

Legionellosis in Queensland

2016

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Published by the State of Queensland (Queensland Health), September 2017



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Acknowledgements

This report was prepared by the Communicable Diseases Branch, Department of Health. We gratefully acknowledge the clinicians in Queensland public health units who manage the public health follow up and collect surveillance data for legionellosis cases, alongside Queensland laboratories for the continued provision of laboratory services to detect *Legionella* in Queensland.

1. Introduction

Legionellosis is an infection caused by Legionella bacteria. Legionella bacteria are Gram negative bacilli with 48 species and at least 70 serogroups recognised (1). Legionella bacteria are widespread in the environment, and in particular in natural and man-made aquatic environments (2, 3). They can be found in creeks, ponds, and soil, as well as having been isolated from hot water systems, cooling towers, evaporative condensers, humidifiers, whirlpool spas, respiratory therapy devices, decorative fountains, hot and cold water taps, and shower heads (4). The most common pathogenic species in Australia are *Legionella pneumophila* and *Legionella longbeachae*, with these two species accounting for 99 per cent of all notified cases of legionellosis in 2014 (5). Whilst Legionella bacteria have strict requirements for growth, they may be resistant in their ecological niches to many of the usual mechanisms of disinfecting water supplies, and when protected by biofilm will survive levels of chlorination that would eliminate most enteric pathogens (6).

Legionellosis is acquired through airborne transmission, involving inhalation of Legionella-containing aerosols (1). Most *Legionella spp.* are associated with water, with the exception of *L. longbeachae*, which has been associated with soil, gardening, and potting mixes (7, 8). In addition to airborne transmission from the environment, other modes of transmission are possible. For example, aspiration of water contaminated with Legionella bacteria has been described, but is uncommon and predominantly occurs in persons with swallowing disorders or in conjunction with nasogastric feeding (9).

Legionella is known as an opportunistic pathogen; exposure to the Legionella bacteria will not cause disease in most healthy people as the body's immune system is able to prevent illness. Risk factors for developing legionellosis include being a smoker, having an underlying chronic medical condition/s (including diabetes, chronic heart disease, chronic renal failure) and immunosuppression (from certain types of cancers such as leukaemia and lymphoma, post transplantation, or use of immunosuppressant drugs including glucocorticosteroids), being male, and being aged over 50 years of age (1, 4, 10).

There are two clinical presentations of legionellosis, Pontiac fever and Legionnaires' disease, with differing severity in the two presentations. Pontiac fever is generally a mild, self-limiting febrile illness and Legionnaires' disease is typically a more severe, and potentially fatal pneumonic form (4). Symptoms of the disease may include malaise, myalgia, anorexia, headache, and fever, with a non-productive cough and gastrointestinal symptoms such as abdominal pain and diarrhoea (1). The case fatality rate of Legionnaires' disease is thought to be 10–15 per cent (1, 4); more recent European Union Legionnaires' Disease surveillance indicates case fatality rates of approximately 8-9 per cent (11, 12). In large community outbreaks, where active case finding may identify mild cases of legionellosis, the case fatality rate may be as low as one per cent (13).

This report describes the demographic profile of legionellosis cases, including clinical details, laboratory testing, risk factors, and exposures collected through the public health follow up of cases in Queensland.

2. Methods

Legionellosis is a notifiable condition on pathological diagnosis under the Queensland *Public Health Regulation 2005*. This requires pathology providers to notify the Department of Health of any positive tests for *Legionella spp.* as per the Queensland notification criteria guidelines for laboratories (14). Cases were classified as per the national case definition for legionellosis (see Box 1) into confirmed (valid) or probable cases (15). Notified cases are followed up by public health physicians, nurses and environmental health officers to establish clinical symptoms, risk factors, and exposure history.

Box 1: Legionellosis case definition (effective 1 January 2013)

Confirmed case

A **confirmed case** requires **laboratory definitive evidence** AND **clinical evidence**.

Laboratory definitive evidence

Isolation of *Legionella* OR detection of *Legionella* urinary antigen OR seroconversion or a significant increase in antibody level or a fourfold or greater rise in titre to *Legionella*.

Clinical evidence for confirmed cases

Fever OR cough OR pneumonia

Probable case

A **probable case** requires **laboratory suggestive evidence** AND **clinical evidence**.

Laboratory suggestive evidence

Single high antibody titre to *Legionella* OR detection of *Legionella* by nucleic acid testing OR detection of *Legionella* by direct fluorescence assay.

Clinical evidence for probable cases

Fever AND cough OR pneumonia

Data were extracted from the Queensland Notifiable Conditions System on 16 March 2017 for all confirmed and probable cases of legionellosis with onset of disease between 1 January 2007 and 31 December 2016. Cases were assigned to a geographic Hospital and Health Service (HHS) area based on their residential address at the time of notification. Whilst Children's Health Queensland is a Queensland Hospital and Health Service, it does not have a geographic area nor population assigned to it and so has not been reported in the HHS of residence tables in this report.

Descriptive analyses were performed using Microsoft Excel™. Geographic distribution analyses used Queensland Hospital and Health Service (HHS) boundaries. All rates were calculated using the Queensland Estimated Resident Population (ERP) 2007-2015. The 2015 population was used to calculate 2016 rates as 2016 ERP was not available at time of report.

3. Demographic data

There were 48 notified cases of legionellosis notified in Queensland in 2016, consisting of 30 confirmed cases and 18 probable cases (Table 1). The notification rate in 2016 was 1.0 case per 100,000 population. The number of notified cases of legionellosis in 2016 showed a decreasing trend following the peak in 2013, with the decrease in the proportion of probable cases seen in 2015 persisting (37 per cent in 2016) (Figure 1).

Table 1: Number of cases of legionellosis by confirmation status, Queensland, 2007-2016

Year of onset	Confirmed n (%)	Probable n (%)	Total n (%)
2007	47 (98%)	1 (2%)	48 (100%)
2008	30 (100%)	0 (0%)	30 (100%)
2009	50 (93%)	4 (7%)	54 (100%)
2010	34 (81%)	8 (19%)	42 (100%)
2011	43 (93%)	3 (7%)	46 (100%)
2012	46 (66%)	24 (34%)	70 (100%)
2013	84 (51%)	80 (49%)	164 (100%)
2014	46 (49%)	47 (51%)	93 (100%)
2015	50 (63%)	30 (37%)	80 (100%)
2016	30 (63%)	18 (37%)	48 (100%)

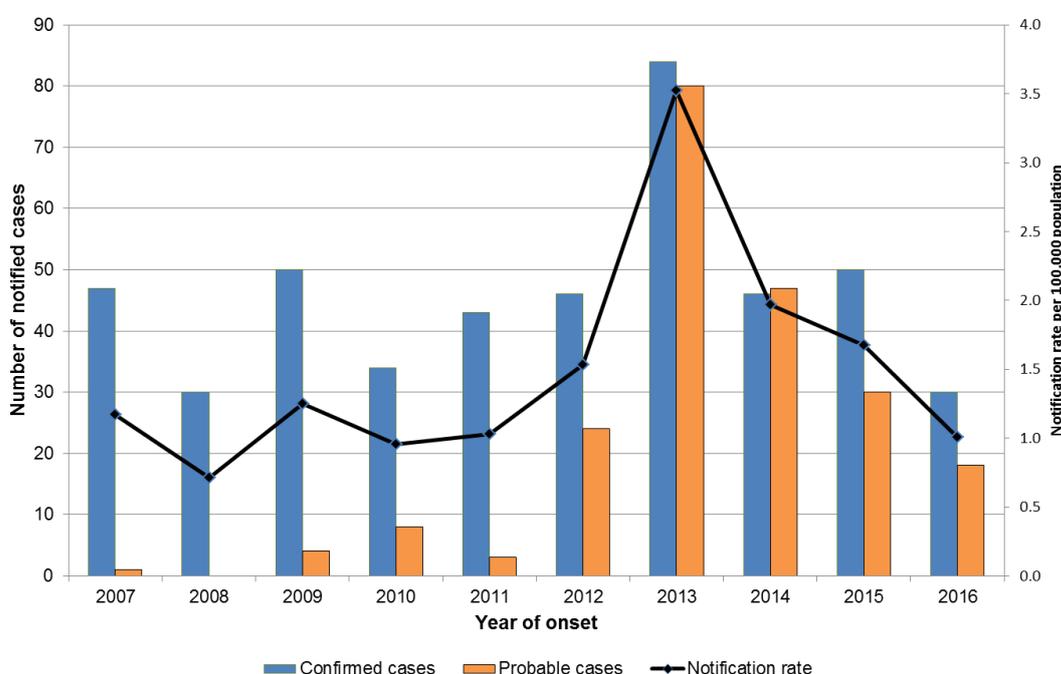


Figure 1: Notified cases of legionellosis by confirmation status and notification rate of total legionellosis, Queensland, 2007-2016

There were 36 males (75 per cent) and 12 females (25 per cent) notified in 2016. The age range of cases was 32 to 91 years, with a median age of 67.5 years for all cases. The median age for males was 69.5 years and 58.5 years for females. The modal (most frequently notified) age group was the 70-74 year age groups, with notification rates highest in the 80-84 and 85 and older age groups at 6.1 cases per 100,000 population per year (Figure 2).

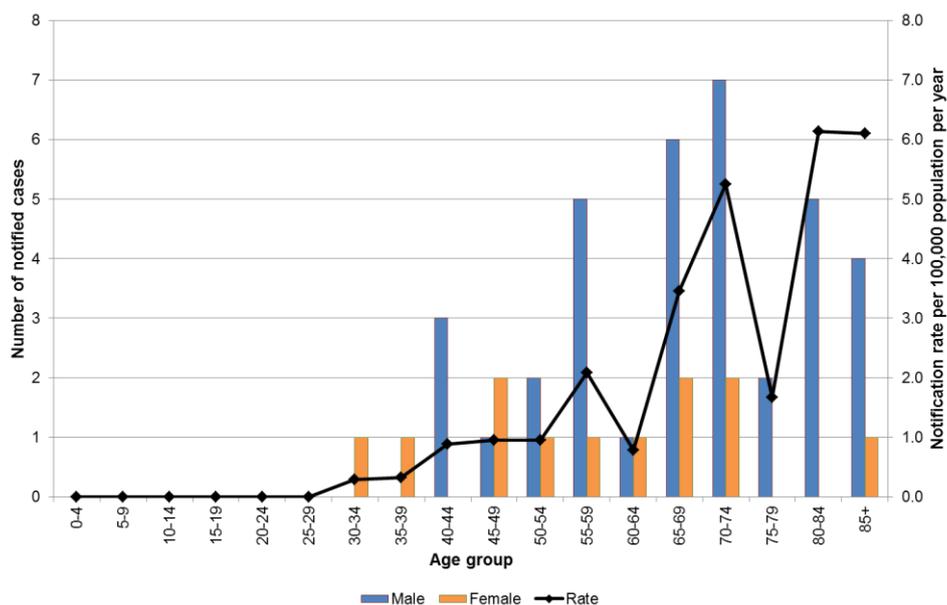


Figure 2: Notified cases and notification rate by age group and sex, Queensland, 2016

In 2016, 29 notified cases (60 per cent) were found to be caused by *L. pneumophila*, and 19 cases (40 per cent) caused by *L. longbeachae*. No other species were detected in Queensland in 2016. Over the ten year period from 2007-2016, there were 310 cases (46 per cent) of *L. pneumophila*, 252 cases (37 per cent) of *L. longbeachae*, and 113 cases (17 per cent) of other and unspiciated Legionella (Figure 3).

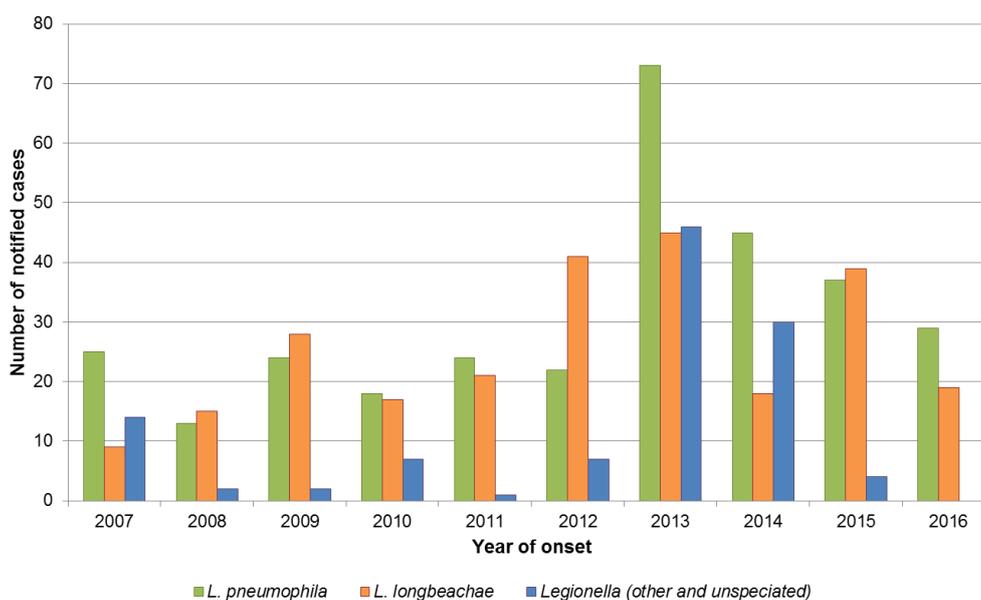


Figure 3: Number of notified cases of legionellosis by species, Queensland, 2007-2016

In 2016, the highest notification rate for all cases of legionellosis was Sunshine Coast Hospital and Health Service (HHS) with 2.3 notified cases per 100,000 population per year (9 cases), followed by Darling Downs HHS (4 cases, 1.4 cases per 100,000 population per year), and Wide Bay HHS (3 cases, 1.4 cases per 100,000 population per year) (Table 2). These rates are based on small numbers and are not age-standardised, so they do not necessarily indicate any change in legionellosis risk in these HHSs. Geographic distribution is based on a case's usual place of residence at the time of diagnosis and not necessarily their place of exposure.

Table 2: Number of cases by species and confirmation status, and notification rate of legionellosis by Hospital and Health Service of residence, Queensland, 2016

HHS	<i>L. pneumophila</i>		<i>L. longbeachae</i>		Total cases	Notification rate (per 100,000 population)
	Confirmed	Probable	Confirmed	Probable		
Cairns and Hinterland	1	-	-	-	1	0.4
Central Queensland	3	-	-	-	3	1.3
Central West	-	-	-	-	-	-
Darling Downs	1	-	1	2	4	1.4
Gold Coast	3	-	-	-	3	0.5
Mackay	-	-	-	1	1	0.5
Metro North	5	1	2	4	12	1.3
Metro South	3	2	-	3	8	0.7
North West	-	-	-	-	-	-
South West	-	-	-	-	-	-
Sunshine Coast	4	1	2	2	9	2.3
Torres and Cape	-	-	-	-	-	-
Townsville	2	-	-	-	2	0.8
West Moreton	2	-	-	-	2	0.7
Wide Bay	1	-	-	2	3	1.4
Total	25	4	5	14	48	1.0

4. Laboratory testing

Laboratory definitive evidence (culture, urinary antigen testing, or seroconversion or 4-fold rise in serological titre) was obtained for 30 cases (63 per cent), with laboratory suggestive evidence (PCR or single high serological titre only) found in the remaining 18 cases (37 per cent). *L. pneumophila* cases were most frequently identified from urinary antigen testing (76 per cent), whilst *L. longbeachae* cases were most frequently identified from single high serological titres (79 per cent), three of which also had seroconversion or a four-fold serological rise identified (Table 3). It is important to note that urinary antigen testing is specific for *L. pneumophila* serogroup 1 and cannot be used to diagnose other species of Legionella.

Table 3: Number and proportion of legionellosis cases with positive laboratory results by test type* and species, 2016

	Laboratory definitive evidence			Laboratory suggestive evidence		Total cases n (%)
	Culture n (%)	Urinary antigen n (%)	4 fold serological rise n (%)	PCR n (%)	Single high serological titre n (%)	
<i>L. pneumophila</i>	5 (17%)	22 (76%)	3 (10%)	9 (31%)	3 (10%)	29 (100%)
<i>L. longbeachae</i>	1 (5%)	n/a	3 (16%)	0 (0%)	15 (79%)	19 (100%)
Total	6 (13%)	22 (46%)	6 (13%)	9 (19%)	18 (38%)	48 (100%)

*More than one test type may be performed for each case, with some cases represented in more than one cell

Sixteen of the probable cases (89 per cent) were diagnosed by single high serological titre only, with *L. longbeachae* accounting for 78 per cent of probable cases. Two *L. pneumophila* cases (11 per cent) were identified by positive PCR only.

5. Clinical presentation

Seventy-five per cent of legionellosis cases notified in 2016 reported pneumonia, with 83 per cent of these cases reported as having pneumonia confirmed by chest x-ray (CXR). Legionnaires' disease (or legionellosis pneumonia) was reported in 24 *L. pneumophila* cases (83 per cent), with five cases (17 per cent) reported as having a non-pneumonic form of legionellosis. For *L. longbeachae*, 12 cases (63 per cent) reported pneumonia, 3 cases (16 per cent) were reported not to have pneumonia, and this was unknown for 3 cases (16 per cent). The key clinical features of fever, cough and pneumonia have been reported separately for both confirmed and probable cases (Table 4 and 5).

Table 4: Notified cases of confirmed cases of legionellosis by key clinical features* and species, Queensland, 2016

	Fever n (%)	Cough n (%)	Pneumonia n (%)	Pneumonia (confirmed by CXR) n (%)	Pneumonia (unconfirmed) n (%)	Total cases n (%)
<i>L. pneumophila</i>	22 (83%)	21 (84%)	22 (88%)	19 (76%)	3 (12%)	25 (100%)
<i>L. longbeachae</i>	5 (100%)	3 (60%)	4 (80%)	4 (80%)	0 (0%)	5 (100%)
Total	27 (90%)	24 (80%)	26 (87%)	23 (77%)	3 (10%)	30 (100%)

*Cases may report more than one clinical feature or symptom, with cases represented in more than one cell

Table 5: Notified cases of probable legionellosis by key clinical features* and species, Queensland, 2016

	Fever n (%)	Cough n (%)	Pneumonia n (%)	Pneumonia (confirmed by CXR) n (%)	Pneumonia (unconfirmed) n (%)	Total cases n (%)
<i>L. pneumophila</i>	4 (100%)	4 (100%)	2 (50%)	1 (25%)	1 (25%)	4 (100%)
<i>L. longbeachae</i>	13 (93%)	13 (93%)	8 (57%)	6 (43%)	2 (14%)	14 (100%)
Total	17 (94%)	17 (94%)	10 (56%)	7 (39%)	3 (17%)	18 (100%)

*Cases may report more than one clinical feature or symptom, with cases represented in more than one cell

The most common clinical features in addition to fever, cough, and pneumonia, were malaise, headache, and anorexia (Table 6).

Table 6: Notified cases of legionellosis by additional clinical features* and species, Queensland, 2016

	<i>L. pneumophila</i>		<i>L. longbeachae</i>		Total cases n (%)
	Confirmed	Probable	Confirmed	Probable	
Headache	11 (44%)	2 (50%)	4 (80%)	6 (43%)	23 (48%)
Anorexia	13 (52%)	0 (0%)	4 (80%)	5 (36%)	22 (46%)
Malaise	16 (64%)	3 (75%)	3 (60%)	8 (57%)	30 (63%)
Abdominal pain	3 (12%)	0 (0%)	0 (0%)	1 (7%)	4 (8%)
Myalgia	10 (40%)	1 (25%)	3 (60%)	8 (57%)	22 (46%)
Diarrhoea	9 (36%)	0 (0%)	4 (80%)	2 (14%)	15 (31%)

*Cases may report more than one clinical feature or symptom, with cases represented in more than one cell. The proportion of cases not reported to have an additional symptom may be because they did not have the symptom, or the information was unknown

Seventy-three per cent of notified cases were hospitalised for legionellosis in 2016, with the highest proportion of hospitalised cases in those diagnosed with *L. pneumophila* (Table 7).

Table 7: Hospitalisation of notified cases of legionellosis by species and confirmation status, Queensland, 2016

Species	Confirmation status	Hospitalised n (%)	Not hospitalised n (%)	Unknown n (%)	Total cases n (%)
<i>L. pneumophila</i>	Confirmed	23 (92%)	2 (8%)	0 (0%)	25 (100%)
	Probable	2 (50%)	2 (50%)	0 (0%)	4 (100%)
	Total	25 (86%)	4 (14%)	0 (0%)	29 (100%)
<i>L. longbeachae</i>	Confirmed	4 (80%)	1 (20%)	0 (0%)	5 (100%)
	Probable	6 (43%)	7 (50%)	1 (7%)	14 (100%)
	Total	10 (53%)	8 (42%)	1 (5%)	19 (100%)
Total (all cases)		35 (73%)	12 (25%)	1 (2%)	48 (100%)

Hospital length of stay was known for 24 cases (69 per cent) of the 35 cases reported to have been hospitalised. The median length of stay (where known) was 8.5 days, with a range of 0 days (same day admission and discharge) to 81 days. The median length of stay for cases hospitalised due to *L. pneumophila* was 10 days, and five days for *L. longbeachae*. Complications were reported for 14 cases – 10 cases of *L. pneumophila*, and 4 cases of *L. longbeachae*. Complications included intubation, ICU admission, septic shock, organ failure and death. Four people died following legionellosis infection; all were infected with *L. pneumophila* and all were considered to have died as a result of their infection.

6. Risk factors

Risk factors for legionellosis include increasing age, cigarette smoking, diabetes, chronic lung disease, renal disease, malignancy, and compromised immunity (1, 4). Forty cases (83 per cent) notified in 2016 were aged 50 years or older, with 21 cases (44 per cent) aged 70 years or older. Ten cases (21 per cent) reported smoking (unknown smoking status for 8 per cent).

Twenty-one cases (44 per cent) reported having at least one chronic disease, with 21 per cent reporting respiratory disease, 23 per cent reporting cardiac disease, 8 per cent reporting chronic renal disease and 29 per cent reporting diabetes (Table 8).

Table 8: Notified cases of legionellosis by selected chronic disease risk factors* and species, Queensland, 2016

	<i>L. pneumophila</i> n (%)	<i>L. longbeachae</i> n (%)	Total cases n (%)
Respiratory disease	6 (21%)	4 (21%)	10 (21%)
Chronic renal disease	4 (14%)	0 (0%)	4 (8%)
Cardiac disease	11 (38%)	0 (0%)	11 (23%)
Diabetes	10 (34%)	4 (21%)	14 (29%)

* Cases may report more than one chronic condition, with cases represented in more than one cell

Eight cases (17 per cent) reported being immunocompromised, with the most common reason being the use of immunosuppressive medications (Table 9).

Table 9: Notified cases of legionellosis by immunocompromised condition risk factors* and species, Queensland, 2016

	<i>L. pneumophila</i> n (%)	<i>L. longbeachae</i> n (%)	Total cases n (%)
Immunosuppressive medications	5 (17%)	2 (11%)	7 (15%)
Oncology treatment	1 (3%)	1 (5%)	2 (4%)
Transplant recipient	1 (3%)	0 (0%)	1 (2%)

* Cases may report more than one immunocompromised condition, with cases represented in more than one cell

7. Exposures

Legionella pneumophila

Twenty-three of the 29 cases (79 per cent) were considered to be Queensland acquired, as they did not report travel interstate or overseas during their exposure period. Three *L. pneumophila* cases (10 per cent) reported overseas travel during their exposure period and were considered to have been overseas acquired; two cases in Thailand, and one case in Indonesia. Two cases (7 per cent) travelled within Australia to multiple states during their exposure period. Travel history during their exposure period was unknown for one case.

There were no common source clusters identified in Queensland in 2016.

The most frequent potential exposure reported by *L. pneumophila* cases was being in the vicinity of cooling towers (12 cases, 41 per cent), followed by use of respiratory devices (6 cases, 21 per cent) (Table 10). Other known potential exposure risks for *L. pneumophila* were reported for a small number of cases only.

Table 10: Notified cases of *L. pneumophila* by self-reported potential exposures*, Queensland, 2016

	Yes n (%)	No n (%)	Unknown n (%)	Total n (%)
Cooling towers	12 (41%)	11 (38%)	6 (20%)	29 (100%)
Spa pool	2 (7%)	25 (86%)	2 (6%)	29 (100%)
Fountains	3 (10%)	20 (69%)	6 (21%)	29 (100%)
Humidifier	1 (3%)	24 (83%)	4 (14%)	29 (100%)
Respiratory device	6 (21%)	19 (66%)	4 (14%)	29 (100%)

Two cases (7 per cent) were reported to having been hospitalised during their exposure period in 2016, 27 cases (93 per cent) were not hospitalised during their exposure period. One case spent their entire reported exposure period in hospital, though no environmental evidence was found and water tests conducted at the hospital were negative for *L. pneumophila*. Clinical review of the case raised the possibility of the presence of legionella infection at the time of hospital admission, with progression of disease associated with incomplete treatment. The other case was hospitalised for only a small proportion of their exposure period only, and the case reported other possible environmental exposures during their exposure period.

Legionella longbeachae

For *L. longbeachae* cases, 12 of 19 cases (63 per cent) reported gardening activities during their exposure period. Six of these cases (50 per cent) reported using potting mix, though no common specific brand was identified. Fifteen cases (79 per cent) were considered to have been acquired in Queensland, two cases within Australia (exposures in multiple Australian states during exposure period), one case where part of their exposure period was overseas in Belgium and part in Australia, and one case where travel history during their exposure period was unknown.

8. Discussion

The number of notified cases of legionellosis in Queensland is low at around one case per 100,000 population per year. Notifications continued to decrease in 2016 following a peak in 2013. The peak in 2013 was the result of a large increase in notifications in June–October 2013, which was likely the result of increased testing due to public awareness following the widespread coverage of the legionellosis cases at the Wesley Hospital in June 2013 (16, 17). There has been a decrease in cases diagnosed by serology alone since 2013, in particular for *L. pneumophila* cases. The proportion of *L. pneumophila* cases in 2016 that had a positive urinary antigen test and/or PCR test increased compared to 2015.

As reported previously, the increase in probable cases in the past five years compared to pre-2009 was the result of a change to the national probable case definition. Historically, probable cases required laboratory suggestive evidence, clinical evidence, and an epidemiological link to a confirmed case (Queensland Legionella Guidelines 2005); however the requirement for an epidemiological link was removed in subsequent guidelines. This change may have resulted in the identification of more cases with milder disease or the potential to capture cases with non-specific symptoms that have an existing high Legionella titre.

The continued high proportion of cases (87 per cent) reporting a clinical presentation with pneumonia (88 per cent of which had chest x-ray confirmation) and 73 per cent of all cases hospitalised following their onset of illness confirms that the majority of cases notified have a clinically significant illness, and are diagnosed through investigation of predominantly community acquired pneumonia or pneumonia-like illness. This is similar to data published for 2015 (18). Confirmed cases were more likely to be hospitalised than probable cases; however it is possible that more intensive laboratory methods were used for diagnosis when a case was hospitalised (e.g. isolation from bronchial lavage or lung tissue). Risk factor data for Queensland for 2016 remains consistent with 2015 and published information on legionellosis.

Notification data rely on passive notification from laboratories. It is likely these figures underrepresent the total number of legionellosis infections in Queensland, given not all cases of legionellosis will be tested, especially those with mild symptoms. Changes in the number of notified cases could be the result of a number of factors including the availability of new tests over time (such as the introduction of urinary antigen testing in 2008 in Queensland), changes in testing by medical practitioners, and a possible increase or decrease in infections.

Single titre serology results for Legionella in combination with non-specific symptoms such as fever and cough can make a definitive diagnosis difficult. In addition, a proportion of the general population have measurable serological titres to Legionella in the small number of serological studies undertaken, with antibodies to *L. pneumophila* serogroup 1 at a titre of 1:128 found in 1–20 per cent of the general population (1), and 1:≥256 in approximately 5-10 per cent of the population (species not specified) (19). Cross-reactive antibodies have been found occasionally in patients with infections caused by non-Legionella bacteria (20).

Where confirmation of diagnosis cannot be achieved by culture or urinary antigen testing, paired acute and convalescent sera to determine seroconversion or significant

increase is ideal, however serological testing of culture-proven cases with Legionnaires' disease has shown approximately 25 per cent of cases will not seroconvert at all (4). This in combination with the non-specific symptoms in particular of Pontiac fever may result in the misclassification of a small proportion of non-cases as probable cases with the current case definition. There were no unspecified legionellosis notifications in 2016, likely due to the use of specified antibody tests by all major pathology laboratories in Queensland.

Information on potential exposures is collected to assist in environmental investigations if required. These do not necessarily reflect whether an actual source was identified. Environmental investigations are conducted by Public Health Units. Information on the outcomes of community environmental investigations is not currently recorded or collated systematically state wide for surveillance purposes.

Notified cases of legionellosis continued to decrease in 2016, continuing the trend seen since 2013. Legionnaires' disease, in particular that caused by *L. pneumophila*, continued to be the predominant form of legionellosis notified in Queensland during 2016. Legionella infection remains a small, but potentially serious cause of community acquired pneumonia, with almost three-quarters of cases in 2016 hospitalised. It remains of public health importance because of high mortality rates, particularly in untreated, immunocompromised patients; potential for outbreaks in community setting; and a rare potential for nosocomial transmission to immunocompromised patients.

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