The Downside to Green Development:

Face-Value Efficiency and its Relationship to Legionella Growth

ENWARE

INTRODUCTION

The ongoing push for sustainable development in the building and construction industry is a justified one. The industry is responsible for 48 per cent of energy use in the United States and 45 per cent of their greenhouse gas emissions, and makes up 23 per cent of Australia's greenhouse gas emissions.[1,2] The main benchmarks for sustainability, Green Star and the WELS rating system in Australia, have been aiming for simplicity in order to maximise their reach and subsequent adoption. This simplicity, combined with the current approach to sustainability as a kind of box to tick, has led to a disconnection between the design and construction of a building and its ongoing occupancy and management. While the performance of a building is a priority across all levels of Green Star, these benchmarks have created unforeseen consequences for the wellbeing of building users by failing to demonstrate an understanding of the knock-on effects when a building is not managed correctly. The current water efficiency solutions under sustainability benchmarks, combined with a lack of information available within building management services, have created environments perfect for the growth and transmission of Legionella bacteria.

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LEGIONELLA'S RISK AND GREEN BUILDING PRACTICES

The risk that Legionella poses to building occupants is particularly potent within hospital and aged-care sectors, where patients are at increased risk due to age or existing illnesses.[3] Those factors, along with some medications, play a part in suppressing the effectiveness of the immune system in fighting off further infection. In worst-case scenarios, sufficient exposure to Legionella (via breathing in airborne water particles) can lead to Legionnaires Disease, a potentially fatal form of pneumonia.

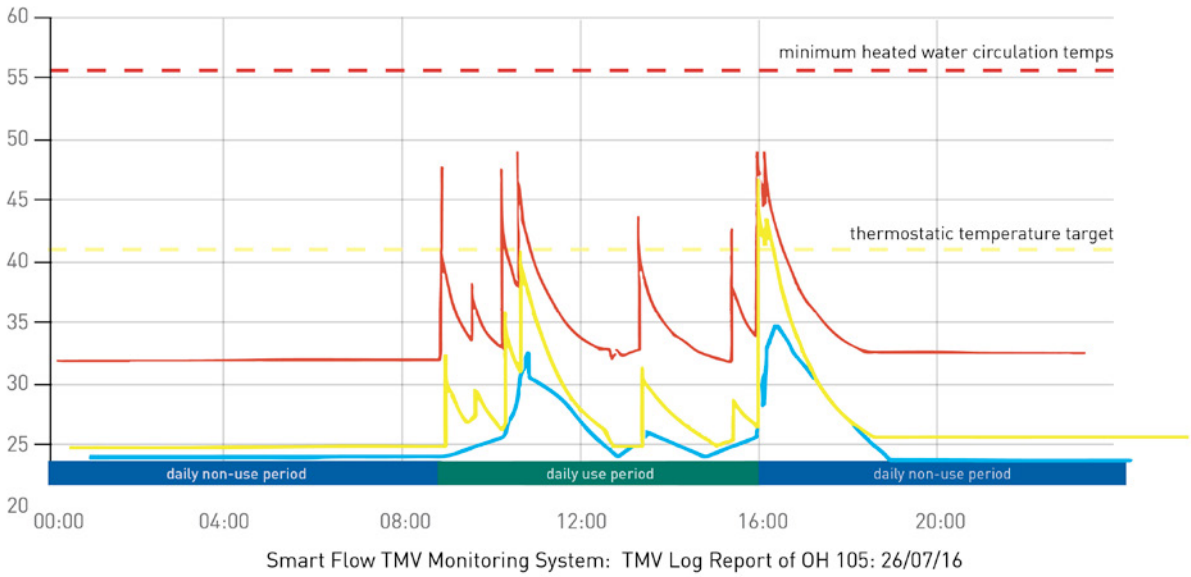
In practice, oversights within current green building strategies can encourage the growth of Legionella bacteria in these high-risk environments, as well as within other building types with similarly complex water systems. These strategies include the collection and storage of water for on-site use, the use of low-flow taps (which have the highest WELS ratings), and the reliance on both potable and non-potable water sources.[4,5] All three practices reduce the amount of water travelling through the pipes at any point and increase the time water spends within the system, thus encouraging stagnation (known as 'dead legs') and creating the conditions for Legionella to grow.

This scenario has already played out in Australia, with a hospital designed to meet the highest Green Star accreditation becoming a health risk once operational. Following the handover, the facility management team faced significant issues, as the low water movement and progressive occupancy resulted in significant Legionella test results. Attempts to reduce water stagnation by increasing the flow through the building resulted in the water heating systems failing to circulate water at suitable temperatures, further exacerbating the issues. Developers, architects and engineers need to more closely consider the functional use of the facility to ensure bacterial risks in the water system and its management are fundamental elements of the design brief.

The number of outlets installed is also of consideration when managing the growth of Legionella bacteria – a factor that exists regardless of green building practices. The Building Code of Australia (BCA) legislates how many outlets are required based on building occupancy. However, when paired with low-flow taps, the provision of either too many outlets or simply providing them in spatial configurations where certain outlets are favoured over others can also create a health hazard. A lack of sufficient use can once again lead to dead legs, or situations where taps and other similar outlets simply aren't being used for long enough for hot water to kill bacteria, or are too far from the hot water system to be at an adequate temperature as heat is lost along the pipework. The design of the facility plays a pivotal role in ensuring water related occupational risks are mitigated, as every fixture point is a potential dead leg if it is not used. Stagnation and temperature are primary factors that influence biofilm and microbial growth in water systems.

The National Environmental Health Standing Committee (enHealth) released guidelines in 2015 that "recommended" hot water temperatures circulate greater than sixty degrees Celsius for preventing Legionella growth.[6] However, usage data results from actual building management shows that temperature requirements and adequate flow rates are not being met, demonstrable through figure 1.1. *Smart Flow TMV Monitoring System: TMV Log Report for OH 105* shows a typical day's usage in a clinical room of a hospital. Only at a single point in the day do hot water temperatures reach fifty degrees Celsius, and the tap remains unused for the majority of the day. Additionally, temperatures high enough to kill legionella bacteria are also high enough to scald, and require more energy to maintain. As a solution to manage water at that temperature, EnHealth recommends the use of thermostatic mixing valves (TMVs) to mitigate the risk of scalding. Further to this, NSW Health Infrastructure also recommends that "for warm water systems, the use of thermostatic mixing valves with remote monitoring is the preferred method of delivering warm water".[7] Two common green practices designed to conserve water and energy: lowering water heater temperature set points and using less drinking water, are counteracting the effectiveness of these guidelines, potentially encouraging the growth of Legionella and putting the public at risk.[8]

Fig 1.1



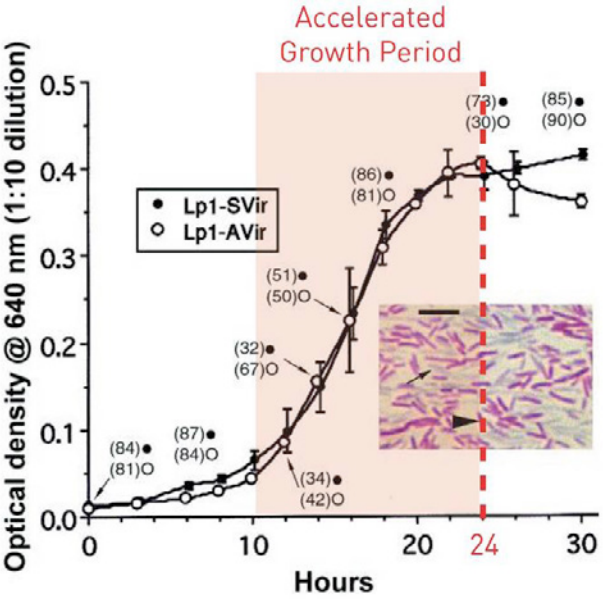


Fig 1.2

As long as there is a disconnect between the design and occupation of a building, [water risk management plans] will be significantly less effective in reducing health hazards than [their] potential suggests, and risk mitigation will continue to be highly reactionary

CURRENT CLIMATE OF LEGIONELLA REPORTING

As part of a Legionella management strategy, enHealth recommends, "all unused outlets be flushed every seven days at full flow. Where outlets have the facility to mix warm and cold water, both warm and cold sections must be flushed".[9] However, research has indicated that in laboratory conditions Legionella growth occurs fastest within a day, potentially rendering a seven-day flushing cycle redundant if conditions are optimal within a plumbing network (See figure 1.2).[10] Most buildings of concern currently have no adequate means of determining the use of outlets or efficiency of the system, and rely on a crew of staff to undertake flushing of every tap once a week. Not only does this method have no traceability to determine either occurrence or effectiveness, but also relies on the incorrect assumption that all of the taps have experienced the same flow levels and require flushing. Without constant monitoring of water flow at distal points in the system, this flushing requirement can lead to a waste of water, energy and hospital resources – detracting from the sustainability measures otherwise in place.

In 2015 two patients died in Queensland hospitals as a result of Legionella found in the potable water supply, and in response the Queensland government has implemented new legislation dictating the compulsory reporting of Legionella testing results in all hospitals and aged care facilities.[11,12] Under the new legislation, which will likely be adopted by other states in the future, these facilities will have to develop comprehensive water risk management plans. As long as there is a disconnect between the design and occupation of a building however, this process will be significantly less effective in reducing health hazards than its potential suggests, and risk mitigation will continue to be highly reactionary.

RECONNECTING DESIGN AND CONSTRUCTION WITH ONGOING MAINTENANCE

In order to reconnect design and construction with ongoing maintenance, there first needs to be a greater understanding of the impacts of specific design decisions and conversation occurring between the two phases of a building's life. Specifying low-flow taps in particular might appear to offer environmental and cost benefits, but holds the potential for increased levels of water stagnation and the growth of Legionella bacteria. Underused outlets present the same problem, whether they occur because the layout of outlets (on the scale of a single room as well as throughout the building) causes preferential treatment, or for reasons less evident, such as an increase in the use of alcohol based hand rubs as an alternative to washing hands. TMVs provide a solution for the problem of scalding when water in the system is hot enough to kill Legionella bacteria, but are only useful in that role assuming that water is heated to adequate temperatures while in circulation. Environmental goals are crucial to hold and reach, but not at the expense of health and safety – and especially not if the measures then taken to manage health and safety eliminate the effectiveness of sustainability efforts. From a maintenance perspective, correctly managing the issue of Legionella growth and transmission depends on an adequate ability to track the use and disuse of complex and dynamic water systems.

ENWARE AUSTRALIA

As an Australian owned and based company with strong local manufacturing capabilities and an extensive overseas supply network, Enware has 80 years of history and a wealth of experience in delivering water that works for life. This experience provides the knowledge and trust to allow close collaboration with a range of industries, employing the use of research and design led innovation to produce better solutions. Their approach is focused around better understanding the needs of the user which has led to them becoming industry leaders in plumbing and personal safety.

Most recently, Enware has developed Smart Flow™, an intelligent water management system that ensures visibility of real time plumbing dynamics, including flow and fixture usage, temperature stability and temperature circulation. The integration of such a system within the facility design creates the opportunity for building management services to accurately specify when and how to protect against bacterial growth, without wasting water, energy and manpower in the process. Furthermore, it allows for more accurate documentation and publication of data in support of Legionella testing results and water quality risk management plans as per new regulations, and reduces the need for major system interventions as a reaction to legionella proliferation. By improving performance visibility, user health and safety, operational budgets and the environment can be maintained and protected.

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