UTAH DEPARTMENT OF HEALTH

Legionellosis

Also known as Legionnaires' disease and Pontiac Fever

Disease Plan

Quick Links

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Questions about this disease plan?

Contact the Utah Department of Health Bureau of Epidemiology: 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.
- Both LD and PF present with anorexia, malaise, myalgia, headache, and fever. Abdominal pain and diarrhea are also common.
- Extra-pulmonary *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; for Pontiac fever 5-72 hours, most often 24-48 hours. Public health officials have reported incubation periods up to 26 days under rare circumstances.

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.

Laboratory Testing

Type of Lab Test/Timing of Specimen Collection

- Culture from lower respiratory tract*
- *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

**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.

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 not transmitted from person-to-person; thus, isolation of patients is unnecessary.

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 DISEASE IMPORTANT TO PUBLIC HEALTH?

Legionella has been recognized as a common cause of both community-acquired and hospital-acquired pneumonia since its first identification in 1976 during an outbreak at an American Legion Convention in Philadelphia. Legionellosis generally refers to two 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. It is associated with approximately 25% of healthcare-associated cases. In the United States, reported cases of Legionnaires' disease have grown by nearly four and a half times since 2000, with more than 6,000 cases of Legionnaires' disease reported in 2015. It is believed that this disease is under-recognized and underdiagnosed.

Although rare, Legionella bacteria may also present as an extra-pulmonary infection, e.g., wound, graft, and etc., infection from environmental contamination of surgical equipment or graft components with use of tap water.

✓ DISEASE AND EPIDEMIOLOGY

Legionellosis is associated with three distinct clinical syndromes, Legionnaires' disease, Pontiac fever and extra-pulmonary 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 and Pontiac fever are anorexia, 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. Extra-pulmonary *Legionella* may present with wound instability and drainage or serous fluid.

Causative Agent

Legionellosis is an acute bacterial disease caused by *Legionella* species. *L. pneumophila* is the most common species, which causes over 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, and serology.

- Culture of tracheal aspirates or bronchoscopy specimens is the most specific method, and assists 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 20–95%. Specimens from the lower respiratory tract will provide greater sensitivity than sputum.

- 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.
- Urinary antigen is a rapid test that is sensitive early in the infection, but as the infection progresses, sensitivity may drop (estimated sensitivity 65–95%). 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 due to other serogroups will not be detected.
- 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%, making this an unacceptable diagnostic test.
- DFA is 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.

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 of 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.

Case Fatality

Legionnaires' disease: Mortality rates are highly variable, ranging from 1−80%, depending on the underlying health of the patient, the promptness of specific therapy, 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 with severe underlying disease. The average fatality rate for sporadic disease is estimated to be about 10%−15%, and about 25% for healthcare-associated disease.

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.

- 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.
- *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 cultivatable.
- Also, *Legionella* bacteria readily form a biofilm on surfaces, which can reduce the effectiveness of disinfection procedures.

Transmission

Legionellosis is transmitted via the airborne route when aerosols are inhaled from a water source contaminated with *Legionella* bacteria, or through aspiration. There is anecdotal evidence that consuming contaminated water or ice may also lead to disease. Legionellosis is not known to be transmitted from person-to-person.

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.

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

Legionella is usually not transmitted from person-to-person, however, a single episode of person-to-person transmission has been reported.

Susceptibility

People at highest risk are over the age of 50 years, males, smokers or others with chronic respiratory diseases, diabetics, and people who are immunocompromised (such as corticosteroid use, cancer, transplants, etc.). Prior infection does not necessarily prevent re-infection.

Incubation Period

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

Period of Communicability

Legionellosis is not transmitted from person-to-person.

Epidemiology

Legionnaires' disease was named after an outbreak that occurred among people attending an annual convention of the American Legion in Philadelphia in 1976. Since then, *Legionella* has been recognized as a common cause of both community-acquired and hospital-acquired pneumonia. Legionellosis has a worldwide distribution. An estimated 8,000–18,000 people develop Legionnaires' disease in the U.S. each year; about 6,000 cases of Legionnaires' disease were reported in the U.S. in 2015. 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. Outbreaks usually occur in the summer and fall, though cases can occur year-round. 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-acquired pneumonia.

✓ PUBLIC HEALTH CONTROL MEASURES

Public Health Responsibility

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

Multiple cases – not healthcare-associated

- Three cases of *Legionella* in a 30-day period are considered 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 two healthcare-associated cases in a 6-month period.
- Meet with infection control practitioners and document steps that they are taking to resolve the issue.

Primary Prevention Strategy

Following efforts for primary prevention are as follows:

- Provide updates through the quarterly Utah Healthcare Infection Prevention (UHIP) Governance Committee.
- Perform Infection Control Assessment & Response (ICAR) audits with Utah facilities, including obtaining and reviewing the facilities' water management program (WMP).
- Provide memos, educational resources, and WMP surveys with feedback.

Vaccine

There is no vaccine available.

Isolation and Quarantine Requirements

Isolation: None
Hospital: None
Quarantine: None

✓ CASE INVESTIGATION

Reporting

Report any illness presenting with fever, myalgia, cough, *or* pneumonia to public health authorities that meets *any* of the following laboratory criteria:

- Isolation of any *Legionella* organisms from respiratory secretions, lung tissue, pleural fluid, other normally sterile fluid or extra-pulmonary site.
- Detection of *L. pneumophila* serogroup 1 antigen in urine.
- Fourfold or greater rise in specific serum antibody titer between acute and convalescent specimens to *L. pneumophila* serogroup 1.
- Fourfold or greater rise in antibody titer between acute and convalescent specimens 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 between acute and convalescent specimens to multiple species of *Legionella* using pooled antigen and validated reagents.
- Detection of specific *Legionella* antigen or staining of the organism in respiratory secretions, lung tissue, pleural fluid or extra-pulmonary site by direct fluorescent antibody (DFA).

- Detection of specific *Legionella* antigen or staining of the organism in respiratory secretions, lung tissue, pleural fluid or extra-pulmonary site by immunohistochemistry (IHC).
- Detection of *Legionella* species by a validated nucleic acid assay.

✓ Report any person whose healthcare record contains a diagnosis of legionellosis.
✓ Report any person whose death certificate lists legionellosis as a cause of death or a significant condition contributing to death.

Other recommended reporting procedures

- All cases of legionellosis (travel-associated and non-travel-associated) should be reported.
- Reporting should be ongoing and routine.
- *Frequency of reporting should follow the Utah Department of Health's routine schedule.*

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

Criterion	Reporting
Clinical Presentation	
Fever	O
Myalgia	O
Cough	O
Pneumonia	O
Healthcare record contains a diagnosis of legionellosis	S
Death certificate lists legionellosis as a cause of death or a significant condition contributing to death	S
Laboratory Findings	
Isolation of any *Legionella* organism from respiratory secretions, lung tissue, pleural fluid, or other normally sterile fluid	O
Detection of *L. pneumophila* serogroup 1 antigen in urine	O
Fourfold or greater rise in antibody titer between acute and convalescent specimens to *L. pneumophila* serogroup 1 using validated reagents	O
Fourfold or greater rise in antibody titer between acute and convalescent specimens to specific species or serogroups of *Legionella* other than *L. pneumophila* serogroup 1 (e.g., *L. micdadei*, *L. pneumophila* serogroup 6).	O
Fourfold or greater rise in antibody titer between acute and convalescent specimens to multiple species of *Legionella* using pooled antigen and validated reagents	O
Detection of specific *Legionella* antigen or staining of the organism in respiratory secretions, lung tissue, or pleural fluid by direct fluorescent antibody (DFA)	O

Detection of specific *Legionella* antigen or staining of the organism in respiratory secretions, lung tissue, or pleural fluid by immunohistochemistry (IHC)	O
Detection of *Legionella* species by a validated nucleic acid assay	O

Notes:
S = This criterion alone is sufficient to identify a case for reporting.
O = At least one of any "O" criteria in each category (e.g., clinical presentation and laboratory findings) is required to report a case.
(Source: CSTE Position Statement 09-ID-45)

Case Definition
Legionellosis (2020)

Clinical description

Legionellosis is associated with three clinically and epidemiologically distinct illnesses: Legionnaires' disease, which is characterized by fever, myalgia, cough, and clinical or radiographic pneumonia; and Pontiac fever, a milder illness without pneumonia. Extra-pulmonary legionellosis is rare and may present with wound instability and/or abnormal drainage.

Laboratory criteria for diagnosis

Suspect

- By seroconversion: 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).
- By seroconversion: fourfold or greater rise in antibody titer to multiple species of *Legionella* using pooled antigen and validated reagents.
- By the detection of specific *Legionella* antigen or staining of the organism in respiratory secretions, lung tissue, pleural fluid or extra-pulmonary site by direct fluorescent antibody (DFA) staining, immunohistochemistry (IHC), or other similar method, using validated reagents.

Confirmed

- By culture: isolation of any *Legionella* organism from respiratory secretions, lung tissue, pleural fluid, or extra-pulmonary site.
- By detection of *L. pneumophila* serogroup 1 antigen in urine using validated reagents.
- By seroconversion: fourfold or greater rise in specific serum antibody titer to *L. pneumophila* serogroup 1 using validated reagents.
- By detection of *Legionella* species from lower respiratory secretions, lung tissue, pleural fluid, or extrapulmonary site by a validated nucleic acid assay.

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

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)

Case classification

***Confirmed Legionnaires' disease (LD*)**: a clinically compatible case of LD that meets at least one of the confirmatory laboratory criteria.

Probable Legionnaires' disease: a clinically compatible case with an epidemiologic link during the 14 days before onset of symptoms.

Suspect Legionnaires' disease: a clinically compatible case that meets at least one of the presumptive (suspect) laboratory criteria.

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 extra-pulmonary site.

Suspect Extrapulmonary legionellosis (XPL): a clinically compatible case of XPL with supportive laboratory evidence of *Legionella* at an extra-pulmonary site.

Travel-associated Legionnaires' disease: a case that has a history of spending at least one night away from home (excluding healthcare settings) either in the same country of residence or abroad, in the 14 days before onset of illness.

Travel-associated Pontiac fever: 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

Presumptive healthcare-associated Legionnaires' disease (HA-LD): *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 HA-LD.

Not healthcare-associated Legionnaires' disease**:** a case that did not spend any time in a healthcare facility during the 14 days before onset of symptoms.

Classification Table

Table III. Criteria for defining a case of *Legionella.*

Criterion	Confirmed	Suspected
Clinical Presentation		
Fever	O	O
Myalgia	O	O
Cough	O	O
Pneumonia	O	O
Laboratory Findings		
Isolation of any *Legionella* organism from respiratory secretions, lung tissue, pleural fluid, or other normally sterile fluid	O	
Detection of *L. pneumophila* serogroup 1 antigen in urine	O	
Fourfold or greater rise in antibody titer between acute and convalescent specimens to *L. pneumophila* serogroup 1 using validated reagents	O	
Fourfold or greater rise in antibody titer between acute and convalescent specimens to specific species or serogroups of *Legionella* other than *L. pneumophila* serogroup 1 (e.g., *L. micdadei*, *L. pneumophila* serogroup 6)		O
Fourfold or greater rise in antibody titer between acute and convalescent specimens to multiple species of *Legionella* using pooled antigen and validated reagents		O
Detection of specific *Legionella* antigen or staining of the organism in respiratory secretions, lung tissue, or pleural fluid by direct fluorescent antibody (DFA)		O
Detection of specific *Legionella* antigen or staining of the organism in respiratory secretions, lung tissue, or pleural fluid by immunohistochemistry (IHC)		O

Detection of *Legionella* species by a validated nucleic acid assay (PCR)	O	
Epidemiological Risk Factors		
History of spending at least one night away from home, either in the same country of residence or abroad, in the fourteen days before onset of illness	C	C
History of healthcare exposure	C	C
Exposure to whirlpool spas	C	C
Recent repairs or maintenance work on domestic plumbing	C	C

Notes:
O = At least one of any "O" criteria in each category (e.g., clinical presentation and laboratory findings) in the same column is required to classify a case.
C = This finding corroborates (e.g., supports) the diagnosis of—or is associated with—legionellosis, but is not included in the case definition.

Case Investigation Process

- Complete investigation form.
- Within seven days of notification of legionellosis case, the investigating health department will ascertain whether the case-patient spent at least one night away from home in the 10 days before onset of illness.
- Identify whether case is healthcare-associated or travel-associated.
- If history of travel is present in the 14 days before onset of illness, the Utah Department of Health will, within seven 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.
- If there is no history of travel in the 14 days before onset of illness, the Utah Department of Health will complete the legionellosis case report and send to CDC within 30 days of notification.
- If there are epidemiologically-linked, travel-associated legionellosis cases, CDC will notify within one day, and work with state health departments to investigate further.

Outbreaks

An outbreak will be defined as:

- Two or more cases of nosocomial *Legionella* in a healthcare facility in any 6-month period.
- Three or more cases of *Legionella* (not healthcare-associated) identified with onset dates within a 30-day period.

Additional investigation measures (see Suggested Outbreak Activities) will be implemented during either of these situations. 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 Legionnaires' disease identified during a period of prospective surveillance for new cases.
- No detection of *Legionella* in samples collected during remediation water testing.

Outbreak Response Protocol (facilities)

The investigation team should include a wide range of stakeholders, including building engineering staff, infection preventionists, medical staff, epidemiologists, etc. Following is a list of suggested activities for outbreak investigation teams to consider. Although the list is a comprehensive list for use in a full *Legionella* outbreak investigation in a facility, it can be also adapted to investigate single cases of healthcare-associated LD, and not all activities listed may be relevant to every outbreak situation. These activities are also provided in a checklist format (see Appendix A).

- Perform case investigations on individual cases using the investigation form in UT-NEDSS/EpiTrax and verify that individual cases meet the case definitions for suspect and confirmed legionellosis.
- Determine if additional testing, e.g., 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 seven days of the initial notification if travel history is present, and within 30 days of notification for patients with no travel history.
- Obtain clinical samples for culture on any newly-identified cases or post-mortem specimens, when applicable. *L. pneumophila* bacterial 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* from environmental sources within a facility.
- Determine if there is an outbreak using the following criteria:
    - Two or more cases of nosocomial *Legionella* in a healthcare facility in any 6-month period.
    - Three or more cases of *Legionella* (not nosocomial) identified with onset dates within a 30-day period.
- Using the facility-centric module, look for additional earlier cases by performing a retrospective look back of cases in the EpiTrax surveillance database 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. 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 public health outbreak response plan.
    - Define outbreak by person, time and place.
    - Identify key stakeholders for the investigation team.
    - Define lead role, proposed steps, anticipated resources and roles and responsibilities.
    - Define local health department capacity and required level of involvement.

    - Define expectations/preferences for communication and frequency during investigation.
- Investigation coordination call/meeting with wider group of stakeholders, e.g., building engineering staff, infection preventionists, laboratory personnel, medical staff, environmental, epidemiologists etc. to review case line listing, formulate an action plan and to discuss 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 to the outbreak location for known outbreaks. There is a separate questionnaire to collect additional exposure data for cases associated with a cruise ship.
- Collect additional medical history information on case patients using the medical record extraction form.
- Implement temporary interim measures for facilities experiencing a potential potable water outbreak. These include, but are not limited to:
    - *the use of bottled water*
    - *restricting showers (sponge baths instead)*
    - *avoid exposure to hot tubs or hydrotherapy pools*
    - *closing the building*
    - *halting 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 new cases of pneumonia for *Legionella* by urinary antigen test.
- Review any environmental risks, recent plumbing work or repairs or recent construction projects.
- Review 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, e.g., 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 Lab 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 running WGS on clinical and/or environmental *Legionella* isolates.
- Perform contingency and corrective actions to water management program.
- Perform any remediation measures, e.g., 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, e.g., installing point-of-use filters on any shower heads or sink faucets.
- If water testing results continue to be out of control, consider more extensive engineering control interventions to incoming water such as copper-silver ionization systems.
- Schedule interim meetings or updates (as needed) to apprise all stakeholders of 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 Legionnaires' disease identified during a period of prospective surveillance for new cases.
    - No detection of *Legionella* 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) system.

*The approach to follow-up water sampling is dependent upon 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.

Identifying Case Contacts

Legionella is not transmissible from person-to-person.

- In the event of an outbreak with a known transmission source, identifying individuals at high risk is reasonable. High-risk patients are detailed in the “Susceptibility” section.

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. CDC encourages all buildings in healthcare facilities to develop comprehensive water management programs to reduce the risk of *Legionella* growth and spread. CDC has resources on their website to assist facilities with understanding facility’s water system and developing a water management plan.

https://www.cdc.gov/legionella/downloads/toolkit.pdf

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8. Specialty Labs; Use and Interpretation of Laboratory Tests.
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10. Guidelines for Preventing Health-Care-Associated Pneumonia, 2003: Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC).
11. Guidelines for Environmental Infection Control in Health-Care Facilities and Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC).
12. Johns Hopkins Point of Care Information Technology.
13. Salt Lake Valley Health Department Disease Investigation Plan.
14. Council for State and Territorial Epidemiologists (CSTE) Position statements. Available from URL: http://www.cste.org/default.asp?page=PositionStatements.
15. What Clinicians Need to Know about Legionnaires' Disease. Available at: https://www.cdc.gov/legionella/downloads/fs-legionella-clinicians.pdf.
16. Correia AM, Ferreira JS, Borges V, et al. Probable person-to-person transmission of Legionnaires' disease External. *N Engl J Med*. 2016;374:497–8.
17. Centers for Medicare and Medicaid Services CMS (2018) Requirement to Reduce *Legionella* Risk in Healthcare Facility Water Systems to Prevent Cases and Outbreaks of Legionnaires' Disease (LD). [Online] available from: https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/SurveyCertificationGenInfo/Downloads/QSO17-30-HospitalCAH-NH-REVISED-.pdf.

CDC Outbreak Resources and Worksheets

CDC Communications Tool for *Legionella*
https://www.cdc.gov/legionella/health-depts/communications-resources.html

CDC *Legionella* Environmental Assessment Form
https://www.cdc.gov/legionella/downloads/legionella-environmental-assessment.pdf

CDC Worksheet to Identify Buildings at Increased Risk for *Legionella* Growth and Spread https://www.cdc.gov/legionella/wmp/toolkit/wmp-risk.html

Council of State and Territorial Epidemiologists (CSTE) Position Statements

05-ID-01 Strengthening surveillance for travel-associated legionellosis and revised case definitions for legionellosis [Online] available from: https://cdn.ymaws.com/www.cste.org/resource/resmgr/PS/05-ID-01FINAL.pdf.

09-ID-45 Public Health Reporting and National Notification for Legionellosis [Online] available from: https://cdn.ymaws.com/www.cste.org/resource/resmgr/PS/09-ID-45.pdf.

19-ID-04 Revision to the Case Definition for National Legionellosis Surveillance [Online] available from: https://cdn.ymaws.com/www.cste.org/resource/resmgr/2019ps/final/19-ID-04_Legionellosis_final.pdf.

✓ VERSION CONTROL

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

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

V.12.17: Added “Critical Clinician Information” section, “Why is Disease Important to Public Health” section, and “UT-NEDSS 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).

✓ 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 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 apply to manual data entry, as well.

Test-Specific Rules

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

Test Type	Test Result	Create a New Event	Update an Existing Event
Antigen	Positive	Yes	Yes
	Negative	No	Yes
	Equivocal	Yes	Yes
Culture	Positive	Yes	Yes
	Negative	No	Yes
	Equivocal	Yes	Yes
IgM Antibody	Positive	Yes	Yes
	Negative	No	Yes
	Equivocal	No	Yes
PCR/amplification	Positive	Yes	Yes
	Negative	No	Yes
	Equivocal	No	Yes
Total Antibody (by EIA, IFA, TRF, etc.)	Positive	Yes	Yes
	Negative	No	Yes
	Equivocal	No	Yes
IgG Antibody	Positive	Yes	Yes
	Negative	No	Yes
	Equivocal	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 A: *Legionella* Outbreak Response Checklist

Following is a comprehensive list of suggested activities to be adapted for use in a full *Legionella* outbreak investigation in a facility. Not all activities listed may be relevant to every 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, e.g., urinary antigen test or culture is necessary to confirm a case of Legionnaires' Disease (LD).	Public health epidemiologists		
	Submit case report forms with risk factor information to the CDC within seven 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. *L. pneumophila* bacterial 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* 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: • Two or more cases of nosocomial *Legionella* in a healthcare facility in any 6-month period • Three or more cases of *Legionella* (not nosocomial) identified with onset dates within a 30-day period.	Public health epidemiologists		

	Look for additional earlier cases by performing a retrospective lookback of cases in the EpiTrax surveillance database with possible links to the same facility or geographic area.	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. Sample Line Listing to track Disease Outbreak Cases. Community and healthcare-associated outbreak line list: https://www.cdc.gov/legionella/downloads/line-list-community.xlsx	Public health epidemiologists		
	Set up an internal meeting/coordination call with state and local health departments to formulate and coordinate public health outbreak response plan. Complete the HAI Investigation Planning Agenda Template to: • Define outbreak by person, time and place. • Identify key stakeholders for the investigation team. • Define lead role, proposed steps, anticipated resources and roles and responsibilities. • Define local health department capacity and required level of involvement. • 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 stakeholders, e.g., building engineering staff, infection preventionists, laboratory personnel, medical staff, environmental, epidemiologists, etc., to review case line listing, formulate an action plan and to discuss temporary interim measures for facilities experiencing a potential potable water outbreak.	Facility medical and engineering staff, laboratory personnel, state and local epidemiologists, environmental epidemiologists, facility corporate officials, etc.		

	Consider using the extended hypothesis-generating questionnaire to collect additional exposure information or customizing a more detailed questionnaire to the outbreak location for known outbreaks. https://www.cdc.gov/legionella/downloads/template-hypothesis-generating-questionnaire-508.pdf Use the following form to collect additional exposure data for cases associated with a cruise ship: https://www.cdc.gov/legionella/downloads/template-cruise-ship-questionnaire.pdf	Public health epidemiologists		
	Collect additional medical history information on case patients using the medical record extraction form. https://www.cdc.gov/legionella/downloads/template-medical-abstraction-template.pdf	Public health epidemiologists		
	Implement temporary interim measures for facilities experiencing a potential potable water outbreak. These include, but are not limited to: • the use of bottled water • restricting showers (sponge baths instead) • avoid exposure to hot tubs or hydrotherapy pools • closing the building • halting 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. https://www.cdc.gov/legionella/health-depts/communications-resources.html	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* by urinary antigen test.	Facility medical staff		
	Review any environmental risks, recent plumbing work or repairs or recent construction projects.	Environmental team		
	Review building water system and management plan and identify any deficiencies or potential stagnation points.	Environmental team		

	Complete the Worksheet to Identify Buildings at Increased Risk for *Legionella* Growth and Spread. https://www.cdc.gov/legionella/wmp/toolkit/wmp-risk.html	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. https://www.cdc.gov/legionella/downloads/legionella-environmental-assessment.pdf	Environmental team, facility building and maintenance engineers		
	Gather available epidemiologic information, e.g., 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. *The approach to follow-up water sampling is dependent upon the specific circumstances of the outbreak. One widely-used approach, outlined in HICPAC Guidance (https://www.cdc.gov/infectioncontrol/pdf/guidelines/healthcare-associated-pneumonia-H.pdf) 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' Disease Laboratory Response Plan to streamline operations.	UPHL		

	https://www.cdc.gov/legionella/downloads/labtoolkit.pdf			
	Consider running WGS on clinical and/or environmental *Legionella* isolates.	Public health epidemiologists, environmental team, UPHL		
	Perform contingency and corrective actions to water management program.	Environmental public health team, facility building and maintenance engineers		
	Perform any remediation measures, e.g., 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, e.g., installing point-of-use filters on any shower heads or sink faucets.	Environmental public health team, facility building and maintenance engineers		
	If water testing results continue to be out of control, consider more extensive engineering control interventions to incoming water such as copper-silver ionization systems.	Facility building and maintenance engineers, corporate staff		
	Schedule interim meetings or updates (as needed) to apprise all stakeholders 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: • No new cases of Legionnaires' disease identified during a period of prospective surveillance for new cases • No detection of *Legionella* in samples collected during remediation water testing • An effective water management program is in place.	Public health epidemiologists, environmental team		

	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		