

The Rise of Legionella

By Kelly A. Reynolds, MSPH, PhD

President Obama visits Flint, MI and assures residents that the filtered drinking water is safe and free of lead contamination by taking a sip himself. The operative word here is not just safe but filtered. While POU devices have effectively minimized lead exposures from Flint's municipal water supply, other contaminants are still a concern. Specifically, *Legionella* infections have notably increased in the region and more broadly in the US. Deficiencies in water quality management are the primary cause of these infections and thus, in many cases, are preventable. Preventing *Legionella*, however, requires additional efforts beyond treatment at the tap.

Increasing cases

Legionella was first discovered in 1976 when a mysterious illness struck staff and attendees at a convention for the American Legion in Philadelphia, PA. During this outbreak, 182 people were sickened and 29 died.¹ Additional illnesses were eventually linked to cooling towers, water misters, decorative fountains, hot tubs and showers. From these sources, the bacteria could be aerosolized and spread in micro-droplets of water that were inhaled by unsuspecting victims.

The majority of cases today occur in middle-aged men and show a seasonal increase in summer to fall months, particularly in the eastern US, but women and older populations are also at risk; outbreaks do occur year round.² *Legionella* infections manifest into two distinct clinical outcomes: Legionnaires Disease (LD), which is an acute respiratory disease similar to pneumonia, and Pontiac Fever (PF), which is a milder, flu-like illness. Most of the cases reported to the NNDSS are LD. Given the greater severity of LD compared to PF, this may be due to a greater tendency to order *Legionella* testing in patients with LD.

Legionella cases in the US are reported via a passive surveillance system where physicians and diagnostic laboratories submit data to the CDC's National Notifiable Disease Surveillance System, aimed at tracking outbreaks. Reports to the NNDSS increased from 0.42 to 1.62 incidences in 100,000 persons between 2000 and 2014, an increase of 286 percent.³ Actual cases are thought to be higher given the inherent lack of diagnosis and reporting of the disease. Currently the CDC receives reports of about 5,000 cases of *Legionella* infection each year but the true incidence is thought to be as high as 18,000. Reasons for the increase are not fully known; however, at least some is attributed to better laboratory testing, reporting and surveillance. Aging infrastructure and a growing population of elderly persons are also thought to contribute to the incidence increase. Other reasons, including increased awareness by physicians and even climate change, have been suggested.

Case fatality rates in outbreaks have been reported as high as 40 percent in the literature but with the changing epidemiology of the disease now reported in younger populations, fatality rates have decreased to below 10 percent.⁴ *Legionella* infection is now recognized as a common cause of community-acquired pneumonia that can lead to serious infections and hospitalizations.

It's in the water

Legionella is commonly present in the environment and we are exposed routinely to the organism. Environmental sources include groundwater and surface waters. The bacterium is indigenous in the environment and commonly colonizes drinking water distribution pipes. Municipal, household and hospital water distribution systems are all vulnerable to contamination. Routine levels of chlorine residual in distribution systems are typically not high enough to prevent *Legionella* from occurring in pipes. The greatest risk of infection is when *Legionella* multiplies in a water system and bacteria-laden droplets of water are inhaled. Although not as common, *Legionella* can be transmitted by drinking water that results in aspiration when the water inadvertently enters the windpipe instead of the stomach. This occurs when water essentially 'goes down the wrong pipe.'

In an investigation of 27 outbreaks of LD from 2000-2014, the CDC found that 56 percent were due to potable water distribution systems, with 22 percent due to cooling towers and seven percent from hot tubs.³ Forty-four percent of the outbreaks were at hotels and resorts, 19 percent at long-term care facilities and 15 percent at hospitals, largely due to increased immunocompromised and elderly populations.

Outbreaks from waterborne pathogens are reported in the CDC's *Morbidity and Mortality Weekly Reports (MMWR)*. The most recent report, published in 2015, included cases from 2011-2012. According to the report, "For 2011-2012, 32 drinking water-associated outbreaks were reported, accounting for at least 431 cases of illness, 102 hospitalizations and 14 deaths." *Legionella* was responsible for 66 percent of outbreaks and 26 percent of illnesses and viruses and non-*Legionella* bacteria together accounted for 16 percent of outbreaks and 53 percent of illnesses. The two most commonly identified deficiencies leading to drinking water-associated outbreaks were *Legionella* in building plumbing systems (66 percent) and untreated groundwater (13 percent).⁵ The report further identified the need for "continued vigilance by public health, regulatory and industry professionals to identify and correct deficiencies associated with building plumbing systems and groundwater systems," in order to prevent the majority of the reported drinking water outbreaks.

While most *Legionella* outbreaks are linked to large, complex

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water systems, transmission can occur via household exposures to *Legionella* in domestic water systems. One study in 1992 found that six percent (14/218) of the homes surveyed were positive for the bacterium but that the risk of infection in the residents was low.⁶ The Occupational Safety and Health Administration (OSHA) has published a guidance for home owners on how to identify areas in the premise plumbing where *Legionella* might persist and how to ensure minimal growth and transmission by maintaining proper temperature levels and reducing any stagnant areas in the distribution lines. For additional control, POU devices must be considered not just at the drinking water faucet but at other areas in the home where the bacteria can be aerosolized and inhaled, including shower heads, misters and fountains.

Infection prevention

In the CDC outbreak investigation, researchers determined that many of these outbreaks could have been prevented with proper maintenance of the building water system. Fifteen outbreaks (65 percent) were linked to process failures, 12 (52 percent) to human errors, eight (35 percent) to equipment failures and eight (35 percent) to unmanaged external changes.³

To address the need for improved system maintenance, a new industry standard was published in 2015 by ASHRAE for prevention of *Legionella* growth and transmission in building water systems.⁷ (The standard is based on the use of best practices for identifying and minimizing *Legionella* growth and transmission in large or complex water systems using chlorination and temperature controls.) The CDC has also developed a companion toolkit, *Developing a Water Management Program to Reduce Legionella Growth & Spread in Buildings: A Practical Guide to Implementing Industry Standards* (www.cdc.gov/legionella/maintenance/wmp-toolkit.html) to help guide users through the ASHRAE standard and the development of a water management plan. In the toolkit, the CDC promotes the use of routine testing to monitor for *Legionella* growth and the efficacy of control measures.

A preventable illness

Legionella disease is treatable; however, misdiagnosis has delayed treatment in some instances where the disease then progressed toward serious and even fatal outcomes. Recognizing that *Legionella* may be the cause of pneumonia-like symptoms in both the elderly and middle-aged populations has increased physician recognition of the disease and improved chances for disease management. While we are hearing more about *Legionella*

now (and particularly since the spotlight remains on Flint's water issues), it has been a common waterborne contaminant and a common cause of respiratory disease for decades. Strict diligence in water system maintenance is required to prevent *Legionella* infections. POU devices will also reduce *Legionella* risks but proper consideration of the multiple sources of exposure from faucets to showers, to cooling towers and fountains must be practiced.

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