WATER SERVICES
ASSOCIATION OF AUSTRALIA

FACT SHEET:
Legionella

Legionella species and human infection

Legionella bacteria were discovered after a pneumonia outbreak at a convention of the American Legion in Philadelphia, USA, in 1976. The cause of the disease was identified as a previously unknown bacterial species which was given the name *Legionella pneumophila*. Over the next few years it was learned that *Legionella* bacteria could grow to high concentrations in warm water circulating in cooling towers and then be released into the air in water aerosols. Inhalation of the aerosols, which were small enough to reach the lungs, could then result in infection among susceptible people. Outbreaks were also linked to other situations where water aerosols were generated, including spa baths, fountains and warm water systems in buildings.

Legionella bacteria occur commonly in fresh water and soil environments worldwide. At least 50 different species have been identified and about 20 of these have been linked to disease in humans. Exposure to *Legionella* bacteria can result in either of two forms of illness:

- Legionnaires' disease, a form of pneumonia which may be fatal, particularly in the elderly, or in people with existing illnesses and conditions which affect the health of the lungs or the immune system. Symptoms include fever, shortness of breath, cough, headache, muscle aches and pains.
- Pontiac fever, a short flu-like illness which lasts a few days.

Symptoms of Legionnaires' disease usually develop between 2 and 10 days after exposure, while Pontiac fever symptoms often develop more quickly, sometimes within a few hours. Neither of these illnesses is transmitted person-to-person. Legionnaires' disease is included in Australia's national notifiable disease surveillance system.

In most countries of the world, *Legionella pneumophila* is responsible for more than 90% of Legionnaires' disease cases; however, in Australia, a species called *Legionella longbeachae* causes slightly more infections than *Legionella pneumophila*. A number of other *Legionella* species are also capable of causing Legionnaires' disease and/or Pontiac fever, but these occur much less commonly. Most infections by *Legionella* species have been linked to some type of water exposure; however, in the case of *Legionella longbeachae*, infections seem to be associated only with the inhalation of particles of potting mix or soil.

Legionnaires' disease is relatively rare, with about 350 cases being reported in Australia each year. Most cases are not associated with outbreaks, but instead occur as single infections in the community, with no apparent links to each other. Risk factors associated with *Legionella* infection include smoking, older age, alcoholism, diabetes, cancer, chronic respiratory or kidney disease, and organ transplantation (due to the use immunosuppressive drug treatment post transplantation). The illness is more common in men than in women.

For a number of years after the discovery of Legionnaires' disease it was believed that inhalation was the only way for people to become infected with *Legionella* bacteria; however, it is now known that some cases occur by aspiration (when water or food goes 'down the wrong way' into the lungs when swallowing). This is thought to be the cause of most *Legionella* infections that occur in people who are already in hospital or nursing homes, and may also be responsible for some of the cases arising in the community.

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Legionella in water supplies

At water temperatures below about 20 °C, *Legionella* bacteria are often present in small numbers in natural fresh water sources, and they are consumed as food by larger predatory microorganisms, such as amoebae or ciliates. However, at temperatures in the range of 25 °C to 45 °C, some *Legionella* species are able to establish a parasitic relationship with a host microorganism (most commonly an amoeba) and grow inside it, instead of being digested and killed. The *Legionella* bacteria grow and multiply within the host and are eventually released into the water in a highly infective form. It is believed that growth of *Legionella* within host amoeba species occurs mainly in biofilms which are present on surfaces in contact with water, rather than in the water phase. Most natural fresh water bodies are not warm enough to permit significant *Legionella* growth, but some cases of Legionnaires' disease have been attributed to baths supplied by water from natural hot springs.

Management of *Legionella* risks

When water is abstracted from natural sources and treated to produce drinking water, the water treatment and disinfection processes that are designed to remove or inactivate microbial pathogens of faecal origin also reduce the numbers of *Legionella* bacteria and their host organisms, but do not entirely eliminate them. Within drinking water distribution systems, measures such as the maintenance of disinfectant residuals, the minimisation of sediment build up in pipes and storage tanks, and preventing ingress of contamination may help to limit biofilm growth. Chloramine disinfection has been shown to reduce biofilm growth and *Legionella* occurrence to a greater degree than chlorine disinfection, but may be associated with increased growth of other opportunistic pathogens, such as Mycobacterium species.

The risk of *Legionella* infection directly from drinking water supplies is considered to be low because conditions are generally not favourable for the extensive regrowth of amoeba and *Legionella*. Drinking water is not routinely monitored for the presence of *Legionella* species, and there is little information on the occurrence or concentrations of these bacteria in drinking water. After water leaves the distribution system, and enters the plumbing systems of buildings and the devices attached to these plumbing systems, a significant increase in risk may occur if the ambient conditions promote the growth of biofilms and *Legionella*. Key factors in promoting growth are the absence of a disinfectant residual, warm water temperatures (25 °C to 45 °C), water recirculation and/or stagnation, the availability of nutrients, and the presence of sludge, scale or rust. Infections may then occur if people are exposed to water aerosols.

Therefore, the management of health risks from *Legionella* bacteria focuses on reducing opportunities for *Legionella* growth in building plumbing and plumbed devices, and minimising the generation of water aerosols. Approaches to *Legionella* control vary among Australian states and territories, and span a range from mandatory regulations, through to codes of practice and the provision of advisory information. Specific devices and situations addressed in relation to risk management for *Legionella* include the following:

- cooling towers
- water systems in hospitals and other healthcare institutions
- hot and warm water systems
- spa baths, fountains, and other water features that may generate aerosols
- working with potting mix and soil (for *Legionella longbeachae* infection risk).

Control measures vary according to the circumstances. They may include designing systems to minimise water stagnation and reduce aerosol generation, regular disinfection and cleaning, dosing with biocides and dispersants to reduce biofilm growth, the use of corrosion control agents, maintaining cold water temperatures below the favourable growth range, and maintaining hot water temperatures above the favourable growth range. Given that cooling towers have the capacity to cause large disease outbreaks, regular testing for general bacterial growth (as an indicator of potential biofilm load) and for *Legionella*

bacteria is often required. Regulations also focus on hospitals and nursing homes because some patients may be highly vulnerable to *Legionella* infection because of underlying diseases or medical procedures.

Internationally, the Netherlands is the only country to have introduced regulations governing *Legionella* levels in tap water supplies, in addition to regulations affecting building plumbing and water-using devices. At present there is no evidence that this approach provides an additional reduction in the risk of Legionnaires' disease.

Trends in occurrence

Reported rates of Legionnaire's disease in Australia have been stable over the last decade, except for some peaks associated with outbreaks. Changes in weather and climate may affect the occurrence of this infection in the future. Large outbreaks of Legionnaires' disease have been associated with cooling towers in Australia, and other countries, and the increased use of this type of air conditioning during prolonged periods of high temperature has the potential to increase opportunities for exposure, thus leading to more cases of disease. However, changes in regulations for *Legionella* in cooling towers and hospital/healthcare facilities in some jurisdictions may counteract such effects.

Changing patterns of rainfall may also influence disease risks, as studies in several countries have shown that the rate of Legionnaires' disease cases increases slightly after rain events. The timing of the increase is similar to the incubation period of the disease, suggesting that rainfall is linked to an immediate increase in exposure rather than increasing the growth of the bacteria, although it is not clear exactly how this might happen. The number of cases also rises during periods of high humidity, perhaps due to more prolonged survival of the bacteria in aerosols.

More information is available from your State or Territory Health Department website.

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