to undertake endorsed online training about Q fever and Q fever vaccination could help make this a more routine part of consultations with their patients [23], while previous research has demonstrated the utility of specialized research methods which identify and address community-specific issues with access to vaccine [24,25]. Such an approach should form part of a broader One Health strategy toward Q fever awareness and control; the "other" category of occupations in our survey included veterinary students, police detectives and shipboard stockmen to name a few, demonstrating the many intersections between human and animal health, the environment and broader society that Q fever inhabits. Therefore, any Q fever control strategy should seek to incorporate as many of these intersections as possible. The collaborative aspects of the One Health approach have been demonstrated as well-suited to controlling a disease as complex as Q fever, both in Australia and elsewhere [10,26].

Mixed methods research approaches have well-established precedent, and a purposive sampling approach such as this is warranted to garner pilot data from this very specific population [27], that is, Australian beef industry workers, with a focus on those residing in Queensland's Central West. The restricted nature of pilot studies mean that this investigation has some limitations. We used a convenience sample recruited at an industry event with

known high attendance of beef industry workers from Central and Central West Queensland, particularly farmers. Therefore, the results cannot be generalized to all beef industry workers in Australia, although the purposive nature of our approach means that the results may be reasonably applied to beef industry workers in Central and Central West Queensland, with note that more work is needed to fully understand the issues. While the qualitative data garnered helped inform the interpretation of the quantitative survey results, care must be taken in assigning any significant meaning to these findings at a broad level: This is a pilot study and therefore it constitutes a “scratch of the surface” of the underlying reasons for farmer’s Q fever vaccination behavior. Furthermore, the questionnaire was not validated for this population, although some of the items have been previously assessed for face and content validity and internal consistency in other populations [18]. Nevertheless, it serves as a platform on which to base a larger study of this population.

5. Conclusion

Q fever vaccine uptake among this group of beef industry workers was relatively low, with “obvious” barriers such as distance and cost reported as less of an obstacle. Finding time to leave the property and seek vaccination and the requisite testing appears to be a more pressing issue for many farmers and graziers. Further study to clearly elicit why time is an issue and the drivers behind it are required to enable well-targeted awareness campaigns to be developed and implemented.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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