# Legionnaires Disease: the Victorian Picture

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## Abstract

*Notifications of legionnaires disease have increased markedly in Victoria in the past five years. This increase has been partly due to improved case detection and has been accompanied by a fall in case fatality ratios. Further improvements in outcomes require enhanced clinical suspicion in primary care settings and an understanding of the value and use of current tests. Cooling towers are an important source of Legionella infection, and recent legislative changes will improve the management of risk in these settings. Data from the accompanying registration process may also improve knowledge of critical factors contributing to Legionella overgrowth in cooling towers and subsequent illness. Clinicians should attempt to obtain positive cultures from all cases.*

## Introduction

*Legionella* is a gram-negative environmental organism naturally associated with water bodies and soil. Compared with other water-borne bacterial pathogens, it is relatively tolerant of harsh environmental conditions, high temperatures and chlorine ion concentrations. This tolerance is partly due to the ability of the genus to live intracellularly; in the environment it is often associated with free-living amoebae and in humans it can reside within macrophages, offering protection from host immune responses.

Compared with the previous triennium (1995–97), *Legionella* notifications in Australia over the past three years (1998–000) increased from 171 cases per year (range of 160–192), on average, to 335 cases per year (range of 260–474). The increased notifications were almost wholly due to increases in South Australia, Queensland and Victoria.

The differential uptake of new diagnostic technology such as urinary antigen testing, along with the varied public health response to individual cases, is likely to be responsible for the increased recognition, the variation in notification rates among States, and the increasing proportion of cases attributed to *L. pneumophila* serogroup 1.

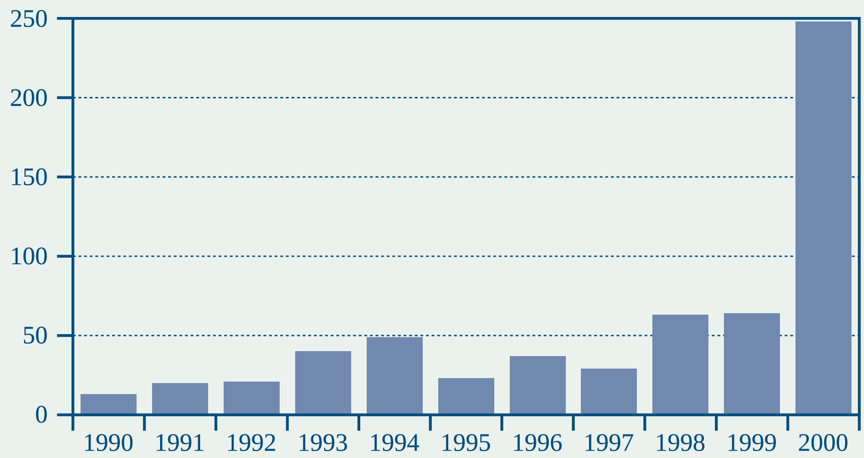
Legionnaires disease was first reported in Victoria in 1979. The number of cases notified in Victoria each year has since gradually increased, with a more marked rise in recent times (Figure 1). Notification of cases is most frequent in summer and autumn. Table 1 shows notifications in Victoria during the period 1996–99. The increasing notification trend continued in 2000 with almost 250 cases. Even after removing the effect of the outbreak at Melbourne Aquarium, this represents a further doubling of incidence. *L. pneumophila* (particularly serogroup 1) continues to represent the bulk of Victorian cases, unlike the situation elsewhere in Australia where *L. longbeachae* accounts for up to one third of cases.

Some of the increase in notifications is attributable to improved diagnostic tools and may represent cases that previously would have gone unrecognised—the increase being associated with a fall in mortality and a fall in the culture positive rate. While the reduced mortality trends and the presumed increased case detection are laudable, the immediate challenges in Victoria are to continue achieving improved rates of early diagnosis, to lessen the risk associated with cooling towers, and to use the opportunities afforded by recent legislative changes to enhance knowledge required for risk management. These challenges are considered in the following sections.

## Diagnosis of Legionnaires Disease

Achieving further improvements in case outcomes requires an enhanced clinical suspicion in primary care settings and an understanding of current test utility. Fatalities continue to occur where the diagnosis has not been made ante-mortem, with the coroner detecting two cases in 2001. The clinical and radiological findings alone cannot definitely identify cases of legionnaires disease, and no single laboratory test will identify all cases of the disease. Accurate diagnosis depends on a combination of high clinical suspicion, the culture of respiratory specimens, the detection of *Legionella* antigens in urine, and serology to detect immune responses to the bacterium.

Figure 1: Legionella Notifications in Victoria, 1990–2000



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Culture of respiratory specimens is still the gold-standard diagnostic test for legionellosis. Given that sputum production is not a prominent feature of legionellosis, bronchoscopic collection of specimens should be considered wherever appropriate. Culture will detect all *Legionella* species and serotypes, usually within two to five days. Culture will also allow more detailed examination of the isolates by subtyping for epidemiological purposes.

The *Legionella* urinary antigen test provides the most rapid method of laboratory diagnosis. Laboratories use both ELISA and immunochromatography methods. This test is specific for *L. pneumophila* serogroup 1, but may give weaker positive results for other Legionella species and serotypes. Urinary antigen is normally detectable around three days after the onset of symptoms and may be excreted for weeks (to months) following infection. Early treatment with appropriate antibiotics may reduce the level of antigen excretion; however, the test is highly sensitive and is usually positive in patients requiring hospitalisation. False positive results are rarely reported.

Serology is less useful for acute diagnosis, because *Legionella* antibodies may not appear until four to six weeks post infection and because there is a high level of individual variability in humoral immune responses to *Legionella*. Some patients do not mount any detectable antibody response, despite the presence of culture-proven respiratory infection. Also, any population has a small proportion of healthy subjects with low-level antibodies detectable, necessitating the demonstration of a rise in titre between acute and convalescent sera for an accurate serological diagnosis. A single high titre (greater than or equal to 512) may indicate recent infection, but for optimum use of serology testing, a convalescent serum specimen should be collected six to eight weeks following the onset of disease.

Table 1: Legionella Notifications in Victoria, 1996–99

| | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|
| Total number of notifications | 36 | 29 | 63 | 64 |
| Male numbers (% of total) | 26 (72%) | 25 (86%) | 15 (81%) | 44 (69%) |
| Deaths (case fatality ratio) | 7 (19%) | 5 (17%) | 8 (13%) | 5 (8%) |
| Cases with positive culture (% of total) | 22 (61%) | 17 (59%) | 33 (53%) | 15 (23%) |
| *L. pneumophila* serogroup 1 (% of all cases) | 27 (75%) | 22 (76%) | 60 (95%) | 56 (88%) |

## Minimising the Risks of Cooling Tower Systems

Where sources of infection have been identifiable after notification, cases in Victoria appear to have been associated with cooling towers. Cooling tower systems are commonly used in industry either to cool fluids in industrial processes or as part of an air-conditioning system. The warm and moist environment inside a cooling tower provides an ideal setting for the growth of bacteria, including *Legionella*.

The Victorian Government has introduced a new strategy to reduce the risks associated with cooling towers. This strategy includes the compulsory registration of all cooling tower systems, the development of risk management plans to address the risks of cooling tower systems and independent auditing of the plans. The new regulations have been accompanied by increased industry support in the form of guides and information.

Risk management is regarded as the key theme of this new strategy. The critical risks associated with the management, design and use of the cooling tower system must be managed well to avoid *Legionella* bacteria multiplying in a system and potentially infecting susceptible people with legionnaires disease.

Every risk management plan must set out a maintenance program to address the potential risks of a cooling tower system. Detailed in the new Building (*Legionella*) Regulations, these risks include stagnant water, poor water quality, nutrient growth, deficiencies in the cooling tower system, and the location of and access to towers.

To assist industry the Department of Human Services has produced a ‘Guide to Developing Risk Management Plans for Cooling Tower Systems’ which discusses these critical risks. It includes a risk classification table to assist cooling tower system owners understand the risks, and it recommends maintenance programs proportionate to the risk classification. The risk classification incorporates not only risks inherent in the system but also the susceptibility and number of persons potentially exposed. The maintenance programs include routine inspections, service, cleaning, and bacterial testing (including for *Legionella*).

The new Regulations do not mandate sampling for *Legionella* in cooling towers. Previous studies[1] of routine sampling of cooling towers have shown great variability in systems over time. Thus, health risks from cooling towers cannot be reliably assessed from *Legionella* testing alone. The Victorian approach, therefore, is to recommend the use of *Legionella* testing as a performance measure and the use of other parameters relating to water quality (such as pH and biocide levels) as control measures. The guide for risk management plans outlines recommended frequencies for *Legionella* testing based on risk classification.

## Addressing the Knowledge Deficit

The required registration of all cooling towers in Victoria will enable the collection of data on the engineering factors predisposing to (1) colonisation of cooling towers and (2) transmission of *Legionella* to humans. It is plausible over time that data will be available to address the importance of issues such as tower type, maintenance programs, and the type and timing of biocide use. Smaller-sized cooling towers and operating conditions have been implicated in a review of the seasonal nature of legionnaires disease.[2]

The increasing reliance on urinary antigen testing has indirectly reduced the number of cultures available for comparison with environmental samples. While some doubt has been cast on the sensitivity of these comparisons,[3] there is a public health benefit from obtaining a positive culture in all clinical settings because clinical disease can then be matched to possible environmental sources. Over time then, more information may become available on those aspects of cooling towers that predispose to disease causation.

The symbiotic relationship between *Legionella* and amoeba in biofilms and the effect of this relationship on *Legionella* in cooling towers require further study. Some existing data show that Legionella can reproduce within amoebae,[4] that amoebae can expel vesicles of respirable size that contain infectious doses of *Legionella*[5] and that not only do these vesicles resist some biocides such as isothiazolin,[6] but the biocides may have a stimulant effect on the amoebae.[7] Previous studies have also highlighted the varying effectiveness of differing biocides against *Legionella*.[8] It is hoped that cooling tower register data will provide information about the role of biocide dosing in *Legionella* release.

Recent changes in testing regimes have altered the epidemiology of *Legionella* notifications. This change is likely to be magnified by altered public awareness produced by the legislative changes and associated enhanced inspections. Further research will be required to understand more clearly the 'true incidence'. An opportunity exists for Victoria to be at the forefront of global efforts to understand and control legionnaires disease.

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