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'The reason why I got it … ' – messages from people diagnosed with leptospirosis about infection in the workplace and its impact on livelihoods

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ABSTRACT

In Aotearoa New Zealand, leptospirosis is a disease that mostly affects people working with livestock on farms and in abattoirs, with Māori and Pasifika workers more likely to be hospitalised than others. This article shares an analysis of thirteen interviews with people diagnosed with leptospirosis. They were asked to advise colleagues and employers, as well as share how their illness had affected their income – informing health officials and workplace insurers. Their comments suggest that most workers are aware of the importance of Personal Protective Equipment (PPE) and safe operating environments, and they know how they contracted the disease. However, they remove PPE or take shortcuts knowingly, often under time pressure. Comments on the financial impact of their illness suggest most farmers received support from family and community, but most meat-processing workers did not. Worse, while most farmers said their financial losses were limited, many meat-processing workers felt forced to return to work too soon because they needed the income. Farmers were almost exclusively farm owners. Financial assistance (ACC) is more needed for some than for others. However, while such assistance is welcomed when it arrives, all interviewees described personal interactions with the administration of financial assistance as disrespectful or dispiriting.

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Introduction

Humans can become ill with zoonotic diseases when infectious agents from animals pass to people. Zoonotic diseases are common: more than 60% of known and emerging human infectious diseases are zoonotic (Allen et al. 2017; Rahman et al. 2020). Leptospirosis is a bacterial zoonosis that can infect people through direct contact with an infected animal's urine, or indirectly through a contaminated environment such as

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soil, water or food. After an incubation period that generally takes between 2 and 20 days the symptoms include fever, headaches and muscle aches, and more severe outcomes can include organ failure. Many strains of *Leptospira* bacteria are distributed around the world and the presentation and severity of the disease are linked to the infecting strain. While potentially fatal, especially in the Least Developed Countries (Costa et al. 2015), many leptospiral infections are mild and serious infections can be treated with antibiotics (Haake and Levett 2015).

Rodents are well-recognised mammalian hosts for *Leptospira* around the world, but any infected mammal can shed the bacteria and thus infect humans, including livestock, the main recognised maintenance hosts for *Leptospira* in Aotearoa New Zealand. In Aotearoa New Zealand, leptospirosis was first identified in the 1950s (Whitcombe et al. 2020) and while the incidence peaked in the 1970s, the incidence in the 1990s was still 4.4 per 100,000 people, with meat-processing workers most likely to be infected (164 per 100,000), followed by livestock farmers (92 per 100,000) (Thornley et al. 2002, p. 29). However, the introduction of vaccination programmes against *Leptospira* in dairy cattle and pigs in the early 1980s (Marshall and Chereshsky 1996; Fairley 1997), plus the increasing use of recommended management measures such as rodent control, the use of personal protective equipment, covering of wounds and some limited adoption of vaccination in other livestock species, have seen the incidence of leptospirosis in people decline and then stabilise to an average of 2.01 per 100,000 in the 1999–2017 period (Nisa et al. 2020, p. 841). To contextualise the overall incidence of leptospirosis in Aotearoa New Zealand, we note that between 1999 and 2017 approximately 1.8% of the country's population was employed in the livestock industry and 0.5% worked in the country's meat-processing industry (Benschop et al. 2021).

According to El-Tras et al. (2018, p. 164), leptospirosis affects people who identify as European and Māori a few percentage points more than their proportion in the population; other ethnic groups appear to be affected a few percentage points less. Other research, however, points out that hospital admissions for infectious diseases 'differed considerably between ethnic groups; rates for Pacific peoples and Māori were about double those of the European' (Baker et al. 2012, p. 1115). Specifically for leptospirosis patients, Māori and Pacific were 1.4 times more likely to be hospitalised than Pākehā and this estimate was adjusted for age, sex, serovar, deprivation and occupation (Sokolova et al. 2021). This suggests the burden of infectious diseases on Māori and Pacific families, already overrepresented in most measures of inequalities, is higher than for other groups. In terms of gender inequalities, about 90% of people notified with leptospirosis are men; this probably reflects gender-specific roles in the work environment because where men and women work alongside each other on the same tasks, there was no significant difference in notification rates (El-Tras et al. 2018, pp. 164–165). What remains a constant throughout the decades is that 'incidence remained highest in meat workers and farmers' (Nisa et al. 2020, p. 842). To appreciate the financial burden of leptospirosis, we note that these costs are about USD 18.80 million per 100,000 people (Sanhueza et al. 2020).

Against this background, a team comprising veterinary scientists, epidemiologists, molecular biologists, social scientists, general practitioners, Māori health advisers and biostatisticians has been carrying out nation-wide research into leptospirosis in Aotearoa New Zealand between 2019 and 2022, with financial support from the Health Research

Council (HRC). As part of this research, a team with mixed backgrounds interviewed thirteen people who had been diagnosed with leptospirosis between 2019 and 2021 and who worked in meat-processing or farming occupations. The purpose of these interviews was to explore what messages and advice these people would give to others working in or around the livestock industry and to those in occupational healthcare, based on their lived experiences.

We open this article by outlining this research's methodology. Next, we present messages and advice about managing infection risks in the workspace. The analysis of these messages is mostly, relevant for people associated with livestock farming or the meat-processing industry – as workers, employers or health officials. After this, we share interviewees' comments about the impact of leptospirosis on their livelihoods. The analysis of these comments is primarily relevant for health policymakers, Aotearoa New Zealand's public Accident Compensation Corporation (ACC) and other, private, workplace insurers. In a closing section, we draw several conclusions that can assist in preventing leptospirosis infection in the workspaces of farms and processing plants. In addition, these conclusions offer some guidance to health officials and the ACC to improve the targeting of financial assistance from the ACC, as well as the ACC's reputation in the workplace.

Methodology

Between July 2019 and July 2021, the District Health Boards recorded 151 notifications of a diagnosis of leptospirosis; all were invited to participate in research and 80 of them accepted the invitation. The team of researchers and collaborators not only included academics from diverging disciplines in the natural and social sciences but also stakeholders such as laboratory technicians and Māori health advisers in DHBs, officials from the trade union and general practitioners. Arguably, designing and undertaking research to understand the characteristics and impact of zoonotic disease on people, their families and their communities demands the close collaboration of people from different academic disciplines and different professional backgrounds (Tobi and Kampen 2018; Harrison et al. 2020; Buyalskaya et al. 2021). We have found ourselves sharing similar experiences and reflections with other research teams, exploring the purpose and implications of transdisciplinarity (Vinetz et al. 2005; Binder et al. 2015; Knapp et al. 2019). Yet, it is worth noting that while we feel comfortable presenting our research as taking a transdisciplinary approach (Benschop et al. 2022), we also discovered that trying to engage both Pākehā sciences and mātauranga Māori (Māori knowledge) appears to be moving 'beyond a transdisciplinary model' (Moewaka Barnes et al. 2021, p. 306), with questions about the interfaces (pūtahitanga) between the two (Durie 2020; Sterling et al. 2020).

As with most cross- or transdisciplinary research, our research used a mix of quantitative and qualitative research methods (Teddlie and Tashakkori 2011; Almeida 2018; Timans et al. 2019). On the one hand, we used quantitative surveys with probability sampling and a case–control study, which produced data and findings that can be generalised to wider populations. Simply put, these surveys produce statistically relevant analyses, but do not reveal more personal experiences and views of research participants, nor do they allow the exploration of matters that researchers have not thought of. To hear participants' views delve deeper into their experiences, and possibly hear about matters we as researchers had not thought of, we used a semi-structured interview (Brown and Danaher 2019; DeJonckheere and Vaughn 2019), particularly as they are 'the most useful because of [their] focus and flexibility … may yield unexpected information' (Bamberger and Mabry 2020, p. 251). For this reason, semi-structured interviews with a self-selecting or a non-random purposive sample of people add significant value to mixed methods research, even if the findings are not generalisable to the wider population.

Using three selection criteria – diagnosed with leptospirosis between July 2019 and July 2021, working on livestock farms or in meat-processing plants, and having completed a set of surveys over a nine-month period – 61 of the 80 people who had accepted the invitation to participate in research were listed as potential interviewees. We then pragmatically considered availability and accessibility of researchers and interviewees for interviews at or near people's homes and approached 13 people asking for a semi-structured interview, prioritising diversity and thereby a chance at in-depth and potentially new insights from various personal profiles and professional environments (Table 1) enabling what Fusch and Ness defined as 'data triangulation for correlating [findings from] people, time, and space' (Fusch and Ness 2015, p. 1411). All 13 agreed keenly, also ensuring that people from all groups affected by leptospirosis were heard. (Ultimately, COVID-19 lockdown regulations led to some interviews being held via video conferencing. However, a review of the interview transcripts suggested no systemic differences between the two modalities.) With each interviewee's consent, the interview was audio-recorded, and the most relevant parts of the interview were transcribed. Each interviewee received this selective transcription of the interview, averaging nearly 5000 words, for approval or editing and all transcripts were approved.

We asked the 13 interviewees four open questions, and this article reports their answers to two questions: (1) Given your experience with leptospirosis, what advice would you offer people in the workspace, such as colleagues and employers? and (2) Can you tell me about the consequences and support for your income and bills for your household because of your leptospirosis? (The findings and analysis regarding the other two other open questions are detailed in [reference omitted for peer review]).

The transcripts were coded for recurring themes. If at least one-third of the thirteen interviewees (i.e. four people) chose to talk about a particular matter in response to the two questions, then we considered this matter was a 'recurring theme'. Having at least four individual people talking about such a particular matter means, in our view, that this matter is likely to be important beyond these few individuals' personal experiences. Looking for recurring themes in the 13 selective transcripts raises the question 'Is that a sufficient number of interviews to reach data saturation?' One methodological review of similar research concludes that '92% [of the themes] were identified within the first 12 interviews' (Guest et al. 2020, p. 2), another research finds that '16 or fewer interviews were enough to identify common themes' (Hagaman and Wutich 2017, p. 23). Similarly, Hennink et al see that 'code saturation was reached at nine

Table 1. Interviewees by gender, ethnicity and livestock sector.

Gender	Ethnicity	Occupation	
4 Female	9 European	4 Dairy farming	4 Dry stock farming
9 Male	4 Māori	5 Meat processing	

interviews, whereby the range of thematic issues was identified' (2017, p. 591). This leaves us reassured that the recurring themes we present in the next section most likely capture all relevant themes. As a next step, we will share these themes with representatives of all stakeholders to socialise them and then, when possible, include them in future surveys to determine the statistical relevance of each theme among workers in meat-processing plants and on farms.

Results

In this section, we detail the recurring themes in the transcripts and organise these themes in sections with messages directed at various (groups of) audiences: colleagues, health officials and employers and health officials and ACC.

Talking about the workspace: messages to colleagues

When people with leptospirosis were asked for their messages or thoughts to colleagues 'in the workspace', five recurring themes came to the surface. Four of these recurring themes are down-to-earth practices and we will start this section by detailing these. However, the most frequently recurring theme outlined at the end of this section is quite revealing in suggesting quite a number of people working in the livestock industry – on farms and in meat-processing plants – are well-informed about infection risks regarding leptospirosis.

Use PPE, though it is not always practical

First off, and perhaps unsurprisingly, about half the interviewees – six of the thirteen (46%) – advised their colleagues to use the appropriate PPE (Personal Protective Equipment) and wear it appropriately. However, among these comments, there was also often an acknowledgement that wearing PPE could be uncomfortable, make doing certain tasks harder or that the availability of the most appropriate PPE may be erratic.

> WorkSafe, they go, you know, a little bit over the top … Okay, we do need it … I have been on both sides of the fence. I've been a farmer and a trainer. (#2)

> I would just say wear your protective gear … I was on a job that didn't really need gloves because you weren't touching it, as such, but it was still getting on you and I wouldn't wear gloves because it made the job more difficult … on the farm, I work here, they have a rule that they will always wear gloves in the cow shed, but like it is getting so hot at the moment (#6)

> Because if you haven't got the protective gear to do your job, you know, they really need to get that to you. You wear masks and a snood and everything but it's still floating around me yeah … You've got your you got rubber gloves but the rubber gloves they break on you. They did give me the facemask, then the face shield. Or you just wear your ordinary office safety glasses. (#10)

Use of first-aid plasters

Still on messages to colleagues regarding preventative practices in the workplace, five of the thirteen interviewees (38%) advised their colleagues and peers to cover cuts on their hands with first-aid plasters to avoid infection with leptospirosis, even when several acknowledged in the same breath that getting minor cuts covered with plaster may be a bother.

> I just don't wear plasters … unless it's a major one. (#1)

> You know … cover those cuts. (#2)

> One cut, it gets in your pores and that is it. (#12)

Wash hands

Next, five of the thirteen interviewees (38%) advised their colleagues in strong terms to 'wash your hands', all the time, every time. Interestingly, all but one of these interviewees underscored this washing hands was especially important before eating any food.

> All the killing we do, shooting deer and all this … you go out docking or doing stuff you know, you don't, you don't always have clean hands. You know, you just eat lunch. (#1)

> Make sure you have a decent wash and clean all the blood and shit off you so that when you're eating sandwiches or whatever, that you are clean, because from your hands to your mouth that's where you can pick it up. (#7)

> You know the mimi [urine] on the bobby calves is sticky. You don't just want to wipe it into the pores of your skin. You need to wash it off … Wash, wash, wash … you're going to be eating your food. (#10)

Vaccinate your sheep, cows

Four of the thirteen interviewees (31%) advised their colleagues and peers to make sure their livestock – both cows and sheep – are vaccinated against leptospirosis.

> Vaccinate your sheep is what I reckon. So, we've started doing it. (#1)

> The farm that I work at now I ask about vaccinating the cows. I made it really very clear when I went to all my interviews that I need to make sure that your cows are vaccinated. (#6)

> I vaccinated them [cows] … not necessarily everyone will have done that. They are supposed to but still it doesn't always get it done … It's a shame yep. (#9)

Focus on the source and moment of infection

Perhaps remarkably, nearly two-thirds of the interviewees – eight of thirteen (62%) – began their response to the question about advice to colleagues with a detailed reflection on how and where they believed they were infected with leptospirosis. Some of them pin-pointed the moment.

> The reason why I got it, it was doing some shearing shed maintenance … Got down to the last machine … reached into grab it … It hooked on something that was my hand, cut my fingers. Oh, okay, my hands are dirty. So, it made it bleed. And um, jeez I'd better cover that, got stuff from the car and covered it up … That little wee cut … catastrophic results (#2)

> Yeah, when I got infected … I was up into the front part of my boat. Cleaning. Under the bunks and rats had made a big, huge nest. I cleaned it up and then I got the water blaster

and water blasted. I think it was like a little droplet from the water blaster is what infected me. (#8)

That area … that's actually where I caught the infection, because it was where I was taking the skin off and the urine splashed up and went over the top of me … It was on one Friday; one Friday I was actually covering for someone. (#12)

It may be worth noting that these interviewees also indicated there was awareness about specific locations or activities in their workplaces carrying higher risks for contracting leptospirosis than other locations or activities. One noted for example, 'I'm stuck in that area … not many people actually want to get in there, it is too bloody for them, too messy' (#12). However, others commented that this awareness, if it is there, may not help much because 'We just carry on to get some money for food on your table, you've got to pay for your rent. We just do what we must and take the nastiness' (#10). In contrast, two interviewees made comments suggesting that it was not worth looking into the matter of how or where they got infected with leptospirosis. 'It hasn't really bothered me' (#3) and 'I don't know. Whatever … It's just odd. I don't know. It's bad luck' (#5).

Talking about the workspace: messages to health officials and employers

The analysis of the messages and comments in interviews yielded two recurring patterns that spoke to the responsibilities of employers and health officials. First, many interviewees spoke of the need to provide more and more targeted information on leptospirosis. Second, several interviewees advised that employers and the self-employed needed to improve the working conditions of the workspace to reduce the risk of infection.

Provide targeted information on leptospirosis: places and platforms

Most interviewees discussed the matter of accessing information about leptospirosis. However, when it came to how health officials and employers should avail information about leptospirosis and preventative measures, there was a very clear divide between providing information to the 'people who are not computer smart' and, on the other hand, 'the young fellows there' (#7). For what is most likely to be the older generation, four of the thirteen (31%) interviewees noted a preference for paper-based (local newspapers, emails from vets, brochures and cards) and face-to-face information available in local places of importance to farmers or employees in the meat-processing industry.

There's still a lot of farmers out there like me that don't do computers … So, there's a fair few of us in our group that are, you know, my age, and just want to stay old school in Pahiatua, so yeah … farmers turning up. you know, you can have afternoon tea … chance for them to catch-up. Cockies [small farmers] need time off-farm. So, we do discussion group once a month. (#1)

I got all those papers and I've read them. I actually took them to work. (#7)

Well, it would be handy if there was a brochure or something at the at the plant, so people know what symptoms … if they are going to contract it. That would be very handy. Because they don't have any there. (#12)

A similar size group of interviewees – five of thirteen (38%) – indicated they accessed a range of platforms on the internet to get information on leptospirosis, ranging from a Google search to Facebook groups and specific websites such as DairyNZ.

> I just Google stuff. (#8)

> DairyNZ … they're really good, good page on the website. (#9)

> I was on Facebook, and I was reading about it. (#10)

Improve working conditions

Four of the thirteen interviewees (31%) provided advice with regard to improving working conditions to reduce the risks of infection with leptospirosis. The advice fell into two distinct categories. On the one hand, there was advice to farmers; people who had control over the working environment, their own farms and sheds. The overall tone of this advice was one of 'Just do it'.

> Talking about New Zealand and, you know, we're in the 21st Century now. And we are still working in slums? … Farmers you know, they are their own worst enemy … I see … a lot of machines [that] haven't been serviced in their lifetime … You walk into a wool shed and you can't see because it's too dark. It's just bloody too dark … a little bit of white paint around woolsheds … some of these fancy LED lights. (#2)

> There's rats … they do come in in the autumn like. Yeah. Like, sometimes when I turn the light on in the shed then I might see a rat run across the floor. So, you just put some rat bait down. (#5)

On the other hand, interviewees, who worked as employees in the meat-processing industry, shared advice on how to improve working conditions in the plant. The tenor of their advice was, however, one of low expectations because they deemed the managers of the industry were less interested in carrying the costs of improving the working conditions.

> When I told [name of company] about it, they just kind of brush it off like but didn't care about it, but it was a sickness that I should never really get from working there. Like they just didn't care. I mean that's just the type of people that work there, they just don't really care. (#6)

> [I am] near pulling the hide so everything's flicking in your face, it's getting in into your pores. You know and that, I think that needs more on the health and safety side … you got hot water, you got steam and stuff floating in the air … Sometimes the bobbies are above you because the chain is not straight … so the bobby calves are higher than you are … These people owning this company … they can turn a blind eye. (#10)

Talking about livelihoods: messages to health officials and the ACC

When interviewees replied to the question about the consequences of their leptospirosis infection on their income and financial situation, their messages to health officials and the ACC showed three recurring themes. Two recurring themes involve comments on assistance the interviewees received from their immediate family and from the wider community. This provides health policymakers with insights into the existing social (rural) support that kicks in when the need arises. The third recurring theme comprises comments on the impact that a disease like leptospirosis can have on people's financial security and interviewees divide themselves into two rather diverging groups.

Assistance from spouses and family

As already hinted above, about half the interviewees explained they had been shielded from financial hardship by having spouses and/or family members who took over their work or most critical tasks to ensure income or give financial support. Some interviewees who did talk of financial hardship also noted the support in labour or money they received from family or spouses. In all, seven of the thirteen interviewees (54%) detailed the assistance they received from immediate or wider family in cash or labour.

> I didn't really know if it was going to work, just like that's okay, Mum or Dad can support me if I run short. (#6)

> I had really amazing family that helped with the cows while I was really crook. (#9)

> You can't just live off the wife, the little income that she gets. Right yeah that was just not enough, you can count on $400. (#12)

Assistance from employees, colleagues or the wider community

Next to the assistance in labour or cash offered by family members, four of the thirteen interviewees (31%) also highlighted how employees, or colleagues, on farms, had stepped up to 'go the extra mile', or how people in their local community had taken up critical tasks on the farms.

> People that had to drop the whatever they were doing to come and run my farm for me when I was in hospital … It's what anyone does in a rural community … If you're a good person, then everyone is going to help you. So, but if you're not … well, people are still going to help you. (#1)

> I still got my own little farm. Got a really good friend and she helped me out. Yeah, it's good. (#2)

> We made it work here [in the business where interviewee now works]. (#9)

Financial impact of leptospirosis

When asked to comment on the financial effects of leptospirosis, the interviewees were divided into two groups: those whose circumstances or preparations shielded them from suffering significant financial hardship as a consequence of having leptospirosis – and those who had not. Among our thirteen interviewees, seven (54%) explained how they had been shielded from financial hardship. These seven interviewees mentioned a mix of ways in which the financial effects of their leptospirosis were mitigated; they accessed sizable savings, and/or had income streams and/or could count on spouses, family, employees or the wide community taking up (critical) parts of their work.

> We're very fortunate with our setup of the farm … We were lucky. You know, we had the savings, and we still have the income from the farm coming through. (#1)

> We feel sufficiently wealthy. And we're still well in addition to our super we've got substantial savings and we've also got a regular non-work-related income … I really would say that there was no financial impact, nothing for us. (#4)

> In regard to livelihood, I really wasn't affected that much. (#9)

Two of the other six interviewees commented they deemed the financial assistance received from the ACC as good or sufficient and suffered no financial hardship. The remaining four interviewees (31%) did report experiences of loss of income or financial distress.

> It was hay making season and that's what I get my major part of income from … I had to get another contractor and to do the job for me … I would say I lost quite a bit of income. (#8)

> I had to draw on my savings. (#10)

> Yeah, the week in hospital and then like three or four days at home. And then back at work … because you know the money situation. You've got to pay the bills somehow. (#12)

Financial support from the ACC was a topic that emerged in about half the interviews. An analysis of the interviews shows three recurring themes and all of them show quite widely shared or unanimous views. First, interviewees volunteered comments on the ACC's reputation across the livestock industry. Second, the interviewees who received financial assistance from the ACC also seem to be quite unanimous in their views of the financial assistance received. Finally, the third recurring theme that emerged captures the shared experiences of those interviewees who had had direct personal contact with ACC staff.

Reputation of the ACC

Before presenting findings on interviewees' access to ACC assistance, the analysis of the interview transcripts suggests that the reputation of the ACC in their environment may affect the decision of potential claimants to claim assistance. In clear terms, six of the thirteen interviewees (46%) made negative or low-expectations comments on the ACC. The descriptor of 'dicking people around' was used repeatedly.

> You know what ACC is like? Deny, deny … But we were ready to lawyer-up … going to dick us around … telling us that it wasn't going to happen. And I'm still in hospital. (#1)

> [Q: Did you consider ACC?] No, pretty hard to get usually … the most they do is cover the cost of the physio … When you are self-employed it is hard to prove loss of income … they go off your balance sheet and if you had a crappy year, you get bugger all or if you've had a good year, you might get something. (#3)

> You know it's hard to get on ACC. They probably know it's hard to get … They don't help you. (#10)

Assistance from the ACC

Probably partly as a consequence of the ACC's reputation among some interviewees, or partly because some they felt they did not need ACC assistance, or partly because they thought they would not qualify, a majority of the interviewees – eight of thirteen (62%) – did not undertake to apply for ACC assistance after their leptospirosis diagnosis.

Table 2. Type of interviewees' engagement with the ACC.

	Number of interviewees
Did not apply for ACC assistance	8
Applied for ACC assistance and received assistance	4
Applied for ACC assistance and did (yet) not receive assistance	1

Of the five interviewees who applied for ACC assistance, four had received financial assistance and one was still in a drawn-out process of obtaining it (Table 2).

Those who received ACC assistance shared comments suggesting they were pleased with the support or even surprised by the fact they received support from the ACC:

> ACC paid us for [spouse: '80% of his wages … For two months']. (#1)

> ACC paid, you know, much. I was really surprised … I was quite pleased. I didn't expect it to be you know, as much as that. (#2)

> I waited I waited. I waited months before I got compensation … Once you get paid it is ok. (#10)

Experience with ACC staff and processes

Irrespective of interviewees receiving ACC assistance, the interview transcripts show that six of the thirteen interviewees (46%) had had direct personal experience with ACC staff and processes. None of them commented in positive terms about these experiences. Most felt pushed around by multiple ACC staff through processes that they did not (clearly) understand, leaving interviewees frustrated or disheartened.

> We had a caseworker … She was like a flannel. We were left with like, 'Is this a caseworker?' … And the wording had to be perfect … It's just ACC. Yeah, they can just be mongrels … They're having a crack at your integrity. And that annoys, that annoys me. You know, 'So what, you're telling me I'm a liar?' (#1)

> They didn't want to accept because I couldn't prove that I had lepto. They wanted to have some sort of special test … They don't go out of their way to help you and our doctor didn't even know about it. They just want to make excuses … I got passed around to three or four different people … impossible to try and claim for ACC if you're self-employed. (#8)

> Yeah, and then they can blame you. Now trying to put the blame on you on how you got it … they ask you or have you worked on a farm, do you go hunting. Do you have rats at your house? Those are the questions that you get, so I say no bro, so I live in town I have got no risk. No, no I don't go on a farm, and I don't go hunting. They'll do anything to try and pinpoint something, you know that you've done in your life. If they can, they put blame on you. (#10)

Conclusions

Conclusions from interviews with thirteen people who have been diagnosed with leptospirosis between 2019 and 2021 and who volunteered to discuss their experiences with a Massey University research team should be prefaced with a note that our sampling enabled the exploration of in-depth data but is not representative of the people infected with leptospirosis. However, the personal characteristics of interviewees comprise men and women, European and Māori and farm workers as well as employees in the meat-processing industry. In this light, voices from many different groups are heard.

The interviewees expressed their advice and reflections on leptospirosis in two spheres. In the first sphere, they discuss managing or reducing the risk of infection in the workspace. Three conclusions emerge from the comments for colleagues and the self-employed and two conclusions speaking to health officials and employers. In the second sphere, the interviewees share how having leptospirosis, and often still suffering the effects after many months, has affected their livelihoods. These are messages directed mostly at health officials and ACC staff.

When it comes to managing infection risks in the first sphere, that of the workspace of a farm or meat-processing plant, the interviewees present three conclusions to their colleagues. First, nearly half the interviewees advised their colleagues to use the appropriate PPE – including the use of plasters to cover minor cuts on their hands. However, as they do so, they also acknowledge that using PPE (including plasters) is often a hindrance to, or discomfort, while performing the tasks. In the same sphere as comments on PPE, another recurring theme in the interviews was the advice to farmers to vaccinate their livestock. Even as many interviewees have suffered or continue to suffer the debilitating effects of leptospirosis, they still appreciate that the actual use of PPE in the workspace is limited. The first conclusion is that there is a need to investigate more closely as to how, where (in the meat-processing line, as well as on dairy farms), for whom (as people have different body sizes and shapes) and to what extent, each piece of PPE (gloves, goggles, face shields, aprons, etc.) may cause hindrance or discomfort to the extent that it leads users to put or push PPE aside. In addition, it would be advisable to include a review of recent literature on research that suggests some of the PPE may have limited effectiveness in the way it is used.

Second, the analysis of the interviews suggests that nearly half the interviewees advise their colleagues to wash their hands more often – particularly before eating. While research on the means of infection with leptospirosis is not conclusive when it comes to determining what the most occurring pathways for infections are, it is remarkable that interviewees focus exclusively on infection via the mucous membranes in the mouth by eating and not infection via the eyes or nose by rubbing as these places may itch from sweating. From these findings, it follows that it may be beneficial to highlight in instructional events and media that infection with leptospirosis happens not only via the mouth but also via the eyes and nose.

Third, and remarkably, nearly two-thirds of the interviewees believed they knew the place and moment (incident) of infection with leptospirosis in the workspace. The perceptions of some of these interviewees may be coloured by what is commonly referred to as ‘recall bias’ – e.g. when people fall ill with food poisoning, they try to trace back what they ate and then single out what they think caused it even if tests suggest that is unlikely to have been the case – but even so, these findings suggest high levels of knowledge and situational awareness around infection risks among many people on farms and in the meat-processing industry. However – and in combination with earlier conclusions regarding the limited use of PPE – these findings also lead to a conclusion that has an importance beyond colleagues in the workspace: knowing of risks, having situational awareness and having access to PPE, does not necessarily stop infections. A few comments suggest that workers may take infection risks knowingly because they feel pressured by workload and the need to make a living. 'We just do what we must and take the nastiness' (#10).

Following these three conclusions on infections in the workspace directed mainly at colleagues, the analysis of the interviews suggests two conclusions primarily directed at health officials and employers. First, the interviews reveal that a majority of the interviewees argue that more information and more targeted information on leptospirosis is needed. As for the latter, interviewees suggest the older generation is likely to prefer more information face-to-face or on paper, while the younger generation prefers, and is more likely to find, information on the internet. However, and importantly, these calls from interviewees for more and more targeted information on leptospirosis are at odds with the preceding conclusion that many workers believe they know how and where they were infected and therefore, seem to be informed about the risks of infection with leptospirosis. A conclusion for health officials and employers is that careful discussion with affected parties is needed to clarify this apparent contradiction: it is not evident that more training, more location-specific leaflets and more PPE will have a significant impact on knowledge of infection risks or actual infection rates.

A second conclusion on infections in the workspace for health officials and employers relates to a recurring pattern of comments about the working conditions. For farmers, the advice is they could reduce the risks of infections via small cuts by making sure there is enough light and visibility, that the tools are well-maintained and that pest control measures are applied. For employers and health officials in the meat-processing industry, the comments are sharper and darker, suggesting the interviewees have little confidence these employers care about working conditions and the associated risks. Tentatively, a conclusion from the interviews is that peer-to-peer conversations about improving physical working conditions on farms may very well yield an effect, but for the meat-processing industry regulatory inspection and enforcement may be needed to improve physical working conditions.

As noted, a second sphere of messages revolves around the impact leptospirosis has had on interviewees' income and livelihoods. These messages are primarily meant for policymakers in public health and ACC staff. Two conclusions emerge from the analysis of the interviews. First, family members of the interviewees offered financial support to about half of the interviewees from both farms and meat processing plants. Interviewees working on farms also received support in the form of labour to take care of tasks they could no longer perform. In addition, about a third of the interviewees working on farms reported receiving assistance from the wider rural community, to keep their farms running. The conclusion is, therefore, that while about half the people infected with leptospirosis received financial support and labour from their family and the neighbourhood to keep their livelihoods going, there is also the other half who does not report receiving material or labour assistance. This group comprises mostly people infected in the meat-processing industry, and this suggests that any intervention to reduce the impact of leptospirosis on livelihoods may need to prioritise people working in this industry. (Notably, changes in the meat-processing industry in the last couple of decades seem to have eroded the 'camaraderie' and 'strong social support among the workers' that research by Keefe-Ormsby (2010, p. 63) found when interviewing workers in the meat-processing industry in the 1990s.)

Second, looking at the overall impact of infection with leptospirosis on interviewees' income and livelihoods, the analysis of the interviews suggests a divide between the interviewees. About half of the interviewees indicated that being ill with leptospirosis had not significantly affected their income or livelihoods; most of them were farmers. This is not only because of the financial and labour assistance they have received from their family and rural community but also because they had other income streams and assets. 'We're very fortunate with our setup of the farm' (#1). In contrast, the other half of the interviewees – all working in the meat-processing industry – suffered significant financial losses or had to return to work a few days after being discharged from the hospital. 'Because, you know, the money situation' (#12). The conclusion, therefore, is that current access and processes of ACC can lead to rather inequitable outcomes in financial support for people infected with leptospirosis in their workplaces.

This critical importance of financial assistance from the ACC for about half the interviewees brings us to the final two conclusions from the interviewees that relate specifically to the ACC. First, about half the interviewees commented on the ACC in clearly negative terms and low expectations regarding financial assistance. 'It's hard to get on ACC' (#10). This pattern from our interviews matches ACC records obtained under the Official Information Act showing that a total of 346 leptospirosis claims for ACC assistance were made between 2006 and 2018, of which ACC declined 43% (Uy 2019, p. 81). This negative reputation probably contributed to the finding that a majority of interviewees did not even undertake to apply for financial assistance. It is, therefore, important to reiterate the other finding that the minority who did apply and receive financial assistance reported being pleasantly surprised with the financial assistance they received. 'I didn't expect it' (#2). The conclusion from these findings is that there seems to be a large gap between what people in the workspace expect from the ACC in terms of financial assistance and what they may receive. Obviously, both sides would benefit from seeing this gap bridged.

Second, irrespective of interviewees receiving financial assistance from the ACC, about half the interviewees talked about their personal experiences with the ACC – and all did so in negative terms regarding administrative processes and ACC staff. 'They're having a crack at your integrity' (#1). These stories inevitably feed the earlier finding of the poor reputation of the ACC among people in the workspace of farms and meat-processing plants. The conclusion regarding the ACC is that any endeavour by the ACC to bridge the gap between, on the one hand, its poor reputation among people in the workspace and, on the other hand, the appreciation of the persons who do receive financial assistance from the ACC, would probably need to include careful consideration of administrative processes and staff interaction with applicants. The interviews with people infected with leptospirosis suggest that even if financial assistance is successfully applied for and much appreciated, many applicants experience the process as frustrating and the interaction with the ACC as dispiriting, which will continue to taint the ACC's reputation.

Response from stakeholder representatives to findings

Once the draft of this article was complete, we sought responses from representatives of key stakeholders in the industry with whom we have ongoing collaboration, including Dairy New Zealand, Rural Women New Zealand, The Accident Compensation Corporation, The Meat Industry Association and the Meat Workers and Related Trades Union Aotearoa. While all engaged with us on this article, often in meetings with us, only the latter accepted the invitation to respond in writing to our findings. To illustrate an important aspect of our transdisciplinary approach, we are pleased to present their response.

Meat Workers and Related Trades Union Aotearoa (Assistant to the National Secretary, Amanda Stephens)

On behalf of the Meat Workers and Related Trades Union Aotearoa, we appreciate the findings from this research. The findings have led us to think about recommendations for risk management that are specific to three aspects of the red-meat production process: 1. before stock arriving at the slaughter floor; 2. while workers are in contact with animals and animal products on the slaughter floor and 3. in the event of a worker contracting leptospirosis, as follows:

- The development of a pen-side urine test that detects shedding in mobs of stock pre-slaughter. Justification: if the meat plant knows that a particular mob has shedders then you can put preventive measures in place on the chain, e.g. slow the chain down, give people more time between, to keep washing and make sure everything's covered, to make it less likely that workers get exposed.
- PPE specific to meat industry needs is researched and developed (lightweight, comfortable for diverse sizes and shapes and meets trading partners' requirements for food safety and COVID-19 reduction). Justification: PPE has been adapted for medical use or agricultural use; the slaughter-board is a hot, sticky and loud place; the industry employs Pacifica, Filipinos and women.
- Agreement with workplace insurers that if a meat worker tests positive for leptospirosis they automatically get covered. Justification: this takes a lot of stress away and the more stress people are under, the longer they take to recover.

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Human ethics

Our research received ethics approval from Aotearoa New Zealand's Health and Disability Ethics Committee, reference number 19/STH/80. The study also received local ethics approval from relevant District Health Boards (DHBs) in Aotearoa New Zealand and worked in consultation with Māori representatives in these DHBs.

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