Legionellosis in Queensland

2015

Queensland Government

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Published by the State of Queensland (Queensland Health), November 2016

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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 transmitted 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, 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 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 generally a 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 also common (1). 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.

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.

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 18 April 2016 for all confirmed and probable cases of legionellosis with onset of disease between 1 January 2006 and 31 December 2015. 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) 2006-2014. The 2014 population was used to calculate 2015 rates as 2015 ERP was not available at time of report.

3. Demographic data

There were 80 notified cases of legionellosis notified in Queensland in 2015, consisting of 50 confirmed cases and 30 probable cases (Table 1). The notification rate in 2015 was 1.7 cases per 100,000 population. Aside from the peak in the number of notified cases and notification rate in 2013, there has been an increasing trend in the notification rate over the past 10 years (Figure 1).

Table 1: Number of cases of legionellosis by confirmation status, Queensland, 2006-2015

Year of onset	Confirmed n (%)	Probable n (%)	Total n (%)
2006	34 (97%)	1 (3%)	**35 (100%)**
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	83 (51%)	81 (49%)	**164 (100%)**
2014	46 (49%)	47 (51%)	**93 (100%)**
2015	50 (63%)	30 (38%)	**80 (100%)**

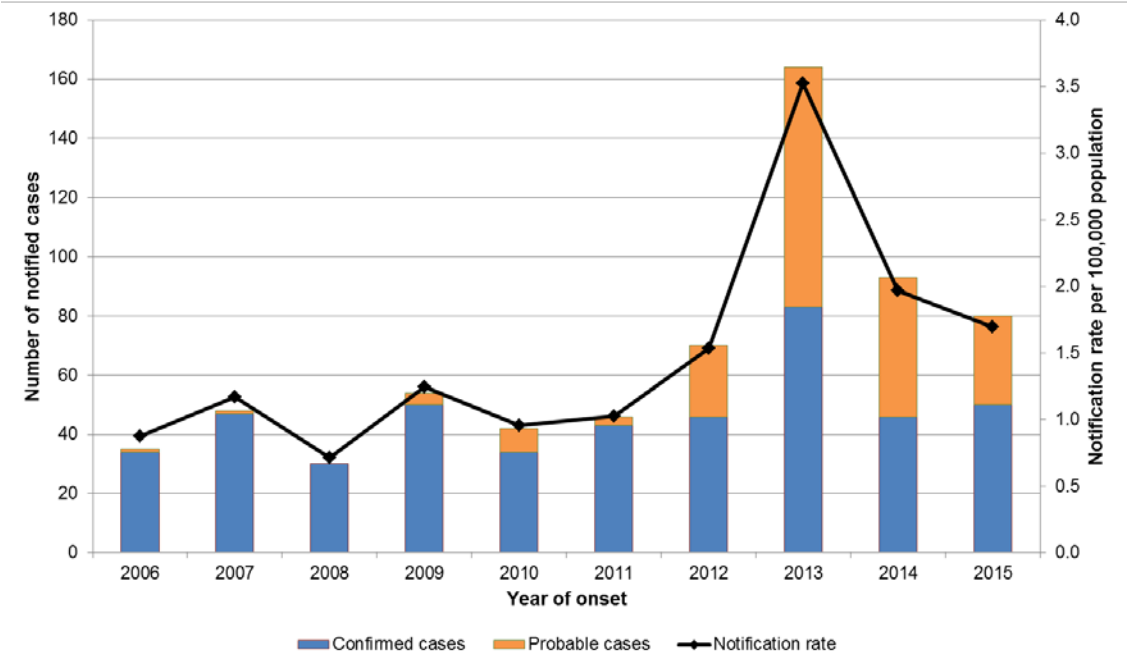

Figure 1: Notified cases of legionellosis by confirmation status and notification rate of total legionellosis, Queensland, 2006-2015

There were 47 males (59 per cent) and 33 females (41 per cent) notified in 2015. The age range of cases was six years to 97 years, with a median age of 66 years for all cases. The median age for males was 69 years and 61 years for females. The modal (most frequently notified) age groups were the 55-59 and 75-79 year age groups, with notification rate highest in the 75-79 year ago group at 13.2 cases per 100,000 population per year (Figure 2).

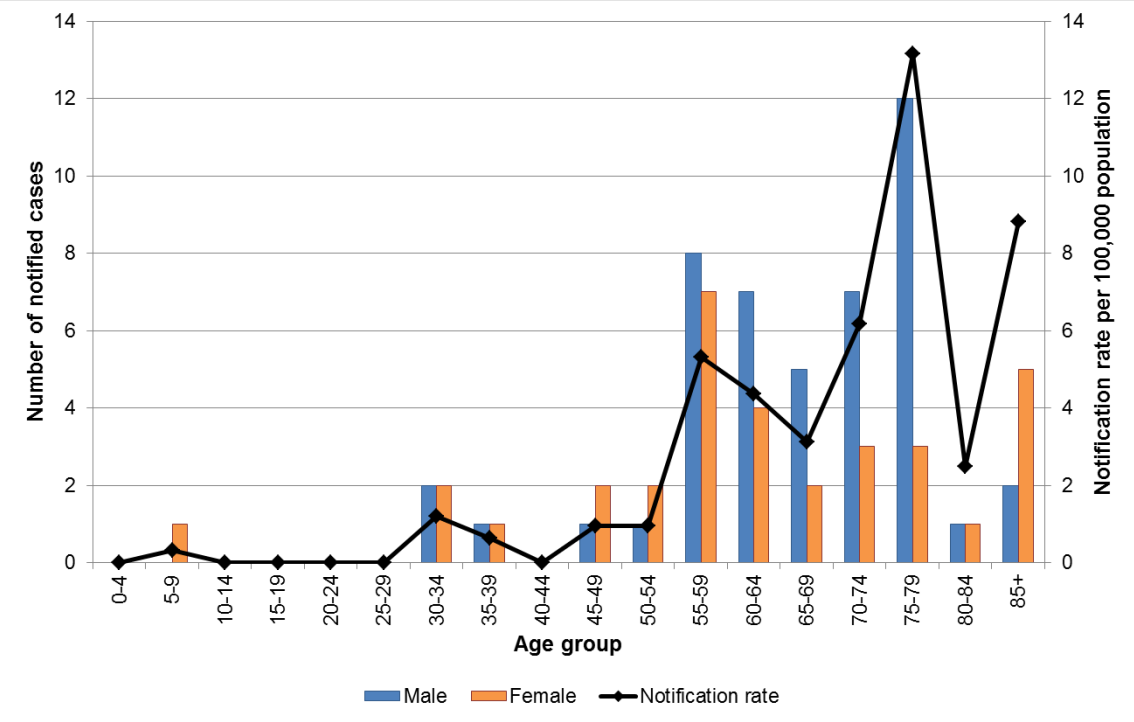

Figure 2: Notified cases and notification rate by age group and sex, Queensland, 2015

In 2015, 37 notified cases (46 per cent) were found to be caused by *L. pneumophila*, 39 cases (49 per cent) caused by *L. longbeachae*, and 4 cases (5 per cent) were unspeciated. No other species were detected in Queensland in 2015. Over the decade from 2006-2015, there were 307 cases (46 per cent) of *L. pneumophila*, 238 cases (36 per cent) of *L. longbeachae*, and 117 cases (19 per cent) of other and unspeciated legionellosis (Figure 3).

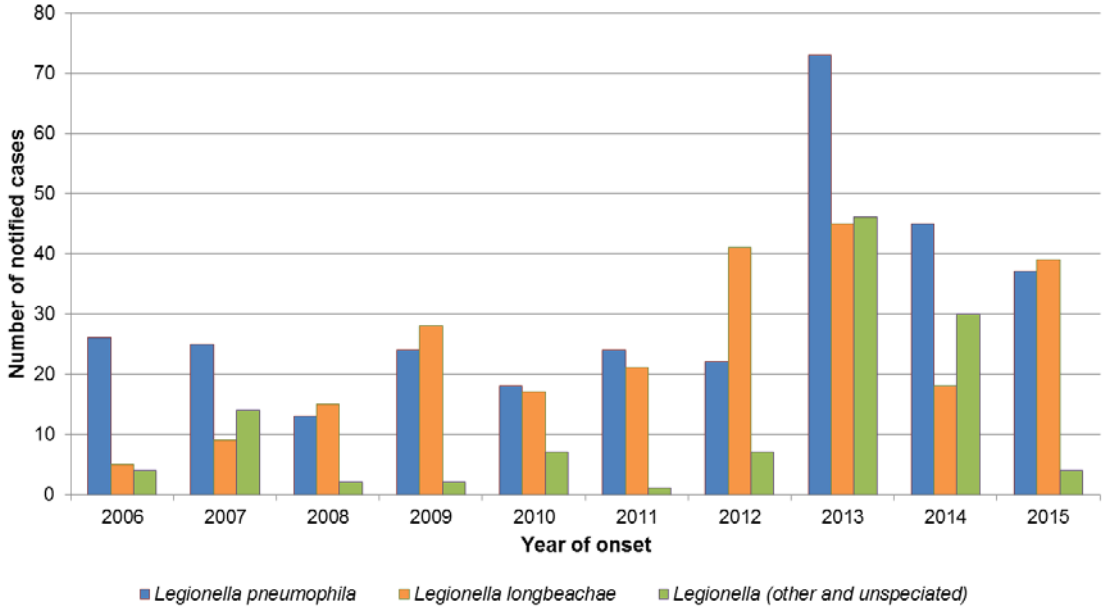

Figure 3: Number of notified cases of legionellosis by species, Queensland, 2006-2015

In 2015, the highest notification rate for all cases of legionellosis was in Central Queensland Hospital and Health Service (HHS) with 3.1 notified cases per 100,000 population per year (7 cases), followed by Sunshine Coast HHS (10 cases, 2.6 cases per 100,000 population per year), and Metro South HHS (26 cases, 2.4 cases per 100,000 population per year) (Table 2). Geographic distribution is based on a case's usual place of residence at the time of diagnosis and not necessarily their place of exposure. Case numbers in HHSs with smaller populations are small, and may be subject to fluctuation in case numbers and rates so need to be interpreted with caution. Historical total cases of legionellosis and rates for 2006-2015 based on the current HHS boundaries are shown in Table 3.

Table 2: Number of cases by species and confirmation status, and notification rate of legionellosis by Hospital and Health Service of residence, Queensland, 2015

HHS	*L. pneumophila*		*L. longbeachae*		Legionellosis (unspeciated)		Total cases	Notification rate (per 100,000 population)
	Confirmed	Probable	Confirmed	Probable	Confirmed	Probable		
Cairns and Hinterland	-	1	1	-	-	-	**2**	**0.8**
Central Queensland	2	2	1	2	-	-	**7**	**3.1**
Central West	-	-	-	-	-	-	**-**	**0.0**
Darling Downs	1	-	3	1	-	-	**5**	**1.8**
Gold Coast	2	-	1	1	-	-	**4**	**0.7**
Mackay	-	-	2	1	-	-	**3**	**1.6**
Metro North	6	-	2	6	-	1	**15**	**1.6**
Metro South	9	4	3	7	-	2	**25**	**2.3**
North West	-	-	-	-	-	-	**-**	**0.0**
South West	-	-	-	-	-	-	**-**	**0.0**
Sunshine Coast	4	-	4	2	-	-	**10**	**2.6**
Torres and Cape	-	-	-	-	-	-	**-**	**0.0**
Townsville	1	-	-	-	-	-	**1**	**0.4**
West Moreton	3	-	2	-	1	-	**6**	**2.3**
Wide Bay	2	-	-	-	-	-	**2**	**0.9**
Total	**30**	**7**	**19**	**20**	**1**	**3**	**80**	**1.7**

Table 3: Number of notified cases of legionellosis and notification rate per 100,000 population per year by Hospital and Health Service of residence, Queensland, 2006-2015

HHS	Number of cases (notification rate per 100,000 population)									
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Cairns and Hinterland	1 (0.5)	0 (0.0)	1 (0.4)	5 (2.2)	1 (0.4)	0 (0.0)	0 (0.0)	3 (1.2)	2 (0.8)	2 (0.8)
Central Queensland	1 (0.5)	2 (1.0)	1 (0.5)	1 (0.5)	1 (0.5)	0 (0.0)	1 (0.5)	3 (1.3)	4 (1.8)	7 (3.1)
Central West	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Darling Downs	0 (0.0)	7 (2.8)	1 (0.4)	3 (1.1)	2 (0.8)	9 (3.4)	6 (2.2)	3 (1.1)	0 (0.0)	5 (1.8)
Gold Coast	2 (0.4)	5 (1.0)	7 (1.4)	3 (0.6)	6 (1.2)	5 (0.9)	11 (2.0)	10 (1.8)	3 (0.5)	4 (0.7)
Mackay	4 (2.6)	0 (0.0)	0 (0.0)	2 (1.2)	0 (0.0)	3 (1.7)	2 (1.1)	2 (1.1)	1 (0.5)	3 (1.6)
Metro North	5 (0.6)	4 (0.5)	6 (0.7)	4 (0.5)	11 (1.3)	8 (0.9)	19 (2.1)	51 (5.5)	29 (3.1)	15 (1.6)
Metro South	10 (1.1)	13 (1.4)	4 (0.4)	16 (1.6)	11 (1.1)	9 (0.9)	18 (1.7)	49 (4.6)	40 (3.7)	25 (2.3)
North West	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (3.2)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
South West	0 (0.0)	0 (0.0)	2 (7.8)	4 (15.4)	3 (11.5)	2 (7.6)	1 (3.8)	3 (11.2)	0 (0.0)	0 (0.0)
Sunshine Coast	6 (1.8)	5 (1.5)	1 (0.3)	8 (2.3)	4 (1.1)	2 (0.5)	5 (1.3)	18 (4.8)	6 (1.6)	10 (2.6)
Torres and Cape	0 (0.0)	2 (8.8)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Townsville	1 (0.5)	2 (0.9)	1 (0.5)	0 (0.0)	0 (0.0)	1 (0.4)	0 (0.0)	1 (0.4)	1 (0.4)	1 (0.4)
West Moreton	3 (1.5)	2 (0.9)	3 (1.4)	6 (2.6)	1 (0.4)	3 (1.2)	5 (2.0)	17 (6.6)	1 (0.4)	6 (2.3)
Wide Bay	2 (0.9)	6 (3.1)	3 (1.5)	2 (1.0)	1 (0.5)	4 (1.9)	2 (1.0)	4 (1.9)	6 (2.8)	2 (0.9)
Total	**35 (0.2)**	**48 (0.2)**	**30 (0.7)**	**54 (1.2)**	**42 (1.0)**	**46 (1.0)**	**70 (1.5)**	**164 (3.5)**	**93 (2.0)**	**80 (1.7)**

Over the 10 year period in 2006-2015, state wide notification rates for *L. pneumophila* varied between 0.4-1.6 cases per 100,000 population per year. In addition, there was significant variability based on geographic location and year. The average notification rate for *L. pneumophila* in this period was highest in Metro South HHS and West Moreton HHS (both 1.0 cases per 100,000 population per year) (Table 4).

Table 4: Number of notified cases of *L. pneumophila* and notification rate per 100,000 population per year by Hospital and Health Service of residence, Queensland, 2006-2015

	Number of cases (notification rate per 100,000 population)										
HHS	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**Average**
Cairns and Hinterland	1 (0.5)	0 (0.0)	1 (0.4)	2 (0.9)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.8)	0 (0.0)	1 (0.4)	**0.7 (0.3)**
Central Queensland	1 (0.5)	1 (0.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (1.8)	**0.6 (0.3)**
Central West	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	**0 (0.0)**
Darling Downs	0 (0.0)	4 (1.6)	1 (0.4)	1 (0.4)	1 (0.4)	4 (1.5)	0 (0.0))	1 (0.4)	0 (0.0)	1 (0.4)	**1.3 (0.5)**
Gold Coast	0 (0.0)	2 (0.4)	5 (1.0)	1 (0.2)	3 (0.6)	3 (0.6)	4 (0.7)	7 (1.3)	1 (0.2)	2 (0.4)	**2.8 (0.5)**
Mackay	4 (2.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.6)	1 (0.6)	0 (0.0)	0 (0.0)	0 (0.0)	**0.6 (0.4)**
Metro North	2 (0.3)	2 (0.2)	3 (0.4)	4 (0.5)	8 (0.9)	4 (0.4)	6 (0.7)	24 (2.6)	16 (1.7)	6 (0.6)	**7.5 (0.8)**
Metro South	7 (0.7)	9 (0.9)	1 (0.1)	8 (0.8)	3 (0.3)	6 (0.6)	7 (0.7)	27 (2.5)	20 (1.8)	13 (1.2)	**10.1 (1.0)**
North West	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	**0 (0.0)**
South West	0 (0.0)	0 (0.0)	0 (0.0)	1 (3.9)	0 (0.0)	1 (3.8)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	**0.2 (0.8)**
Sunshine Coast	5 (1.5)	2 (0.6)	0 (0.0)	4 (1.1)	1 (0.3)	2 (0.5)	2 (0.5)	4 (1.1)	2 (0.5)	4 (1.0)	**2.6 (0.7)**
Torres and Cape	0 (0.0)	1 (4.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	**0.1 (0.4)**
Townsville	1 (0.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.4)	1 (0.4)	**0.3 (0.1)**
West Moreton	3 (1.5)	1 (0.5)	1 (0.5)	2 (0.9)	1 (0.4)	2 (0.8)	2 (0.8)	7 (2.7)	1 (0.4)	3 (1.1)	**2.3 (1.0)**
Wide Bay	2 (1.1)	3 (1.6)	1 (0.5)	1 (0.5)	1 (0.5)	1 (0.5)	0 (0.0)	1 (0.5)	4 (1.9)	2 (0.9)	**1.6 (0.7)**
Total	**26 (0.6)**	**25 (0.6)**	**13 (0.3)**	**24 (0.6)**	**18 (0.4)**	**24 (0.5)**	**22 (0.5)**	**73 (1.6)**	**45 (1.0)**	**37 (0.8)**	**30.7 (0.8)**

The highest average notification rate from 2006-2015 for *L. longbeachae* was in South West HHS at 5.0 cases per 100,000 population per year, though case numbers were small and no cases reported in the last two years (Table 5).

Table 5: Number of notified cases of *L. longbeachae* and notification rate per 100,000 population per year by Hospital and Health Service of residence, Queensland, 2006-2015

	Number of cases (notification rate per 100,000 population)										
HHS	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**Average**
Cairns and Hinterland	0 (0.0)	0 (0.0)	0 (0.0)	3 (1.3)	1 (0.4)	0 (0.0)	0 (0.0)	1 (0.4)	1 (0.4)	1 (0.4)	**0.7 (0.3)**
Central Queensland	0 (0.0)	1 (0.5)	1 (0.5)	1 (0.5)	1 (0.5)	0 (0.0)	1 (0.5)	2 (0.9)	2 (0.9)	3 (1.3)	**1.2 (0.6)**
Central West	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	**0 (0.0)**
Darling Downs	0 (0.0)	3 (1.2)	0 (0.0)	1 (0.4)	1 (0.4)	5 (1.9)	6 (2.2)	2 (0.7)	0 (0.0)	4 (1.4)	**2.2 (0.8)**
Gold Coast	1 (0.2)	1 (0.2)	1 (0.2)	2 (0.4)	2 (0.4)	2 (0.4)	6 (1.1)	3 (0.5)	2 (0.4)	2 (0.4)	**2.2 (0.4)**
Mackay	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.6)	0 (0.0)	2 (1.2)	1 (0.6)	1 (0.6)	1 (0.5)	3 (1.6)	**0.9 (0.5)**
Metro North	2 (0.3)	1 (0.1)	3 (0.4)	0 (0.0)	2 (0.2)	4 (0.4)	12 (1.3)	14 (1.5)	4 (0.4)	8 (0.8)	**5.0 (0.6)**
Metro South	2 (0.2)	0 (0.0)	3 (0.3)	8 (0.8)	4 (0.4)	2 (0.2)	7 (0.7)	6 (0.6)	5 (0.5)	10 (0.9)	**4.7 (0.5)**
North West	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (3.2)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	**0.1 (0.3)**
South West	0 (0.0)	0 (0.0)	2 (7.8)	3 (11.6)	3 (11.5)	1 (3.8)	1 (3.8)	3 (11.2)	0 (0.0)	0 (0.0)	**1.3 (5.0)**
Sunshine Coast	0 (0.0)	0 (0.0)	1 (0.3)	4 (1.1)	2 (0.6)	0 (0.0)	2 (0.5)	6 (1.6)	1 (0.3)	6 (1.6)	**2.2 (0.6)**
Torres and Cape	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	**0 (0.0)**
Townsville	0 (0.0)	2 (0.9)	1 (0.5)	0 (0.0)	0 (0.0)	1 (0.4)	0 (0.0)	1 (0.4)	0 (0.0)	0 (0.0)	**0.5 (0.2)**
West Moreton	0 (0.0)	0 (0.0)	1 (0.5)	4 (1.7)	0 (0.0)	1 (0.4)	3 (1.2)	3 (1.2)	0 (0.0)	2 (0.8)	**1.4 (0.6)**
Wide Bay	0 (0.0)	1 (0.5)	2 (1.0)	1 (0.5)	0 (0.0)	3 (1.5)	2 (1.0)	3 (1.4)	2 (0.9)	0 (0.0)	**1.4 (0.7)**
Total	**5 (0.1)**	**9 (0.2)**	**15 (0.4)**	**28 (0.6)**	**17 (0.4)**	**21 (0.5)**	**41 (0.9)**	**45 (1.0)**	**18 (0.4)**	**39 (0.8)**	**23.8 (0.5)**

4. Laboratory testing

Laboratory definitive evidence (culture, urinary antigen testing, or seroconversion or 4-fold rise in serological titre) was obtained for 50 cases (63 per cent), with laboratory suggestive evidence (PCR or single high serological titre only) found in the remaining 30 cases (37 per cent). *L. pneumophila* cases were most frequently identified from urinary antigen testing (59 per cent), whilst *L. longbeachae* cases were most frequently identified from single high serological titres (64 per cent) (Table 6). 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 6: Number and proportion of legionellosis cases with positive laboratory results by test type* and species, 2015

	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 (%)	
L. pneumophila	9 (24%)	22 (59%)	4 (11%)	6 (16%)	8 (22%)	**37 (100%)**
L. longbeachae	4 (10%)	n/a	12 (31%)	2 (5%)	25 (64%)	**39 (100%)**
Legionella spp (unspeciated)	0 (0%)	n/a	1 (25%)	0 (0%)	3 (75%)	**4 (100%)**
Total	**13 (16%)**	**22 (28%)**	**17 (21%)**	**8 (10%)**	**36 (45%)**	**80 (100%)**

*More than one test type may be performed for each case

Despite being laboratory suggestive evidence, all positive PCR tests were in cases where they also had other laboratory definite evidence. All 30 probable cases were diagnosed by single high serological titre only, with *L. longbeachae* accounting for 67 per cent of probable cases (range of serological titres 256 –4096), *L. pneumophila* for 23 per cent (range of serological titres 512 –2048) and unspeciated legionellosis cases for 10 per cent (range 512 –1024).

5. Clinical presentation

Seventy-four per cent of legionellosis cases notified in 2015 reported pneumonia, with 54 per cent confirmed by chest x-ray (CXR). Legionnaires' disease (or legionellosis pneumonia) was reported in 32 *L. pneumophila* cases (86 per cent), with five cases (14 per cent) reported as having a non-pneumonic form of legionellosis. For *L. longbeachae*, 24 cases (61 per cent) reported pneumonia, 11 cases (28 per cent) were reported not to have pneumonia, and this was unknown for four cases (10 per cent). The key clinical symptoms of fever, cough and pneumonia have been reported separately for both confirmed and probable cases (Table 7 and 8).

Table 7: Notified cases of confirmed cases of legionellosis by key clinical symptoms* and species, Queensland, 2015

	Fever n (%)	Cough n (%)	Pneumonia n (%)	Pneumonia (confirmed by CXR) n (%)	Pneumonia (unconfirmed) n (%)	Total cases n (%)
L. pneumophila	25 (83%)	28 (93%)	27 (90%)	20 (67%)	7 (23%)	**30 (100%)**
L. longbeachae	16 (84%)	14 (74%)	15 (79%)	11 (58%)	4 (21%)	**19 (100%)**
Legionella spp (unspeciated)	1 (100%)	1 (100%)	1 (100%)	1 (100%)	0 (0%)	**1 (100%)**
Total	**42 (84%)**	**43 (86%)**	**43 (86%)**	**32 (86%)**	**11 (22%)**	**50 (100%)**

*Cases may report more than one clinical symptom

Table 8: Notified cases of probable legionellosis by key clinical symptoms* and species, Queensland, 2015

	Fever n (%)	Cough n (%)	Pneumonia n (%)	Pneumonia (confirmed by CXR) n (%)	Pneumonia (unconfirmed) n (%)	Total cases n (%)
L. pneumophila	6 (86%)	6 (86%)	5 (71%)	3 (43%)	2 (29%)	**7 (100%)**
L. longbeachae	17 (85%)	16 (80%)	9 (45%)	7 (35%)	2 (10%)	**20 (100%)**
Legionella spp (unspeciated)	3 (100%)	3 (100%)	2 (67%)	2 (67%)	0 (0%)	**3 (100%)**
Total	**26 (87%)**	**25 (83%)**	**16 (53%)**	**12 (40%)**	**4 (13%)**	**30 (100%)**

*Cases may report more than one clinical symptom

The most common symptoms in addition to fever, cough, and pneumonia, were malaise, headache, and anorexia (Table 9).

Table 9: Notified cases of legionellosis by additional clinical symptoms* and species, Queensland, 2015

	L. pneumophila n (%)		*L. longbeachae* n (%)		Legionellosis (unspeciated) n (%)		Total cases n (%)
	Confirmed	Probable	Confirmed	Probable	Confirmed	Probable	
Headache	10 (33%)	5 (71%)	7 (37%)	7 (35%)	0 (0%)	0 (0%)	**29 (36%)**
Anorexia	14 (47%)	3 (43%)	7 (37%)	3 (15%)	0 (0%)	2 (67%)	**29 (36%)**
Malaise	13 (43%)	5 (71%)	11 (58%)	8 (40%)	1 (100%)	1 (33%)	**39 (49%)**
Abdominal pain	1 (3%)	2 (29%)	5 (26%)	4 (20%)	0 (0%)	0 (0%)	**12 (15%)**
Myalgia	7 (23%)	4 (57%)	6 (32%)	5 (25%)	0 (0%)	0 (0%)	**22 (29%)**
Diarrhoea	13 (43%)	1 (14%)	3 (16%)	6 (30%)	0 (0%)	1 (33%)	**24 (30%)**

*Cases may report more than one clinical symptom. 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

Sixty-six per cent of notified cases were hospitalised for legionellosis in 2015, with the highest proportion of hospitalised cases in those diagnosed with *L. pneumophila* (Table 10).

Table 10: Hospitalisation of notified cases of legionellosis by species and confirmation status, Queensland, 2015

Species	Confirmation status	Hospitalised n (%)	Not hospitalised n (%)	Unknown n (%)	Total cases n (%)
L. pneumophila	Confirmed	28 (93%)	2 (7%)	0 (0%)	30 (100%)
	Probable	1 (14%)	6 (85%)	0 (0%)	7 (100%)
	Total	**29 (78%)**	**8 (22%)**	**0 (0%)**	**37 (100%)**
L. longbeachae	Confirmed	16 (84%)	3 (16%)	0 (0%)	19 (100%)
	Probable	8 (40%)	9 (45%)	3 (15%)	20 (100%)
	Total	**24 (62%)**	**12 (31%)**	**3 (8%)**	**39 (100%)**
Legionella spp (unspeciated)	Confirmed	0 (0%)	1 (100%)	0 (0%)	1 (100%)
	Probable	0 (0%)	2 (67%)	1 (33%)	3 (100%)
	Total	0 (0%)	**3 (75%)**	1 (25%)	**4 (100%)**
Total (all cases)		**53 (66%)**	**23 (29%)**	**4 (5%)**	**80 (100%)**

Hospital length of stay was known for 47 cases (89 per cent) of the 53 cases reported to have been hospitalised. The median length of stay was six days, with a range of one to 33 days. The median length of stay was very similar for cases hospitalised due to *L. pneumophila* (6 days) and *L. longbeachae* (6.5 days). Complications were reported for 17 cases – 11 cases of *L. pneumophila*, 5 cases of *L. longbeachae* and 1 case of unspeciated legionellosis. Complications included respiratory failure, intubation, ICU admission, septic shock, and death. Five people died following legionellosis infection – four were infected with *L. pneumophila* and one with *L. longbeachae*. Two cases were considered to have died as a result of their infection, two cases were considered to have died of other causes and this information is not yet known for one case.

6. Risk factors

Risk factors for legionellosis include increasing age, cigarette smoking, diabetes, chronic lung disease, renal disease, malignancy, and compromised immunity (1, 4). Seventy cases (88 per cent) notified in 2015 were aged 50 years or older, with 34 cases (43 per cent) aged 70 years or older. Fourteen cases (18 per cent) reported smoking (unknown smoking status for 14 per cent).

Forty-six cases (58 per cent) reported having at least one chronic disease, with 20 per cent reporting respiratory disease, 20 per cent reporting cardiac disease, 10 per cent reporting chronic renal disease and 8 per cent reporting diabetes (Table 11).

Table 11: Notified cases of legionellosis by selected chronic disease risk factors* and species, Queensland, 2015

	L. pneumophila n (%)	*L. longbeachae* n (%)	Legionellosis (unspeciated) n (%)	Total cases n (%)
Respiratory disease	8 (22%)	7 (18%)	1 (25%)	16 (20%)
Chronic renal disease	5 (14%)	3 (8%)	0 (0%)	8 (10%)
Cardiac disease	9 (24%)	6 (15%)	1 (25%)	16 (20%)
Diabetes	2 (5%)	4 (10%)	0 (0%)	6 (8%)

* Cases may report more than one chronic condition.

Fifteen cases (19 per cent) reported being immunocompromised, with the most common reason being the use of immunosuppressive medications (Table 12).

Table 12: Notified cases of legionellosis by immunocompromised condition risk factors* and species, Queensland, 2015

	L. pneumophila n (%)	*L. longbeachae* n (%)	Legionellosis (unspeciated) n (%)	Total cases n (%)
Immunosuppressive medications	6 (16%)	7 (18%)	0 (0%)	13 (16%)
Oncology treatment	5 (14%)	1 (3%)	0 (0%)	6 (8%)
Transplant recipient	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Other	2 (5%)	1 (3%)	0 (0%)	3 (4%)

* Cases may report more than one immunocompromised condition.

Five cases (6 per cent) reported risk factors other than a chronic disease or immunocompromised condition that were not specified.

7. Exposures

Legionella pneumophila

Twenty-eight of the 37 cases (76 per cent) were considered to be Queensland acquired, as they did not report travel interstate or overseas during their exposure period. Six *L. pneumophila* cases (16 per cent) reported overseas travel during their exposure period, of which four cases were considered to have been overseas acquired; two cases in Thailand, and one case each in Indonesia and New Zealand. Two cases spent part of their exposure period overseas and part in Australia so have been unable to be classified. Three cases (8 per cent) travelled within Australia to multiple states during their exposure period.

There were no common source clusters identified in Queensland in 2015, however one Queensland case was part of a cluster in another state.

The most frequent potential exposure reported by *L. pneumophila* cases was exposure to cooling towers (20 cases, 54 per cent) (Table 13). Other known potential exposure risks *for L. pneumophila* were reported for a small number of cases only.

Table 13: Notified cases of *L. pneumophila* by self-reported potential exposures*, Queensland, 2015

	Yes n (%)	No n (%)	Unknown n (%)	Total n (%)
Cooling towers	20 (54%)	7 (19%)	10 (27%)	**37 (100%)**
Spa pool	1 (3%)	31 (84%)	5 (13%)	**37 (100%)**
Fountains	5 (14%)	27 (73%)	5 (13%)	**37 (100%)**
Humidifier	2 (5%)	28 (76%)	7 (19%)	**37 (100%)**
Respiratory device	2 (5%)	30 (81%)	5 (13%)	**37 (100%)**

Four cases (11 per cent) were reported to having been hospitalised during their exposure period in 2015, 31 cases (84 per cent) were not hospitalised during their exposure period, and this was unknown for two cases. Two cases spent their entire exposure periods in hospital and were considered hospital acquired. The other two cases were hospitalised for part of their exposure period only, and environmental investigations did not demonstrate nosocomial acquisition.

Legionella longbeachae

For *L. longbeachae* cases, 25 of 39 cases (64 per cent) reported gardening activities during their exposure period. Nineteen of these cases (76 per cent) reported using potting mix, though a specific brand was only reported for a small proportion of these cases and no specific brand was identified. Thirty cases (77 per cent) were considered to have been acquired in Queensland, one case within Australia (exposures in multiple Australian states during exposure period), one case each in New Zealand and the United States of America, and six cases where place of acquisition was unknown.

8. Discussion

The number of notified cases of legionellosis decreased in 2015 following a peak in 2013, though reported case numbers remain elevated compared to pre-2013 numbers. 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.

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 high proportion of cases (74 per cent) reporting a clinical presentation with pneumonia (of which 73 per cent had chest x-ray confirmation) and two-thirds of 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. Confirmed cases were more likely to be hospitalised; 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 2015 remains consistent with that published, with the highest notification rates in those aged 75-79 years. There was one probable case notified in a child based on a single high serological titre. Infection in children is unusual, and whilst they did meet the clinical picture for Legionnaires' disease, it is possible that they had a pre-existing exposure to Legionella bacteria or cross reacting antibodies with an unrelated clinical illness.

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. The increase in 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), increased testing by medical practitioners, and a possible increase in infections. In addition, single titre serology results for Legionella in combination with non-specific symptoms such as fever and cough can make a definitive diagnosis difficult. Both the Communicable Diseases Network of Australia Legionellosis case definition (15), and the Queensland Notification Criteria Guidelines for Laboratories (14) do not define a clear cut-off for 'single high titre', relying on testing laboratories to interpret results based on the specific serological kits used. In Queensland in 2015, there was only one probable case with a single titre of 1:256 to *L. longbeachae* who also fit the clinical picture with fever, cough and pneumonia. All other probable cases had a single high titre of 512 or greater. Also, 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* serogroups 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) (18). Cross-reactive antibodies have been found occasionally in patients with infections cause by non-Legionella bacteria (19). Where confirmation 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. The decrease in unspecified legionellosis notifications in 2015 was likely the result of a major pathology provider changing serological kits from a *Legionella* Group antibody test (which included *L. bozemanii*, *L. longbeachae*, *L. dumoffii*, *L. gormanii*, *L. micadadei,* and *L. jordanis*, and were classified as *Legionella* unspecified) to a *L. longbeachae* Group 1 and 2 specific antibody test.

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.

The majority of legionellosis cases notified in 2015 had the more severe form of disease, Legionnaires' disease, and required hospitalisation. Legionella infection remains a small, but potentially serious cause of community acquired pneumonia. It is 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.

References

1. Heymann DL, editor. Control of Communicable Diseases Manual. 19th ed. Washington: American Public Health Association; 2008.
2. Cianciotto NP. Pathogenicity of Legionella pneumophila. International Journal of Medical Microbiology. 2001;291(5):331-43.
3. Swanson M, Hammer B. Legionella pneumophila pathogenesis: a fateful journey from amoebae to macrophages. Annual Reviews in Microbiology. 2000;54(1):567-613.
4. Edelstein PH, Roy CR. Legionnaires' Disease and Pontiac Fever. In: Bennett JE, Dolin R, Blaser MJ, editors. Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases. Eighth Edition ed: Elsevier Saunders; 2015.
5. Australian Government Department of Health. Australia's notifiable diseases status, 2014: Annual report of the National Notifiable Diseases Surveillance System. Comm Dis Intell 2016;40(1):E48-145.
6. Schaechter M, Engleberg NC, DiRita VJ, T. D. Schaechter's mechanisms of microbial disease. Philadelphia: Wolters Kluwer Health; 2012.
7. Steele TW, Moore CV, Sangster N. Distribution of Legionella longbeachae serogroup 1 and other legionellae in potting soils in Australia. Appl Environ Microbiol. 1990;56(10):2984–8.
8. Whiley H, Bentham R. Legionella longbeachae and Legionellosis. Emerg Infect Dis. 2011;17(4):579–83.
9. Johnson JT, Yu VL, Best MG, Vickers RM, Goetz A, Wagner R, et al. Nosocomial legionellosis in surgical patients with head-and-neck cancer: implications for epidemiological reservoir and mode of transmission. Lancet (London, England). 1985;2(8450):298-300.
10. Bartram J, Chartier Y, Lee JV, Pond K, Surman-Lee S, editors. Legionella and the prevention of legionellosis: World Health Organization; 2007.
11. Amato-Gauci A, Jong Bd, Coulombier D, Hallström L, Takkinen J, Ursut D, et al. Legionnaires' disease in Europe 2011. Legionnaires' disease in Europe 2011. Stockholm: European Centre for Disease Prevention and Control; 2013.
12. Beauté J, Jong Bd, Amato-Gauci A, Coulombier D, Hallström L, Robesyn E, et al. Legionnaires' disease in Europe 2010. Legionnaires' disease in Europe 2010. 2012.
13. Sopena N, Force L, Pedro-Botet ML, Barrufet P, Sauca G, García-Núñez M, et al. Sporadic and epidemic community legionellosis: two faces of the same illness. European Respiratory Journal. 2007;29(1):138-42.
14. Queensland Department of Health. Queensland Notification Criteria - Guidelines for Laboratories [updated March 201621 April 2016]. Available from: https://www.health.qld.gov.au/cdcg/documents/notif-criteria-guide.pdf.
15. Australian Government Department of Health. Legionellosis case definition [23 June 2016]. Available from: http://www.health.gov.au/internet/main/publishing.nsf/Content/cda-surveil-nndss-casedefs-cd_legion.htm.
16. Queensland Department of Health Chief Health Officer Branch. Review of the prevention and control of Legionella pneumophila infection in Queensland. 2013.
17. Bartley PB, Ben Zakour NL, Stanton-Cook M, Muguli R, Prado L, Garnys V, et al. Hospital-wide Eradication of a Nosocomial Legionella pneumophila Serogroup 1 Outbreak. Clinical Infectious Diseases. 2016;62(3):273-9.
18. Centers for Disease Control and Prevention. *Legionella* (Legionnaires' Disease and Pontiac Fever Diagnosis, Treatment, and Prevention 2016 [updated 14 June 20166 September 2016]. Available from: https://www.cdc.gov/legionella/clinicians/diagnostic-testing.html.
19. Reller LB, Weinstein MP, Murdoch DR. Diagnosis of Legionella Infection. Clinical Infectious Diseases. 2003;36(1):64-9.