WATER QUALITY & HEALTH COUNCIL
PERSPECTIVES

An Update on *Legionella* Bacteria Management in Building Water Systems

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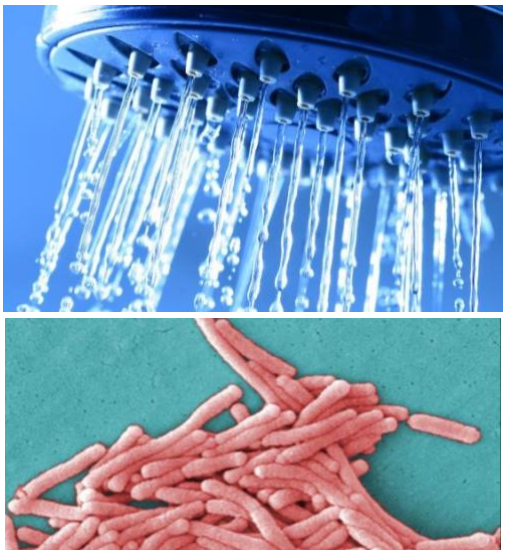

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We continue to write about U.S. waterborne disease caused by *Legionella* bacteria and their management in building water systems because of their unrelenting public health significance. Legionnaires' disease first made headlines following the 1976 American Legion conference in Philadelphia. That infamous outbreak included 182 cases of severe pneumonia and 29 deaths. Over 40 years later, major outbreaks continue to make the news—most recently in Atlanta with 1 death and over 60 probable cases of Legionnaires' disease. Ironically, Atlanta is the home of the U.S. Centers for Disease Control and Prevention (CDC), which has spent decades investigating outbreaks and helping prevent *Legionella* infections, called legionellosis.

For the past two years, I chaired an expert committee of the National Academies of Science, Engineering, and Medicine (NASEM) that examined the ecology and diagnosis, transmission via water systems, quantification, prevention and control, and policy and training issues affecting the *Management of Legionella in Water Systems*. This article provides an update on *Legionella* in building water systems, focusing on some key findings and recommendations from the committee's recently released report concerning *Legionella* control in building water systems. Controlling *Legionella* in water systems was also the focus of a 2018 conference in Baltimore, Maryland, and a recently concluded 2019 follow-up conference in Los Angeles, California. It is clear that managing *Legionella* and Legionnaire's disease is a global water quality and health priority.

Legionella and Legionellosis

Legionella bacteria occur naturally in warm freshwater environments like lakes and streams. Because they grow optimally inside free-living amoebae associated with biofilms that coat wet surfaces, *Legionella* also occur in a wide variety of constructed water systems such as premise plumbing (e.g., household pipes). Exposure occurs via contaminated aerosols produced by showerheads, faucets, hot tubs, cooling towers, and decorative water features like fountains. "Wherever there are water and pipes eventually one can find *Legionella* including in many human-made building water systems."[1] Further, because of stagnation, premise plumbing frequently lacks a disinfectant residual, and *L. pneumophila* can grow in public water systems to high numbers particularly when chlorine residuals are low or non-detectable (<0.1 mg/L).

People may become infected when they breathe in a mist (small airborne water droplets) that contains *Legionella*. Most healthy people exposed to *Legionella* do not get sick; people at increased risk include the immunocompromised, persons with a chronic lung disease like emphysema, the elderly, and current or former smokers. Outbreaks of Legionnaires'

[1] *Management of Legionella in Water Systems*, NASEM 2019.

disease, which kills and afflicts more people in the United States than any other reportable waterborne disease, are tracked and reported by CDC and occur when two or more people are exposed to *Legionella* in the same place and get sick at about the same time.[2] Legionnaires' disease outbreaks are commonly associated with buildings or structures with complex water systems, like hotels and resorts, long-term healthcare facilities, hospitals, and cruise ships. However, the actual disease burden of Legionnaires' disease is generally acknowledged to be underreported; most illnesses (96%) are sporadic cases for which the primary exposure source of *Legionella* is never identified.

2019 NASEM Report Highlights

Chapter 4 of the new NASEM report addresses strategies and applications for *Legionella* control in building water systems, including temperature control, disinfection, flow and flushing management, plumbing material selection, distal devices (i.e., plumbing fixtures far-removed from centralized water treatment and heating), and prevention of aerosols. It covers potable water supply, large institutional buildings and households, cooling towers and humidifiers, and hot tubs. Chapter 5 covers regulations and guidelines for *Legionella* management. Multiple strategies and technologies can be considered as their effectiveness are often closely related. For example, optimized flow and removal of premise plumbing "dead ends" is required for effective delivery and maintenance of heat shocks as well as chemical disinfectants.

Below are some key findings and recommendations from the NASEM report:

- All public buildings, including hotels, businesses, schools, apartments, and government buildings, should have a water management plan or program to reduce the risk of *Legionella* growth and spread.
- A minimum disinfectant residual level should be required throughout public water systems with treatment performance validated by routine monitoring for *Legionella* in the distribution system. How best to do this should be researched.
- Although it is unclear to what extent disinfection residuals can consistently achieve *Legionella* control within premise plumbing, recent research shows that monochloramine better controls *Legionella* risk in building water systems than free chlorine, but the reasons for the improved performance are not yet clear.
- Hot-water heater temperatures should be maintained above 60°C (140°F) and exceed 55°C (131°F) at distant plumbing fixtures; maintaining temperatures outside *Legionella's* preferred growth range of 25°C to 43°C (77°F to 109°F) is one of the key strategies for *Legionella* control.
- Guidance and improved education about *Legionella* management are needed for homeowners, especially for at-risk subpopulations such as the elderly.
- To help protect high-risk occupant populations, low-flow fixtures should not be allowed in hospitals and long-term care facilities; low-flow fixtures like faucets and showers increase water age, restrict disinfectant levels, and decrease disinfection provided by high-water temperatures.
- Green building codes can complicate and increase *Legionella* management and risk by increasing water residence times, decreasing or eliminating disinfectant residuals, and lowering hot-water temperatures, particularly at distant plumbing fixtures. Criteria for certifying green buildings as well as energy- and water-conservation features should account for risk factors for *Legionella.*

The Future of Legionella Management

We cannot control or understand what we do not measure and there is a great need to invest in systematic and quantitative studies on the occurrence of *Legionella* bacteria in building water systems. As new methods gain acceptance, more data on how effective the multi-barrier approaches are will be forthcoming. This will require partnerships between government agencies, water utilities, and building managers to ultimately control and reverse the trends of this disease.

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[2] Legionellosis also includes a less serious, flu-like infection called Pontiac fever.