

Legionella: hazards in the mist

Version 2.0



Legionella bacteria occur

naturally in freshwater environments including lakes, rivers, streams and reservoirs. For the most part, the low amounts in these environments pose no risk to human health.

However, legionella can also be present and multiply in water within purpose-built water systems including piping, plumbing, decorative water features, hot water heaters, hot tubs, emergency eye-wash stations and perhaps, most commonly, cooling towers. The bacteria become a hazard to the health of workers and the public when contaminated water becomes aerosolized. Those who inhale these tiny airborne droplets or vapour can develop a mild flu-like illness (Pontiac fever) or more severe pneumonia (Legionnaires' disease).

Evidence suggests exposures responsible for these illnesses can occur in work spaces and public places ranging from hospitals and hotels to office buildings and manufacturing facilities. Exposure can also occur at home.

What is Legionnaire's disease?

Legionnaires' disease acquired its name after an outbreak of pneumonia and related symptoms among people attending the 1976 American Legion convention at a hotel in Philadelphia. In total, 34 people died and more than 200 became ill.

After an extensive investigation, it was believed the bacteria likely thrived in the cooling towers of the building, became aerosolized and spread through the air conditioning system.

Decades later and the legionella bacteria remains a workplace and public health concern. According to [Public Health Ontario](#), there were 332 confirmed cases of Legionnaires' disease or Pontiac fever in 2018, including 22 deaths. This number of cases is a continuation of an upward trend over the previous five years. Even this though represents just the tip of iceberg as the illness is often misdiagnosed as the flu or pneumonia of undetermined origin. In fact, the [U.S. National Academies of Sciences, Engineering, and Medicine](#) estimates an **incidence rate eight to 10 times higher** than the number of reported cases.

What are common symptoms?

The time between initial exposure to the legionella bacteria and the onset of symptoms for Legionnaires' disease ranges from two to 10 days. For Pontiac fever, it is shorter, anywhere from a few hours to a few days.

Those suffering from Pontiac fever experience fever, chills, headache and muscle aches and generally clear within two to five days without treatment.

Patients with Legionnaires' disease usually report many of the following symptoms:

- fever
- chills
- cough
- shortness of breath
- muscle aches
- tiredness
- loss of appetite, and
- nausea, vomiting and diarrhea.

If symptoms persist or you think you may have been exposed to the legionella bacteria, medical attention should be sought. Diagnosis and treatment of Legionnaires' disease is critical in order to avoid serious complications and an extensive road to recovery.

Those suffering with Legionnaires' disease will require treatment with antibiotics. Most will fully recover. Though, according to the U.S. Centers for Disease Control and Prevention (CDC), one in ten who become ill with this disease will die.

Though people of any age may get Legionnaires' disease, older adults are particularly susceptible and face greater risk of death. Additional factors that can influence susceptibility, include:

- size of the aerosol particles (must be less than 5 µm [micrometres] to be inhaled deep in the lungs)
- concentration of Legionella (Sufficient amounts of bacteria must be present in the aerosol to cause infection. The amount varies from person to person.)
- existing weakened immune system
- existing lung disorder or other health conditions including emphysema, COPD, diabetes, kidney disease or cancer, and
- smoking.

What factors aid legionella growth?

A range of factors can aid or cause legionella growth in purpose-built water systems including:

- watertemperaturebetween 25°C and 45°C provides optimal growth conditions
- presence of biofilm (slime that forms on surfaces in contact with water)
- scale and sediment accumulation or corrosion within the water distribution system
- water stagnation or low flow
- low disinfectant residual,
- plastic and rubber plumbing materials, and
- inadequate maintenance (lack of cleaning/disinfecting).

How is it transmitted?

Transmission is predominantly by inhalation into the lungs of airborne mists or vapours contaminated with the legionella bacteria. Though it can happen, there is very little risk of transmission and getting sick through drinking contaminated water. Some evidence suggests contaminated soil can also be a source of transmission. It is not known to spread from person to person.

In the workplace, potential sources of contaminated mists or vapours and transmission include:

- cooling towers and evaporative condensers
- heating, ventilation and air conditioning (HVAC) systems
- humidifiers and vaporizers
- misting machines (used in grocery stores and for cooling)
- decorative fountains
- metalworking fluid systems
- parts washing system
- wastewater (municipal and industry-specific)
- faucets and shower heads
- fire sprinkler systems
- emergency eye washers and safety showers
- hot tubs/whirlpool spas

- specialized medical devices such as respiratory therapy equipment
- pipes carrying water into and through buildings and homes.
- drinking fountain, water cooler, ice machine (attached to water system).

Reductions in normal water use resulting from the temporarily closure of a facility or building or reduced occupancy for months, even weeks, can create hazards upon reopening or ramping up occupancy. The concerns arise from stagnant water throughout the plumbing system and the evaporative cooling system (cooling towers) that can provide optimal growth conditions for harmful pathogens such as the legionella bacteria. Additional concerns can include leaching of metals, including lead, along with the formation of water disinfection by-products. In such situations, a full assessment of the HVAC, plumbing and other potential stagnant water sources should be undertaken by certified technicians prior to re-occupancy.

What control measures can be used?

Ontario's *Occupational Health and Safety Act* requires employers to take all reasonable precautions to protect workers, including protection from the legionella bacteria.

A vital step towards meeting this obligation is the assurance that comprehensive management programs for building water and HVAC systems are in place and functioning effectively including monitoring and controlling for legionella bacteria. Similar management programs are also needed for processes and equipment using water or water-based fluids (metalworking fluids). They must involve identifying areas and specific equipment where legionella could grow, selecting and implementing control measures, along with ongoing maintenance and monitoring of the system, including testing for the bacteria.

In situations where employers may be a tenant in a building or facility, it will be incumbent upon them to reach out to the facility operator or owner to ensure these management programs are in place. Joint health and safety committees (JHSC) or worker health and safety representatives should also consider seeking clarification from the employer and building maintenance company that these programs are in place.

Globally-recognized standards setting organizations and government agencies, including the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), U.S. Environmental Protection Agency and the U.S. Centers for Disease Control and Prevention (CDC), offer important insight into elements to be included in the comprehensive management programs.

The following are some specific examples of measures recommended by the organizations mentioned above:

- maintain hot water at or above 60°C
- maintain adequate disinfectant levels in water (adequate chlorine residual)
- use ultraviolet light radiation
- avoid water stagnation and low flow
- flush unused water lines and drain or eliminate unused plumbing sections (dead legs)
- flush safety showers and eyewash stations monthly
- eliminate standing water anywhere at a workplace (improve surface drainage)
- maintain cleanliness of water systems to avoid the accumulation of scale, sediment and biofilm
- clean entire system twice yearly and continuously use chlorine or other biocides
- clean and disinfect points of discharge (decorative fountains, shower heads and faucets)
- add point of use filters (on faucets, showers)
- ensure filters in HVAC system are kept dry, clean and replaced as recommended
- clean evaporative condenser and condensate drain pans in HVAC system
- clean cooling tower
- ensure cooling tower emissions are not drawn into the building air intakes, and
- mitigate the hazards associated with thermal flushing (aerosolization and scalding), restarting the water system (dislodging of biofilms due to water pressure), and construction activity (dislodging of biofilms due to vibration).

Also consider segregating or insulating cold water systems to avoid temperatures above 20°C and avoiding exposure of large water storage tanks to sunlight that might produce elevated temperature favourable to legionella growth.

Many organizations, including the CDC and the U.S. National Institute for Occupational Safety and Health (NIOSH), also provide important precautionary guidance designed to eliminate or control exposure to legionella bacteria and other microbial growth in metalworking fluids (MWF). Chief among these precautions is the development, implementation and monitoring of a MWF management plan focusing on maintenance of fluid chemistry along with the filtration and delivery system to help provide cleaner MWFs and minimize splashing and emissions. This might include well maintained local exhaust ventilation along with maintaining the temperature of the MWFs below 20°C to slow microbial growth. Further to this point is the storage of MWF containers to avoid temperature extremes that might encourage bacterial growth.

Maintenance activities on water distribution, HVAC systems, MWF systems and other potential sources of

exposure should only be carried out by trained, competent people.

They should be equipped with appropriate personal protective equipment, such as a respirator (equipped with HEPA or "Type H" filters), rubber gloves, goggles and protective clothing and be trained to ensure proper and safe use.

Training is also essential for workers, supervisors, JHSC members and worker health and safety representatives to help them gain important awareness about the legionella bacteria, potential sources of exposure, health impacts and measures for eliminating exposure. This information is critical for JHSC members and worker representatives responsible for monthly workplace inspections and supervisors who, like employers, must take reasonable precautions to protect workers. For workers, this awareness helps them meet their obligation to report hazards to supervisors and to seek medical attention should they suffer related symptoms.

For additional information:

[Public Health Ontario](#)

[American Society of Heating, Refrigerating and Air-Conditioning Engineers \(ASHRAE\)](#)

[U.S. Environmental Protection Agency \(EPA\)](#)



Resource Lines

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675 Cochrane Drive, Suite 710
East Tower, Markham,
Ontario L3R 0B8

416-441-1939
Toll free: **1-888-869-7950**

whsc.on.ca

contactus@whsc.on.ca

Executive Director: **Andrew Mudge**

Director, Policy and Programs:
Loretta Michaud

Editor: **Marty White**

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