

Legionellosis

CDNA National Guidelines for Public Health Units

1. Summary

Public health priority

Priority Classification	Public health response timeline	Data entry timeline
High: all probable and confirmed cases of <i>Legionella pneumophila</i> and any clusters/outbreaks caused by other <i>Legionella</i> species	Act as soon as possible, generally within one working day	Within 3 working days
Routine: Sporadic probable and confirmed cases of <i>Legionella longbeachae</i> and other non- <i>pneumophila</i> cases	Action should be carried out as part of routine duties	Within 5 working days

Case management

Follow-up/respond to all confirmed and probable cases of legionellosis irrespective of species. Determine possible exposures and consider an environmental assessment especially where more than one case of legionellosis reports a similar exposure or if a case has occurred in a healthcare or institutional setting. All cases must be notified to the appropriate State or Territory Communicable Diseases Branch.

Contact management

No management of contacts is required as person-to-person transmission of the disease is likely to be very rare. Consider providing information to people potentially exposed to the same source as the case. Active case finding is undertaken when the source of infection is the workplace or an institutional setting, when the case is part of a cluster or community outbreak or if it is a travel-related case.

2. The disease

Infectious agents

Legionella species are gram-negative, rod-shaped, aerobic bacteria. To 2017, at least 60 species with 70 serogroups have been identified, of which around 30 are known to cause human disease.^{1,2,3}

In Australia the most commonly notified species are *Legionella pneumophila* and *Legionella longbeachae*. *Legionella pneumophila* serogroup 1 causes the majority of outbreaks.

Legionellosis is the term given for any illness caused by *Legionella* bacteria. The spectrum of illness ranges from a severe form of infection with pneumonia, Legionnaires' disease, to a milder self-limiting influenza-like illness without radiographic evidence of pneumonia, Pontiac Fever.⁴

Definitions

Cooling water system (CWS): a heat exchange system that consists of a heat generating plant, a heat rejection plant, interconnecting water recirculating pipe work and associated pumps, valves and controls, and includes a cooling tower or evaporative condenser.

Cooling tower: a device for lowering the temperature of water by evaporative cooling in which atmospheric air is in contact with falling water thereby exchanging heat. An evaporative condenser is a heat exchanger in which refrigerant is cooled by a combination of air movement and water spraying.

Hot water system (HWS): a reticulated water system that distributes or recirculates hot water (>60°C) through the majority of its branches. A hot water system (HWS) may include temperature control devices located near outlets to regulate the delivery temperature.

Warm water system (WWS): a reticulated water system that distributes or recirculates warm water through the majority of its branches at a nominal temperature of 45°C by means of a temperature controlling device.

Adapted from: Health Protection Programs. Control of *Legionella* in manufactured water systems in South Australia. Revised 2013. SA Health, Adelaide. Available at: [SA Health website](#).

Reservoir

Legionella bacteria are found naturally in low levels in aquatic habitats and soil.

Most *Legionella* bacteria thrive in warm water (20°C – 45°C)⁵ and are often associated with CWS or WWS.

L. pneumophila grows readily in closed water systems in built environments such as inside plumbing fixtures and pipes where warm temperatures and the build-up of nutrients and microorganisms on surfaces (called biofilm) provide an ideal environment. In the absence of effective environmental management *Legionella* bacteria can proliferate.

L. longbeachae is often associated with garden soil, potting mix or compost. There have been no reports of *L. longbeachae* acquired via water systems in the built environment.

Mode of transmission

Legionella are transmitted to susceptible humans via inhalation of aerosols, dust, or aspiration of contaminated water. Outbreak data suggests outbreaks that occur with *L. pneumophila* are usually serogroup 1.

A variety of aerosol-producing devices have been associated with outbreaks of Legionnaires' disease, including air conditioning cooling towers, whirlpool spas, showers, Legionellosis SoNG Version 17

decorative fountains, car washes, nebulisers, humidifiers and water misters.^{6,7,8} In these cases, proximity to the aerosol generator, duration of exposure, and presence in an area downstream of the contaminated device have all been found to be risk factors for disease acquisition.⁹

In a small fraction of hospital acquired Legionnaires' disease cases, microaspiration of colonised drinking water into the lungs has been implicated. Data supporting microaspiration of water as a major source of transmission are not convincing. There is evidence to support aspiration of contaminated water as a possible mode of transmission in certain subgroups, such as those receiving nasogastric feeding.^{10,11,12}

Transmission of *L. longbeachae* associated with close contact with potting mixes and other sources has been documented but was not unequivocally demonstrated with multivariate analysis in a case-control study. The gardening environment and behavioural factors were better predictors of infection. These factors included poor gardening hygiene (lack of hand washing prior to eating, drinking or smoking while gardening) and being near dripping hanging flower pots.¹³

Person-to-person transmission of legionellosis is likely to be very rare. In 2016, there was a case documented of a mother who acquired the infection from her ill son.¹⁴

Incubation period

The incubation period during most outbreaks of Legionnaires' disease is variable, averaging between 5 - 6 days (range 2 - 10 days), and outliers from 1 - 28 days.⁹ A nosocomial case with an incubation period of 63 days has been reported.¹⁵

The incubation period of Pontiac fever is from four hours to three days, with a median of about 1.5 days, although incubation periods of up to five days have been reported.⁹

Clinical presentation and outcome

The clinical spectrum of disease caused by *Legionella* sp. is broad and ranges from asymptomatic infection to a mild cough and low grade fever to stupor, respiratory failure, multiorgan failure and rapidly progressive pneumonia leading to death. Pontiac fever is the non-pneumonic form and is an acute, self-limiting influenza-like illness. The clinical presentation of Legionnaires' disease includes fever, loss of appetite, headache, malaise, lethargy and pneumonia. Some patients may also have myalgia, diarrhoea, nausea, vomiting and confusion. Evidence of infection with other respiratory pathogens does not exclude the possibility of coinfection with *Legionella* sp.^{9,16,17} Radiological findings commonly describe a patchy, unilobular infiltrate/consolidation but other appearances may occur along with the presence of pleural effusion.

Persons at increased risk of disease

Legionella are found extensively in the environment and many people are exposed but do not develop illness. People at highest risk of acquiring legionellosis in the community or healthcare facilities are¹⁸:

- severely immunocompromised patients e.g. haematopoietic stem cell transplant (HSCT) and recent organ transplant patients
- patients receiving high doses of immunosuppressive medication.

Other people at higher risk of acquiring legionellosis include:

- those with chronic underlying disease, such as chronic obstructive pulmonary disease, diabetes mellitus, congestive heart failure, chronic liver failure, chronic renal failure
- transplant recipients who are on immunosuppressant therapy
- those receiving monoclonal antibodies
- those with HIV/AIDS and some forms of cancer
- smokers
- people over the age of 50 years.

Additional risk factors for healthcare associated infections include recent surgery, intubation and mechanical ventilation, aspiration of water contaminated with *Legionella* including nasogastric feeds and the use of respiratory therapy equipment contaminated with *Legionella*.¹⁹ Risks are further elevated if there has been recent plumbing work which has caused disturbance of biofilm or a prior history of nosocomial cases in the healthcare facility, given the difficulties of eradicating *Legionella*.²⁰

Disease occurrence and public health significance

Legionnaires' disease is an important cause of community-acquired and hospital-acquired pneumonia with outbreaks of public health significance being reported globally.^{20,21} Global incidence is difficult to quantify due to inequalities of case definitions, diagnostics and surveillance systems.^{21,22}

Most cases of legionellosis are sporadic. Cases occur more commonly among adults over the age of 50 years and men.^{9,16} The disease is rare in children.

In recent years, an average of 400 confirmed and probable legionellosis cases have been notified in Australia each year. In 2014 the notification rate was 1.8 cases per 100,000 population (range 1.4 – 2.2 cases per 100,000 population between 2010 and 2014) (NNDSS data). While in many countries *L. pneumophila* serogroup 1 is the most common causative agent, in Australia, *L. longbeachae* and *L. pneumophila* are notified in almost equal numbers. Notified species in Australia vary by geographical location, with *L. longbeachae* usually comprising the majority of notifications for South Australia and Western Australia while *L. pneumophila* has comprised the majority of notifications in Victoria and New South Wales.²³

Cases occur throughout the year. *Legionella* accounts for between 0.5 and 5 per cent of cases of community acquired pneumonia.^{9,24}

3. Routine prevention activities

Prevention measures for legionellosis focus on the management of the environments in which *Legionella* are likely to proliferate. This includes ensuring compliance with national standards and codes of practice to reduce risk of proliferation and subsequent infection.

- Cooling water systems and warm water sources: Preventative measures focus on minimising the risk of the growth of *Legionella* (especially *L. pneumophila*) in cooling towers and warm water sources through maintenance, water quality, education of building operators, legislation and enforcement. Relevant standards for the control and prevention of *Legionella* in cooling systems include the Australian/New Zealand Standard AS/NZS 3666: 2011, 'Air-handling and water systems of buildings Microbial control'.²⁵ Further guidance can also be found in other relevant Australian and Australian/New Zealand Standards and State and Territory guidelines.^{19,25}

- Compost and potting mix: *L. longbeachae* infection prevention at the individual level focuses on education to reduce individual behavioural risk factors such as encouraging the wearing of gardening gloves, moistening down potting mixes and compost before use, avoid inhalation and paying rigorous attention to hand washing especially after handling potting mix as well as before eating, drinking or smoking. At the industry level, codes of practice have resulted in warning labels promoting safe handling being placed on bags of potting mix.
- Clinical and infection control practices in healthcare facilities: Only sterile water should be used to clean nebuliser medication chambers and in the preparation of aerosol solutions for use in nebulisers and humidifiers.¹⁰⁻¹² In immunosuppressed and intubated patients, nasogastric tubes should only be flushed with sterile water.^{10,26}

4. Surveillance objectives

The objectives of surveillance for legionellosis are:

- to identify potential common sources of infection considering geography, time, travel or other possible links, so as to enable environmental investigation and control measures, where appropriate
- identifying clusters and outbreaks* and
- to monitor the epidemiology of legionellosis, especially Legionnaires' disease, to inform the development of better prevention strategies.

5. Data management

All probable and confirmed cases of *L. pneumophila* and any clusters/outbreaks caused by other *Legionella* species should be entered onto the notifiable diseases database within three working days following notification.

*Definitions:

- **Cluster:** Two or more cases that initially appear to be linked by area of residence or work, including a healthcare or other type of community setting and which have sufficient proximity in dates of onset of illness (e.g. six months) to warrant further investigation.¹⁵
- **Outbreak:** An outbreak is defined as two or more cases where the onset of illness is closely linked in time (weeks rather than months) and where there is epidemiological evidence of a common source of infection, with or without microbiological evidence.¹⁵

Sporadic probable and confirmed cases of *L. longbeachae* and other non-*L. pneumophila* cases should be entered onto the notifiable diseases database within five working days following notification.

Update the serogroup information within one working day of report.

6. Communications

Notify the state or territory communicable diseases branch (CDB) of the case's age, sex, onset date and geographical areas of exposure. Where an exposure occurred outside the public health jurisdiction, the CDB or appropriate public health authority will also notify the relevant PHU or state or territory.

The CDB should report to the National Incident Room cases of *L. pneumophila* whose likely place of acquisition was overseas (with details of identified potential exposure locations and sources, including hotels, spas, misting systems, etc.), for referral to the relevant national authority. The National Incident Room will advise jurisdictions of any specific known sites of potential exposure overseas as relevant.

7. Case definition

An up-to-date list of case definitions can be found on the [Department of Health's website](#).²⁷

The case definition is primarily intended to inform surveillance activities. Public health action may be considered necessary in patients not strictly meeting the criteria for a case.

Legionellosis

(Effective 1 January 2013)

Reporting

Both **confirmed cases** and **probable cases** should be notified.

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 defined as 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* as defined by the testing laboratory

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

8. Laboratory testing

Testing guidelines

- For *L. pneumophila* infection:
 - sputum (or, where available, bronchial washing, induced sputum or lung biopsy) culture to enable matching of any isolates with any available environmental samples (Note: cultures can take up to 14 days), positive cultures should be forwarded to ICPMR at Westmead hospital, and
 - urinary antigen testing of patients suspected to have Legionnaires' disease because infection will be rapidly diagnosed and the test is specific. Most urinary antigen test kits are sensitive for *L. pneumophila* type 1 but some may cover a broader range of *L. pneumophila* serogroups and other *Legionella* species.
- For other species:
 - culture is important
 - ensure that clinical isolates are sent to the state or territory reference laboratory for typing and comparison with environmental isolates.

- urinary antigen testing may or may not be appropriate depending on the species able to be identified with the type of kit used
- Serology:
 - many cases are diagnosed by serological tests; hence the diagnosis is often retrospective. Interpretation of single high titres is difficult. Seroconversion may not occur until 3-6 weeks or even later after onset or not occur at all.
- PCR techniques and genome sequencing are increasingly being used.

Table 1. Legionellosis testing^{26,28-30}

Test	First test	Second test	Reasons for test
Urinary antigen (for LP1)	ASAP	If the result of the first test is negative, repeat the test 4-5 days post onset of symptoms	May remain positive weeks to months.
Serum antibody (Blood)	Early acute phase (e.g. within 3-4 days onset) as baseline	3-6 weeks after onset. Test in parallel with first specimen.	Antibody levels rise in response to infection and may remain high for many months or years
Sputum culture (induced specimen preferred)	ASAP	Not required	Often difficult to collect as cough frequently non-productive
PCR (broncho alveolar lavage (BAL) or induced sputum specimens)	ASAP	Not required	PCR may still be positive after sputum culture becomes negative

For further details regarding testing visit:

- The [Public Health Laboratory Network \(PHLN\) laboratory case definitions website](#).²⁷
- Mandell, Douglas, and Bennett's *Principles and Practice of Infectious Diseases*.⁹
- [Centers for Disease Control and Prevention, Legionella, Diagnostic Testing](#).³⁰

9. Case management

Response times

Response for *L. pneumophila* cases and clusters/outbreaks caused by other *Legionella* species should commence as soon as possible, generally within one working day for probable or confirmed cases. Begin the follow-up investigation using the Legionnaires' disease investigation form (Appendix 1). If case is sporadic *L. longbeachae* and other non-*L. pneumophila* species, follow-up should be carried out as part of routine duties.

Response procedure

Case investigation

The response to a notification will normally be carried out in collaboration with the case's healthcare providers. PHU staff should ensure that action has been taken to:

- seek, where practicable, the doctor's permission to contact the case or relevant care-giver
- find out if the case or relevant care-giver has been told what the diagnosis is before beginning the interview
- confirm the date of onset, signs and symptoms of the illness
- confirm results of relevant pathology tests, or recommend the tests be done (see [Section 8](#) Laboratory testing)
- identify likely source(s) of a cluster or outbreak.
- inform the appropriate PHU, state or territory CDB, see [Section 6](#) Communications.

Exposure history

For a *L. pneumophila* case:

Identify all movements and higher-risk activities undertaken by the case during the exposure period. Ask about exposures during the exposure period including potential workplace, social, sporting, travel, healthcare and domestic exposures in the two to ten days before onset.

For *L. pneumophila* and species other than *L. longbeachae* questions should be asked about the following exposures:

- potential exposures to mists from CWS (e.g. air-conditioning cooling towers) through working in or visiting areas with large buildings (e.g. city centres, shopping centres)
- hot and warm water systems
- spa pools
- history of hospital admission (see [active case finding](#) section)
- history of residence in a long-term care facility or other institution (see [active case finding](#) section)
- other sources of water aerosols, e.g. respiratory devices, cooling mist spray systems in public areas, fountains, vegetable mist machines, gardening spray systems, car washes.

For probable healthcare associated cases:

If a case has spent their entire exposure period in a healthcare facility then intensive investigations and management of identified problems must be undertaken. If a case has spent part of their exposure period in a healthcare facility or institution investigations should still be undertaken to assess whether there is a significant risk in that facility. Factors to be considered are:

- susceptibility of the case to legionellosis
- presence of alternative sources of exposure outside the healthcare facility
- prior history of a case/cases associated with the facility
- recent plumbing work that has caused significant disturbance to biofilm to relevant parts of the healthcare facility

- quality of the water safety plan for the facility including adequacy of plumbing plans for the facility, age of the plumbing, presence of dead-legs, and adequate temperature maintenance throughout the relevant system^{8,31}
- previous results of testing and implementation of the actions outlined in the water risk management plan.

For a *L. longbeachae* case:

Questions should be asked about gardening activities including:

- hand washing practices
- if a mask and/or gloves were used
- if potting mix or compost mix was used, and if so what brand and place of purchase
- types of pots and watering systems in use.

Case treatment

Refer to the current [Therapeutic Guidelines, Antibiotic](#).³²

Education

The case or relevant care-giver should be informed about the nature of the infection and the mode of transmission, see fact sheet (Appendix 2).

Isolation and restriction

None

Active case finding

Active case finding is not usually required except in the following circumstances:

1. a confirmed case's workplace is suspected to be the source of infection
2. a (single) case has spent some or all of his/her incubation period in a setting such as a hospital, residential aged care facility or other institution where there are people at increased risk of legionellosis.
3. a cluster or outbreak is identified in the community
4. a high risk potential source is identified e.g. air-conditioning cooling towers, spa pool, WWS/HWS, fountain, misting system or car wash, or for *L. longbeachae*, apparent clusters of cases associated with particular brands of potting mix or other gardening soils.

Note, if it is a travel related case, please refer to [Section 6](#). Communications.

Depending on the context, active case finding should include a review of all notified cases from the past three to six months seeking to identify common exposures. In an institutional setting it may need to extend to review of medical records to identify previously undiagnosed cases.

Where there is a high index of suspicion that the case's workplace is the source of infection consider:

- informing the state or territory workplace health and safety agency at [Safe Work Australia](#)
- sending an alert to all staff to communicate

- information about the risk
- early signs and symptoms for which they should seek medical attention
- the need to contact the PHU if they develop symptoms.

Case finding in implicated healthcare settings: contact the manager or the person responsible for infection control (as appropriate) and request that active surveillance for pneumonia in other residents and staff be conducted for at least ten days (maximum incubation period) after the risk is believed to have been controlled. This may be demonstrated by no detection of *Legionella* by a laboratory accredited by NATA for *Legionella* testing using an appropriate sampling regimen and level of detection.

Even when an outbreak has been controlled in a healthcare facility there should be ongoing surveillance because; while risks can be substantially reduced the source of infection cannot usually be eliminated.⁷

10. Environmental evaluation

An environmental evaluation of possible sources should be undertaken for all notifications, especially if the case spent some or all of his/her incubation period in a setting such as a hospital or other institutional setting with people at increased risk of disease. The breadth of the investigation will be decided at the individual PHU level, taking the species of *Legionella* and local factors into consideration. For example, a notification may give environmental health officers (EHOs), or those with appropriate expertise, an opportunity to check registers of air-conditioning cooling towers held by a jurisdiction, and provide information to managers of premises while testing any suspected cooling towers. The holding and use of registers may vary across jurisdictions.

Identify all potential sources relevant to the species of *Legionella* including cooling towers and WWS/HWS, as well as potting mix or other gardening soils.

Obtain samples for analysis as appropriate. Positive samples should be held and matched against any human isolates. Sampling of potting mix and gardening soils is not normally indicated for sporadic cases of *L. longbeachae* infection.

11. Contact management

Identification of contacts

Contacts of cases are not at risk of disease, unless they share the same environmental exposure.

Contact definition

Not applicable

Prophylaxis

Not applicable

Education

Nil routine

Isolation and restriction

Nil

12. Special situations

Clusters/Outbreaks

Where more than one case of legionellosis reports a common exposure a cluster/outbreak investigation should be initiated. A single nosocomial case should be regarded as an outbreak. This includes:

- interviewing cases/carers about all possible exposures
- mapping movements of cases during the exposure period
- an urgent environmental evaluation including a search for possible sources of aerosol generation that are likely to have travelled to the vicinity in which the cases were potentially exposed.
- it should be noted that a common exposure site shared over a three to six month period may be due to chance alone
- the common exposure area of an air-conditioning cooling tower source of aerosols is typically within a 500 metre radius, but in determining the investigation area, consider:
 - distances from the common point of exposure, building height, cooling tower height, direction of plume(s), wind direction, prevailing weather conditions at the time of likely exposure (temperature, inversion layers and relative humidity) and the number of cooling towers potentially involved
 - the jurisdiction's register if available, but be aware of the likelihood for unregistered cooling towers in buildings in the vicinity
 - potential for higher health risk e.g., where many people at increased risk of disease could be exposed
 - known history of poor performance/compliance
 - within a central business district the distance covered by the investigation may differ
- liaising, as appropriate, with the environmental testing laboratory regarding samples. Samples with *Legionella* species detected should be held and matched against isolates from linked cases
- notifying the public health media manager. Consider issuing a media release to encourage people with relevant symptoms who may have been exposed to a likely source to seek medical care
- when there are cases clustered tightly in time or place initiate active surveillance. This may include contacting GPs and respiratory and infectious disease physicians to assist in case finding; reviewing Emergency Department data for cases of community-acquired pneumonia; and where well defined and readily contactable exposed groups can be identified (such as a workplace), issuing a fact sheet or letter to members of the group
- communicating the findings of the investigation to health care workers and the community
- when the investigation identifies unregistered cooling towers provide feedback to the building owner and relevant authority.

13. References and additional sources of information

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