Knowledge Is Power:
Reducing the Risk of Legionnaires’ Disease from Contaminated Water Systems
by Dan Broder

Legionnaires’ disease, a severe and potentially deadly form of pneumonia, is increasingly a threat to public health. According to the Centers for Disease Control and Prevention (CDC), cases of the disease caused by *Legionella* (the genus of waterborne bacteria responsible for causing Legionnaires’ disease; most frequently the *Legionella pneumophila* species) almost quadrupled between 2000 and 2014 (Garrison et al, 2016). Legionella accounts for more drinking water-related outbreaks in the United States than all other contaminants combined, has a case-fatality rate of greater than 9 percent, and leads to annual health care-associated costs of more than $430 million (Collier et al, 2012). This is a critical time to turn the tide against Legionnaires’ disease, and water treatment officials, building managers, and regulators are on the frontlines.

What You Need to Know About *Legionella*

*Legionella* bacteria can be free-living, survive in a host amoeba, or be part of biofilm. All three situations can be present in potable and non-potable water systems. People can become ill when *Legionella* are aspirated and infect macrophages in the lungs. People at high risk for Legionnaires’ disease include those with chronic lung disease, those with compromised immune systems, and people 50 years of age or older. In addition to the susceptibility of the patient, other key risk factors include the extent of exposure, and the virulence of...
the strain of *Legionella*. Of the more than 60 species of *Legionella*, *L. pneumophila* is the species responsible for the vast majority of Legionnaires’ disease cases.

Further exacerbating the public health issue is the burgeoning threat of antibiotic resistance. According to a recent study at Tufts University, up to two percent of hospitalizations for infections from premise pathogens like *Legionella* show evidence of resistance, and those patients cost 10 to 40 percent more than patients with nonresistant infections. The study’s authors warn that the lack of regulation of premise plumbing systems can lead to inconsistent monitoring and reporting of potentially dangerous deficiencies in an aging infrastructure, and call for policymakers and researchers to pinpoint public health interventions that could reduce the risk of infections caused by bacteria in plumbing (Naumova et al., 2016).

**Growing Demand for Testing**

Outbreaks of Legionnaires’ disease have been traced to U.S. hospitals and chain hotels in just the last few months alone. The good news is that the spread of *Legionella* can be successfully managed by following thorough water safety plans, which should include periodic testing to ensure the building water system is well controlled.

Growing awareness of the risks of *Legionella* – in part due to the connection between Legionnaires’ disease cases and the change of source water in Flint, Michigan – is raising fresh questions about water quality and safety that water quality engineers, treatment plant technicians, scientists, government officials, regulatory agency personnel, manufacturers, and other groups and individuals must be prepared to address.

Currently, New York is the only state in the nation to have laws mandating testing for *Legionella*. The new regulations in New York grew out of emergency regulations that were enacted when 133 residents of the South Bronx were sickened with *Legionella* and 16 people died (City of New York Department of Health and Mental Hygiene, 2016). The source of the outbreak was determined to be a cooling tower, but potable water, especially in hospitals and other buildings with complex hot water systems, is an equally important source of *Legionella* transmission. New York now requires both that cooling towers be registered and tested for *Legionella*, and that all general hospitals and residential health care facilities in the state perform quarterly *Legionella* culture sampling and analysis.

On a national level, the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) offers non-binding guidelines and standards establishing minimum *Legionella* risk management requirements for building water systems for all.

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buildings (other than single family residences) for potable and non-potable water. The Department of Veterans Affairs has gone a step further. The VA has developed a policy for the prevention of healthcare-associated Legionnaires’ disease, which includes mandatory testing of its buildings’ potable water distribution systems for Legionella pneumophila to determine if their engineering controls are successfully inhibiting Legionella growth.

Water Quality Professionals and Government Regulators Play an Important Role in Reducing Public Health Risk

According to the CDC, all building owners should determine whether their building water systems are at increased risk for growing and spreading Legionella. The CDC also states that building owners should, as needed, develop and follow Legionella water safety plans that are tailored to their specific building water systems. Regional water experts and government officials should also encourage this practice. A recent literature review published by the U.S. Environmental Protection Agency (USEPA) offers review of several options available to building owners (USEPA, 2016). Once in place, routine testing is an essential part of measuring whether these water management plans are effectively controlling the building’s Legionella risk.

Accurate and reliable quantitative test results are required for decision makers to understand where there are the greatest risks in a water system so they can reduce them. Water quality engineers can help building owners and the public understand the value of looking at both the concentration of Legionella at a given point in the system and frequency of Legionella-positive outlets throughout the system to gauge risk and establish appropriate control measures. It should be noted that Legionella is virtually impossible to completely eradicate in complex water systems, but it can be effectively controlled through proper monitoring and control measures.

Focusing detection and control efforts on Legionella pneumophila, the primary causative agent of Legionnaires’ disease, may increase the efficiency and efficacy of a water safety plan. Legionella pneumophila is the most common and clinically relevant species of Legionella. It thrives in low-nutrient conditions and grows as biofilms on the inner surfaces of pipes. Biofilms allow these pathogens to resist disinfectants and environmental stressors, and aid in the spread of antibiotic resistance and virulence genes. Water management plans that include measures to address these conditions and effectively control Legionella pneumophila will also control other species of Legionella at the same time. This focus may help building operators avoid the costs and dangers of unnecessary shutdowns and/or treatment triggered by the detection of Legionella species that are far less virulent than Legionella pneumophila.

State-of-the-Art Testing

Historically, accurate testing for Legionella has been hard to do well without years of experience. Traditional membrane filtration culture methods are complex and often require more subjectivity and expert judgement than regulators and other officials would like. Even within the canon of standard methods, variations in technique and results are common from laboratory to laboratory and even from bench to bench. Testing protocols include many homebrew hybrids of standard culture methods that have evolved over the years as microbiologists seek to improve the precision of their counts. Indeed, some laboratories routinely run as many as 11 plates to come up with a count for a single water sample.

Scientists at IDEXX have been studying the best way to detect Legionella for years. One of the difficulties in Legionella testing is to discriminate between Legionella and non-target organisms without inadvertently reducing the culturable Legionella organisms in the sample or having overgrown plates that are difficult to accurately read and count. Samples that are not readable must be retested, which often requires time-consuming resampling. Key opinion leaders in the fields of both water quality and human disease helped identify the need for a culture test that was simple to run, met or exceeded the accuracy of existing culture methods and could specifically detect and quantify Legionella pneumophila, the primary causative agent of Legionnaires’ disease.

Beating Legionella

CDC investigations show that almost all outbreaks of Legionnaires’ disease in the United States over the past 14 years could have been prevented with more effective water safety management programs. Incorporating the ASHRAE standard into licensing and accreditation requirements and public health codes across the United States will substantially reduce the public health risk posed by Legionella. Making water safety plans a priority and a routine part of building ownership and management will reduce deaths from this illness, but will also require education, enforcement, and the right testing to be sure the Legionella control measures in these plans are effective over time.

References


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