Ministry of Health

Legionella Investigation Reference Document

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Version 1.0 – Significant updates

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Preamble

This reference document provides information to support local Boards of Health (BOHs) with the implementation of the Infectious Diseases Protocol (as current) and the corresponding appendix (as current), under the Ontario Public Health Standards (OPHS), as it relates to the investigation of *Legionella* cases and outbreaks.¹ Under the <u>Health Hazard Response</u> Protocol (as current), BOHs are required to conduct surveillance of environmental factors in the community, assess associated risk factors and emerging trends related to illnesses and injuries in order to reduce the risk of illness or injury to the public. BOH are also required to respond to complaints and reports of illness related to *Legionella* in health care settings, as stated in the Institutional/Facility Outbreak Management Protocol (as current).² BOHs are also required to assist institutions in developing their own policies and procedures for outbreak prevention and management.²

Disclaimer

This reference document is intended to be used when investigating cases of legionellosis in Ontario in all types of settings. It provides background information on *Legionella* case and outbreak management, and details on performing environmental and laboratory investigations.

When reviewed in conjunction with resources for *Legionella* investigation by <u>Public Health</u> <u>Ontario</u> (PHO) including the <u>Public Health Inspector's Guide to Environmental Microbiology</u> <u>Laboratory Testing</u>³, <u>Legionella</u>: <u>Questions and Answers</u>⁴ and others, this document supports the local Board of Health (BOH) with *Legionella* investigations that may be associated with various water systems, including, but not limited to: hot and cold water plumbing systems, air conditioning cooling towers, whirlpool spas, and decorative fountains, in a variety of settings.

Background

Environmental sources

Legionella bacteria are found in natural water environments (e.g., rivers, lakes, ponds, reservoirs) and in soils.⁶ Its growth is optimal within free-living amoebae associated with microbial biofilms that can be found in human-made water systems.⁷ Large, complex water systems can increase the risk of *Legionella* growth. In addition, poorly maintained human-made water systems can provide conditions to facilitate the growth of *Legionella* species, including particularly warm temperatures in the range of 25-45°C, stagnant water, nutrients

due to corrosion, presence of biofilm, and reduced levels of residual chemical disinfectants in water.^{7–9} *Legionella* cases and outbreaks are often linked to these human-made water systems.⁷

Sources of *Legionella* include:^{6,7,10}

- Potable water plumbing features and devices:
 - o Showerheads
 - Electronic and manual faucets
 - Flexible hoses or connections to faucets
 - Hot water tanks and heaters, water storage tanks
 - Ice machines
 - o Appliances directly connected to water supply

Non-potable water features and devices:

- Cooling towers and other evaporative condenser systems (containing water and a fan as part of centralized air-cooling systems for buildings or industrial processes)
 - Note, if an air cooling system (e.g., home, car) is not water cooled (i.e., is waterless), the risk for *Legionella* growth and aerosolization is minimal¹⁰
- Spas, steam rooms or wet saunas
- Whirlpool spas or hot tubs, and hydrotherapy pools
- Decorative fountains and water features
- Medical or dental equipment (e.g., CPAP machine, bronchoscopes)
- Humidifiers (including ultrasonic humidifiers)
- Water misting devices (e.g., vegetable/fruit mister in grocery store, restaurant/outdoor mister)
- Dishwashers¹¹
- Water birthing baths
- Car washes
- Vehicle <u>windshield washer fluid tank</u> (if water is used in the tank instead of windshield washer fluid)¹²
- Street cleaning machines
- Sprinkler and hose reel systems¹³
- Soil, potting soil/compost (*Legionella longbeachae*)⁷

Causative agent

Legionella species are gram negative, fastidious, aerobic bacilli.¹ At least 20 of the more than 60 species have been implicated in human disease.¹ Globally, *Legionella pneumophila*, particularly serogroup 1, is attributed to 85-90% of confirmed cases.^{7,14,15}

Epidemiology

Refer to PHO's <u>Reportable Disease Trends in Ontario</u> reporting tool and surveillance reports located on PHO's <u>Legionellosis page</u> for the most up-to-date information on legionellosis trends in Ontario.

Typically, legionellosis follows a seasonal pattern in Ontario with case counts increasing in the late spring through the summer before declining again in the fall. Legionellosis cases in Ontario predominantly exhibit a sporadic pattern, with no identified common source. Between 2014 and 2023, 2.5% (67/2,706) of confirmed legionellosis cases were linked to a common source exposure (e.g. cluster/outbreak).

Transmission

The main route of *Legionella* transmission to humans is by inhalation of contaminated water aerosols. Exposure from water systems occurs when fixtures or mechanisms aerosolize water allowing the bacteria to be transported by air into the lungs.⁷ Although rare, individuals can become infected from aspirating contaminated water into the lungs (e.g., those with swallowing difficulties, patients sucking on or chewing ice from contaminated ice machines).¹⁶

Risk factors for Legionella infection

The following factors increase susceptibility to legionellosis:^{15,16}

- Age over 50 years
- Smoker (current or former)
- Chronic lung disease (e.g., asthma, emphysema, chronic obstructive pulmonary disease)
- Other chronic diseases (e.g., diabetes, kidney disease, heart disease)
- Use of respiratory therapy equipment (e.g., nebulizer, CPAP, BiPAP)
- Weakened immune system due to medications or underlying illness/treatment (e.g., chemotherapy, radiation therapy, immunosuppressive medications, systemic malignancy, HIV infection with detectable viral load)

Clinical presentation and incubation period

Individuals exposed to *Legionella* may develop legionellosis of which there are two clinical forms:

• **Pontiac fever**: mild and self-limited influenza-like illness

 Legionnaires' disease: more severe lung infection (i.e. pneumonia) that may result in hospitalization and death¹⁶

	Pontiac fever ^{16,17}	Legionnaires' disease ^{16,17}
Incubation Period	5 to 72 hours, most often 24 to 48 hours	 2 to 14 days, most often 5 to 6 days
Common symptoms/ presentation	Cough Fever/chills Anorexia Malaise Myalgia Headache	 Cough Fever/chills Anorexia Malaise Myalgia Headache Pneumonia Confusion

Period of communicability

Legionella is not established to have person-to-person transmission.

Roles and Responsibilities

During a BOH-led *Legionella* investigation, several ministries, agencies, and other partners may be involved directly or indirectly. The recommended roles and responsibilities are not limited to the parties mentioned below and can vary depending on the investigation.

Role of Ministry of Health (MOH):

• Provide support to BOHs and oversight of program delivery, communications, and information

Role of Boards of Health (BOHs):

- Identify, investigate, and report confirmed cases/clusters/outbreaks of legionellosis (Refer to <u>Appendix D: Legionella Case and Outbreak Investigation Flow Chart</u>)
- Conduct an environmental investigation, including an environmental risk assessment, review of documents (water safety plan [WSP], building schematics, maintenance records, etc.), and, as appropriate, collecting environmental samples to identify and mitigate the source in the event of an outbreak/cluster
- Surveillance/monitoring of cases of legionellosis

- Support owners/operators of water systems by providing information on mitigating the risk of *Legionella*
- Ensure that owners/operators of water systems associated with *Legionella* risk are taking steps to implement remediation and control measures (usually through a water system consultant)
- Assist owners/operators in *Legionella* outbreak management
- Enforce legislation (e.g., *Health Protection and Promotion Act*) relating to the prevention and control of health hazards, as appropriate

Role of Public Health Ontario (PHO):

• Provide scientific and technical advice and/or technical support to BOHs, relating to case and outbreak investigation, data collection and local surveillance, environmental risk assessment, sampling and laboratory testing to identify the source of *Legionella*

Role of Owners and Operators of Water Systems:

- Comply with all applicable laws, regulations and requirements related to the maintenance and operations of their facility
- Manage operation and maintenance of water systems; including keeping records (e.g., operation and maintenance records, water flushing regime)
- Develop (often in consultation with the owner/operator's water system consultant) and implement a plan for emergency control measures and remediation in the event of a *Legionella* case or outbreak
- Develop, implement and continually review a WSP
- In healthcare settings, surveillance/monitoring of cases of legionellosis and report to the BOH

Role of *Legionella* / Water System Consultant:

- Design, implement, monitor and/or evaluate remediation plans (treat the system)
- Design and/or implement WSPs, including consideration of local codes, regulations and industry standards, sampling and analysis for *Legionella* if applicable, etc.⁵

Role of the Ministry of Labour, Immigration, Training and Skills Development:

- Set, communicate and enforce the *Occupational Health and Safety Act* and its regulations including employer and supervisor responsibilities, to ensure workers are protected from health and safety hazards (e.g., *Legionella*)
- Investigate incidents of occupational illness such as suspected or confirmed worker illness due to *Legionella*

• Collaborate with local PHUs (e.g., identification of workplace associated sources of *Legionella*)

Case and Contact Management

Provincial surveillance case definitions

Refer to <u>Appendix 1: Case Definitions and Disease-Specific Information Disease:</u> <u>Legionellosis</u> for information on the legionellosis case definitions.¹

Case management

PHO offers several assays for the detection of *Legionella* in support of a diagnosis of legionellosis (see <u>Laboratory Investigation</u>).

Most individuals with legionellosis are diagnosed with a *Legionella* urinary antigen test (UAT). The *Legionella* UAT is a non-culturable specimen, therefore, respiratory culture is recommended for all cases with a positive *Legionella* UAT result. A clinical culture is required to make a genetic linkage to an environmental culture and is critical to support a *Legionella* environmental investigation (See <u>Laboratory Investigation</u>). Legionellosis treatment is at the discretion of the health care provider.

Refer to <u>Appendix 1: Case Definitions and Disease-Specific Information Disease:</u> <u>Legionellosis</u> for more information on legionellosis case management.

Contact management

Contact investigation or management is not required.

Case investigation

The case exposure investigation provides crucial information to guide the environmental investigation for identifying possible epidemiological links to potential sources of exposure reported by cases. Refer to <u>Appendix D: Legionella Case and Outbreak Investigation Flow</u> <u>Chart</u> for steps to consider in an investigation.

BOHs may use the <u>Ontario Investigation Tool (OIT)</u> to generate hypotheses about potential *Legionella* exposure locations and contaminated sources. The information captured in the OIT is intended to guide the investigation process and when possible satisfy the integrated Public Health Information System (iPHIS) requirements. To better identify and link commonly reported exposures, BOHs may enter exposure locations in iPHIS by creating an Exposure record with complete details, such as full name of the linked place, complete address and date. Key information captured in the OIT include:

- Case classification (i.e., confirmed or probable case)
- Etiologic agent (*Legionella* species and serogroup, if applicable)
- Demographics (age, gender, address at time of illness onset)
- Occupation

- Medical risk factors (refer to <u>Risk Factors</u>)
- Clinical and diagnostic information
 - Signs and symptoms (refer to <u>Clinical presentation and incubation period</u>)
 - Symptom onset date or best proxy (e.g., specimen collection date, reported date)
 - o Legionella specimen site (e.g., urine, lower respiratory tract specimen)
 - Results of medical tests ordered (e.g., chest x-ray, laboratory tests)
 - Highest level of care required (e.g., emergency department visit, hospitalization, intensive care unit [ICU] admission)
- All case activities (including date and address) within the 14-day incubation period:
 - Travel history including within Ontario
 - Residency, employment or visit to a congregate care setting including longterm care homes, retirement homes, or hospitals
 - History of exposure to aerosolized potable/non-potable water or other potential sources (refer to <u>Environmental sources</u>)

Where an employer is advised by or on behalf of a worker that the worker has an occupational illness due to *Legionella* exposure at the workplace, or that a claim in respect of an occupational illness has been filed with the Workplace Safety and Insurance Board (WSIB) by or on behalf of the worker, the employer shall give written notice, within four days of being so advised, to a Director of the Ministry of Labour, Immigration, Training and Skills Development of Ontario (MLITSD), to the Joint Health and Safety Committee or health and safety representative at the workplace, and to the trade union, if any. For more information on reporting occupational illnesses, please see: <u>Reporting workplace incidents and</u> <u>illnesses</u>.¹⁸

Data Entry

BOHs are required to enter the minimum mandatory data elements in iPHIS within **one business day** of receiving initial notification of the case of legionellosis. Refer to iPHIS <u>Bulletin # 17</u> for additional information on the provincial requirements for the timely entry of cases and outbreaks.

Outbreak Assessment

Outbreak considerations

BOHs should suspect a legionellosis cluster or outbreak when two or more *Legionella* cases are epidemiologically linked by their location (e.g., institution, residence, defined geographical area) and time from a potential common exposure (e.g., cases have symptom onset within 14 days of potential common exposure). When initiating an outbreak investigation, BOHs should consider establishing an outbreak investigation team, that may include the Medical Officer of Health (or Associate), members of the case investigation

team, members of the environmental health team, epidemiologists, communications specialists, etc.

As part of their initial outbreak assessment, BOHs should review:

- Case(s) data, including laboratory results and which specimens have been submitted for microbiological testing
- All potential exposure locations for confirmed *Legionella* cases reported within a defined geographical area (e.g., by building, by neighbourhood) or time period to assess for clustering
 - Note that water aerosols containing *Legionella* may be dispersed in the atmosphere several kilometers from their source (e.g., a cooling tower) depending on factors such as the size of the water system and wind patterns^{19–23}
 - When cases are geographically dispersed, mapping cases may help identify potential sources
- Other symptomatic individuals (e.g., family member, roommate, resident in same building) who may be linked to the location and have had a common exposure source

BOHs should consider alerting local health care providers if there is an increase in community *Legionella* cases above baseline or when a *Legionella* cluster or outbreak is suspected or declared. This can assist with *Legionella* case finding and ensure appropriate testing of individuals with signs and symptoms of legionellosis.

Public Health Ontario (refer to <u>Appendix E: PHO Contact Information</u>) is available to provide support for the investigation, including assigning an investigation or provincial outbreak number (where applicable) and assistance with the environmental investigation.

Refer to <u>Appendix 1: Case Definitions and Disease-Specific Information Disease:</u> <u>Legionellosis</u> and the <u>Infectious Diseases Protocol</u> for information on public health management of infectious disease outbreaks.

Declaring an outbreak over

BOHs have discretion on when to declare an infectious disease outbreak over. BOHs should use an enhanced surveillance period (e.g., two incubation periods or one incubation period plus a reporting delay) to monitor for additional cases prior to declaring an outbreak over.^{24–} ²⁷ Additional considerations for declaring a *Legionella* outbreak over may include:

- No occurrence of new cases epidemiologically linked to an identified common source after remediation occurred (e.g., no detection of *Legionella* in post-remediation environmental samples)
- A return to baseline/expected level of legionellosis cases (e.g., during a community outbreak)

PHO is available for consultation on when to declare a *Legionella* outbreak over (refer to <u>Appendix E: PHO Contact Information</u>).

Public Health Environmental Risk Assessment

During a *Legionella* investigation, the BOH should identify potential sources of *Legionella* associated with the case or cluster/outbreak. In situations where cases are distributed in the community with no epidemiologic link to a common location, multiple potential exposure sources of water aerosolization may be identified. The BOH should perform environmental risk assessments for identified locations (see: <u>Conducting and Interpreting the</u> <u>Environmental Assessment; Centers for Disease Control and Prevent (CDC) *Legionella* <u>Environmental Assessment Form</u>) to assess the risk of *Legionella* proliferation and water aerosol exposures arising from components of the water system(s).⁶</u>

Factors to consider when determining when to initiate an environmental risk assessment may include susceptibility of the population affected, existence of clinical samples available, potential exposures during the incubation period, etc. When combined with the epidemiological data available, this assessment will help prioritize environmental exposure points to consider when developing a sampling plan, if required. In health care or congregate care settings with a vulnerable population, a single case should be investigated with urgency to rule out a setting-associated exposure during the incubation period.

Refer to <u>Appendix D</u>: <u>Legionella Case and Outbreak Investigation Flow Chart</u> for steps to consider in an investigation.

The following steps of an Environmental Risk Assessment are recommended:^{28,29}

- Based on the epidemiologic investigation (as discussed in the <u>Case and contact</u> <u>management section</u>), determine possible sources of aerosolized water in the case's environment, (i.e., exposures to potable and non-potable <u>water sources</u> producing aerosols during the case's incubation period).
 - If a cooling tower may be a potential exposure source, refer to <u>CDC Strategies</u> for Identifying Cooling Towers³⁰
 - Where applicable and feasible, consider implementing water restrictions and shut down potential aerosolizing sources, if not already done. Consider the population's susceptibility to Legionnaires' disease.
- 2. Request a meeting with personnel with knowledge of the water system (e.g., building owner/operator, facilities maintenance staff) and water system consultant, where applicable.
 - Review written water safety protocols, such as a <u>Water Safety Plan (WSP)</u> or *Legionella* management and control policy, if available.
- 3. For a water system in a building, review the actual as-built layout of the water system with building owner/operator; the schematic may be helpful if available (e.g., if building plumbing system is a potential source), for:
 - The incoming water supply, whether from a municipal water system or from a private source; and the type of residual disinfectant used, if any.

- Whether hot or cold water is recirculated, supplied on demand or stored.
- Water softening filters, hot water storage tanks, expansion vessels, filters, pumps and strainers.
- The type of fittings, including faucets, showers, toilet cisterns, aerators, thermostatic mixing valves (TMV) and electronic faucets.
- Any points where there is a possibility of low flow or no flow, such as dead ends (or "dead legs") and parts of the system out of use (e.g., a wing under construction, or unused plumbing that is still connected).
- Water systems (fire suppression systems, emergency showers and eye wash stations) or terminal points (showers, bathroom taps) that are infrequently used; and
- The design and location of building structures, e.g., the position of air intakes (including open windows) for the facility in relation to the location of cooling tower exhausts.
- 4. Determine overall status of repair, maintenance, use and stagnancy (including records if available) for other potable and non-potable systems that may release water aerosols that cases may have been exposed to (refer to <u>Environmental</u> <u>sources</u>).
- 5. For all water systems, review information or records on:
 - Any recent construction, renovation, maintenance work²⁸ and associated water outages; infrequently used outlets that may allow stagnation; cleaning, flushing and disinfection procedures; and site and date of any remediation measures.
 - Physical and chemical water treatment methods and maintenance records.
 - Any onsite monitoring results for the water system (e.g., residual disinfectant levels, pH, turbidity, temperature), for trends.
 - Any past laboratory microbiological test results for *Legionella*.
- 6. For all water systems, in collaboration with water system owner/operator, assess for the potential of physical and chemical conditions within the water system likely to support the growth of *Legionella*, such as:
 - Deposits of sludge, scale, corrosion, organic matter and biofilm;
 - Areas where the water may reach 25°C 45°C in normal or abnormal use, such as during construction, uninsulated cold and hot water distribution pipes, etc.;
 - Cold water pipes in close proximity to heat sources, such as in ice machines or hot water pipes;
 - Where residual disinfectant levels are inadequate or absent;

- Where materials (e.g., rubber hoses) and/or components (e.g., electronic faucets, aerators, hydrostatic shock absorbers) could support microbial growth; and
- Thermostatic mixing valves.

Laboratory Investigation

Clinical specimens and testing

The most commonly requested *Legionella* laboratory test is the <u>urinary antigen test or UAT</u>, which detects *Legionella* antigen shed into the urine of persons currently or previously infected with *Legionella pneumophila* serogroup 1.

Note:

- *Legionella* antigen has been known to persist in urine for 3 to 6 months post disease resolution
- The *Legionella* UAT detects antigen derived from *L. pneumophila* serogroup 1 *only*; a negative test result does not rule out legionellosis caused by other *Legionella* species or serogroups
- UAT for *Legionella* does not allow for culture or sequencing
- Refer to Public Health Ontario's laboratory test information sheet for additional information regarding *Legionella* <u>UAT</u>

In addition to submitting a urine specimen, the submission of a lower respiratory specimen(s) (e.g., bronchoalveolar lavage [BAL], sputum) is recommended given the limitations of the UAT. Lower respiratory specimens are tested via <u>Legionella PCR and culture</u>. Culture isolates are required for molecular sequencing which, when environmental isolates are also available, may support identification of the environmental source of Legionella infection. Refer to PHO's laboratory test information sheet for additional detail regarding <u>Legionella PCR and Culture</u>.

For information on the advantages and disadvantages of diagnostic tests, see the <u>Centers</u> for Disease Control and Prevention (CDC) resource.

Environmental sampling and testing

Environmental sampling should be considered for investigations of *Legionella* clusters or outbreaks where a potential common *Legionella* exposure(s) has been identified. Environmental sampling may be considered where a single *Legionella* case has been identified on a case-by-case basis (e.g., case resides in an institution with a vulnerable population). Important considerations include:

- Whether microbiological test results will inform public health action.
- The likelihood that the source being sampled can be linked to the clinical case(s).
- The urgency of identifying and eliminating a potential source.

PHO's Environmental and Occupational Health (EOH) and laboratory teams are available to provide advice on the sampling strategy and environmental testing for *Legionella*.

- Refer to <u>Appendix E for PHO Contact Information</u>.
- Contact PHO's laboratory when an environmental investigation for *Legionella* is being considered, in order to facilitate timely testing and to support related requirements (e.g., sampling recommendations, provision of sampling materials, requisition form).
- PHO's <u>Public Health Inspector's Guide to Environmental Microbiology Testing</u> outlines the guidance for *Legionella* sample collection, selection of sampling sites, sample type, transport and submission to the laboratory.³

Sampling points should be prioritized in order of the most likely locations where the source of *Legionella* bacteria may be found, with potential for aerosolized water that cases could have been exposed to.^{3,29,31}

- <u>Appendix A</u> summarizes potential sampling sites for *Legionella*.³²
- Focus on areas that are conducive to *Legionella* amplification (e.g., where there is warm water, 25°C - 45°C) and aerosolization. Refer to <u>Environmental Sources</u>.
- Ideally, sampling should occur **prior** to any remediation of water systems.^{28,29,32} BOHs should enquire about any superchlorination or other remediating actions that may have been done to the water system prior to sampling. Refer to <u>Appendix B:</u> <u>Environmental Sampling Considerations for BOH</u> prior to sampling.
- Sampling points should be reassessed as the investigation progresses and more information becomes available to locate the source of *Legionella* that may have led to the cases.³¹
- Temperature, disinfection residual, and pH of the water system should be collected when sampling. Refer to <u>Appendix B, Table 1: Example of a Sampling Collection</u> <u>Form</u>.

IMPORTANT: Do NOT wait for microbiological laboratory test results if, based on the risk assessment, a potential source(s) is identified. Remediate once samples have been collected.

Once the BOH has taken environmental samples, the BOH (based on their environmental risk assessment) may instruct the water system operator to minimize potential further exposures by preventing aerosolization and undertaking remediation procedures, pending sampling results. This may involve temporarily discontinuing the use of specific components of the water system (e.g., cooling towers, humidifiers, spas, showers, decorative fountains, ice machines or other aerosol generating items).

 Note, discontinuing the use of water necessary for daily activities in settings such as health care facilities may pose significant limitations to staff and residents. In these situations, alternative water devices or sources may need to be considered by the water system owner/operator. • See section below on Immediate control measures including water restriction.

Health and Safety of Public Health Inspectors (PHIs)

Employers are required to comply with all applicable requirements under the <u>Occupational</u> <u>Health and Safety Act</u> (OHSA). Employers have to take all precautions reasonable in the circumstance to protect workers.³³ This involves:

- Prior to sampling, conducting a health and safety risk assessment of the sampling activity and the site being investigated. This will include how to safely enter potentially contaminated premises to take the samples.
- Providing the necessary training and supply of safety equipment to ensure PHIs can perform their duties safely. The employer may require the use of suitable personal protective equipment (PPE) to minimize the PHIs exposure to *Legionella* bacteria and other hazards during sample collection, based on anticipated conditions. Depending on the setting and potential risks, examples of PPE in a *Legionella* investigation may include fit tested and seal-checked respirator (e.g., N95 respirator or equivalent), safety glasses, hard hat and safety shoes, impermeable gloves, disposable overalls and high visibility vests.³⁴
- During sample collection, staff should minimize the potential to generate aerosols (e.g., taps should be turned on slowly and run gently). Staff at an increased risk of developing legionellosis (see <u>Risk Factors</u> for *Legionella* infection) should not be involved in sampling.³⁴

Immediate Control Measures and Remediation

If the likely environmental source of *Legionella* is identified, immediate control measures should be considered and the water system operator should develop and implement a remediation action plan.

The water system owner/operator should assemble a team with expertise in *Legionella* remediation (that may include water-system consultants, engineers and water treatment experts) to design and implement a remediation plan that may include post remediation verification sampling. Remediation and control of *Legionella* identified in a water system may involve hiring an environmental water consultant with relevant expertise and experience (the CDC provides considerations when <u>Working with Legionella</u> Consultants⁵). The water system owner/operator should provide the BOH with proposed remediation action plans and the opportunity to provide input to protect public health. Refer to <u>Appendix F: Resources</u> for available resources.

Immediate control measures including water restriction

Immediate control measures and remediation can vary depending on the type of setting, specific device, or water system implicated. These measures intend to stop the release of water aerosols from possible sources.

It may be possible to target immediate control measures to the water system (hot water plumbing, hot tub, ice machines, fountain, showers, etc.) or parts of the system (e.g., wing of a building) that are suspected to be contaminated. This can include shutting off the systems until remediation can be implemented.

The following actions can be taken regarding immediate water restrictions and control measures while investigation and definitive management are pending:^{35–37}

Consider:	Avoid:		
 Using sponge baths Removing aerators on faucets to avoid creating aerosols Installing point-of-use microbial water filters capable of filtering <i>Legionella</i> and replace them according to the manufacturer's recommendations Replacing filters (as needed) For the immunocompromised, use bottled water for tooth brushing and drinking Where possible, shut down cooling towers and/or cooling tower fans For patients with swallowing difficulties or risk of aspiration, restrict the use of ice machines 	 Unnecessary sources of aerosolization, such as decorative fountains Using showers Using hot tubs/spas, and hydrotherapy tubs Using water faucets in resident/patient rooms Using ice machines 		

Remediation action plan

A remediation action plan should be implemented by the water system owner/operator or their water consultant (if applicable) if the environmental source is identified. The plan should include disinfection procedures that are effective against *Legionella* and minimize the adverse impact on equipment and building occupants. See the <u>CDC Toolkit for Controlling</u> *Legionella* in Common Sources or Exposure (*Legionella* Control Toolkit).³⁸

Disinfectants used to control *Legionella* and biofilm can be corrosive and can result in water leaks or leaching of metals into the potable water system. A tailored approach accounting for site-specific water system characteristics, building uses, and risk/benefit considerations of the treatment, should guide the remediation.³⁹ It is recommended that the facility work with a water system consultant when developing and implementing the remediation action plan.⁵

Common methods of remediating *Legionella* contaminated water systems include chemical disinfection, thermal disinfection, or both.⁷ Limitations of using thermal remediation methods have been noted, and include challenges with material compatibility (e.g., gaskets and seals), distributing adequate hot water at elevated temperatures throughout the system, and the potential for re-colonization if nutrients and biofilm cannot be purged.^{7,8,40}

Post-remediation sampling

After remediation, all previously contaminated sources should be resampled to ensure that the re-colonization of *Legionella* has not occurred. In health care settings specifically, it is recommended that testing for *Legionella* be conducted to ensure that the remediation was effective.^{24,41,42} The CDC, for example, provides recommendations on <u>post-remediation</u> <u>sampling schedules</u>.²⁴ The CDC recommends that if *Legionella* is detected during this time frame, the water system owner/operator reassess the implemented control measures, consider additional remediation as needed, and restart the post-remediation sampling process .^{24,41} This sampling plan frequency can be adjusted over time based on trend data and can be discussed with the consultant providing remediation services.

Long-Term Prevention

The risk of *Legionella* infection can be mitigated by implementation of a multifaceted preventive control program to reduce the risk of *Legionella* growth and exposure. A preventive control program should include a water safety plan, elimination of stagnant water conditions, management of water temperatures, and potential consideration of supplemental disinfection.

Developing a Water Safety Plan

A water safety plan or program (WSP) identifies areas or devices that would support the growth of *Legionella* and establishes actions that would prevent growth and overall risk of illness. A water safety team (WST) should be established to develop the WSP. The WST should be a multidisciplinary group and include those familiar with the specific water systems and associated equipment in the setting and those with infection prevention and control expertise on *Legionella* bacteria. The WST may include water system/building owner/operator, maintenance employees, water contractors/consultants, health and safety representatives, infection prevention and control professionals, equipment and chemical suppliers, etc.⁹

Refer to <u>Appendix F: Resources</u> for available resources that outline steps to manage *Legionella* in various water systems.

Generally, WSPs follow the principles of hazard analysis and critical control points (HACCP) and outlines the procedures to be followed when developing a plan for preventive maintenance along with effective hazard control measures.⁴³

Each WSP typically follows these basic steps:9

- Describe the building water system(s);
- Identify risks or areas where *Legionella* could grow or spread;
- Put into place appropriate control measures;
- Establish procedures for monitoring whether control measures taken are operating as planned;
- Corrective actions to be taken when control measures are not working;
- Confirm that the program is implemented as designed (verification) and that the program effectively controls the hazardous conditions (validation); and
- Ensure there are supporting activities, including documentation, communication and training of relevant staff.

Risk Communication During an Outbreak

Legionella outbreaks can attract media and public attention depending on the number of cases involved, the setting and the severity of the outbreak. BOHs should develop a communications strategy that provides timely and accurate information to those who need to know about the risk, measures being taken to investigate and mitigate the risk, and individual actions that can be taken, if any. Communication should be relevant, meaningful, timely and understandable for the target audience.

BOHs should consider alerting local health care providers if there is an increase in community *Legionella* cases above baseline or when a case cluster or outbreak is suspected or declared. This can assist with *Legionella* case finding and ensure appropriate testing of individuals with signs and symptoms of legionellosis.

The CDC has developed <u>Communications Resources</u> to help public health officials manage *Legionella* outbreaks that attract media and public attention.⁴⁴ As well, PHO's general resource on <u>risk communication</u> may be helpful.⁴⁵

Glossary

Aerators: A mesh screen attached to a faucet or tap that aerates and conserves water, with additional benefits of retaining particulate and potentially reducing splashing. Aerators incidentally provide a surface area and retention of organic material facilitating biofilm ecology, which can be a reservoir for *legionella* and source of aerosols.

Aerosol: A suspension of tiny free-floating particles in the air that can carry *Legionella* and be inhaled deep into the lungs. Water aerosols can be produced by showers and taps, decorative fountains, whirlpool spas, cooling towers and humidifiers.

Biocide: A chemical agent which can control, inactivate, or kill microorganisms.

Biofilm: A slimy coating produced and inhabited by microorganisms (that may include legionellae), which enables cells to stick to each other, adhere to a surface such as inside of a pipe or fitting and protects microorganisms from biocides, temperature fluctuations and physical removal.⁶

Culture: The multiplication of living Legionella in growth media.

Cooling tower: A device through which heat is transferred to water which is in turn transferred to an air stream. The resulting evaporation cools pipes and fluids which are part of the facility's temperature control system. Drift eliminators are used to reduce water volume in the air stream as they are emitted from the cooling tower. Droplet removal relies on direction changes while passing through the eliminators. Drift eliminators come in many types of configurations including herringbone (blade-type), wave form, and cellular (or honeycomb) designs. Makeup water is fresh water that replaces water lost to evaporation.

Control measure: Any procedure used to prevent or eliminate a hazard or reduce the hazard to an acceptable level.

Dead leg: A length of pipe in a water distribution system that has been capped or left in place, through which water no longer flows. This results in water stagnation, the local consumption of residual disinfectant and temperatures that promote bacterial growth or proliferation.

Environmental risk assessment: Identifying and assessing level of risk posed by a water system, work procedure or process.

Expansion Vessel: Within a pressurized water system, an internal bladder device is often used as a means of accommodating water expansion (which is caused by the water heating). These bladders are often made of synthetic rubber and, given suitable conditions may support the growth of *Legionella*.

Flushing: The process of opening an outlet so that water flows out for a specified period of time. Flushing can be used to prevent stagnating conditions in pipes, to dissipate a biocide after disinfection, and/or to remove contaminants in the system.

Hazard evaluation: A process to determine whether a health hazard exists when workers may be exposed to hazardous materials.

Incubation period: The time interval between initial exposure and appearance of the first

symptom.

Point-of-use filter: A filter (e.g., micro-, ultra-, or nano-filter) specifically designed to prevent the passage of *Legionella* bacteria, or other specific microorganisms and particle contaminants, which may be present in water. Typically, these filters are fitted to water outlets or installed in water supply lines proximal to equipment (e.g., ice machines, drinking fountains).

Pre-flush: Water collected immediately after the tap or fitting is opened. The tap or fitting should not have previously been disinfected. The pre-flush sample represents water held within the tap or fitting, and ideally should be taken when the tap has not been used for several hours.

Post-flush: Water collected after the tap has been running for a period of time (two minutes or more). It may be reflective of the water quality circulating in the system.

Risk management: Determining and implementing precautions to reduce risk.

Serogroup: Subgroup of *Legionella* species distinguishable from other strains on the basis of antigens (proteins) on the surface of the bacteria.

Sporadic case: An isolated or individual case of disease with no links to other cases in time or place, or to a common source of exposure.

Thermostatic mixing valves (TMV): A valve that blends hot water with cold water to prevent scalding.

Vulnerable individual: With respect to legionellosis, a person whose immune system is suppressed and may be unable to fight off an infection caused by the inhalation of *Legionella* bacteria.

Water systems: Refers to any potable and non-potable water systems within the building or on the building site. For the purposes of this document water systems does not include municipal water systems.

Whirlpool spa: Refers to spa pools, spa baths, whirlpools, hot tubs and hydrotherapy pools.

List of Acronyms

Acronyms	Full Term
вон	Boards of Health
CDC	Centers for Disease Control Prevention
iPHIS	Integrated Public Health Information System
LD	Legionnaires' Disease
МОН	Ministry of Health
MLITSD	Ministry of Labour, Immigration, Training and Skills Development
OHSA	Occupational Health and Safety Act
PHI	Public Health Inspector
PHO	Public Health Ontario
PPE	Personal Protective Equipment
PPM	Parts Per Million
TMV	Thermostatic Mixing Valves
UAT	Urinary Antigen Test
WSP	Water Safety Plan
WSIB	Workplace Safety and Insurance Board

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Appendix A: Possible Sampling Sites for Legionella^{7,23,34}

Sampling is based on the environmental and clinical investigations. The table below provides general sample sites for consideration. Refer to <u>PHO's Legionella</u>: <u>questions and</u> <u>answers</u> document for more details and additional sampling sites including decorative fountains, humidifiers, nebulizers, hand powered resuscitators, breathing ventilators, and other equipment.

Sampling Sites	Type of samples	Examples
Potable water system	Bulk water, swabs	 Incoming service connection main Water softener Tanks and cisterns Water heater Expansion vessel Shower and sink faucets (case's room for hospital and institutional settings; and distal ends of plumbing) Thermostatic mixing valves (TMV) Hot water return
Whirlpool spas	Bulk water, swabs	 Water in the pool Swabs from biofilm above the water line, water jets, and filters
Cooling towers	Bulk water, swabs	 Make up water Collection basin (area below the tower for collection of cooled water) Sump (section of the basin from which water is pumped back). Silt and sludge may also be collected here. Return service to cooling tower located near the heat source Drift eliminator (see Glossary under Cooling tower)

Appendix B: Environmental Sampling Considerations for BOHs

Environmental Sampling

- To determine specific sampling locations, along with access to these locations, it is recommended that the water system owner/operator involve an experienced water safety expert or consultant, a health and safety committee member, and a facility employee familiar with the water system and responsible for its maintenance during sampling. The consultant or employee should be able to remove showerheads and faucet aerators to assist BOHs with sample collection.
- BOH Equipment and materials that should be used when conducting sampling activities include:
 - ✓ Personal protective equipment
 - ✓ PHO's laboratory water collection bottles
 - ✓ PHO's laboratory environmental swabs to collect biofilm samples
 - Environmental Microbiology Investigation Requisition Form
 - ✓ Chlorine/chloramine test kit
 - ✓ Calibrated thermometer
 - ✓ pH meter
 - ✓ Camera
 - ✓ Sterile plastic bags
 - ✓ A cooler supplied with ice or frozen refrigerator packs, for storage and transportation
 - ✓ Permanent marker to label water bottles and environmental swabs
- PHO's <u>Public Health Inspector's Guide to Environmental Microbiology Testing</u> outlines the guidance for *Legionella* sample collection, selection of sampling sites, sample type, transport and submission to the laboratory³
- PHO's Environmental Microbiology laboratory requires that samples be stored at or between 2°C and 6°C and transported to the laboratory as soon as possible.
- Care and diligence in collecting information in the form of records, samples, photographs and chain of custody requirements should be adhered to. It is recommended that sampling should be carried out by experienced persons.
- Temperature, pH and residual disinfectant (chlorine or chloramine) testing of both hot and cold water systems should be conducted and documented when samples are collected for PHO's laboratory.⁴⁶ A preprinted sample collection form (see <u>Appendix C</u>)

will save time during sample collection.³² See Table 1 for an example of a completed sample collection form.

Table 1: Example of a Sample Collection	on Form
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Sender's Number*	Collection Date	Sample Type	Sample Description (check all that apply)	Parameter	Comments
2014F-S	September 26, 2023	⊠ Swab □ Water □	 Pre-remediation Post-remediation Pre-flush Post-flush Cold Hot Location/Room: Shower in room 2014 	Temperature: <u>N/A</u> °C Chlorine (ppm): FAC - <u>N/A</u> TC - <u>N/A</u> CC - <u>N/A</u> pH: <u>N/A</u>	
2014F-H	September 26, 2023	□ Swab ⊠ Water □	 Pre-remediation Post-remediation Pre-flush Post-flush Cold Hot Location/Room: Shower in room 2014 	Temperature: <u>50.5</u> °C Chlorine (ppm): FAC – <u>0.05</u> TC - <u>0.20</u> CC - <u>0.15</u> pH: <u>7.1</u>	

Sender's Number*	Collection Date	Sample Type	Sample Description (check all that apply)	Parameter	Comments
2014F-C	September 26, 2023	□ Swab ⊠ Water □	 Pre-remediation Post-remediation Pre-flush Post-flush Cold Hot Location/Room: Shower in room 2014 	Temperature: <u>10.5</u> °C Chlorine (ppm): FAC – <u>0.90</u> TC - <u>1.20</u> CC - <u>0.30</u> pH: <u>N/A</u>	

- *Each sample must be labeled with the unique identifier that must also be affixed to the requisition.
- **Depending on the type of chemical disinfection, Free Available Chlorine (FAC), Total Chlorine (TC) and Combined Chlorine (CC) may be collected.

Appendix C: Sample Collection Form

Sender's Number*	Collection Date	Sample Type	Sample Description (check all that apply)	Parameter	Comments
		□ Swab	□ Pre-remediation	Temperature:	
		□ Water	D Post-remediation	°C	
			D Pre-flush		
			D Post-flush	Chlorine (ppm):	
			□ Cold	FAC	
			🗖 Hot	тс	
				CC	
			Location/Room:		
				pH:	
		□ Swab	□ Pre-remediation	Temperature:	
		□ Water	D Post-remediation	°C	
			D Pre-flush		
			D Post-flush	Chlorine (ppm):	
			□ Cold	FAC	
			🗇 Hot	тс	
				CC	
			Location/Room:		
				рН:	

Sender's Number*	Collection Date	Sample Type	Sample Description (check all that apply)	Parameter	Comments
		□ Swab	□ Pre-remediation	Temperature:	
		□ Water	D Post-remediation	°C	
			D Pre-flush		
			D Post-flush	Chlorine (ppm):	
			□ Cold	FAC	
			🗇 Hot	тс	
			[□]	CC	
			Location/Room:		
				рН:	

*Each sample must be labeled with the unique identifier that must also be affixed to the requisition.

**Depending on the type of chemical disinfection, Free Available Chlorine (FAC), Total Chlorine (TC) and Combined Chlorine (CC) may be collected.

Appendix D: *Legionella* Case and Outbreak Investigation Flow Chart^{1,6,23,47}



Appendix E: PHO Contact Information

Team	Contact Information	Description of
Environmental and Occupational Health	EOH@oahpp.ca	Technical and scientific support for environmental health issues
Communicable Disease Control	<u>Communicable.DiseaseControl@oahpp.ca</u>	Consultation regarding case and cluster/outbreak investigation
PHO's laboratory Customer Service Centre	CustomerServiceCentre@oahpp.ca	Laboratory notification and consultation regarding sampling and testing

Appendix F: Resources

- American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) <u>Standard 188 Legionellosis - Risk Management for Building Water</u> <u>Systems</u>⁴⁸
- American Society of Heating, Refrigerating and Air-Conditioning Engineers
 (ASHRAE) <u>Guideline 12-2023: Managing the Risk of Legionellosis Associated with</u>
 <u>Building Water Systems</u>
- Centers for Disease Control and Prevention (CDC) <u>Toolkit: Controlling Legionella in</u> <u>Common Sources of Exposure³⁸</u>
- Centers for Disease Control and Prevention (CDC) Toolkit: <u>Developing a Water</u> <u>Management Program to Reduce Legionella Growth & Spread in Buildings</u>⁹.
- Centers for Disease Control and Prevention (CDC) <u>Strategies for Identifying Cooling</u> <u>Towers</u>³⁰
- Cooling Technology Institute <u>Legionellosis Guidelines GDL 159</u>49
- Health and Safety Executive (HSE) Legionnaires' Disease Technical Guidance
 - o Part 1: The control of Legionella bacteria in evaporative cooling systems
 - o Part 2: The control of Legionella bacteria in hot and cold water systems
 - Part 3: The control of *Legionella* bacteria in other risk systems
- The National Academies of Sciences, Engineering and Medicine <u>Management of Legionella in Water Systems</u>⁷
- Public Health Ontario (PHO) Legionella: questions and answers⁴
- Public Health Ontario (PHO) <u>Public Health Inspector's Guide to Environmental</u> <u>Microbiology Laboratory Testing</u>³
- Public Works and Government Services Canada <u>MD 15161 2013 Control of</u> <u>Legionella in Mechanical Systems⁵⁰</u>
- Sanitation Foundation International (NSF) Standard 453: Cooling Towers Treatment, Operation, and Maintenance to Prevent Legionellosis.⁵¹
- WHO Legionella and the prevention of legionellosis⁶