Utah Department of Health & Human Services

# Legionellosis

**(Legionnaires' disease, Pontiac fever, extrapulmonary legionellosis)**

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## Disease plan

### Quick links



**Last updated: April 23, 2024 by Jeff Rogers, Andrea Price, and Sarah Rigby**

**Questions about this disease plan?**

**Contact the Utah Department of Health and Human Services (DHHS) Office of Communicable Diseases at: 801-538-6191.**

# Critical clinician information

## Clinical evidence

**Signs/symptoms**

- Legionnaires' disease (LD) is characterized by pneumonia and a non-productive cough.
- Pontiac fever (PF) is a self-limited febrile illness accompanied by cough caused by *Legionella*.
- LD and PF both present with anorexia, malaise, myalgia, headache, and fever. Abdominal pain and diarrhea are also common.
- Extrapulmonary *Legionella* disease is rare, but can cause infections such as cellulitis, abscesses, endocarditis, or meningitis.

**Period of communicability**

- Legionnaires' disease is usually not transmitted from person to person.

**Incubation period**

- For Legionnaires' disease: 2–14 days, most often 5–6 days. Public health officials have reported incubation periods up to 26 days under rare circumstances.
- For Pontiac fever 5–72 hours, most often 24–48 hours.

**Mode of transmission**

- People contract *Legionella* by inhaling aerosolized water droplets containing the bacteria; other modes are possible, including aspiration of contaminated water.
- Extra-pulmonary acquisition may include joint surgery, grafts, etc.

## Indications that warrant testing patients with pneumonia for Legionnaires' disease

- Patients who fail outpatient antibiotic treatment for community-acquired pneumonia.
- Patients who have severe pneumonia, in particular those who require intensive care.
- Immunocompromised patients who have pneumonia.
- Patients with a travel history (patients who have traveled away from their home overnight within 14 days before symptom onset).
- Hospitalized patients with healthcare-associated pneumonia (pneumonia with onset > 48 hours after admission) that have additional risks for Legionnaires' disease (e.g. known smoker, immunocompromised, etc.).
- Patients with an overnight stay in a healthcare facility within 14 days before symptom onset.
- Patients with an epidemiologic link to a setting with a confirmed source of *Legionella* or that has been associated with at least one laboratory-confirmed case of Legionnaires' disease.

## Testing for healthcare-associated Legionnaires' disease is especially important if any of the following are identified in a healthcare facility

- Other patients with healthcare-associated Legionnaires' disease diagnosed in the past 12 months.
- Positive environmental tests for *Legionella.*
- Current changes in water quality that may lead to *Legionella* growth (such as low chlorine levels or nearby construction).

## Laboratory testing

**Type of lab test/timing of specimen collection**

- Culture from lower respiratory tract specimen*
- *Legionella* urine antigen (EIA)*
- Paired serum serology (must have paired sera collected at acute onset to 2 weeks after symptoms and 3 to 6 weeks later) *
- Polymerase chain reaction (PCR)*
- Direct fluorescent antibody (DFA) stain
- Matrix-assisted laser desorption/ionization time-of-flight (MALDI-TOF)

**Denotes acceptable test methodologies for confirmed case status in conjunction with chest X-ray diagnosed pneumonia.*

**Type of specimens**

- Lower respiratory specimen, lung tissue, urine, serum specimens, or extrapulmonary site.

## Treatment recommendations

**Type of treatment**

- Macrolides (especially azithromycin) and the respiratory tract fluoroquinolones (especially levofloxacin) are effective for the treatment of *Legionella* infection.
- Antibiotics are not shown to be indicated in cases of Pontiac fever.

**Time period to treat**

- The total duration of therapy for *Legionella* pneumonia is 7–10 days. A longer course of antibiotics of 21 days might be considered for immunosuppressed patients who are severely ill upon presentation.

**Prophylaxis**

- There are no vaccines to prevent Legionnaires' disease.
- The key to prevention of Legionnaires' disease is to improve building water management and reduce environmental risk factors for growth and spread of *Legionella* bacteria.

## Contact management

**Isolation of case**

- Legionnaires' disease is usually not transmitted from person to person; thus, it is not necessary to isolate patients.

## Infection control procedures

- Maintenance of the water systems in which *Legionella* may grow is the key to preventing Legionnaires' disease. If *Legionella* is found in a healthcare facility's water system, the facility should work to eliminate the bacteria.
- The Centers for Medicare and Medicaid Services (CMS) mandates that all buildings in healthcare facilities develop comprehensive water management programs to reduce the risk of *Legionella* growth and spread.

# Why is *Legionella* important to public health?

*Legionella* bacteria have been recognized as a common cause of both community-associated and healthcare-associated pneumonia since it was first identified. Legionellosis generally refers to 2 clinical manifestations: Legionnaires' disease (LD) and Pontiac fever (PF). Legionnaires' disease, which can cause a fatal form of pneumonia, often requires hospitalization and results in death for about 10% of identified cases overall. Pontiac fever presents like a mild case of the flu, self-resolves without requiring treatment, and is not known to cause death. In rare cases, *Legionella* bacteria may also present as an extra-pulmonary infection, such as in a wound or graft, from environmental contamination of surgical equipment or graft components with use of tap water.

The first identified cases of Pontiac fever occurred in 1968 in Pontiac, Michigan, among people who worked at and visited the city's health department. The more severe form was identified in 1976 during an outbreak at an American Legion Convention in Philadelphia, which earned it the name Legionnaires' disease. In the U.S., reported cases of Legionnaires' disease have grown by nearly 9 times since 2000, with more than 10,000 cases of Legionnaires' disease reported in 2018.[1,2] It is believed that this disease is under-recognized and under-diagnosed.

# Disease and epidemiology

## Clinical description

Legionellosis is associated with 3 distinct clinical syndromes: Legionnaires' disease, Pontiac fever, and extrapulmonary legionellosis (XPL). Legionnaires' disease, the more severe manifestation, is characterized by pneumonia, whereas Pontiac fever is associated with self-limiting, non-pneumonic, flu-like illness. The most common initial symptoms of Legionnaires' disease are loss-of-appetite, myalgia, malaise, and headache. These symptoms are followed by fever (up to 102ºF–105ºF), chills, and a non-productive cough. Other symptoms may include abdominal pain, mental confusion, and diarrhea.

Pontiac fever initially begins with a fever and myalgia, though symptoms may include headache, chills, or fatigue. Extrapulmonary *Legionella* may present with wound instability and drainage of serous fluid.

## Causative agent

Legionellosis is an acute bacterial disease caused by *Legionella* species. *L. pneumophila* is the most common species, which causes more than 80% of human infections. Numerous serogroups are implicated in human disease, although *L. pneumophila* serogroup 1 is most commonly associated with disease in humans.

## Differential diagnosis

Legionnaires' disease usually cannot be distinguished from other forms of pneumonia and requires specific tests to confirm the diagnosis.

## Laboratory identification

There are many ways to identify *Legionella*: culture, urinary antigen, DFA, PCR, MALDI-TOF and serology.

- **Urinary antigen** is a rapid test that is sensitive early in the infection, but as the infection progresses, sensitivity may drop (estimated sensitivity 70–100%). However, in some individuals the antigen can remain elevated for many months after the infection, and thus may not represent the etiological agent for the current event. Also, the urinary antigen only detects antigen produced by *L. pneumophila* serogroup 1. Thus, disease caused by other serogroups will not be detected.
- **PCR testing of respiratory secretions** is sensitive and is not impacted by prior antibiotic treatment (unlike culture). The sensitivity and specificity of this test can vary widely depending upon the expertise of the laboratory performing the testing.
- **Culture of tracheal aspirates or bronchoscopy specimens** is the most specific method, and helps with outbreak investigations because isolates can be compared with environmental isolates to determine the source of the infection. But culture sensitivity may be lower than some other identification methods, depending upon the quality of the specimen and the expertise of the laboratory performing the culture. Sensitivity can range from 20–80%. Specimens from the lower respiratory tract will provide greater sensitivity than sputum.[2]
- **Serology** is not helpful for acute diagnosis; it requires paired sera (acute and convalescent) for interpretation. Convalescent sera is best when collected 4–6 weeks after infection. Some serological assays only detect serogroup 1, others can detect additional serogroups. The sensitivity of serology ranges from 20–75%, which makes this an unacceptable diagnostic test.
- **Direct fluorescent antibody (DFA) stains** are less sensitive (20–60%) and false positives occur, especially when using sputum as a sample, because the reagents can cross-react with other oral flora.
- **MALDI-TOF** is an emerging laboratory technique used to detect *Legionella* spp. from clinical specimens and is reported as having a 96.8% sensitivity while specificity of *Legionella spp*. is estimated at 63.9%.[3]

  **UPHL:** The Utah Public Health Laboratory (UPHL) can provide confirmation of and serological grouping of isolates from clinical labs. The UPHL can also provide environmental testing for water samples. Arrangements for environmental tests must

be made in advance.

## Treatment

Macrolides (especially azithromycin) and the respiratory tract fluoroquinolones (especially levofloxacin) are effective for *Legionella* infection.[4] Antibiotic therapy lasts 5–10 days on average, but may be adjusted for severity of illness. Immunocompromised individuals often receive a longer course of antibiotics.

## Case fatality

**Legionnaires' disease**: Mortality rates are highly variable, ranging from 1−80%, depending on the underlying health of the patient, how quickly specific therapy is started, and whether the disease is sporadic, nosocomial, or part of a large outbreak. The highest mortality rates have been reported in untreated nosocomial disease in patients who have severe underlying disease. The average fatality rate for sporadic disease is estimated to be about 10%−15%, and about 25% for healthcare-associated disease.[5]

**Pontiac fever:** This is rarely fatal.

## Reservoir

*Legionella* is commonly found in the environment. The bacteria are most likely to reproduce in high numbers in warm, stagnant water. In this environment, they live as intracellular parasites of free-living amoebae.[6]

- Generally, *Legionella* reservoirs are thought to be aqueous and can be found in a variety of habitats such as lakes, streams, or coastal oceans.
- It can also be found in man-made habitats such as cooling towers, spas or hot tubs, showers, fountains, respiratory therapy devices, grocery store misters, dental equipment that sprays water, etc.
- *Legionella* can grow at a wide range of temperatures, from 5°C–50°C (41°F–122°F), but warm water 25°C –40°C (77°F–104°F) will support the highest concentration of organisms.[7]
- *Legionella* can be found in hot and cold tap water, even in ice machines.
- Since it can be found in the soil, it is possible that soil disturbances (such as excavation) may also lead to cases of disease.
- *Legionella* can be difficult to recover from the environment due to their ability to enter into a resting state where the organisms are viable, but are not culturable.
- Also, *Legionella* bacteria readily form a biofilm on surfaces, which can reduce the effectiveness of disinfection procedures.

## Transmission

Legionellosis is transmitted through the air, when a water source contaminated with *Legionella* bacteria becomes aerosolized and inhaled.[8] There is anecdotal evidence that consuming contaminated water or ice may also lead to disease. Legionellosis is not usually transmitted from person to person, however, a single episode of person-to-person transmission has been reported.[9]

Any water source that might be aerosolized should be considered a potential source for transmission of *Legionella*. The bacteria are rarely found in municipal water supplies and tend to colonize plumbing systems and point-of-use devices. To colonize, *Legionella* bacteria usually require a temperature range of 25ºC–42.2ºC (77ºF –108ºF) and are most commonly located in hot water systems. However, cold water systems and ice machines with filters have been documented to harbor *Legionella*, and should not be overlooked as a possible source.[10, 11]

*Legionella* bacteria do not survive drying. Therefore, air-conditioning equipment condensate, which frequently evaporates, is not a likely source.

## Susceptibility

People at highest risk are older than age 50, males, smokers or others with chronic respiratory diseases, people with diabetes, and people who are immunocompromised (such as corticosteroid use, cancer, transplants, etc.).[4,12] Prior infection does not necessarily prevent re-infection.

## Incubation period

For Legionnaires' disease, 2–14 days, most often 5–6 days. Public health officials have reported incubation periods up to 26 days under rare circumstances. For Pontiac fever, 5–72 hours, most often 24–48 hours.[13]

## Period of communicability

No period of communicability is defined for legionellosis, as it is not typically transmitted from person to person.

## Epidemiology

Legionnaires' disease was named after an outbreak that occurred among people who attended an annual convention of the American Legion in Philadelphia in 1976. Since then, *Legionella* has been recognized as a common cause of both community-associated and healthcare-associated pneumonia. Legionnaires' disease has a worldwide distribution. An estimated 8,000–18,000

people develop Legionnaires' disease in the U.S. each year; about 10,000 cases of Legionnaires' disease were reported in the U.S. in 2018. Most of these are single, isolated cases that are not associated with an outbreak. *L. pneumophila* serogroup 1 is responsible for about 80% of the cases.[14] Outbreaks usually occur in the summer and fall, although cases can occur year-round. Additionally, Legionnaires' disease is more prevalent in the Northeast and East North Central region.[15]

Serologic surveys have shown a prevalence of antibodies to *L. pneumophila* serogroup 1 at a titer of ≥1:128 in 1–20% of the population. Illness most severely affects older persons, especially those who smoke cigarettes (odds ratio ranges between 2 to 7), male gender (odds ratio about 2, possibly due to the fact that men are more likely to be smokers), or have chronic lung disease. Other risk factors include immunosuppressive therapy and immunosuppressive diseases such as AIDS and diabetes (odds ratio approximately equals 6). *Legionella* is estimated to be responsible for 1–9% of cases of community-associated pneumonia.

# Public health control measures

## Public health responsibility

- Investigate all suspect cases of disease and fill out and submit appropriate disease investigation forms (all diseases attributed to legionellosis).
- Provide education to the general public, clinicians, and first responders about disease transmission, prevention, and diagnosis.
- Identify clusters or outbreaks of this disease.
- Identify sources of exposure and stop further transmission.
- Identify whether the case was healthcare-associated.
- Identify whether the case was travel-associated.

**Single case—not healthcare-associated**

- Collect travel information during the 14-day period (3 days for PF) prior to illness onset. Obtain information on hotels, campgrounds, etc., and dates.

**Single case—healthcare-associated**

- Collect information that encompasses the 14-day exposure period (3 days for PF) on hospital or long-term care facility, dates of inpatient/outpatient visits, floors, wards, and room numbers. Also collect information on respiratory therapy and exposure to ice.

**Multiple cases—not healthcare-associated**

- Two cases of legionellosis in a 30-day period, in the same location, are considered an outbreak (also called a cluster).
- Investigators should look closely at individual cases that do not meet the typical risk

factors.

**Multiple cases—healthcare-associated**

- Any hospital or long-term care facility that has evidence of 2 healthcare-associated cases in a 6-month period.
- Investigators should meet with infection control practitioners and document steps they are taking to resolve the issue.

### Prevention

Primary prevention of *Legionella* is done at individual businesses and healthcare facilities, through consistent water monitoring under a water management plan. This prevents *Legionella* growth in premise plumbing and reduces the risk of disease spread. Prevention also includes taking corrective action when failures in the water management plan are found.

Local and state health departments support *Legionella* prevention by increasing awareness of *Legionella* and providing education and resources to assist facilities. This includes, but is not limited to:

- Providing updates and education to public health and healthcare partners, such as Utah Healthcare Infection Prevention Governance Committee (UHIP-GC).
- Performing infection control assessment and response (ICAR) audits or water infection control risk assessments (WICRA) with Utah healthcare facilities, including obtaining and reviewing their water management program (WMP).
- Sharing memos, educational resources, and WMP surveys with feedback.

### Vaccine

A legionellosis vaccine is not currently available.

### Isolation and quarantine requirements

There is no need for patient isolation or quarantine restrictions.

## Case investigation

### Reporting (CSTE position statement, 2019)

*Note: The following section is copied directly from CSTE position statement 19-ID-04.*[16]

A. Narrative: A description of suggested criteria for case ascertainment of a specific condition.

Standard reporting refers to the process of healthcare providers or institutions (e.g., clinicians, clinical laboratories, hospitals) submitting basic laboratory or clinical information to

governmental public health agencies about potential cases of illness that meet certain reporting requirements or criteria. Legionellosis infections meeting the surveillance case definition may also be ascertained by the secondary analysis of administrative health data or clinical data. The purpose of this section is to provide those criteria that should help to determine whether a specific illness should be reported to public health authorities.

A1. Clinical criteria for reporting

No clinical criteria alone are sufficient to generate a report to public health authorities.

A2. Laboratory criteria for reporting

Report any person with any of the following laboratory findings/results to public health authorities:

- Legionnaires' disease (LD):
    - Isolation of any *Legionella* organism from lower respiratory secretions, lung tissue, or pleural fluid
    - Detection of any *Legionella* species from lower respiratory secretions, lung tissue, or pleural fluid by a validated nucleic acid amplification test
    - Detection of *Legionella pneumophila* serogroup 1 antigen in urine using validated reagents
    - Fourfold or greater rise in specific serum antibody titer to *Legionella pneumophila* serogroup 1 using validated reagents
    - Fourfold or greater rise in antibody titer to specific species or serogroups of *Legionella* other than *L. pneumophila* serogroup 1 (e.g., L. micdadei, L. pneumophila serogroup 6)
    - Fourfold or greater rise in antibody titer to multiple species of *Legionella* using pooled antigens
    - Detection of specific *Legionella* antigen or staining of the organism in lower respiratory secretions, lung tissue, or pleural fluid by direct fluorescent antibody (DFA) staining, immunohistochemistry (IHC), or other similar method, using validated reagents
- Pontiac fever (PF):
    - Detection of *Legionella pneumophila* serogroup 1 antigen in urine using validated reagents
    - Fourfold or greater rise in specific serum antibody titer to *Legionella pneumophila* serogroup 1 using validated reagents
    - Fourfold or greater rise in antibody titer to specific species or serogroups of *Legionella* other than *L. pneumophila* serogroup 1 (e.g., L. micdadei, L. pneumophila serogroup 6)
    - Fourfold or greater rise in antibody titer to multiple species of *Legionella*

using pooled antigens

- Extrapulmonary legionellosis (XPL):
    - Isolation of any *Legionella* organism from any extrapulmonary site
    - Detection of any *Legionella* species from any extrapulmonary site by a validated nucleic acid amplification test
    - Detection of specific *Legionella* antigen or staining of the organism from any extrapulmonary site by direct fluorescent antibody (DFA) staining, immunohistochemistry (IHC), or other similar method, using validated reagents

A3. Epidemiologic linkage criteria for reporting

None required.

A4. Vital records criteria for reporting

1. Report any person whose death certificate lists Legionnaires' disease, legionellosis, extrapulmonary legionellosis, or Pontiac fever anywhere on the death certificate.

A5. Other criteria for reporting

1. Report any person whose healthcare/medical record contains a diagnosis Legionnaires' disease, legionellosis, extrapulmonary legionellosis, or Pontiac fever.

**Table 1. Criteria to determine whether a case should be reported to public health authorities**

| Criterion | Legionnaires' disease | Extrapulmonary legionellosis | Pontiac fever |
|---|---|---|---|
| **Laboratory criteria for reporting** | | | |
| Isolation of any *Legionella* organism from lower respiratory secretions, lung tissue, or pleural fluid | S | | |
| Isolation of any *Legionella* organism from any extrapulmonary site | | S | |
| Detection of any *Legionella* species from lower respiratory secretions, lung tissue, or pleural fluid by a validated nucleic acid amplification test | S | | |
| Detection of any *Legionella* species from any extrapulmonary site by a validated nucleic acid amplification test | | S | |
| Detection of *Legionella pneumophila* serogroup 1 antigen in urine using validated reagents | S | | S |
| Fourfold or greater rise in specific serum antibody titer to *Legionella pneumophila* serogroup 1 using validated reagents | S | | S |
| Fourfold or greater rise in antibody titer to specific species or serogroups of *Legionella* other than L. *pneumophila* serogroup 1 (e.g., *L. micdadei, L. pneumophila* serogroup 6) | S | | S |
| Fourfold or greater rise in antibody titer to multiple species of *Legionella* using pooled antigens | S | | S |
| Detection of specific *Legionella* antigen or staining of the organism in lower respiratory secretions, lung tissue, or pleural fluid by direct fluorescent antibody (DFA) staining, immunohistochemistry (IHC), or other similar method, using validated reagents | S | | |
| Detection of specific *Legionella* antigen or staining of the organism from any extrapulmonary site by direct fluorescent antibody (DFA) staining, immunohistochemistry (IHC), or other similar method, using validated reagents | | S | |

| | | | |
|---|---|---|---|
| *Detection of *Legionella* species by MALDI-TOF mass spectrometry | S | | |
| **Vital records criteria for reporting** | | | |
| Death certificate lists Legionnaires' disease as a cause of death or a significant condition contributing to death | S | | |
| Death certificate lists Pontiac fever as a cause of death or a significant condition contributing to death | | | S |
| Death certificate lists extrapulmonary legionellosis as a cause of death or a significant condition contributing to death | | S | |
| Death certificate lists legionellosis as a cause of death or a significant condition contributing to death | S | S | S |
| **Other criteria for reporting** | | | |
| Healthcare record contains a diagnosis of Legionnaires' disease | S | | |
| Healthcare record contains diagnosis of Pontiac fever | | | S |
| Healthcare record contains a diagnosis of extrapulmonary legionellosis | | S | |
| Healthcare record contains a diagnosis of legionellosis | S | S | S |

Notes:

S = This criterion alone is sufficient to identify a case for reporting.

*Locally determined; not included in CSTE position statement 19-ID-04

## CSTE case definition (CSTE Position Statement, 2023)

*Note: The following section is copied directly from CSTE position statement 19-ID-04.*[16]

A. Narrative: Description of criteria to determine how a case should be classified.

A1. Clinical criteria

Legionellosis is associated with three clinically and epidemiologically distinct illnesses: Legionnaires' disease, Pontiac fever, or extrapulmonary legionellosis.

**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.

**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.

**Extrapulmonary legionellosis (XPL):** *Legionella* 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 *Legionella* at that site.

A2. Laboratory criteria

*Confirmatory laboratory evidence:*

- Isolation of any *Legionella* organism from lower respiratory secretions, lung tissue, pleural fluid, or extrapulmonary site
- Detection of any *Legionella* species from lower respiratory secretions, lung tissue, pleural fluid, or extrapulmonary site by a validated nucleic acid amplification test
- Detection of *Legionella pneumophila* serogroup 1 antigen in urine using validated reagents
- Fourfold or greater rise in specific serum antibody titer to *Legionella pneumophila* serogroup 1 using validated reagents

*Presumptive laboratory evidence:*

None required for case classification

*Supportive laboratory evidence:*

- Fourfold or greater rise in antibody titer to specific species or serogroups of *Legionella* other than *L. pneumophila* serogroup 1 (e.g., *L. micdadei, L. pneumophila* serogroup 6)
- Fourfold or greater rise in antibody titer to multiple species of *Legionella* using pooled antigens.
- Detection of specific *Legionella* 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.

**Table 2. Legionnaires' disease case classification by positive laboratory test result and methodology in conjunction with X-ray diagnosed pneumonia**

*Note: The following table is adapted from CSTE position statement 05-ID-01.*[17]

| Laboratory test | Case classification |
|---|---|
| Culture of respiratory secretions or tissue | Confirmed |
| Urinary antigen for *L. pneumophila* serogroup 1 | Confirmed |
| Serology—*L. pneumophila* serogroup 1 using validated reagents | Confirmed—4-fold increase |
| Validated nucleic acid assay | Confirmed |
| Serology—species-specific antigen other than *L. pneumophila* serogroup 1 | Suspect |
| Serology—multiple species (pooled antigen) | Suspect |
| Detection of *Legionella* antigens or staining of the organism | Suspect—Direct fluorescent antibody (DFA) |
| Matrix-assisted laser desorption ionization–time-of-flight mass spectrometry (MALDI–TOF MS) of clinical isolate from respiratory secretions or tissue | Confirmed |

A3. Epidemiologic linkage

1) Epidemiologic link to a setting with a confirmed source of *Legionella* (e.g., positive environmental sampling result associated with a cruise ship, public accommodation, cooling tower, etc.).

**OR**

2) Epidemiologic link to a setting with a suspected source of *Legionella* that is associated with at least one confirmed case.

A4. Case classifications

**Confirmed Legionnaires' disease (LD):**

A clinically compatible case of LD with confirmatory laboratory evidence for *Legionella*.

**Probable Legionnaires' disease (LD):**

A clinically compatible case with an epidemiologic link during the 14 days before onset of symptoms.

**Suspect Legionnaires' disease (LD):**

A clinically compatible case of LD with supportive laboratory evidence for *Legionella*.

**Confirmed Pontiac fever (PF):**
A clinically compatible case of PF with confirmatory laboratory evidence for *Legionella*.

**Probable Pontiac fever (PF):**
A clinically compatible case with an epidemiologic link during the 3 days before onset of symptoms.

**Suspect Pontiac fever (PF):**
A clinically compatible case of PF with supportive laboratory evidence for *Legionella*.

**Confirmed Extrapulmonary legionellosis (XPL):**
A clinically compatible case of XPL with confirmatory laboratory evidence of *Legionella* at an extrapulmonary site.

**Suspect Extrapulmonary legionellosis (XPL):**
A clinically compatible case of XPL with supportive laboratory evidence of *Legionella* at an extrapulmonary site.

## Travel-associated case definition

**Travel-associated Legionnaires' disease (LD):** A case of Legionnaires' disease in a patient who has a history of spending at least one night away from home (excluding healthcare settings) in the 14 days before onset of illness.

**Travel-associated Pontiac fever (PF):** A case of Pontiac fever in a patient who has a history of spending at least one night away from home (excluding healthcare settings) in the 3 days before onset of illness.

## Healthcare-associated case definition

**Presumptive healthcare-associated Legionnaires' disease:** A case with ≥10 days of continuous stay at a healthcare facility during the 14 days before onset of symptoms.

**Possible healthcare-associated Legionnaires' disease:** A case that 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 Legionnaires' disease.

**Table 3. Classification table: Criteria for defining a case of legionellosis**

| Criterion | Legionnaires disease | | | Extrapulmonary legionellosis | | Pontiac fever | | |
|---|---|---|---|---|---|---|---|---|
| | Suspect | Probable | Confirmed | Suspect | Confirmed | Suspect | Probable | Confirmed |
| | | | | | | | | |
| Patient presents with radiographic or clinical pneumonia | O | O | O | | | | | |
| Patient presents with symptoms of lower respiratory illness | O | O | O | | | | | |
| Patient presents with symptoms of acute illness | | | | | | N | N | N |
| Diagnostic testing reveals evidence of *Legionella* from an extrapulmonary site of disease | | | | N | N | | | |
| **Laboratory evidence** | | | | | | | | |
| Isolation of any *Legionella* organism from lower respiratory secretions, lung tissue, or pleural fluid | | | O | | | | | O |
| Isolation of any *Legionella* organism from any extrapulmonary site associated with clinical disease | | | | | O | | | |
| Detection of any *Legionella* species from lower respiratory secretions, lung tissue, or pleural fluid by a validated nucleic acid amplification test | | | O | | | | | O |
| Detection of any *Legionella* species from any extrapulmonary site associated with clinical disease by a validated nucleic acid amplification test | | | | | O | | | |
| Detection of *Legionella pneumophila* serogroup 1 antigen in urine using validated reagents | | | O | | | | | O |
| Fourfold or greater rise in specific serum antibody titer to *Legionella pneumophila* serogroup 1 using validated reagents | | | O | | | | | O |
| Fourfold or greater rise in antibody titer to specific species or serogroups of *Legionella* other than *L. pneumophila* serogroup 1 (e.g., *L. micdadei, L. pneumophila* serogroup 6) | O | | | | | O | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Fourfold or greater rise in antibody titer to multiple species of *Legionella* using pooled antigens | O | | | | | O | | |
| Detection of specific *Legionella* antigen or staining of the organism in lower respiratory secretions, lung tissue, or pleural fluid by direct fluorescent antibody (DFA) staining, immunohistochemistry (IHC), or other similar method, using validated reagents | O | | | | | O | | |
| Detection of specific *Legionella* antigen or staining of the organism from any extrapulmonary site associated with clinical disease by direct fluorescent antibody (DFA) staining, immunohistochemistry (IHC), or other similar method, using validated reagents | | | | O | | | | |
| **Epidemiological linkage evidence** | | | | | | | | |
| A clinically compatible case with an epidemiologic link to a setting with either a confirmed source of Legionella or a suspected source of Legionella associated with at least one confirmed case | | N | | | | | N | |
| Epidemiologic link occurred during the 14 days before onset of symptoms | | N | | | | | | |
| Epidemiologic link occurred during the 3 days before onset of symptoms | | | | | | | N | |

Notes:

N = All “N” criteria in the same column are NECESSARY to classify a case. A number following an “N” indicates this criterion is only required for a specific disease/condition subtype (see below). If the absence of a criterion (i.e., criterion NOT present) is required for the case to meet the classification criteria, list the absence of criterion as a necessary component.

C = At least one of these “O” (ONE OR MORE) criteria in each category (categories=clinical evidence, laboratory evidence, and epidemiologic evidence) in the same column—in conjunction with all “N” criteria

## Case investigation process

- The investigating health department, within 7 days of notification of the legionellosis case, will ascertain whether the case-patient spent at least 1 night away from home in the 10 days before onset of illness.
- Identify whether the case is healthcare-associated or travel-associated.
- Complete the investigation form.
- If history of travel is present in the 14 days before onset of illness, the Utah Department of Health and Human Services will, within 7 days of the initial notification, report travel destination (city and state or country) and dates of travel to CDC and to the state of travel.[18]
- If there is no history of travel in the 14 days before onset of illness, the Utah Department of Health and Human Services will complete the legionellosis case report and send it to the CDC within 30 days of notification.
- If there are epidemiologically-linked, travel-associated legionellosis cases, CDC will notify within 1 day, and work with state health departments to investigate further.

## Outbreaks

An outbreak will be defined as:

- Two or more cases of nosocomial legionellosis in a healthcare facility in any 6-month period.
- Two or more cases of legionellosis (not healthcare-associated) identified with onset dates within a 30-day period, linked to the same place.

Additional investigation measures will be implemented during either of these situations (see suggested outbreak activities). During an outbreak, both urine antigen and culture testing from lower respiratory secretions should be conducted, and all adults with pneumonia should be tested for legionellosis.

Public health investigators will need to determine the end of an outbreak on a case-by-case basis. Possible considerations include:

- No new cases of legionellosis identified during a period of prospective surveillance for new cases.
- No detection of *Legionella* spp. in samples collected during remediation water testing.

## Outbreak response protocol (for outbreaks in any setting)

The investigation team should include a wide range of partners, including building engineering staff, infection preventionist, administration, epidemiologists, etc. Below is a comprehensive list of suggested activities for a *Legionella* outbreak investigation in a facility or business. It can also be adapted to investigate single cases of healthcare-associated LD, although some listed activities may not be relevant. A checklist of these activities is available in the appendix.

- Perform case investigations on individual cases using the investigation form in EpiTrax and verify that individual cases meet the case definitions for suspect and confirmed legionellosis.
- Determine if additional testing such as a urinary antigen test or culture is necessary to confirm a case of Legionnaires' disease.
- Submit case report forms with risk factor information to the CDC within 7 days of the initial notification if travel history is present, and within 30 days of notification for patients who have no travel history.
- Obtain clinical samples for culture on any newly-identified cases or post-mortem specimens, when applicable. *Legionella* spp. isolates obtained from patient samples can provide important epidemiological information. Isolates can be placed in storage for potential future whole-genome sequencing (WGS) for comparison against other isolates from patients involved in the same outbreak and against *Legionella* spp. from environmental sources within a facility.
- Determine if there is an outbreak using the following criteria:
    - Two or more cases of legionellosis (not nosocomial) identified in the same place, with onset dates within a 30-day period.
    - Two or more cases of nosocomial legionellosis in a single healthcare facility in any 6-month period.
- Use the facility-centric module to perform a retrospective look back of cases in the EpiTrax surveillance database to look for additional earlier cases with possible links to the same facility or geographic area.
- Develop a line list of cases associated with the common exposure, facility, or geographic area. Consider using the CDC templates for community and healthcare-associated cases. Use sample line listing to track disease outbreak cases: community and healthcare-associated.
- Set up an internal meeting/coordination call with state and local health departments to formulate and coordinate a public health outbreak response plan.
    - Define outbreak by person, time, and place.
    - Identify key partners for the investigation team.
    - Define lead role, proposed steps, anticipated resources, and roles and responsibilities.
    - Define local health department capacity and required level of DHHS involvement.
    - Define expectations/preferences for communication and frequency during investigation.
- Investigation coordination call/meeting with a wider group of partners, such as, building engineering staff, infection preventionist, laboratory personnel, medical staff, environmental, and epidemiologists to review case line listing, formulate an action plan, and to talk about temporary interim measures for facilities experiencing a potential potable water outbreak.
- Consider using the extended hypothesis-generating questionnaire to collect additional exposure information or customizing a more detailed questionnaire specific to the outbreak location for known outbreaks. There is a separate questionnaire to collect additional exposure

data for cases associated with a cruise ship.

- Use the medical record extraction form to collect additional medical history information on case patients.
- Implement temporary interim measures for facilities experiencing a potential potable water outbreak. These include, but are not limited to:
    - the use of bottled water
    - restrict showers (sponge baths instead)
    - avoid exposure to hot tubs or hydrotherapy pools
    - close the building
    - stop admissions to the affected area
- Distribute notification letters to the appropriate audience(s). The CDC Communications Tool is a good resource for this.
- Enhanced surveillance of cough, fever, and respiratory illness.
- Test any additional cases of pneumonia for *Legionella* by urinary antigen test.
- Review any environmental risks, recent plumbing work or repairs, or recent construction projects.
- Review the building water system and management plan and identify any deficiencies or potential stagnation points.
- Complete the Worksheet to Identify Buildings at Increased Risk for *Legionella* Growth and Spread.
- Complete the *Legionella* Environmental Assessment Form to identify possible sources of *Legionella* and perform careful monitoring of temperature, pH and residual disinfectant.
- Gather available epidemiologic information, such as possible case exposures to particular showerheads, sink faucets, etc.
- Look for shared risk factors and form hypotheses.
- *Based on the environmental assessment and generated hypotheses, collect water and/or swab samples and perform testing for *Legionella* bacteria on identified high-risk areas. The Utah Public Health Laboratory (UPHL) can assist with collection and testing requirements.
- In situations where multiple water samples are tested during an outbreak, consider following the Legionnaires' Disease Laboratory Response Plan guidelines to streamline operations.
- Consider submitting clinical and/or environmental *Legionella* isolates to UPHL for whole genome sequencing (WGS) analysis.
- Perform contingency and corrective actions to the water management program.
- Perform any remediation measures, such as superheating, system flushes, the use of draining devices, and re-test as needed. Base remediation on findings of environmental assessment, sampling results, and epidemiologic findings from the investigation.
- Consider any additional control measures, such as installing point-of-use filters on any shower heads or sink faucets.
- Consider more extensive engineering control interventions to incoming water such as

copper-silver ionization systems if the water testing results continue to be out of control.
- Schedule interim meetings or updates (as needed) to make sure all partners know the status of the outbreak and remediation efforts.
- Produce an outbreak after-action report with outbreak findings, ongoing recommendations, and lessons learned.
- Determine the end of an outbreak on a case-by-case basis. Possible considerations include:
    - No new cases of legionellosis identified during a period of prospective surveillance for new cases.
    - No detection of *Legionella* spp. in samples collected during remediation water testing.
    - An effective water management program is in place.
- Enter the outbreak information into the National Outbreak Reporting System (NORS).

*The approach to follow-up water sampling depends on the specific circumstances of the outbreak. One widely-used approach, outlined in HICPAC guidance, consists of bimonthly collection of environmental samples for culture for a period of 3 months. If *Legionella* does not grow from samples during the 3-month monitoring period, cultures should be collected monthly for another 3 months.

## Identify case contacts

Legionellosis is not usually not transmitted from person to person.

- In the event of an outbreak with a known transmission source, it's reasonable to identify individuals at high risk. High-risk patients are detailed in the susceptibility section.

## Infection control procedures for healthcare facilities

The key to preventing legionellosis is maintenance of the water systems in which *Legionella* spp. may grow. Healthcare facilities are required to have policies to prevent and reduce growth of *Legionella* spp, especially a water management plan.[19] If *Legionella* spp. is found in a healthcare facility's water system, the facility should work to eliminate the bacteria.

CDC encourages healthcare facilities to develop comprehensive water management programs to reduce the risk of *Legionella* growth and spread. CDC has resources to help facilities understand their water system and develop a water management plan.

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### CDC outbreak resources and worksheets

1. CDC Communications Tool for *Legionella*
2. CDC *Legionella* environmental assessment form
3. CDC worksheet to identify buildings at increased risk for *Legionella* growth and spread

### Council of State and Territorial Epidemiologists (CSTE) position statements

1. 19-ID-04 Revision to the case definition for national legionellosis surveillance
2. 09-ID-45 Public health reporting and national notification
3. 05-ID-01 Strengthening surveillance for travel-associated legionellosis and revised case definitions for legionellosis

# Version control

V.12.17: Added “Critical Clinician Information” section, “Why is Disease Important to Public Health” section, and “UT-NEDSS/EpiTrax Minimum/Required Fields by Tab” section. Updated “Disease and Epidemiology” section (Clinical Description, Case Fatality, Transmission, and Epidemiology) and “Case Investigations” section (Outbreaks, and added Infection Control Procedures).

V.03.19: Added table II. Case classification by laboratory testing methodology and "Suggested Outbreak Activities (Facilities)" section with suggested activities.

V.05.20: Added new CSTE position statement tables and updated disease plan to align with the latest 2019 CSTE position statement. Primary prevention strategy added. Updated outbreak response plan with an available Appendix checklist format.

V.03.23: Expanded clinical considerations for all types of legionellosis (Legionnaires’ disease, Pontiac Fever and Extrapulmonary legionellosis). Updated resource pages to CDC and others. Updated data figures of *Legionella* burden and impact. Updated CSTE position statement language. Added MALDI-TOF as a validated clinical test for the detection of *Legionella* spp. from clinical specimens. Updated to reflect new DHHS writing style guide and branding.

# UT-NEDSS/EpiTrax minimum/required fields by tab

**Demographic**

- Patient first name
- Patient last name
- Birth date
- Gender
- Race
- Ethnicity
- Address: State
- Address: County
- Address: City
- Address: Street number
- Address: Street name
- Address: Unit number
- Address: Postal code
- Phone area code
- Phone number

**Clinical**

- Patient disease
- Disease onset date
- Hospitalized
- Hospitalization facility
- Hospital admission date
- Hospital discharge date
- Date of diagnose
- Patient died
- Date of death
- Pneumonia
- Long-term care facility
- Facility name
- Date of admission
- Date of discharge

**Laboratory**

- Lab name
- Lab collection date
- Lab test date
- Lab organism
- Specimen source
- Test result
- Test status
- Lab units

**Investigation**

- Group living
- Healthcare worker
- Imported from
- Address of exposure
- Outpatient visit
- Work in a hospital (locations)
- Direct patient care (dates and locations)
- Routine water heater use
- Travel overnight (dates and locations)
- Fly on an airplane
- Ride on a boat
- Attend a conference or convention
- Stay in a hotel/motel

**Reporting**

- First date reported to public health

**Administrative**

- Outbreak associated
- Outbreak name
- State case status

# Electronic laboratory reporting processing rules

## Legionellosis infection rules for entering laboratory test results

The following rules describe how laboratory results reported to public health should be added to new or existing events in UT-NEDSS/EpiTrax. These rules have been developed for the automated processing of electronic laboratory reports, although they also apply to manual data entry.

### Test-specific rules

*Test-specific rules describe what test type and test result combinations are allowed to create new morbidity events in EpiTrax, and what test type and test result combinations are allowed to update existing events (morbidity or contact) in EpiTrax.*

| Test Type | Test result | Create a new event | Update an existing event |
|---|---|---|---|
| Antigen | Positive | Yes | Yes |
| | Negative | No | Yes |
| | Equivocal | Yes | Yes |
| | Other | No | Yes |
| Culture | Positive | Yes | Yes |
| | Negative | No | Yes |
| | Equivocal | Yes | Yes |
| | Other | No | Yes |
| IgM Antibody | Positive | Yes | Yes |
| | Negative | No | Yes |
| | Equivocal | No | Yes |
| | Other | No | Yes |
| PCR/amplification | Positive | Yes | Yes |
| | Negative | No | Yes |
| | Equivocal | No | Yes |
| | Other | No | Yes |
| Total antibody (by EIA, IFA, TRF, etc.) | Positive | Yes | Yes |
| | Negative | No | Yes |
| | Equivocal | No | Yes |
| | Other | No | Yes |
| IgG antibody | Positive | Yes | Yes |
| | Negative | No | Yes |
| | Equivocal | No | Yes |
| | Other | No | Yes |
| MALDI-TOF mass spectrometry | Positive | Yes | Yes |
| | Negative | No | Yes |
| | Equivocal | Yes | Yes |
| | Other | No | Yes |

### Whitelist rules

*Whitelist rules describe how long an existing event can have new laboratory data appended to it. If a laboratory result falls outside the whitelist rules for an existing event, it should not be added to that event, and should be evaluated to determine if a new event (CMR) should be created.*

**Legionellosis morbidity whitelist rule:** If the specimen collection date of the laboratory result is 6 months or less after the event date of the morbidity event, the laboratory result should be added to the morbidity event.

**Legionellosis contact whitelist rule:** Never added to contact.

### Graylist rule

*We often receive laboratory results through ELR that cannot create cases, but can be useful if a case is created in the future. These laboratory results go to the graylist. The graylist rule describes how long an existing event can have an old laboratory result appended to it.*

**Legionellosis graylist rule:** If the specimen collection date of the laboratory result is 30 days before to 7 days after the event date of the morbidity event, the laboratory result should be added to the morbidity event.

### Other electronic laboratory processing rules

If an existing event has a state case status of "not a case," ELR will never add additional test results to that case. New labs will be evaluated to determine if a new CMR should be created.

# Appendix

## *Legionella* outbreak response checklist

Below is a comprehensive list of suggested activities for a *Legionella* outbreak investigation in a facility. Not every activity will be relevant to each outbreak situation. Check off each activity as it is completed.

| ☐ | Description of activity | Responsible parties | Date(s) | Notes |
|---|---|---|---|---|
| ☐ | Perform case investigations on individual cases using the investigation form in EpiTrax and verify that individual cases meet the case definitions for suspect and confirmed legionellosis. | Public health epidemiologists | | |
| ☐ | Determine if additional testing, such as a urinary antigen test or culture is necessary to confirm a case of legionellosis. | Public health epidemiologists | | |
| ☐ | Submit case report forms with risk factor information to the CDC within 7 days of the initial notification if travel history is present, and within 30 days of notification for patients with no travel history. | State health department epidemiologists | | |
| ☐ | Obtain clinical samples for culture on any newly-identified cases or post-mortem specimens, when applicable. *Legionella* spp. isolates obtained from patient samples can provide important epidemiological information.<br><br>Isolates can be placed in storage for potential future whole-genome sequencing (WGS) for comparison against other isolates from patients involved in the same outbreak and against *Legionella* spp. from environmental sources within a facility. | Public health epidemiologists, clinical reference lab, Utah Public Health Laboratory (UPHL) | | |
| ☐ | Determine if there is an outbreak using the following criteria:<br>• Two or more cases of nosocomial legionellosis in a healthcare facility in | Public health epidemiologists | | |

| | | | | |
|---|---|---|---|---|
| | any 6-month period<br>• Two or more cases of legionellosis (not nosocomial) identified with onset dates within a 30-day period. | | | |
| ☐ | Perform a retrospective look back of cases in the EpiTrax surveillance database with possible links to the same facility or geographic area to look for additional earlier cases. | Public health epidemiologists | | |
| ☐ | Develop a line list of cases associated with the common exposure, facility, or geographic area. Consider using the CDC templates for community and healthcare associated cases. Use a sample line listing to track disease outbreak cases.<br>Community and healthcare-associated outbreak line list | Public health epidemiologists | | |
| ☐ | Set up an internal meeting/coordination call with state and local health departments to formulate and coordinate a public health outbreak response plan.<br>Complete the *Legionella* Outbreak Meeting Agenda Template to:<br>• Define an outbreak by person, time, and place<br>• Identify key partners for the investigation team<br>• Define lead role, proposed steps, anticipated resources and roles and responsibilities<br>• Define local health department capacity and required level of DHHS involvement<br>• Define expectations/preferences for communication and frequency during investigation | Public health: state/local health departments (health resource officers, UPHL, epidemiologists, environmental team) | | |
| ☐ | Investigation coordination call/meeting with wider group of partners, such as building engineering staff, infection preventionist, laboratory personnel, medical staff, environmental, epidemiologists, etc., to | Facility medical and engineering staff, laboratory personnel, state and local | | |

| | | | | |
|---|---|---|---|---|
| | review case line listing, formulate an action plan, and to talk about temporary interim measures for facilities experiencing a potential potable water outbreak. | epidemiologists, environmental epidemiologists, facility corporate officials, etc. | | |
| ☐ | Consider using the extended hypothesis-generating questionnaire to collect additional exposure information or customize a more detailed questionnaire specific to the outbreak location for known outbreaks.<br><br>Use this form to collect additional exposure data for cases associated with a cruise ship | Public health epidemiologists | | |
| ☐ | Collect additional medical history information on case patients using the medical record extraction form | Public health epidemiologists | | |
| ☐ | Implement temporary interim measures for facilities experiencing a potential potable water outbreak. These include, but are not limited to:<br>• the use of bottled water<br>• restrict showers (sponge baths instead)<br>• avoid exposure to hot tubs or hydrotherapy pools<br>• close the building<br>• stop admissions to the affected area | Public health epidemiologists, environmental team, facility medical and corporate staff | | |
| ☐ | Distribute notification letters to the appropriate audience(s). The CDC Communications Tool is a good resource. | Public health epidemiologists, facility medical and corporate staff | | |
| ☐ | Enhanced surveillance of cough, fever, and respiratory illness. | Facility medical staff | | |
| ☐ | Test any new cases of pneumonia for *Legionella spp.* by urinary antigen test or lower respiratory culture or PCR. | Facility medical staff | | |
| ☐ | Review any environmental risks, recent plumbing work or repairs, or recent construction projects. | Environmental team | | |

| | | | | |
|---|---|---|---|---|
| ☐ | Review building water system and management plans and identify any deficiencies or potential stagnation points. | Environmental team | | |
| ☐ | Complete this Worksheet to identify buildings at increased risk for *Legionella* growth and spread. | Environmental team, facility building and maintenance engineers | | |
| ☐ | Complete the *Legionella* environmental assessment form to identify possible sources of *Legionella* and perform careful monitoring of temperature, pH, and residual disinfectant. | Environmental team, facility building and maintenance engineers | | |
| ☐ | Gather available epidemiologic information such as possible case exposures to particular shower heads, sink faucets, etc. | Environmental team, facility building and maintenance engineers | | |
| ☐ | Look for shared risk factors and formulate hypotheses. | Public health epidemiologists, environmental team, facility staff | | |
| ☐ | *Based on the environmental assessment and generated hypotheses, collect water and/or swab samples and perform testing for *Legionella* bacteria on identified high risk areas. The Utah Public Health Lab can assist with collection and testing requirements.<br><br>*The approach to follow-up water sampling depends on the specific circumstances of the outbreak. One widely-used approach outlined in HICPAC Guidance consists of bimonthly collection of environmental samples for culture for a period of 3 months. If *Legionella* does not grow from samples during the 3-month monitoring period, cultures should be collected monthly for another 3 months. | Environmental team, facility building and maintenance engineers, UPHL | | |
| ☐ | In situations where multiple water samples are tested during an outbreak, consider following the guidelines in the Legionnaires' | UPHL | | |

| | | | | |
|---|---|---|---|---|
| | Disease Laboratory Response Plan to streamline operations. | | | |
| ☐ | Consider submitting clinical and/or environmental *Legionella* isolates to UPHL for WGS analysis | Public health epidemiologists, environmental team, UPHL | | |
| ☐ | Perform contingency and corrective actions to the water management program. | Environmental public health team, facility building, and maintenance engineers | | |
| ☐ | Perform any remediation measures, such as superheating, system flushes, the use of draining devices, flushing unused plumbing devices, and re-test as needed. Base remediation on findings of environmental assessment, sampling results, and epidemiologic findings from the investigation. | Environmental public health team, facility building, and maintenance engineers | | |
| ☐ | Consider any additional control measures, such as installing point-of-use filters on any shower heads or sink faucets. | Environmental public health team, facility building, and maintenance engineers | | |
| ☐ | Consider more extensive engineering control interventions to incoming water such as copper-silver ionization systems if the water testing results continue to be out of control. | Facility building and maintenance engineers, corporate staff | | |
| ☐ | Schedule interim meetings or updates (as needed) to make sure all partners are aware of the status of the outbreak and remediation efforts. | Public health epidemiologists, environmental team | | |
| | Determine the end of an outbreak on a case-by-case basis. Possible considerations include:<br>• No new cases of legionellosis identified during a period of prospective surveillance for new cases | Public health epidemiologists, environmental team | | |

| | | | | |
|---|---|---|---|---|
| ☐ | • No detection of *Legionella* spp. in samples collected during remediation water testing<br>• An effective water management program is in place. | | | |
| ☐ | Produce an outbreak after-action report with outbreak findings, ongoing recommendations, and lessons learned. | Public health epidemiologists, environmental team | | |
| ☐ | Enter the outbreak information into the National Outbreak Reporting System (NORS) system. | State or local epidemiologists | | |