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An outbreak of leptospirosis associated with cattle workers during the wet season, in the Northern Territory of Australia, 2021

Damien R Brown, Ruwani Peiris, Claire Waller, Elizabeth M Stedman, Susanne E Fitzpatrick, Vicki L Krause, Anthony DK Draper

Abstract

An outbreak of leptospirosis occurred in the Top End of the Northern Territory, Australia, during the wet season in early 2021. There were 14 outbreak cases; most were male (12/14; 86%) and non-Indigenous (13/14; 93%) with a median age of 22 years (range 19–52 years). We conducted a descriptive case series to investigate the outbreak. We determined that the outbreak was most likely due to higher than usual rainfall in a workplace with exposure to cattle, heightened by wearing clothing and footwear which offered little protection, with limited use of personal protective equipment (PPE). Increased and ongoing education for cattle industry workers, and promotion of the use of appropriate clothing and PPE, may minimise the risk of future outbreaks. Australia's national surveillance case definition for leptospirosis should be reviewed to incorporate the use of nucleic acid testing in the detection of leptospirosis.

Keywords: outbreak, leptospirosis, *Leptospira*, cattle, Northern Territory, rainfall.

Background

Leptospirosis is a widespread bacterial zoonotic illness, occurring worldwide but more commonly in the tropics.¹ *Leptospira* spirochetes, of which there are nearly 300 serovars, are found in numerous domestic and wild animals, including rats, cattle, pigs and dogs.¹ Humans can become infected when animal urine or tissue, or environmental matter contaminated with the same, enters the body through skin abrasions or via mucous membranes.¹ Illness can range from a mild, self-limiting flu-like condition to severe and potentially fatal disease.¹ Appropriate antibiotic therapy is usually highly effective.² Outbreaks are often associated with occupation (e.g. farming and cattle work)^{3,4} and with recreational activities (e.g. freshwater sports),^{5,6} with spread exacerbated by heavy rainfall and flooding.^{7–11}

On average, two or three cases of leptospirosis are notified annually in the Northern Territory

(NT), usually in the Top End wet season (Figure 1) with a previous outbreak occurring in 2017.¹²

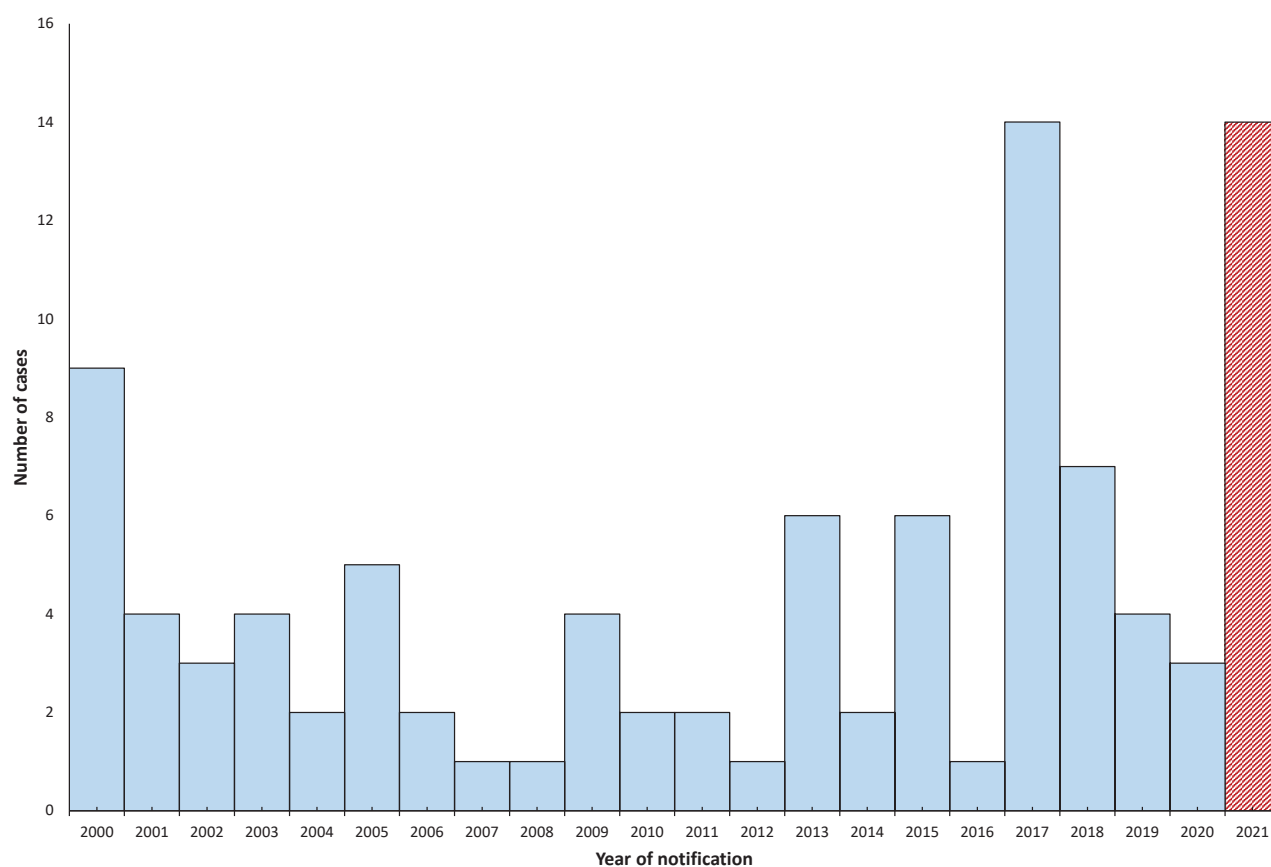
In 2021, a cluster/outbreak investigation was initiated after six cases were notified to the NT Centre for Disease Control (CDC) by 18 February. We describe the investigation.

Methods

Epidemiological investigation

A confirmed outbreak case was defined as any person notified with leptospirosis in the NT (i.e. meeting the Australian national notifiable diseases case definition)¹³ with onset after 1 January 2021. A probable outbreak case was defined as any person with a clinically compatible illness AND an epidemiological link to a confirmed outbreak case AND leptospirosis detected by nucleic acid testing from urine or

Figure 1: Epidemiological curve of leptospirosis cases notified in the Northern Territory, Australia (2000-2021)



blood samples, with onset after 1 January 2021. The detection of leptospirosis by nucleic acid testing is an accepted surveillance case definition by the United States of America's Centres for Disease Control and Prevention¹⁴ but is not regarded, in Australia, as definitive evidence.

Case finding occurred through routine notification activity. Some potential cases self-reported to the CDC following a media release on 1 March 2021 which alerted the NT public to the outbreak.¹⁵

We conducted a descriptive case series investigation. We used a case questionnaire to record symptoms, laboratory results, exposures and risk factors. Descriptive analysis was performed using Microsoft Excel 2010.

Laboratory investigation

Serum, blood or urine was collected and polymerase chain reaction (PCR) testing or serological testing was performed, depending on what was requested by the treating clinician. Serology testing for leptospirosis immunoglobulin M (IgM) was performed on acute phase serum and on convalescent serum (which, if obtained, was collected at least two weeks later) using the microscopic agglutination test (MAT). Serovars of *Leptospira* spp. included in the MAT panel were: Arborea; Australis; Bataviae; Bulgarica; Canicola; Celledoni; Copenhageni; Cynopteri; Djasimen; Grippotyphosa; Hardjo; Javanica; Kremastos; Mendanensis; Panama; Pomona; Robinsoni; Shermani; Szwajizsk; Tarassovi; Topaz; and Zanoni.

Veterinary and environmental investigation

Leptospirosis is not a notifiable disease of animals; however, we reviewed submissions of diagnostic animal cases to the Berrimah Veterinary Laboratory, Darwin, from 1 January 2021 for possible related animal cases. We examined rainfall patterns in the NT using data from the Australian Bureau of Meteorology (BoM).

Results

Epidemiological investigation

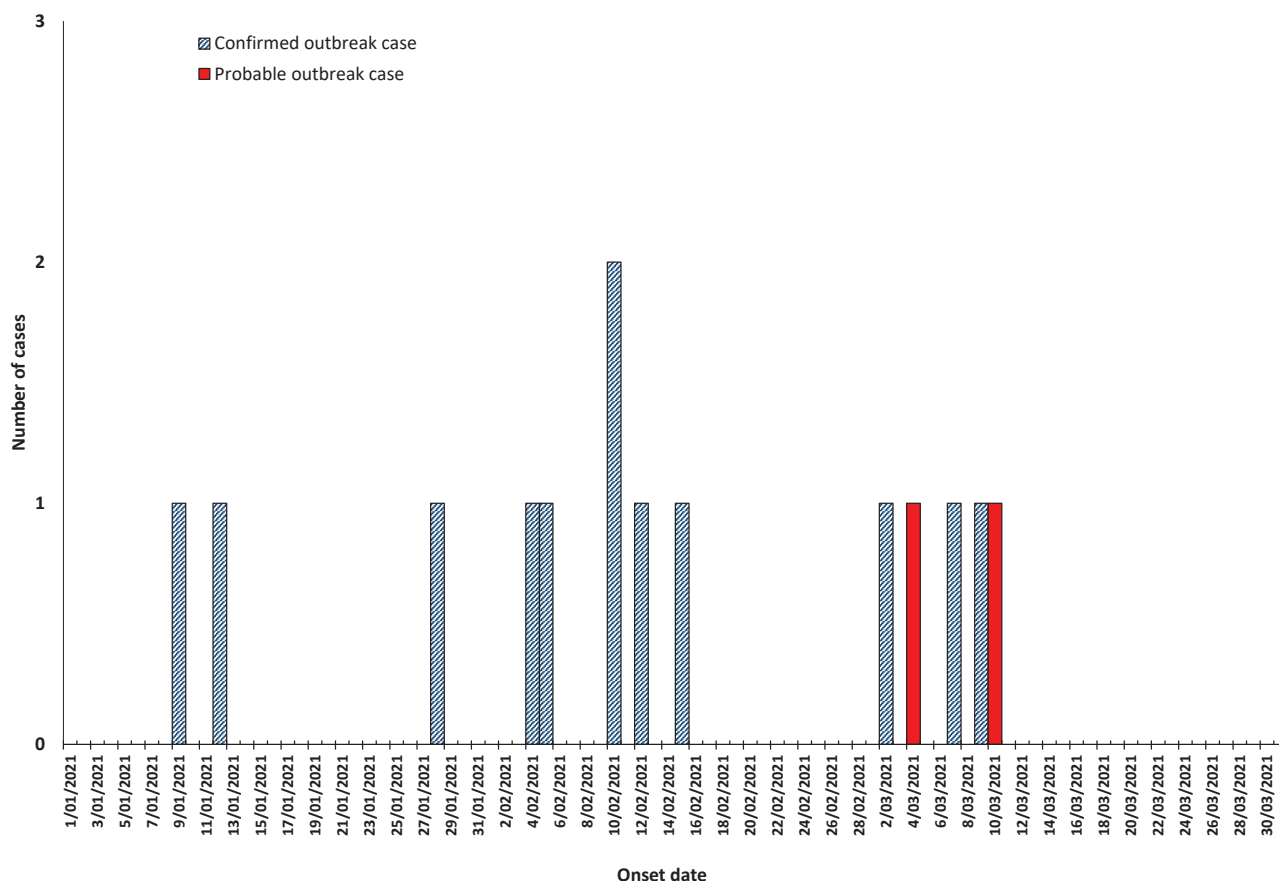
There were 14 cases that met the outbreak case definition: 12 confirmed and two probable cases (Figure 2). The majority of cases were male (12/14; 86%) and non-Indigenous (13/14; 93%), with a median age of 22 years (range 19–52 years).

In addition to fever (14/14; 100%), the predominant symptoms were myalgia/arthralgia (10/14; 71%), headache (10/14; 71%), and rigors (8/14; 57%) (Table 1). There were four cases who required hospitalisation with a median duration of three days (range 2–6 days). No cases required admission to an intensive care unit, and none died.

Twelve cases had significant cattle exposure through their work, one through recreation (fishing near cattle); another could not be interviewed. Two had been pig hunting; another reported a number of rats/mice on their property. All reported minimal if any PPE use; many worked in shorts and wore no gloves when handling cattle, citing high ambient heat and humidity as reasons. Regular handwashing was seldom practised.

Two cases worked and/or lived in the Katherine region and 12 cases in the Daly River/Litchfield regions (Figure 3). Five of the cases worked on

Figure 2: Epidemiological curve of outbreak cases by onset date, 1 January to 31 March 2021 (n = 14)



the same cattle station, accounting for the mid-February peak in cases; two others worked at a cattle transfer station which received cattle from this first cattle station, and indeed from the wider region. Five other stations had one case each.

Laboratory investigation

Of the 14 outbreak cases, 12 were identified to the serovar level; 11 were *Leptospira interrogans* serovar Hardjo and one was *L. weilii* serovar Topaz. Two cases were positive by PCR only (Table 2).

Of the 11 cases that were identified as *L. Hardjo*, ten were interviewed; 9/10 (90%) reported their occupation as ‘cattle worker’ and the other was a student who reported fishing near cattle. The case of *L. Topaz* and the two cases that were PCR positive only (no serovar determined) also worked in the cattle industry.

Table 1: Clinical characteristics of leptospirosis outbreak cases, Northern Territory, Australia, January to March 2021 (n = 14)

Symptom	Number of cases (%)
Fever	14 (100)
Myalgia/arthralgia	10 (71)
Headache	10 (71)
Rigors	8 (57)
Vomiting	6 (43)
Diarrhoea	3 (21)
Conjunctival suffusion	1 (7)

Veterinary and environmental investigation

There were no cases of suspected or confirmed clinical leptospirosis identified in animals.

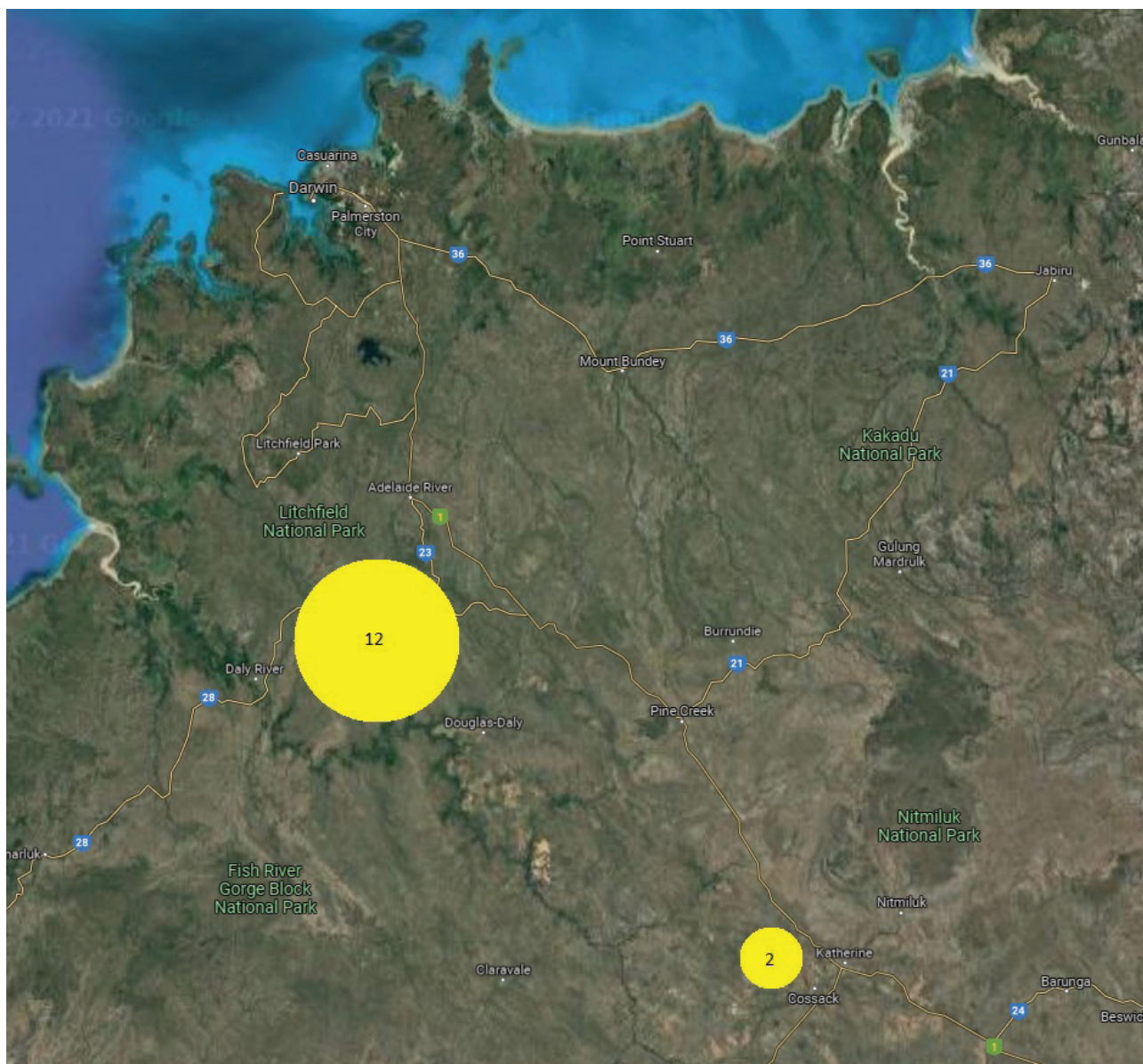
Table 2: Leptospirosis outbreak cases by diagnostic method(s) and results, Northern Territory, Australia, January to March 2021 (n = 14)

Case number	Date of initial test	Onset date	Serology			PCR ^a	
			Acute titre	Convalescent titre ^b	Serovar ^b	Serum ^b	Urine ^b
1	13/01/2021	09/01/2021	3200	—	Hardjo	—	—
2	15/01/2021	12/01/2021	800	—	Hardjo	—	—
3	28/01/2021	28/01/2021	3200	—	Hardjo	—	—
4	6/02/2021	05/02/2021	0	800	Hardjo	Detected	Not detected
5	9/02/2021	09/02/2021	0	800	Hardjo	Not detected	Not detected
6	11/02/2021	10/02/2021	0	200	Hardjo	Detected	—
7	15/02/2021	12/02/2021	0	3200	Hardjo	Detected	—
8	15/02/2021	15/02/2021	0	400	Hardjo	Detected	Detected
9	15/02/2021	10/02/2021	800	1600	Hardjo	Not detected	—
10	18/02/2021	04/02/2021	1600	3200	Topaz	Detected	—
11	4/03/2021	04/03/2021	0	—	—	Detected	—
12	10/03/2021	09/03/2021	0	—	—	Detected	—
13	11/03/2021	07/03/2021	0	1600	Hardjo	Detected	—
14	12/03/2021	10/03/2021	0	1600	Hardjo	—	Detected

a PCR: polymerase chain reaction.

b ‘—’: not available/not tested.

Figure 3: Location of leptospirosis cases in the Top End of the Northern Territory, Australia, January to March 2021 (n = 14)^{a,b}



a Map credit: Google.

b Circles with case numbers represent the wider regions where cases likely acquired their infections.

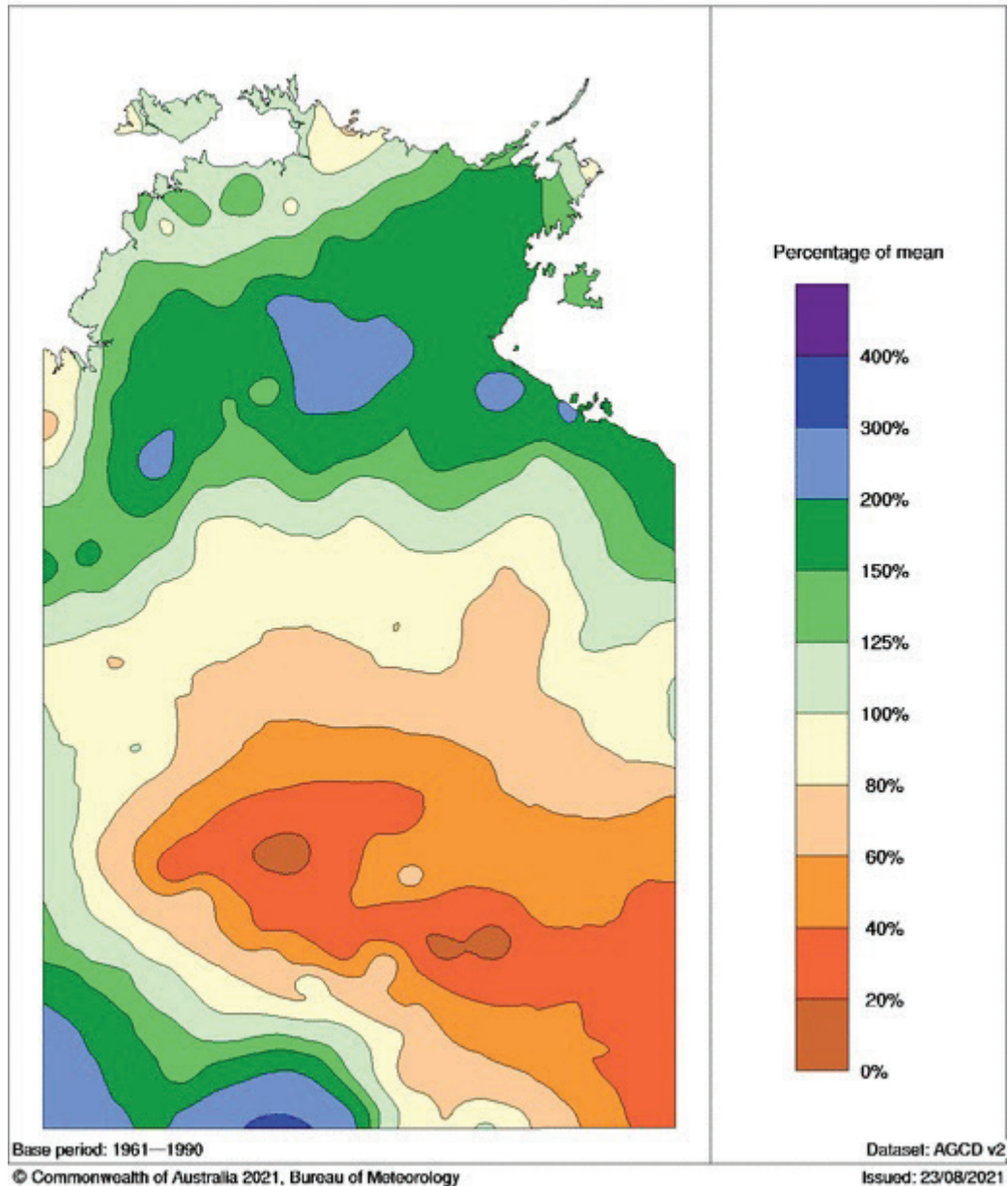
Relevant cattle properties were contacted by a veterinary officer; none reported clinical signs of leptospirosis or other illness in any animals.

February 2021 began with an active monsoon across the Top End of the NT. Rainfall in the NT was 22% above the long-term average for the month and two sites within the generalised outbreak region received their highest February rainfall on record.¹⁶

Public health response

Following the initial detection of an outbreak in February 2021, a media release was issued and industry was engaged.¹⁵ An advisory group was assembled which included the public health unit, Environmental Health, the NT Chief Veterinary Officer, and government media. Managers of cattle stations with known human cases were contacted directly and were provided with information and education

Figure 4: Northern Territory total rainfall compared to mean, February 2021



on prevention.¹⁷ Medical officers and clinic managers were advised to be alert for potential leptospirosis cases in the outbreak region, particularly amongst cattle workers.

Discussion and conclusion

Cattle are well-known sources of human leptospirosis, particularly due to *L. Hardjo*.³ The majority of cases in our outbreak were young cattle workers and the Hardjo serovar was predominant. While no cases of clinical animal disease were reported during this outbreak

investigation, *L. Hardjo* infection in cattle is often subclinical in presentation and may not be observed.¹⁸

It is likely that high rainfall and wet and muddy conditions contributed to the transmission of disease, with hot and humid temperatures also likely contributing to work practices that increased the risk of exposure to workers such as: working in shorts; wearing open footwear (thongs/sandals); and not using appropriate PPE such as gloves, eye shields or aprons when handling cattle or in environments contaminated with urine. Infrequent handwashing, and

smoking while working, also likely increased the risk of infection. There was a lack of awareness of the risks of leptospirosis, with a high turnover of seasonal workers possibly a contributing factor. The provision, upon commencement, of ongoing and regular training and education to cattle workers is arguably the most effective intervention to prevent future outbreaks.

Seasonal prophylactic doxycycline (200 mg weekly) could be a possible preventative measure for cattle workers in the Top End;¹⁹ however, the common side effect of increased photosensitivity and susceptibility to sunburn may detract from its uptake. Furthermore, a systematic review in 2009 did not identify clear benefit from prophylactic doxycycline in preventing leptospirosis.²⁰

Cattle can be effectively vaccinated against *L. Hardjo* and *L. interrogans* serovar Pomona; however, the vaccine schedule is onerous, with doses required at 6 and 12 weeks of age, followed by annual boosters.²¹ Leptospirosis vaccination of cattle in the Northern Territory is uncommon, due to the practical challenges and costs associated with the mustering of large numbers of cattle on extensive pastoral properties.

Our investigation identified that Australia's national notifiable diseases case definition is in need of review. Two of our outbreak cases (probable) were detected by PCR only which currently does not meet the confirmed national surveillance case definition which has not been updated since 2004. A simple change in nomenclature to the required laboratory definitive evidence from "isolation of pathogenic *Leptospira* species" to "detection of pathogenic *Leptospira* species" would result in our probable cases meeting confirmed national surveillance case definitions and would see Australia align with other developed countries.¹

i NOTE ADDED IN PROOF: As updated on 19 December 2021 (and implemented on 1 January 2022), the Australian national case definition for leptospirosis now states that both confirmed cases and probable cases should be notified, the latter requiring laboratory suggestive evidence: viz., detection of pathogenic *Leptospira* species by nucleic acid testing.¹³

Acknowledgements

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Author details

Damien R Brown,¹
Ruwani Peiris,¹
Claire Waller,²
Elizabeth M Stedman,³
Susanne E Fitzpatrick,³
Vicki L Krause,¹
Anthony DK Draper^{1,4}

1. Centre for Disease Control, Public Health Unit, Top End Health Service, Northern Territory Government Department of Health, Darwin, Northern Territory, Australia.
2. Territory Pathology, Northern Territory Government Department of Health, Darwin, Northern Territory, Australia
3. Livestock Biosecurity, Biosecurity and Animal Welfare Branch, Department of Industry, Tourism and Trade, Berrimah, Northern Territory, Australia.
4. Menzies School of Health Research, Darwin, Northern Territory, Australia.

Corresponding author

Anthony Draper
Centre for Disease Control, Public Health Unit, Top End Health Service, Northern Territory Government Department of Health, PO Box 45096, Casuarina NT 0811.
Telephone: +61 8 8922 7635.
Facsimile: +61 8 8922 8310.
Email: anthony.draper@nt.gov.au

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Appendix A

Box A.1: Australian national surveillance case definition, as of February 2021^{a,b}

Only **confirmed cases** should be notified.

Confirmed case

A confirmed case requires **laboratory definitive evidence** only.

Laboratory definitive evidence

1. Isolation of pathogenic *Leptospira* species

OR

2. A fourfold or greater rise in *Leptospira* agglutination titre between acute and convalescent phase sera obtained at least two weeks apart and preferably conducted at the same laboratory

OR

3. A single *Leptospira* micro agglutination titre greater than or equal to 400 supported by a positive enzyme-linked immunosorbent assay IgM result.

a Australian Government Department of Health.¹³

b As updated on 19 December 2021 (and implemented on 1 January 2022), the Australian national case definition for leptospirosis now states that both **confirmed cases** and **probable cases** should be notified, the latter requiring **laboratory suggestive** evidence: viz., detection of pathogenic *Leptospira* species by nucleic acid testing (Australian Government Department of Health).¹³

Box A.2: CDC (United States of America) surveillance case definition^a

Probable

A clinically compatible case with at least one of the following:

- Involvement in an exposure event (e.g., adventure race, triathlon, flooding) with known associated cases, *or*
- Presumptive laboratory findings, but without confirmatory laboratory evidence of *Leptospira* infection.

Confirmed

A case with confirmatory laboratory results, as listed below.

Laboratory Criteria for Diagnosis

Diagnostic testing should be requested for patients in whom there is a high index of suspicion for leptospirosis, based either on signs and symptoms, or on occupational, recreational or vocational exposure to animals or environments contaminated with animal urine.

Supportive:

- *Leptospira* agglutination titer of ≥ 200 but < 800 by Microscopic Agglutination Test (MAT) in one or more serum specimens, *or*
- Demonstration of anti-*Leptospira* antibodies in a clinical specimen by indirect immunofluorescence, *or*
- Demonstration of *Leptospira* in a clinical specimen by darkfield microscopy, *or*
- Detection of IgM antibodies against *Leptospira* in an acute phase serum specimen.

Confirmed:

- Isolation of *Leptospira* from a clinical specimen, *or*
- Fourfold or greater increase in *Leptospira* agglutination titer between acute- and convalescent-phase serum specimens studied at the same laboratory, *or*
- Demonstration of *Leptospira* in tissue by direct immunofluorescence, *or*
- *Leptospira* agglutination titer of ≥ 800 by Microscopic Agglutination Test (MAT) in one or more serum specimens, *or*
- Detection of pathogenic *Leptospira* DNA (e.g., by PCR) from a clinical specimen.

a United States Government Department of Health and Human Services, Centers for Disease Control and Prevention.¹⁴