



Legionellosis Investigation Guide for Healthcare Facilities

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Legionellosis Background Information

Terminology

- **Legionella:** the name of the genus of bacteria that was subsequently identified as the causative pathogen associated with the 1976 outbreak of disease at the American Legion convention in Philadelphia. *Legionella* are common aquatic bacteria found in natural and building water systems, as well as in some soils.
- **Legionellosis:** the term used to describe Legionnaires' disease, Pontiac Fever, and any illness caused by exposure to *Legionella* bacteria.
- **Cluster:** Two or more people with Legionnaires' disease exposed to *Legionella* at the same place at about the same time (as defined by the investigators). * Note, the terms cluster and outbreak can be used interchangeably, but may be used / interpreted differently by the target audience.
- **Outbreak:** Two or more people with Legionnaires' disease exposed to *Legionella* at the same place at about the same time (as defined by the investigators). * Note, the terms cluster and outbreak can be used interchangeably, but may be used / interpreted differently by the target audience.
- **Building Water Systems:** potable and non-potable water systems in the building or on site.
- **Centralized Building Water System:** any system that distributes water to multiple users or multiple locations within the building site.
- **Control Measure:** a disinfectant, heating, cooling, filtering, flushing, or other means, methods, or procedures used to maintain the physical or chemical conditions of water within control limits.
- **Corrective Action:** action taken to return control values to within established limits. Corrective action is necessary when monitoring or measurements indicate control values are outside of the established control limits.
- **Monitoring:** conducting a planned sequence of observations or measurements of the physical and chemical characteristics of control measures.
- **Water Management Program (WMP):** the risk management plan for the prevention and control of legionellosis associated with building water systems, including documentation of the plan's implementation and operation.
- **Non-potable:** Water that is not safe for drinking or for personal or culinary use and that has the potential to cause harmful human exposure to *Legionella*.

Etiologic Agent

Legionellosis (Legionnaires' disease) is caused by the *Legionella* species of bacteria. *Legionella* is a gram-negative bacterium commonly found in natural freshwater environments (e.g. lakes and streams), most often in warm water (25-42°C/77-108°F). Numerous species and subtypes of *Legionella* have been identified; however, *Legionella pneumophila* serogroup 1 causes approximately 80% of cases of human disease.

The bacteria can become a health concern when they grow and spread in human-made building water systems. After *Legionella* grows and multiplies in a building water system, water containing *Legionella* then must spread in droplets small enough for people to breathe in. People can get legionellosis when they breathe in small droplets of water in the air that contain the bacteria. Less commonly, people can get sick by aspiration of drinking water containing *Legionella*. This happens when water accidentally goes into the lungs while drinking. Spread of *Legionella* from person-to-person is very rare but may be possible under certain conditions. Human-made water systems that can transmit *Legionella* include:

- Showerheads and sink faucets
- Cooling towers (structures that contain water and a fan as part of centralized air-cooling systems for building or industrial processes)
- Hot tubs that aren't drained after each use
- Decorative fountains and water features
- Hot water tanks and heaters
- Large plumbing systems
- Ice machines

Of note, home and car air-conditioning units do not use water to cool the air, so they are not a risk for *Legionella* growth (<https://www.cdc.gov/legionella/about/causes-transmission.html>).

Legionella bacteria tend to grow in biofilms or slime on the surfaces of lakes, rivers, and streams, and they are not eradicated by the chlorination used to purify domestic water systems (Figure 1). Low and even non-detectable levels of the organism can colonize a water source and grow to high concentrations under the right conditions.

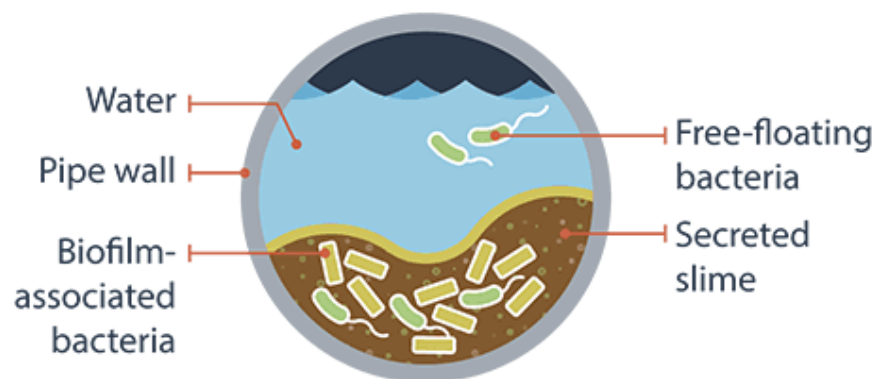
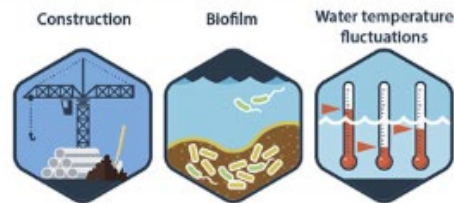


Figure 1. Cross-section of pipe containing biofilm and *Legionella* bacteria.

Water conditions that tend to promote the growth of *Legionella* include:

- Stagnation, low water flow
- Temperatures between 20° and 50°C (68° - 122°F) (optimal range 35° - 46°C [95° - 115°F])
- pH between 5.0 and 8.5
- Sediment, that can promote growth of commensal microflora
- Growth of micro-organisms including algae, flavobacteria, and *Pseudomonas*, which supply essential nutrients for growth of *Legionella* or harbor the organism (amoebae, protozoa).

1. Internal and external factors can lead to *Legionella* growth in building water systems.



2. *Legionella* grows best in large, complex water systems that are not adequately maintained.



3. Water containing *Legionella* is aerosolized through devices.



4. People can get Legionnaires' disease when they breathe in mist or accidentally swallow water into the lungs containing *Legionella*. Those at increased risk are adults 50 years or older, current or former smokers, and people with a weakened immune system or chronic disease.



Spectrum of Clinical Disease and Risk Factors

Infection with *Legionella* bacteria can cause three distinct clinical presentations:

1. Legionnaires' disease (*Legionella* pneumonia)

- Symptoms: fever, myalgias, cough, shortness of breath, clinical or radiographic evidence of pneumonia; associated nausea, vomiting, diarrhea, headache or confusion may be present
- Incubation period: 2–14 days (average 5–6 days); 99% of cases have illness onset within 14 days of exposure
- Outcome: hospitalization is common; case-fatality rate is 10% (25% for healthcare-associated cases)

2. Pontiac fever

- Symptoms: fever, chills, headache, myalgia, fatigue (NO respiratory symptoms or radiographic evidence of pneumonia)
- Incubation period: 24–72 hours
- Outcome: self-limited illness; case-fatality rate is extremely low

3. Extra-pulmonary infection

- Symptoms: variable, depending on location of infection; myocarditis and pericarditis, sinusitis, septic arthritis, cellulitis and others have all been reported in the medical literature
- Incubation period: variable
- Outcome: variable; extremely rare

Most healthy people exposed to *Legionella* do not get sick. People at increased risk of infection from *Legionella* include:

- People 50 years or older
- Current or former smokers
- People with a chronic lung disease (like chronic obstructive pulmonary disease or emphysema)
- People with weak immune systems or who take drugs that weaken the immune system (like after a transplant operation or chemotherapy)
- People with cancer
- People with underlying illnesses such as diabetes, kidney failure, or liver failure

Diagnosis

Possible laboratory tests to confirm the diagnosis of legionellosis include a positive urine antigen, culture, direct fluorescent antibody (DFA) staining of respiratory samples and tissue, PCR assays of urine, respiratory samples, or blood (Table 1). Serologic tests of antibodies are only diagnostic with a 4-fold or greater rise in antibody titer in paired (acute and convalescent) antibody tests collected 4-8 weeks apart.

Serologic testing is not recommended for clinical or public health purposes because of the delay inherent in convalescent testing.

The **preferred diagnostic tests for legionellosis are culture of lower respiratory secretions** (e.g., sputum, bronchoalveolar lavage) on selective media (Buffered Charcoal Yeast Extract Agar [BCYE]) **and the *Legionella* urinary antigen test**. Best practice is to obtain both sputum culture and the urinary antigen test concurrently, ideally before antibiotic administration (antibiotics should not be delayed facilitating specimen collection). The urinary antigen test may detect *Legionella* infections for days to weeks after treatment.

Test	Sensitivity	Specificity	Advantages	Disadvantages
Urinary Antigen	70–100% ¹	95–100%	Rapid (same day)	Only detects Lp1; does not allow for molecular comparison of clinical and environmental isolates
Culture	20–80%	100%	Detects all species and subgroups; can compare clinical and environmental isolates	Technically difficult; slow to grow (>5 days); sensitivity dependent on technologic skill; requires BCYE agar
Serology (Paired)	80–90%	>99%	Possible to detect species and serogroups other than Lp1	Requires paired sera collected at acute onset to 2 weeks and 3–6 weeks later; 5–10% of the population has a titer of ≥1:256
Direct Fluorescent Antibody (DFA)	25–75%	≥95%	Can be performed on pathologic specimens (e.g. lung tissue); possible to detect species and serogroups other than Lp1	Technically difficult; reagents may not be readily available
Polymerase Chain Reaction (PCR)	95–99%	>99%	Can be performed on pathologic specimens (e.g., lung tissue); rapid; possible to detect species and serogroups other than Lp1	Assays vary by laboratory; may not be commercially available in the United States

¹ Sensitivity for *Legionella pneumophila* serogroup 1 (Lp1)

Table 1. Available diagnostic tests for *Legionella* infection

Epidemiology of Legionellosis

Legionellosis
<p>Clinical Criteria:</p> <p>Legionnaires' disease (LD): LD presents as pneumonia, diagnosed clinically and/or radiographically. Evidence of clinically compatible disease can be determined several ways: a) a clinical or radiographic diagnosis of pneumonia in the medical record OR b) if "pneumonia" is not recorded explicitly, a description of clinical symptoms that are consistent with a diagnosis of pneumonia.</p> <p>Pontiac fever (PF): PF is a milder illness. While symptoms of PF could appear similar to those described for LD, there are distinguishing clinical features. PF does not present as pneumonia. It is less severe than LD, rarely requiring hospitalization. PF is self-limited, meaning it resolves without antibiotic treatment.</p> <p>Extrapulmonary legionellosis (XPL): <i>Legionella</i> can cause disease at sites outside the lungs (for example, associated with endocarditis, wound infection, joint infection, graft infection). A diagnosis of extrapulmonary legionellosis is made when there is clinical evidence of disease at an extrapulmonary site and diagnostic testing indicates evidence of <i>Legionella</i> at that site.</p>
<p>Laboratory Criteria:</p> <p>Confirmed:</p> <ul style="list-style-type: none"> Isolation of any <i>Legionella</i> organism from lower respiratory secretions, lung tissue, pleural fluid, or extrapulmonary site Detection of any <i>Legionella</i> species from lower respiratory secretions, lung tissue, pleural fluid, or extrapulmonary site by a validated nucleic acid amplification test (i.e. PCR) Detection of <i>Legionella pneumophila</i> serogroup 1 antigen in urine using validated reagents Fourfold or greater rise in specific serum antibody titer to <i>Legionella pneumophila</i> serogroup 1 using validated reagents <p>Supportive:</p> <ul style="list-style-type: none"> Fourfold or greater rise in antibody titer to specific species or serogroups of <i>Legionella</i> other than <i>L. pneumophila</i> serogroup 1 (e.g., <i>L. micdadei</i>, <i>L. pneumophila</i> serogroup 6) Fourfold or greater rise in antibody titer to multiple species of <i>Legionella</i> using pooled antigens Detection of specific <i>Legionella</i> antigen or staining of the organism in lower respiratory secretions, lung tissue, pleural fluid, or extrapulmonary site associated with clinical disease by direct fluorescent antibody (DFA) staining, immunohistochemistry (IHC), or other similar method, using validated reagents
<p>Case Classification:</p> <p>Confirmed: A clinically compatible case of LD, PF or XPL with confirmatory laboratory evidence for <i>Legionella</i></p> <p>Probable: A clinically compatible case of LD or PF with an epidemiologic link during the incubation period Note: does not apply to XPL cases</p> <p>Suspected: A clinically compatible case of LD, PF or XPL with supportive laboratory evidence for <i>Legionella</i></p>

Healthcare–Associated Legionellosis Cases

A case of legionellosis reporting exposure to a healthcare facility during the 14 days before illness onset is considered a healthcare-associated case.

Healthcare facilities often serve patients at an increased risk for legionellosis (people >50 years of age, current/former smokers, people with weakened immune systems or chronic disease) and utilize large, complex water systems, which can be subject to *Legionella* growth and proliferation. If an effective water management program is not in place, healthcare facilities may put people at risk for legionellosis. Rapid reporting and response to healthcare-associated cases can help identify and mitigate *Legionella* risk in the healthcare setting.

Healthcare facilities can include:

- **Hospitals:** Acute care hospitals, critical access hospitals, children’s hospitals, psychiatric hospitals
- **Long-term care:** Skilled nursing facilities, nursing homes, inpatient hospice, rehabilitation hospitals, psychiatric residential treatment facilities
- **Clinic:** Outpatient clinics, same day surgery centers, outpatient rehabilitation clinics, dialysis centers

- **Presumptive healthcare-associated LD:** A case with ≥10 days of continuous stay at a healthcare facility during the 14 days before onset of symptoms. Note: this was previously referred to as a “definite” healthcare-associated case.
- **Possible healthcare-associated LD:** A case who spent a portion of the 14 days before date of symptom onset in one or more healthcare facilities, but does not meet the criteria for presumptive HA-LD.

Presumptive HC-Associated LD	Possible HC-Associated LD
A case with ≥10 days of continuous stay at a healthcare facility during the 14 days before onset of symptoms.	A case who spent a portion of the 14 days before date of symptom onset in one or more healthcare facilities, but does not meet the criteria for presumptive healthcare-associated LD.
Investigation Steps	
<ul style="list-style-type: none">• Promptly notify the facility• Enhance surveillance• Perform a site visit to view the facility, collect water and swab samples• Review and provide feedback on testing/remediation plan as appropriate	<ul style="list-style-type: none">• Promptly notify the facility• Review previous cases for past 12 months<ul style="list-style-type: none">○ If any reported exposure to the same facility, TDH will follow the same steps as a single presumptive healthcare-associated case.

Investigation Steps for Presumptive Healthcare-Associated Legionellosis

Notification of the facility

A local or regional health department will notify the facility that a legionellosis patient reported staying for ≥ 10 days of continuous stay at their facility during the 14 days before onset of symptoms. This notification is by phone and/or email.

Enhanced surveillance

Retrospective surveillance

Facilities are asked to review medical records to identify cases of the following, within the past 12 months:

- Positive *Legionella* tests
- Cases of undiagnosed pneumonia

The health department can assist with this step if needed.

Prospective surveillance

Facilities are asked to enhance surveillance for 2 months following either the date of facility notification, positive results, or when remediation happens - whichever date is the latest. Any patients with signs and symptoms of pneumonia should have a *Legionella* urinary antigen test. When possible, a respiratory culture should also be collected. If there are additional cases identified through prospective surveillance, surveillance can be extended for up to 6 months.

Site Visit

After notification, a site visit will be scheduled. This visit typically lasts 2-3 hours, depending on the facility size. Preparing ahead of time for the components listed below can shorten the visit duration.

Environmental Assessment

A member of the health department will complete an environmental assessment form with the facility. The purpose of this is to identify potential factors that contribute to *Legionella* growth (e.g., changes in occupancy, water service interruptions, etc.). The form will be sent over for review prior to the site visit.

Review of Water Management Program

Water management programs (WMPs) often detail what to do if a resident tests positive for *Legionella*. Review of the WMP can help determine potential factors that contribute to *Legionella* growth, and next steps.

To prepare for a site visit:

- Identify 1-2 people with knowledge of the patient and building (i.e. facility director, building manager, nursing staff)
- Pull water system maintenance logs (temperature, chlorine)
- Pull *Legionella* water testing results (if available)
- Pull maintenance logs for devices that utilize water (ice machines, sprinklers, decorative fountains, respiratory medical equipment, etc.)
- Provide the health department with the facility water management program and any facility diagrams (including any construction)
- Identify areas the patient visited during their stay

Review of Infection Prevention

Infection preventionists from the Healthcare-Associated Infections (HAI) team will work with facility staff to review respiratory equipment protocols. Personal respiratory devices (e.g. CPAP machines) are a potential source of *Legionella* transmission.

Sampling

A key component of the site visit is sample collection. The purpose of sample collection is to determine if there is any *Legionella* bacteria present in the facility's water system. This step will be completed by members of the health department. Both swab and water samples may be collected, along with water quality measurements like chlorine.

The sample locations should include all central water heaters, storage tanks, and various points along each loop of the potable water system. Sampling should also include areas the patient visited during their stay (e.g. patient room, shower, etc.). Review of a facility diagram prior to the site visit can shorten the duration of sample collection planning on-site.

Once samples are collected, two types of tests are run at the State Public Health Lab:

- Polymerase Chain Reaction (PCR): This test measures if any *Legionella* DNA is present. It does not tell us if the bacteria are alive or dead. Results for this are typically available in 3-5 days.
- Culture: This test isolates any live *Legionella* bacteria and indicates what species it is. Results for this are typically available in 1-2 weeks.

Results from sample collection help guide cleaning recommendations and remediation.

Remediation

Remediation is specific to each facility and the potential sources of exposure. Common remediation recommendations include, but are not limited to:

- Flushing of the building's water system
- Draining and cleaning of decorative water features
- Cleaning and maintenance of a device or machine
- Identifying and following specific manufacturers instructions for medical equipment

Closeout

In general, an investigation will be closed when prospective surveillance is complete (2 months following either the date of facility notification, positive results, or when remediation happens- whichever is the latest).

Investigation Steps for Possible Healthcare-Associated Legionellosis

Notification of the facility

A local or regional health department will notify the facility that a legionellosis patient reported staying at their facility during a portion of their 14 days before onset of symptoms. This notification is by phone and/or email.

Review of Cases

The health department will review legionellosis cases from the past 12 months. If any reported exposure to the same facility, TDH will follow the same algorithm as a presumptive healthcare-associated case.

How to Prevent Legionella Growth

- Complete this short worksheet to see if your building is at high risk for Legionella growth: [Buildings at Risk for Legionella | CDC](#)
- Have a water management plan: [Water Management Program Fact Sheet | CDC](#)
- Regularly clean and maintain ice machines and water dispensers
- Routinely clean and maintain decorative fountains, using chlorine or other disinfectant to minimize *Legionella* growth risk
- Review and follow manufacturer's instructions for using and maintaining respiratory equipment
 - Always use the appropriate water source (usually distilled or sterile)
 - Clean equipment parts and accessories regularly
 - Replace any broken or damaged parts