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Legionella Risk Management and Investigations in Health Care Facilities

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PHO Rounds: *Legionella* Risk Management and Investigations in Health Care Facilities

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Disclosures

- Maurice Coppin does not have any conflicts of interest to disclose
- Kelly Briscoe does not have any conflicts of interest to disclose

Learning Objectives

By the end of this session, participants will be able to:

- Describe how *Legionella* may contaminate human made water systems within health care facilities (HCF).
- Discuss *Legionella* management, including public health case classification, environmental investigation, mitigation strategies.
- Describe laboratory support for *Legionella* investigations.

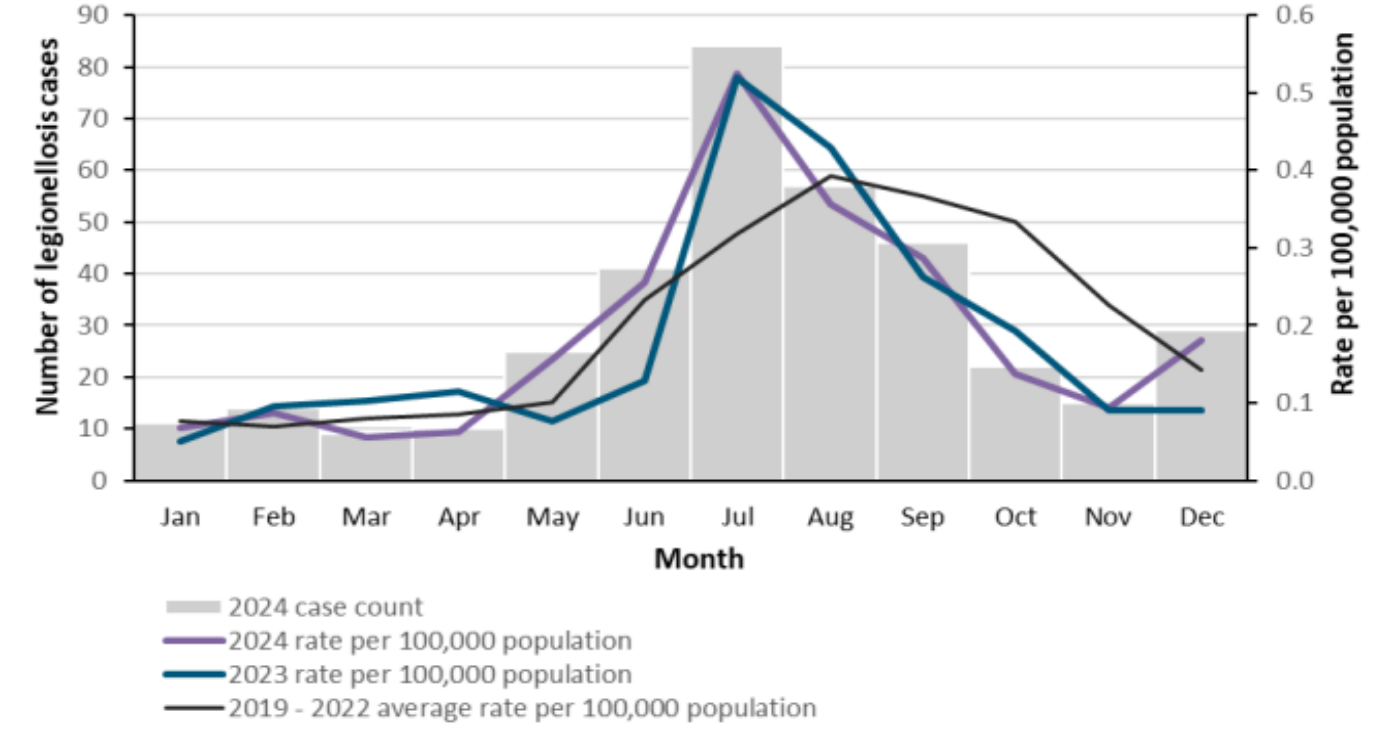
Introduction and Epidemiology in Ontario

Legionella History

- *Legionella*: Identified in 1976 after an outbreak among people who attended an American Legion convention in Philadelphia
- Those affected experienced a form of pneumonia (later became known as Legionnaires' disease)
- Pontiac fever: First identified cases occurred in 1968 in Pontiac, Michigan, among people who worked at and visited the city's health department
- Public Health was able to link *Legionella* as the causative agent for both diseases after the 1976 investigation

Epidemiology: Legionellosis Case Counts and Rates

Figure 1: Confirmed Legionellosis Case Counts and Rates Per 100,000 Population in Ontario: Year 2024 Compared to Rates for the Previous Year (2023) and Average Rates for 2019 - 2022, by Month



Ontario Agency for Health Protection and Promotion (Public Health Ontario). Surveillance report Legionellosis in Ontario: January 1, 2024 to December 31, 2024 [Internet]. Toronto, ON: King's Printer for Ontario; 2025 [cited 2024 Oct 14]. Available from: https://www.publichealthontario.ca/-/media/Documents/L/25/surveillance-report-legionellosis-ontario-2024.pdf

Clinical Presentation and Legionellosis Investigations

Legionella

Agent:

- *Legionella* are bacteria (gram-negative bacilli)
- Clinical disease may occur when susceptible individuals inhale or aspirate an adequate dose of *Legionella* contaminated aerosolized water

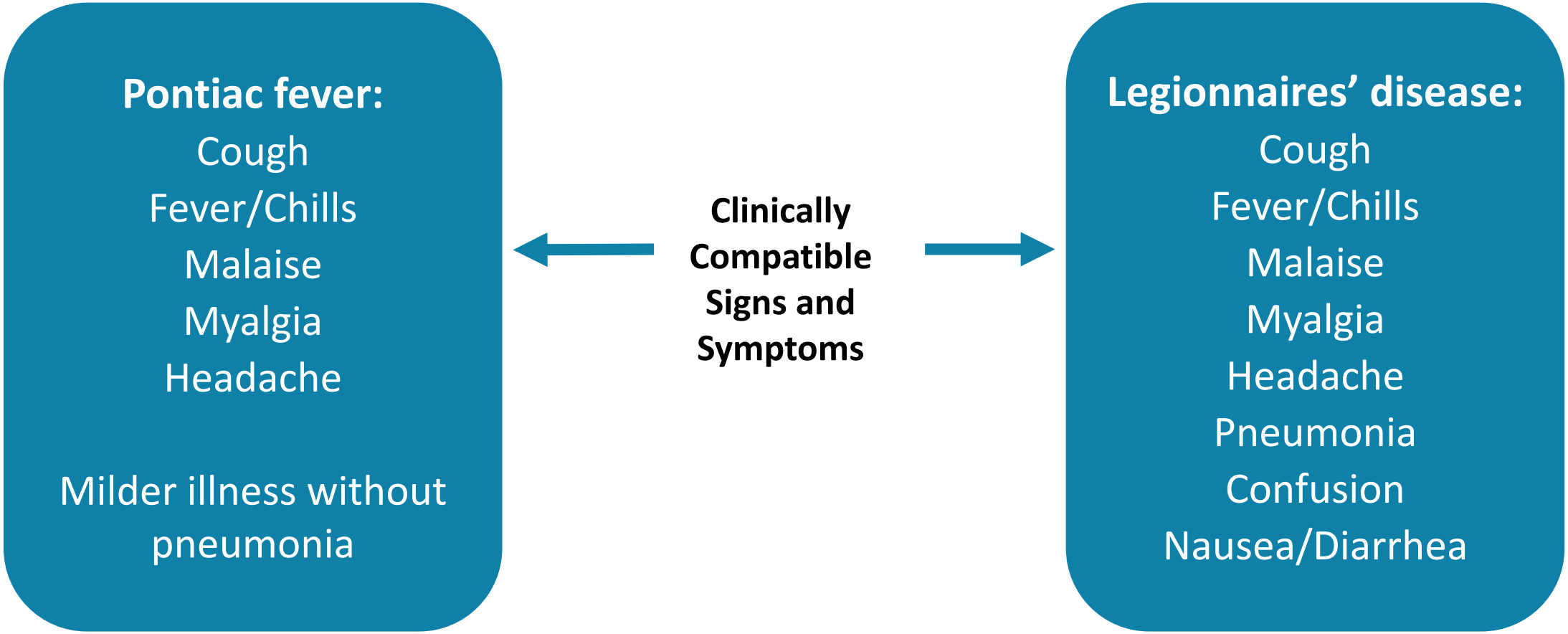
Reservoir:

- Compatible water source*: Legionella* are found throughout the environment, especially in water; cases/outbreaks are often linked to human-made water systems where conditions promote growth

Transmission:

- From the environment
- Not person to person

Legionellosis Manifests as Legionnaire's disease or Pontiac fever



Pontiac fever incubation period:
5–72 hours, most often 24–48 hours

Legionnaires' disease incubation period:
2–14 days, most often 5–6 days

Specimen Collection and Testing - Clinical

Specimen Source	Specimen Container	Analysis	Target	Turn-around time (TAT)
Urine collected during acute phase of illness	>2.0 mL sterile container	Urinary Antigen Testing	*Legionella pneumophila* serogroup 1	Up to two (2) days
Lower respiratory tract specimens*	1 mL of specimen in a sterile container	PCR	*Legionella pneumophila* and *Legionella* species	PCR: up to four (4) days
Lower respiratory tract specimens*	1 mL of specimen sterile container	Culture	*Legionella* species and serogroup**	Culture: up to 15 days

*BAL, bronchial wash, lung tissues, pleural fluid, sputum, etc., collected during the acute phase of illness.

**Clinical isolates are required for molecular analyses to determine the relatedness of the clinical isolate(s) to the environmental isolate(s) by Sequence Based Typing (SBT) for outbreak investigations.

Legionellosis Investigation Considerations

- Consider a cluster/outbreak when two or more *Legionella* cases are epidemiologically linked by location and time of exposure
- Environmental sampling generally should be reserved for investigations involving facilities and disease clusters/outbreaks where a potential common exposure has been identified, but often exceptions in health care facilities

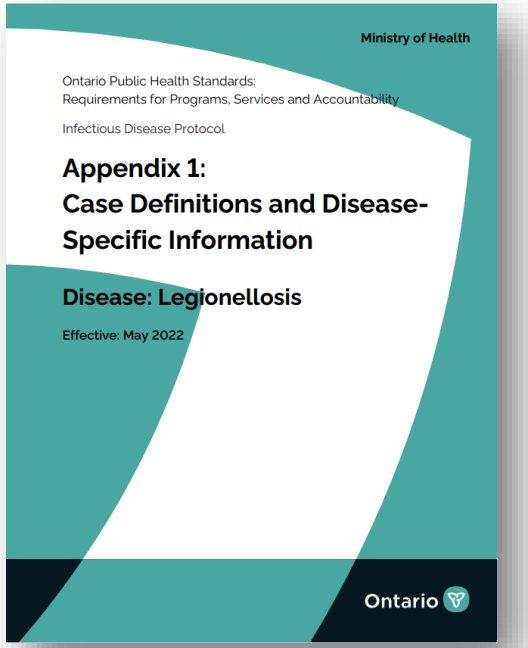
Ontario Agency for Health Protection and Promotion (Public Health Ontario). Legionella: questions and answers [Internet]. 2nd ed. Toronto, ON: Queen's Printer for Ontario; 2019 [cited 2024 Mar 21]. Available from: https://www.publichealthontario.ca/-/media/Documents/F/2019/faq-legionella.pdf?rev=4d6b5a5b960f4f31b7d25aefeb6c3ebb&sc_lang=en

Healthcare-Associated Legionnaires' Disease

Meets the provincial surveillance case definition, as per Appendix 1

- **Presumptive:** ≥10 days of continuous stay at a healthcare facility during the 14 days before onset of symptoms
- **Probable:** spent a portion of the 14 days before date of symptom onset in one or more healthcare facilities
  - Does not meet the criteria for presumptive healthcare-associated Legionnaires' disease
- Personal risk factors for acquisition
  - Age >50 years; smoking, diabetes, lung disease, renal disease, malignancy; and weakened immune system

Confirmed Case Definition



Clinically Compatible Signs and Symptoms

AND

Laboratory Confirmation Criteria: Confirmed cases require isolation or antigen detection of Legionella from clinical specimens like lung tissue or sputum

OR

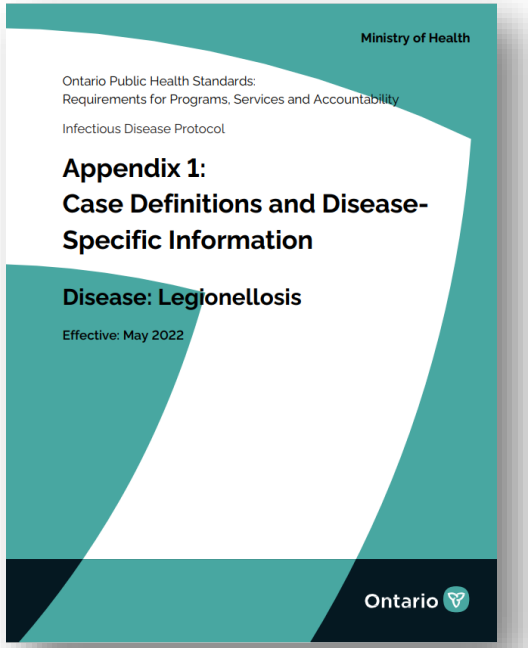
Antibody Titre Measurements: A significant rise or high standing antibody titre in sera indicates infection confirmation in Legionellosis cases

OR

Urine Antigen Detection: Detection of L. pneumophila serogroup 1 antigen in urine is an accepted method to confirm Legionellosis infection

Ontario. Ministry of Health. Ontario public health standards: requirements for programs, services and accountability. Effective May 2022 [Internet]. Toronto, ON: King's Printer for Ontario; 2022 [cited 2025 Oct 14]. Appendix 1: case definitions and disease-specific information, disease: Legionellosis. Available from: https://www.ontario.ca/files/2025-01/moh-ophs-legionellosis-en-2022-05-01.pdf

Probable Case Definition



Probable cases have clinical signs plus laboratory evidence insufficient for confirmation

Laboratory Detection Methods: Detection includes nucleic acid amplification like PCR and staining techniques such as DFA and IHC

Role in Public Health: Probable case definitions aid rapid outbreak response and are required for provincial notifications by PHUs

Support by Health Authorities: Ontario Ministry of Health provides case definitions to assist local health units in surveillance

Ontario. Ministry of Health. Ontario public health standards: requirements for programs, services and accountability. Effective May 2022 [Internet]. Toronto, ON: King's Printer for Ontario; 2022 [cited 2025 Oct 14]. Appendix 1: case definitions and disease-specific information, disease: Legionellosis. Available from: https://www.ontario.ca/files/2025-01/moh-ophs-legionellosis-en-2022-05-01.pdf

Legal and Surveillance Obligations

Legal Reporting Requirements: Legionellosis is legally reportable under Ontario's HPPA and Regulation 135/18, ensuring case notification to authorities

Surveillance and Case Investigation: Each Legionellosis case is individually investigated by PHUs to gather detailed data and monitor disease trends effectively

Data Collection and Reporting: Health units collect data including travel history and exposure to ensure accurate and timely reporting for disease control

Guidance and Regulatory Support: Public Health Ontario provides protocols and bulletins guiding the reporting and surveillance processes for Legionellosis

Outbreaks Case Definitions: Criteria and Adaptability

Tailored Outbreak Definitions: Case definitions for Legionellosis are customized to each outbreak's unique context and disease characteristics

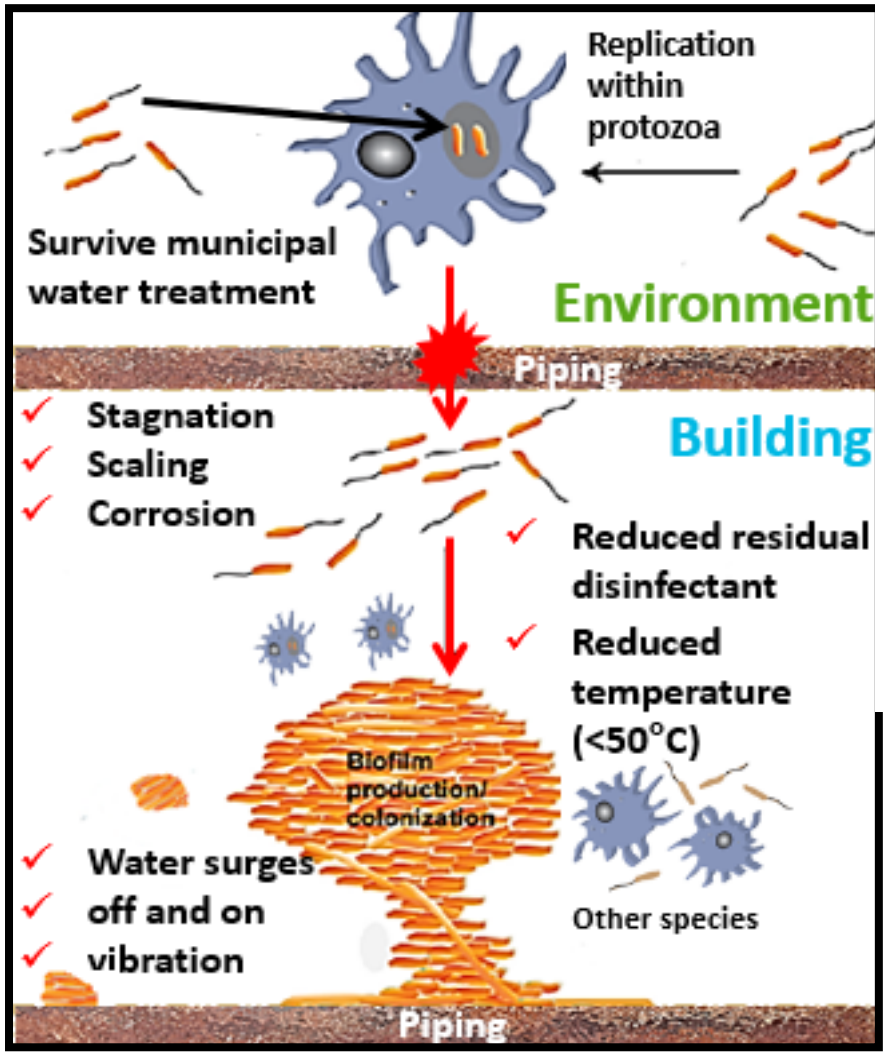
Classification by Probability: Outbreak cases are classified into confirmed and probable to ensure accurate case identification and reporting

Guided Public Health Protocols: The Infectious Diseases Protocol guides health units, ensuring standardized and flexible response strategies

Flexibility and Responsiveness: Flexible definitions enable effective outbreak source identification, mitigation, and prevention of ongoing transmission and infection

Legionella in the Environment

Survival of *Legionella* in the Environment and Exposure



Suitable temperature for multiplication (**20°C and 50°C**)

Low residual disinfectant level

Source of nutrients

Stagnation, scaling and corrosion

↓

Biofilm growth

↓

Creation and dissemination of aerosols containing *Legionella*

Inhaled or aspirated by susceptible host

Adapted from: Abdel-Nour M, Duncan C, Low D, Guyard C. Biofilms: the stronghold of Legionella pneumophila. Int J Mol Sci. 2013;14(11):21660-75. Available from: https://doi.org/10.3390/ijms141121660. Figure 3, p. 21663.

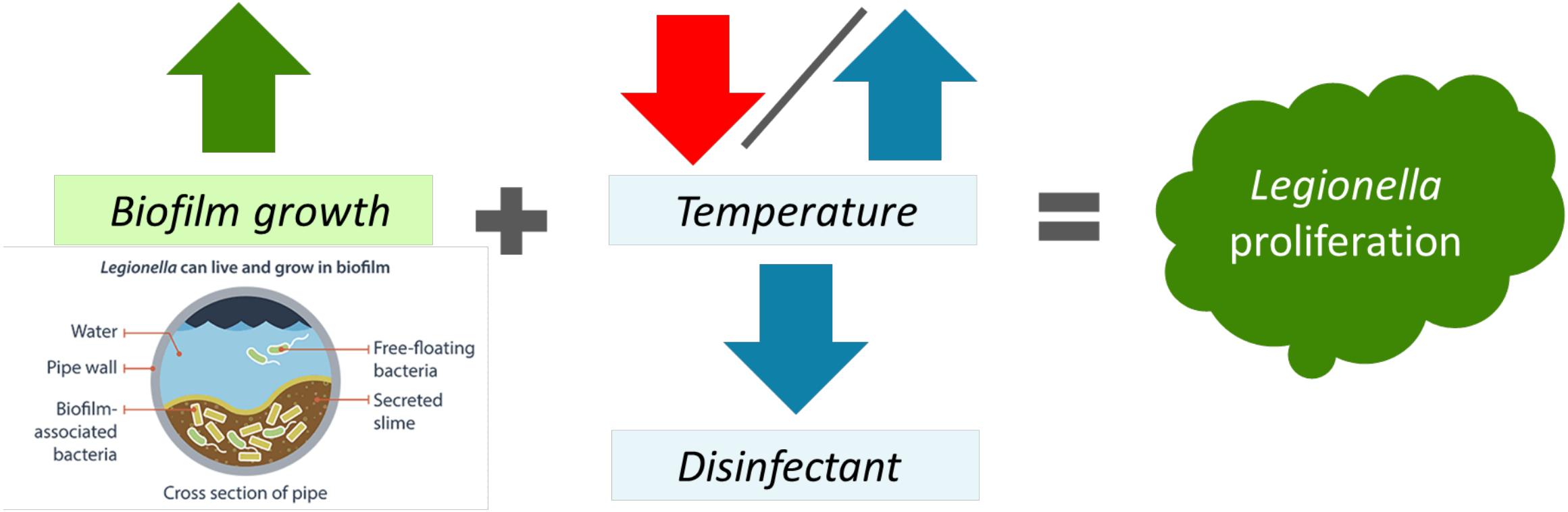
Main Sources of *Legionella*

- Potable water systems
  - Flexible hoses or connections to faucets
  - Electronic and manual faucets
  - Showerheads
- Cooling towers
- Non-potable water systems
  - Spas/hydrotherapy
  - Decorative fountains

Adapted from: Centers for Disease Control and Prevention (CDC), National Center for Immunization and Respiratory Diseases, Division of Bacterial Diseases. What owners and managers of buildings and healthcare facilities need to know about the growth and spread of *Legionella* [Internet]. Atlanta, GA: CDC; 2018 [cited 2023 Apr 21]. Where *Legionella* can grow or spread. Available from: https://www.cdc.gov/legionella/wmp/overview/growth-and-spread.html. Reference to this material does not imply endorsement by CDC.

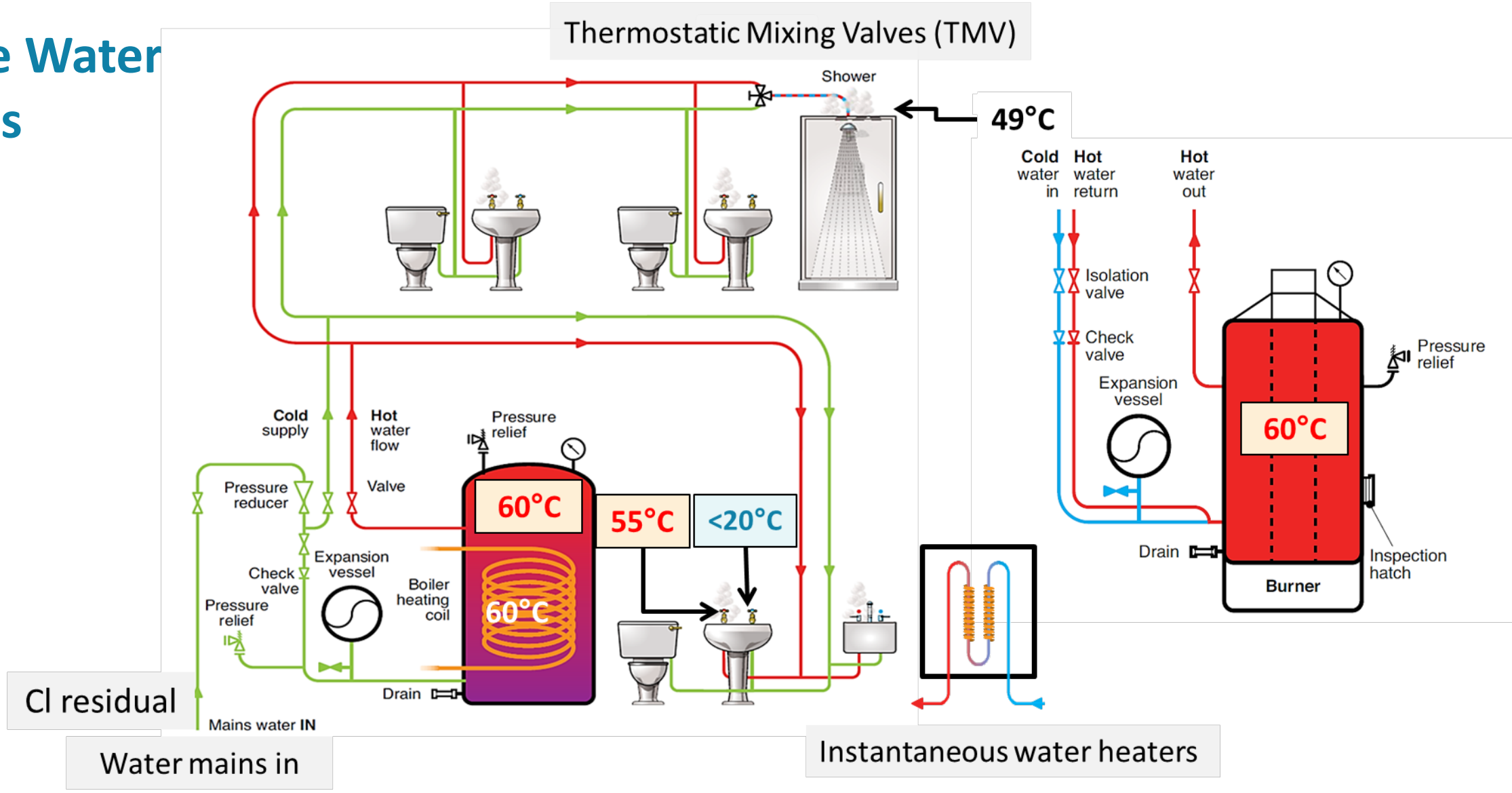
Potable Hot and Cold Water Systems

Outbreaks generally linked to large plumbing systems, such as those found in hotels or resorts, hospitals, and long-term care facilities



Biofilm image source: Centers for Disease Control and Prevention (CDC). What owners and managers of buildings and healthcare facilities need to know about the growth and spread of *Legionella* [Internet]. Atlanta, GA: CDC; 2018 [cited 2023 Apr 21]. Where *Legionella* can grow or spread. Available from: https://www.cdc.gov/legionella/wmp/overview/growth-and-spread.html. Reference to this material does not imply endorsement by CDC.

Potable Water Systems



Adapted from: Health and Safety Executive. Legionnaires' disease: part 2: the control of *legionella* bacteria in hot and cold water systems [Internet]. London: Crown copyright; 2014 [cited 2023 Apr 19]. Figure 2.6, Pressurised mains-fed system with non-recirculating hot water distribution; p. 14. Figure 2.7, Direct-fired (gas) water heaters; p. 15. Available from: https://www.hse.gov.uk/pubns/priced/hsg274part2.pdf. Contains public sector information published by the Health and Safety Executive and licensed under the Open Government Licence

Non-Potable Water Systems

Decorative Fountains

- Lack disinfectant
- Lack maintenance protocol
- Underwater heating source (lighting)

Spas / Hot Tubs

- Water temperature 39 - 40°C
- Disinfectant rapidly lost
  - High temperature
  - High bather load
- Aerosols from jet and air blowers
- Exposure from passing by

Cooling Towers

Large community outbreaks often associated with cooling towers

Cooling towers may be present in larger buildings such as long-term care settings and hospitals

Other Potential Sources of *Legionella*

- Aerosol producing humidifiers
- Misting devices (e.g. grocery mister)
- Water birthing baths (aspiration)
- Powered dental equipment
- **Ice machines** (aspiration)
- Car washes
- Street cleaning machines
- Non-disposable medical equipment
  - Nebulisers, ventilators and other respiratory therapy equipment that uses water for filling or cleaning
- Soil (usually potting mixes) - *L. longbeachae*
- Hospital dishwashers

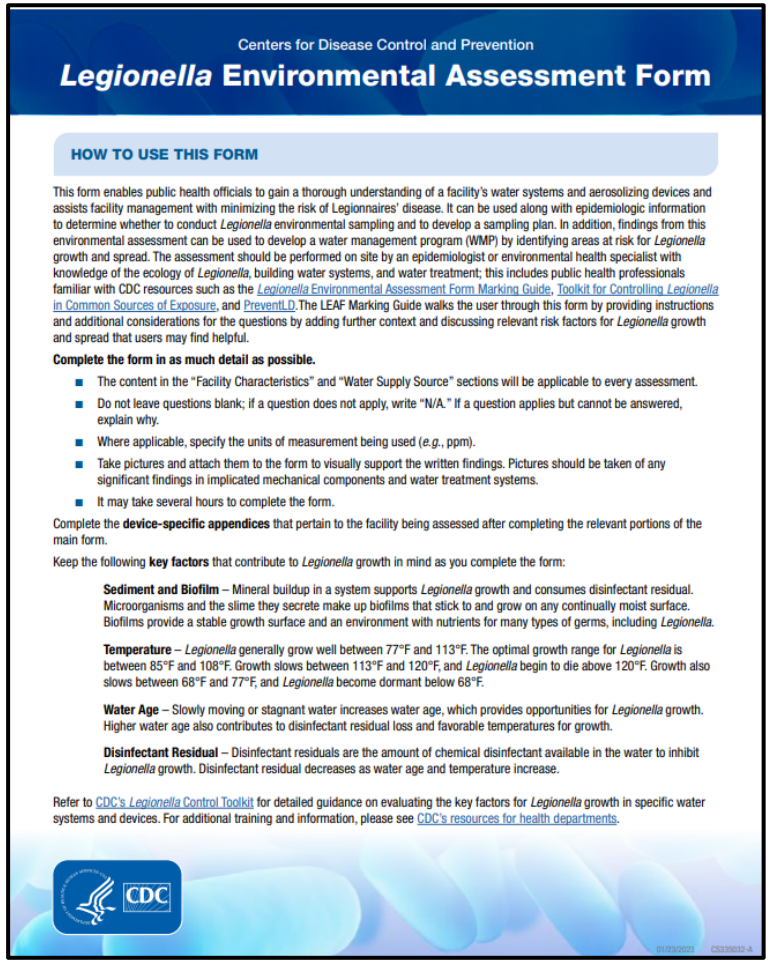
Environmental Investigation

Who might be involved in a *Legionella* investigation?

Involved	Roles & Responsibilities
Facility/ Water System Owner/ Operator	• Manage operation, maintenance of water system • Develop, implement emergency control measures and remediation • Develop, implement and review Water Safety Plan (WSP)
Local Public Health Unit (PHU)	• Identify cases/clusters/outbreaks • Conduct environmental investigation • Surveillance/monitoring of cases • Support water system owner/operators • Verify remediation and control measures implemented
Water System Consultant	• Design, implement, monitor, evaluate remediation plans • Design, implement WSP

Public Health Ontario supports public health units with investigations, as requested

Environmental Risk Assessments for *Legionella* Investigations



Centers for Disease Control and Prevention

Legionella Environmental Assessment Form

HOW TO USE THIS FORM

This form enables public health officials to gain a thorough understanding of a facility's water systems and aerosolizing devices and assists facility management with minimizing the risk of Legionnaires' disease. It can be used along with epidemiologic information to determine whether to conduct *Legionella* environmental sampling and to develop a sampling plan. In addition, findings from this environmental assessment can be used to develop a water management program (WMP) by identifying areas at risk for *Legionella* growth and spread. The assessment should be performed on site by an epidemiologist or environmental health specialist with knowledge of the ecology of *Legionella*, building water systems, and water treatment; this includes public health professionals familiar with CDC resources such as the *Legionella* Environmental Assessment Form Marking Guide, Toolkit for Controlling *Legionella* in Common Sources of Exposure, and PreventLD. The LEAF Marking Guide walks the user through this form by providing instructions and additional considerations for the questions by adding further context and discussing relevant risk factors for *Legionella* growth and spread that users may find helpful.

Complete the form in as much detail as possible.

- The content in the "Facility Characteristics" and "Water Supply Source" sections will be applicable to every assessment.
- Do not leave questions blank; if a question does not apply, write "N/A." If a question applies but cannot be answered, explain why.
- Where applicable, specify the units of measurement being used (*e.g.*, ppm).
- Take pictures and attach them to the form to visually support the written findings. Pictures should be taken of any significant findings in implicated mechanical components and water treatment systems.
- It may take several hours to complete the form.

Complete the **device-specific appendices** that pertain to the facility being assessed after completing the relevant portions of the main form.

Keep the following **key factors** that contribute to *Legionella* growth in mind as you complete the form:

Sediment and Biofilm – Mineral buildup in a system supports *Legionella* growth and consumes disinfectant residual. Microorganisms and the slime they secrete make up biofilms that stick to and grow on any continually moist surface. Biofilms provide a stable growth surface and an environment with nutrients for many types of germs, including *Legionella*.

Temperature – *Legionella* generally grow well between 77°F and 113°F. The optimal growth range for *Legionella* is between 85°F and 108°F. Growth slows between 113°F and 120°F, and *Legionella* begin to die above 120°F. Growth also slows between 68°F and 77°F, and *Legionella* become dormant below 68°F.

Water Age – Slowly moving or stagnant water increases water age, which provides opportunities for *Legionella* growth. Higher water age also contributes to disinfectant residual loss and favorable temperatures for growth.

Disinfectant Residual – Disinfectant residuals are the amount of chemical disinfectant available in the water to inhibit *Legionella* growth. Disinfectant residual decreases as water age and temperature increase.

Refer to CDC's *Legionella* Control Toolkit for detailed guidance on evaluating the key factors for *Legionella* growth in specific water systems and devices. For additional training and information, please see CDC's resources for health departments.

CDC

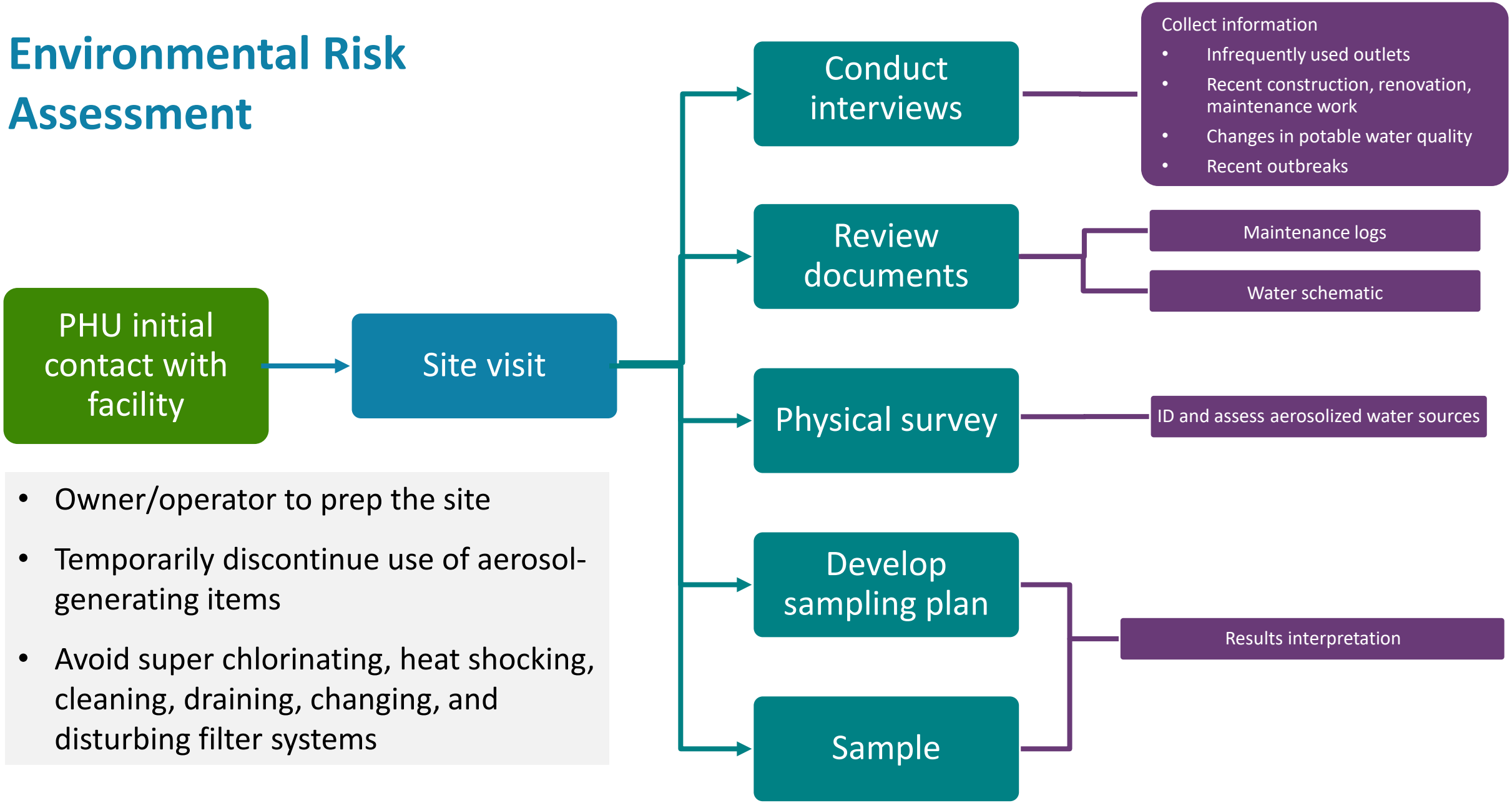
01/23/2023 CS335032-A

Public health goal: identify the source of *Legionella* causing disease

- ✓ Based on case exposure history and epidemiology
- ✓ Identify risk factors for *Legionella* growth and transmission
- ✓ Assess appropriateness of interventions
- ✓ Determine sampling needs
  - ✓ Collect information for a sampling plan

Adapted from: Centers for Disease Control and Prevention (CDC). What owners and managers of buildings and healthcare facilities need to know about the growth and spread of *Legionella* [Internet]. Atlanta, GA: CDC; 2018 [cited 2023 Apr 21]. Where *Legionella* can grow or spread. Available from: https://www.cdc.gov/legionella/wmp/overview/growth-and-spread.html. Reference to this material does not imply endorsement by CDC.

Environmental Risk Assessment



- Owner/operator to prep the site
- Temporarily discontinue use of aerosol-generating items
- Avoid super chlorinating, heat shocking, cleaning, draining, changing, and disturbing filter systems

Environmental Testing (1/2)

- Based on the environmental risk assessment and sampling plan, swabs and water samples can be submitted for testing by the local public health unit
- Environmental swab vials are not the same as the clinical swab; i.e., do not use Nasopharyngeal (NP) swabs for environmental *Legionella* testing
- Environmental swabs and water samples are submitted using the Environmental Microbiology Investigation Requisition

Environmental Testing (2/2)

- Samples may be collected from various wings, floors and rooms, from different aerosol generated water sources (i.e., individual shower, communal shower, hot tub, faucet, etc.) in relation to case exposure history
- Water samples are analyzed by PCR (results available up to 4 days) with swabs analyzed by culture (results available up to 14 days)

Managing *Legionella*

Minimizing the Risk: Immediate Actions to Consider

Goal → Cessation of any water-aerosolizing activity

CONSIDER	AVOID
✓ Using sponge baths	X Using showers
✓ Removing aerators	X Using hydrotherapy tubs
✓ Installing point-of-use filters	X Using water faucets in resident rooms
✓ Replacing filters (as needed)	X Using ice machines

- **Shut down sources of aerosolization: spas, decorative fountains, etc.**
- **Shut down cooling towers, cooling tower fans, where possible**

Remediation Action Plan

- Implement remediation action plan once environmental source identified
- Often involves an environmental consultant
  - Look for prior experience dealing with *Legionella* in water systems
- Methods of remediation may include:
  - Chemical disinfection and/or
  - Thermal disinfection
- Once biofilm containing *Legionella* has become established in a water system, can be challenging to eradicate

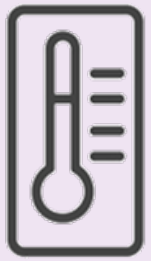
Chemical Disinfection

Chlorine commonly used

Treatment can vary depending on plumbing components

Thermal Disinfection*

Maintain water temperatures using a "heat shock" approach while progressively flushing each outlet in the system for a set amount of time



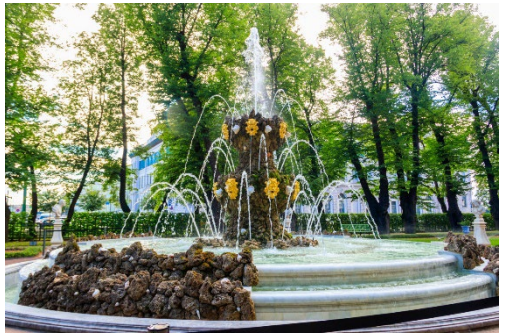
*Limitations noted with thermal disinfection

After remediation, all previously contaminated sources should be resampled, to ensure treatment was effective

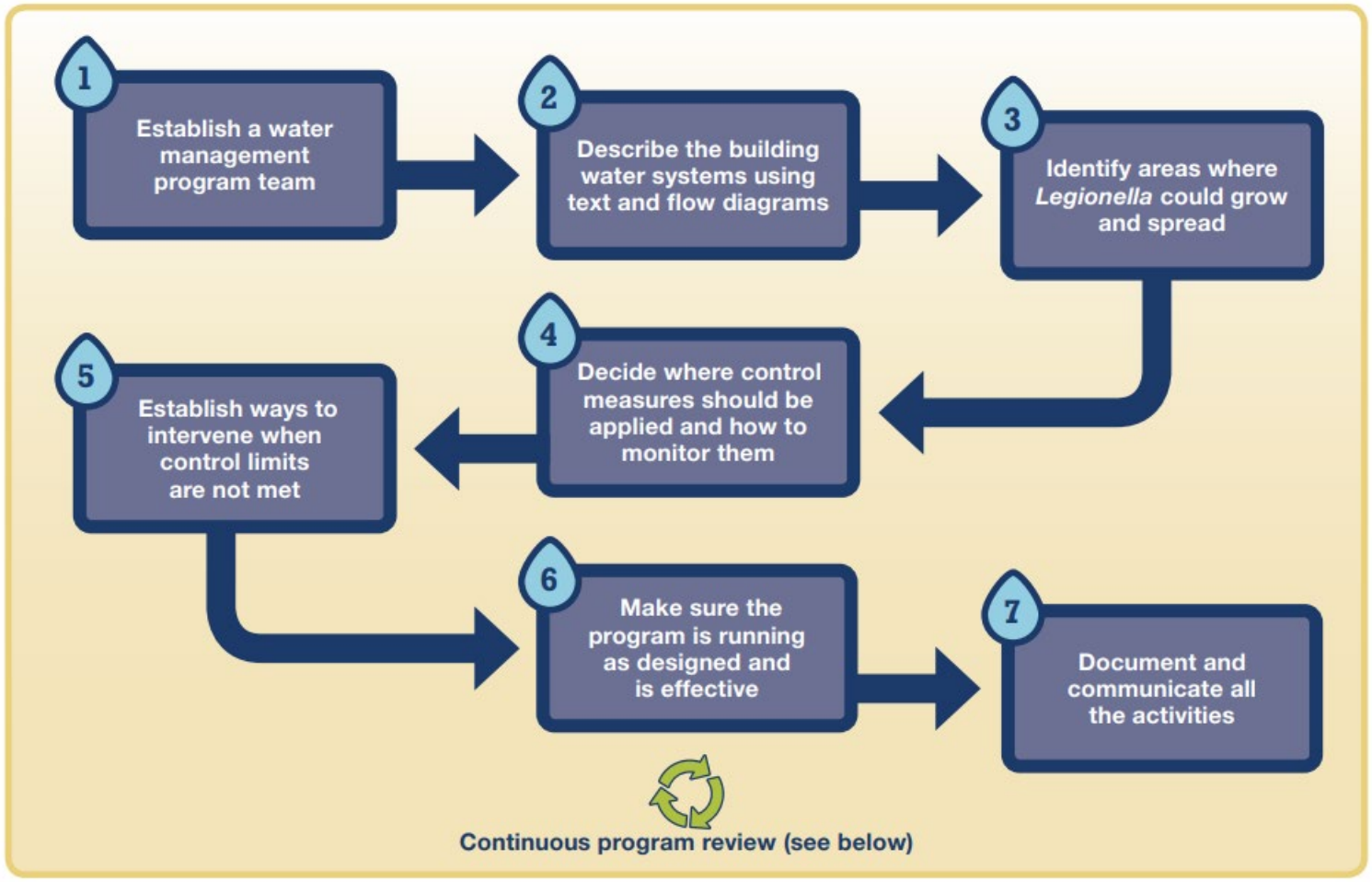
NOTE: Biofilms can be difficult to remove even with thermal and chemical disinfection, and they may serve as a reservoir for persistent *Legionella* contamination

What is a Water Safety Plan (WSP)?

- **Prevention:** A WSP identifies areas or devices that would support the growth of *Legionella,* and the establishment of actions to prevent *Legionella* growth
- **Preparedness:** Developing a plan can improve knowledge of one's system and collate information that would be required in the event of an outbreak investigation and remediation




Water Safety Plan



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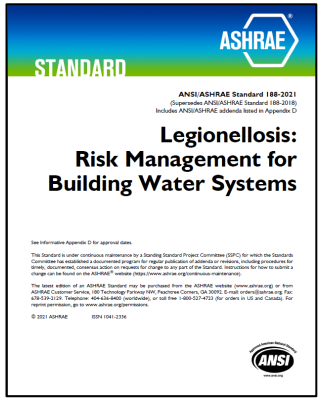
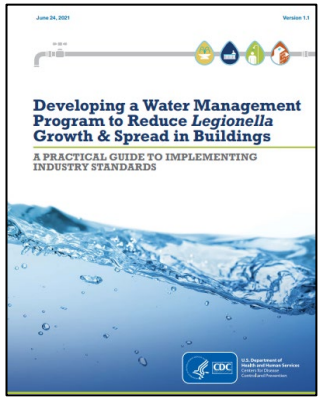
Resources for Developing a Water Safety Plan

- ANSI/ASHRAE Standard 188-2021 - Legionellosis: Risk Management for Building Water Systems
  - Best practices document which focuses on identifying hazardous conditions and applying control measures to prevent Legionella growth and transmission
- CDC - Developing a Water Management Program to Reduce *Legionella* Growth and Spread in Building: A Practical Guide to Implementing Industry Standards
- Cooling Technology Institute Legionellosis Guidelines – GDL 159

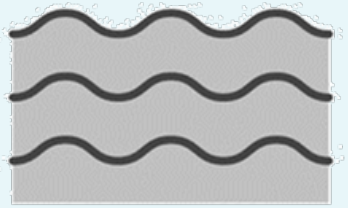
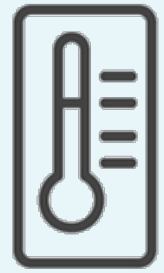




American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), American National Standards Institute (ANSI). ANSI/ASHRAE Standard 188-2021 legionellosis: risk management for building water systems. Peachtree Cornes: ASHRAE; 2021.
Centers for Disease Control and Prevention (CDC). Developing a water management program to reduce Legionella growth & spread in buildings: a practical guide to implementing industry standards [Internet]. Atlanta, GA: CDC; 2018 [cited 2023 Apr 21]. Available from: https://www.cdc.gov/legionella/downloads/toolkit.pdf. Reference to this material does not imply endorsement by CDC.
Cooling Technology Institute (CTI). Legionellosis guidelines – GDL 159 [Internet]. Houston, TX: CTI; 2021 [cited 2023 May 2]. Available from: https://cti-marketplace.myshopify.com/products/gdl-59?variant=40076697567371

Prevention

A key strategy/approach for reducing the risk of Legionnaires' disease is through a multifaceted preventive control program

			
Water safety plan	**Eliminate stagnant water conditions**	**Supplemental disinfection**	**Manage water temperature**

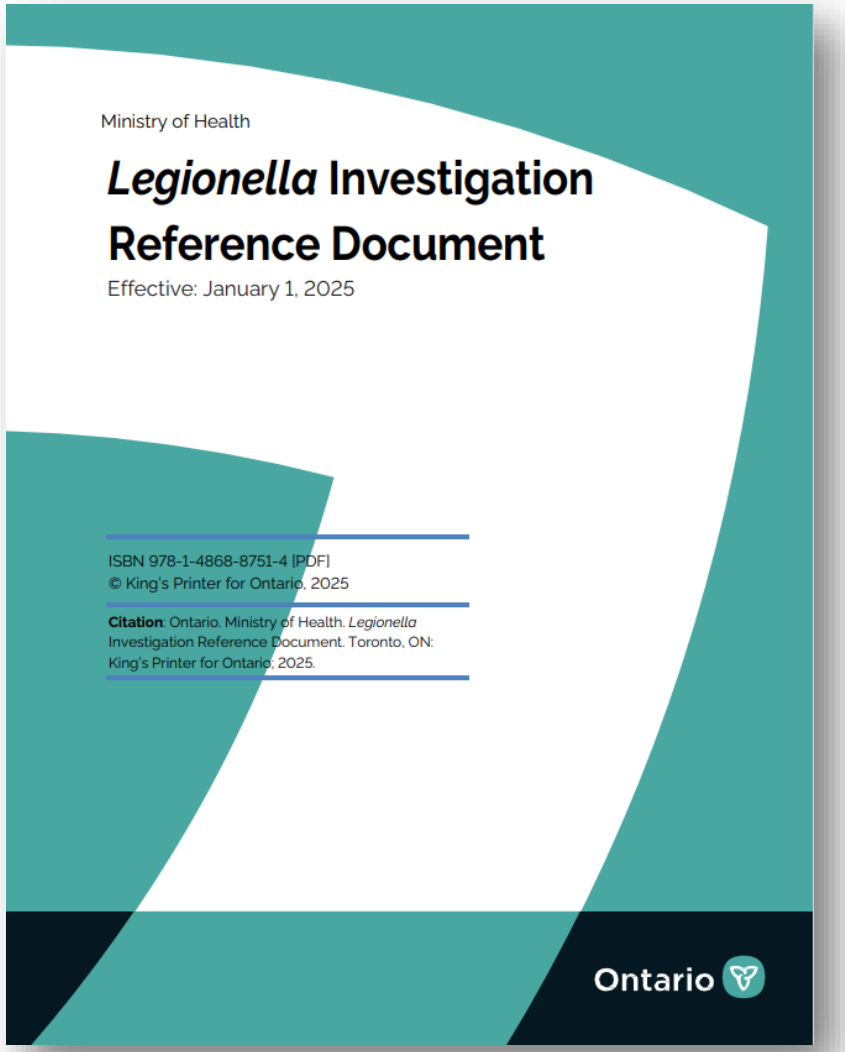
Conclusion and Final Thoughts…

- *Legionella* is a common environmental pathogen
  - With microbial growth conditions and a means of aerosolization, vulnerable individuals in healthcare facilities are at risk
  - The most effective strategy for prevention in health care facilities is through control and management of *Legionella* within building water systems

Adapted from: Centers for Disease Control and Prevention (CDC), National Center for Immunization and Respiratory Diseases, Division of Bacterial Diseases. What owners and managers of buildings and healthcare facilities need to know about the growth and spread of *Legionella* [Internet]. Atlanta, GA: CDC; 2018 [cited 2023 Apr 21]. Where *Legionella* can grow or spread. Available from: https://www.cdc.gov/legionella/wmp/overview/growth-and-spread.html. Reference to this material does not imply endorsement by CDC.

Conclusion and Final Thoughts Cont'd…

- The goal of a *Legionella* investigation is to:
  - Support source identification
  - Prevent further transmission and progression to disease through case exposure history and enhanced surveillance
- Ontario's PHUs are the leads for the public health investigation
- PHO supports PHUs with outbreaks and investigations, upon request



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Resources (1/4)

1. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). Standard 188-2018: Legionellosis: risk management for building water systems. Peachtree Corners, GA: ASHRAE; 2018.

2. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). Guideline 12-2020: managing the risk of Legionellosis associated with building water systems. Peachtree Corners, GA: ASHRAE; 2020.

3. Centers for Disease Control and Prevention (CDC). Defining healthcare facilities and healthcare-associated Legionnaires' disease [Internet]. Atlanta, GA: CDC; 2024 [cited 2025 Oct 14]. Available from: https://www.cdc.gov/investigate-legionella/php/healthcare-resources/healthcare-facilities.html

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