

Legionella Prevention in HVAC Systems

Prof. Ariel Kushmaro, BGU



Executive Summary

While the last year has seen the world focus on COVID-19, there's another airborne pathogen that leads to yearly hospitalization and deaths in the United States.

Legionnaires disease, a form of severe respiratory atypical pneumonia, is far deadlier than COVID-19, with death rates at an appalling 10%. Those infected experience serious respiratory distress, and those over the age of 50 and living with preexisting health conditions are particularly at risk. People contract the disease via airborne droplets containing the legionella bacteria, which is commonly found in both natural and man-made freshwater environments including cooling

systems, cooling towers and water systems in commercial buildings and hospitals. Most public spaces, including hotels, shopping centers, and hospitals use water-based HVAC systems in which the Legionella pathogen can thrive. **With the risk of legionella spread via air conditioning so high, it's critical for businesses, schools, and hospitals to take precautions to ensure the bacteria is not growing within their HVAC systems**

In studies, TADIRAN AIROW was found to reduce the presence of legionella in HVAC systems by up to 99.999%, marking it an effective solution to stop potential Legionnaire's disease outbreaks at the source.

Overview

Legionnaires' disease is an infection of the respiratory system. It is a form of atypical pneumonia caused by the Legionella bacteria.

Legionnaire's disease is contracted by breathing in aerosolized mist or vapor containing the bacteria.

Air-conditioning systems are generally considered potential transmitters of such vapors. Most public spaces including :

- Hotels
- Shopping Centers
- Hospitals
- Public spaces that use water cooled industrial and commercial air conditioners

The water contained in these units and in the cooling-towers may contain Legionella bacteria that thrive in these conditions. The bacteria can spread via small airborne droplets which may be aspirated by people, causing illness¹. Legionnaires' disease is a severe form of pneumonia or lung inflammation caused by the Legionella bacterium. Most people get Legionnaires' disease from inhaling airborne droplets containing the

bacteria. The most susceptible people are the elderly, smokers, and those with weakened immune systems. Common symptoms include fever, chills and a cough. Some people may also experience muscle aches, headaches, tiredness, loss of appetite, loss of coordination, chest pain, or diarrhea and vomiting¹.

The family Legionellaceae consists of the single genus Legionella. To date, the family Legionellaceae comprises over 60 species with 70 serogroups. Approximately 30 species were isolated at least once from patients and have thus been documented as pathogenic to humans. The number of identified species and serogroups of the genus Legionella is on the rise^{2,3}. Most of the Legionnaires' disease cases (nearly 95%), are caused by L. pneumophila, particularly by the L. pneumophila serogroup 1 that is responsible for 84% of the cases worldwide^{4,5}. This is followed by L. longbeachae (3.9%) and L. bozemanii (2.4%), and other involved species, with less frequently, are L. micdadei, L. dumoffii, L. feeleeii, L. wadsworthii and L. anisa (2.2% in total). There are 16 serogroups of L. pneumophila, and two each in L. bozemanii, L. longbeachae, L. londiniensis, L. feeleeii, L. hackeliae, L. sainthelensi, L. spiritensis, L. erythra, and L. quinlivanii, and a single serogroup in each of remaining species^{4,5}.

Legionnaires' disease accounts for 2%-15% of hospitalization cases of community acquired pneumonia⁶. Most of the cases recorded in the U.S. are sporadic. In the 1990s, epidemiological information released by the CDC documented 8,000 to 18,000 hospitalized cases of community-acquired Legionnaires' disease^{7,8}. About one in 10 people who get sick from Legionnaires' disease will die^{9,10}.

Legionella Exposure in Air Conditioned Environment

Factors that can lead to exposure to Legionella from a heating, ventilation, and air conditioning (HVAC) system cooling towers include mismanagement of these systems due to:

- Poor use and maintenance of cooling towers and air conditioners.
- Inadequate workplace procedures for using, maintaining, inspecting, and servicing the HVAC system.

Legionella is commonly found in air-conditioned environments. Researchers in Kuwait used modern molecular technologies to monitor Legionella in air-conditioning systems. For this purpose, 547 samples were collected from 38 cooling towers for the analysis of *L. pneumophila*. These samples included those from cooling water (n=178), air (n=231), and swabs (n=138). Out of the 547 samples, 226 (41%) samples were presumptive positive for *L. pneumophila*, with *L. pneumophila* viable counts in the positive water samples ranging from 1 to 88 CFU/ml¹¹. These results are very alarming, and there is a need to find creative

solutions to minimize the presence of these bacteria in HVAC systems. Research regarding Legionella's persistence in these environments is still not fully explored and additional investigation is required.

In summary, Legionnaires' disease, a severe and potentially fatal form of pneumonia, is usually acquired via inhalation or aspiration of aerosols containing Legionella spp

The primary natural reservoir for Legionella is water and the pathogen colonizes many different natural and man-made freshwater environments, such as cooling systems, cooling towers and water systems in buildings and hospitals.

The Air Purification Effect

TADIRAN AIROW™ unique air purification technology functions **as a Hydrogen Peroxide Generator**. It has been found to be highly effective in eliminating viruses, bacteria and mold at an efficiency level of up to 99.9%.

When installed directly in the AC unit, the device releases H₂O₂ which is distributed throughout the air, and substantially decreases the growth of the bacteria.

TADIRAN AIROW™ uses a discharge current to break apart O₂ (Oxygen) molecules into two separate O atoms. The free oxygen atoms combined with water (H₂O) molecules in the airflow, transform into Hydrogen Peroxide (H₂O₂). The Hydrogen Peroxide is then distributed through the indoor air conditioning unit traveling into the conditioned space thus eliminating aerosol pathogens.

[1] CDC, Legionella (Legionnaires' Disease and Pontiac Fever) Causes, How it Spreads, and People at Increased Risk.

[2] Campèse C, Descours G, Lepoutre A, Beraud L, Maine C, Che D, et al. Legionnaires' disease in France. *Med Mal Infect* 2015; 45(3): 65-71.

[3] Euzéby JP. List of Prokaryotic names with Standing in Nomenclature (LPSN).

[4] Coetzee N, Duggal H, Hawker J, Ibbotson S, Harrison TG, Phin N, et al. An outbreak of Legionnaires' disease associated with a display spa pool in retail premises, Stoke-on-Trent, United Kingdom, July 2012. *Euro Surveill* 2012; 17(37): 20271

[5] Heuner K and Swanson M. Legionella: Molecular microbiology. Caister Academic Press; 2008.

[6] Beauté J, Zucs P, De Jong B. Risk for travel-associated Legionnaires' disease, Europe, 2009. *J Emerg Infect Dis* 2012; 18(11): 1811.

[7] Woodhead MA, Macfarlane JT, McCracken JS, Rose DH, Finch RG. Prospective study of the aetiology and outcome of pneumonia in the community. *Lancet* 1987; 329(8534): 671-674.

[8] MacIntyre CR, Dyda A, Bui CM, Chughtai AA. Rolling epidemic of Legionnaires' disease outbreaks in small geographic areas. *Emerg Microbes Infect* 2018; 7(1): 1-10.

[9] Collier SA, Deng L, Adam EA, et al. Estimate of burden and direct healthcare cost of infectious waterborne disease in the United States. *Emerg Infect Dis*. 2021;27(1):140-9.

[10] Dooling KL, Toews KA, Hicks LA, et al. Active Bacterial Core surveillance for legionellosis—United States, 2011–2013. *MMWR Morb Mortal Wkly Rep*. 2015;64(42):1190–3.

[11] Al-Matawah Q, Al-Zenki S, Al-Azmi A, Al-Waalan T, Al-Salameen F, Ben Hejji A; Legionella detection and subgrouping in water air-conditioning cooling tower systems in Kuwait, *Environ Sci Pollut Res*, 2015; 22: 10235–10241