MDHHS Legionellosis Surveillance and Outbreak Protocol

Note:

While this document is currently finalized, changes driven by national programs are anticipated in the near future. These changes include the provision of risk communications strategies and recommendations. This document will be updated as those become available.

Version 3.1

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Part I:

Legionellosis Overview and Surveillance Protocol

Legionellosis Overview

Occurrence

An estimated 8,000 to 18,000 cases of Legionnaires' disease are hospitalized each year in the United States. In general, the number of cases reported has been on the rise over the past decade. This may reflect a true increase in the frequency of disease due to several factors (e.g., older U.S. population, more at-risk individuals, aging plumbing infrastructure, climate). It may also be a result of increased use of diagnostic testing or more reliable reporting. Cases may occur throughout the year but are more common in the summer and fall. Warmer temperatures and increases in precipitation are associated with an increase in cases. The rate of reported Legionnaires' disease cases in the U.S. tends to be higher in the Mid-Atlantic and Northeastern Central regions than in the south and west.

Clinical Description

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 by 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. Clinical symptoms of pneumonia may vary but must include acute onset of lower respiratory illness with fever and/or cough. Additional symptoms could include myalgia, shortness of breath, headache, malaise, chest discomfort, confusion, nausea, diarrhea, or abdominal pain.
- **Pontiac fever (PF):** a milder illness without pneumonia (must include acute symptom onset of one or more of the following: fever, chills, myalgia, headaches, fatigue, nausea and/or vomiting).
- **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.

Causative Agent

Legionellae species are Gram-negative, non-spore-forming, rod-shaped, aerobic bacilli. There are over 50 species within the family Legionellaceae; species *Legionella pneumophila* serogroup 1 is most commonly associated with disease. Other types of *Legionella* (e.g., *micdadei, bozemanii, longbeachae, dumoffi,* etc.) have been isolated primarily from immunosuppressed patients.

Reservoir

Legionellosis is a waterborne disease. Human-made building water systems and devices that aerosolize water, such as potable water systems, cooling towers, whirlpool spas, and decorative fountains, are the common sources for transmission. Conditions that are favorable to *Legionella* growth include warm water temperatures, stagnation, scale and sediment, and low biocide levels.

Incubation Period

Legionnaires' disease

The incubation period for LD is most commonly 2-14 days, with an average of 5-6 days. Therefore, exposure history data should be collected for the 14 days prior to illness onset. This recommendation is based on observations that most cases have illness onset within 10 days of exposure, but up to 16% of cases have onset more than 10 days after exposure. 99% of cases have illness onset within 14 days of exposure.

Pontiac Fever

The incubation period for Pontiac fever is most commonly 1-3 days. Therefore, exposure history data should be collected for the 3 days prior to illness onset.

Transmission

People are exposed to *Legionella* when they breathe in a mist or vapor (small droplets of water in the air) containing the bacteria. Less commonly, *Legionella* can be spread via aspiration of drinking water into the trachea (windpipe) and lungs instead of down the digestive tract. People at increased risk of aspiration include those with swallowing difficulties. In general, *Legionella* does not spread from one person to another.

At low levels of contamination, most healthy people will not develop illness when they are exposed to the *Legionella* bacteria, or they may develop the milder form of illness, Pontiac fever.

High-Risk Groups

Most healthy people do not become infected with *Legionella* after an exposure. Risk factors for developing Legionnaires' disease include:

- Age >50 years
- Smoking (current or former)
- Chronic lung disease, such as emphysema or COPD
- Immune system disorders due to disease or medication
- Systemic malignancy
- Underlying illness, such as diabetes, renal failure, or hepatic failure

Legionellosis Case Definition (CDC/CSTE 2019)

Laboratory Criteria for Diagnosis

Confirmatory Laboratory Evidence

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

Supportive Laboratory Evidence

- 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, or pleural fluid by direct fluorescent antibody (DFA) staining, immunohistochemistry (IHC), or other similar method, using validated reagents.

The preferred diagnostic tests for Legionnaires' disease are culture of lower respiratory secretions (e.g., sputum, bronchoalveolar lavage) on selective media (Buffered Charcoal Yeast Extract) and the *Legionella* urinary antigen test collected concurrently.

Most cases are identified by urinary antigen testing, not culture. Urinary antigen tests are specific for *L. pneumophila* serogroup 1, which causes the most illness. However, urinary antigen tests will be negative if the person is infected with another species or serogroup (non-*pneumophila* serogroup 1) of *Legionella*. Lower respiratory specimen cultures are vital for linking a case to a potential environmental source, particularly in outbreak settings. Outbreak investigations of Legionnaires' disease rely on both clinical and environmental culture isolates when looking for source exposures.

A single serum antibody titer (acute draw during illness, no convalescent draw) is not diagnostic for legionellosis. Studies have found up to 30% of healthy individuals may have elevated Ig titers for *Legionella*. Furthermore, underlying medical conditions or immunosuppression may prevent a 4-fold increase in titer from occurring. Per CDC clinical guidance, serological assays can be nonspecific and are not recommended in most situations. If a single serum antibody titer is reported to the local health jurisdiction, ask healthcare providers to obtain a urinary antigen test and lower-respiratory specimen for culture (if the case-patient has not been on antibiotics for an extended period).

For more information and on diagnosis, testing, and additional clinical guidance, please consult with MDHHS Legionellosis subject matter experts.

Case Classification

Confirmed: a clinically compatible case with confirmatory laboratory evidence for *Legionella*.

Probable: A clinically compatible case with an epidemiologic link during the 14 days before onset of symptoms for LD, or 3 days before onset of symptoms for PF.

Suspect: a clinically compatible case with supportive laboratory evidence for *Legionella*.

Travel-associated:

- ***Travel-associated LD:*** A case of LD 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 PF:*** A case of PF 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 LD:** A case with ≥10 days of continuous stay at a healthcare facility during the 14 days before onset of symptoms.
- **Possible healthcare-associated LD:** 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.

Reporting and Investigation Responsibilities

Per the Michigan Public Health Code MCL 333.2261, physicians and laboratories are required to report suspect or confirmed cases of legionellosis to the appropriate local health jurisdiction (LHJ) within 24 hours of diagnosis or discovery.

Within 24 hours of receiving a report, the LHJ will enter the case lab information into the Michigan Disease Surveillance System (MDSS) (if not already entered by the laboratory or physician) and begin case follow-up. The LHJ will complete the disease-specific Legionellosis form in MDSS.

Additionally, MDHHS requests that all clinical isolates—and environmental isolates obtained during an outbreak investigation—be sent to the MDHHS Bureau of Laboratories for whole genome sequencing (WGS). If a contractor or consultant is utilized for environmental sampling during an outbreak investigation, a special request from the LHJ to obtain these isolates may be required.

MDHHS Surveillance

MDHHS staff review cases reported into MDSS monthly. If a reported case has been in the MDSS for more than 30 days since referral and has had no follow-up (i.e., still marked as new), MDHHS will contact the LHJ.

In addition to on-going LHJ case investigation/monitoring, MDHHS staff will review reported cases in the MDSS monthly for common exposures prior to illness onset, such as, any out-of-state travel or hospitalizations in the 14 days prior to onset.

- ***Travel-associated cases***—If the case has out-of-state travel overnight to a public place reported by the LHJ, MDHHS Legionellosis subject matter experts will report the case to the Centers for Disease Control and Prevention (CDC) at travellegionella@cdc.gov. People staying at private residences are not reported to CDC. An exception is made for individuals with overnight stay at a public rental home, such as an AirBnB. Notification to CDC should include basic demographics, onset date, lab testing results, hospitalization status, if the person survived or died, where the person traveled (city, state, name of accommodations and address if available), dates of travel and dates of stay in the accommodations, details of the travel (what they did, any exposure to pools, showers, decorative fountains, hot tubs, lakes, etc.), and any information on underlying conditions that may have made the person more susceptible to infection.

- ***Healthcare-associated cases***—A full investigation by the LHJ should be performed when (1) one case of presumptive healthcare-associated Legionnaires' disease is identified; or (2) when two or more cases of possible healthcare-associated Legionnaires' disease are identified within 12 months of each other. If an outbreak investigation is initiated at a healthcare facility, MDHHS Legionellosis subject matter experts will notify the Environmental Health and Safety Section Manager at LARA.

Case Investigation (Local Health Surveillance)

Sporadic Cases

Case investigation is undertaken by the LHJ where the ill individual resides. MDHHS recommends the following investigation steps at the LHJ level:

- Enter the case with lab information into MDSS within 24 hours of notification if not already entered by provider or lab.
- Contact the diagnosing hospital ICP or physician to:
    - Verify that the diagnosis meets the case definition (meets confirmed or suspect clinical AND laboratory criteria)

- Verify and record the illness onset date. An accurate illness onset date is important for the determination of the patient's potential environmental exposures. In certain circumstances, the LHJ medical director, attending physicians, and MDHHS may be consulted to determine an appropriate onset date.
- Collect any additional information about the clinical course of illness.
- Recommend additional testing, as needed (e.g., if serology is done, a convalescent serum must be drawn 2-4 weeks after the initial acute drawn).
- Request a respiratory culture be performed on *Legionella*-specific media. If the hospital lab is uncertain about their capability or unable to perform the culture, the clinical respiratory specimen may be sent to the MDHHS Bureau of Laboratories for culture.
- If a culture has already been performed by the hospital, any *Legionella* isolates should be forwarded to the MDHHS State Laboratory.
- Note discharge date and outcome; if case still hospitalized, check back with hospital until discharge.
- Verify whether the case was previously hospitalized, in a long-term care facility, or had other healthcare exposure during the 14 days prior to onset (if missing or as needed).
- LHJs with a high burden of legionellosis or an LHJ experiencing an increase in cases from baseline should consider completing the "Supplementary Epidemiologic Information" tab on the case report form in the MDSS to assist in identifying potential common exposures among cases.

- Conduct an interview as quickly as possible with the case or proxy (family member or designee if the patient is too ill to complete an interview) and enter data into the MDSS record. Interviews should be completed and entered in MDSS within one week. Specific guidance to complete the case report form can be found at the CDC's webpage for surveillance and reporting resources for health departments.

    - If case is still hospitalized, close case as Completed-Follow-up. Complete when discharged to capture outcome and verify incubation period exposure history. Update MDSS record. Upload any medical records as attachments in the MDSS Notes section.

Healthcare-Associated Cases

The LHJ should monitor cases for common healthcare facility exposures in the 14 days prior to illness onset. A full investigation by the LHJ should be performed when (1) one case of presumptive healthcare-associated Legionnaires' disease is identified; or (2) when two or more cases of possible healthcare-associated Legionnaires' disease are identified within 12 months of each other at a single facility.

If one case of possible healthcare-associated Legionnaires' disease is identified and there are no known additional exposures by other cases to the health care facility within the past year (that resulted in notification by local or state public health), a notification to the healthcare facility is warranted. MDHHS Legionellosis subject matter experts have a letter template that can be provided to the LHJ for completion, if requested. Additional CDC communication resources including notification letter templates, fact sheets, press releases, and sample health advisories can be found at https://www.cdc.gov/legionella/health-depts/communications-resources.html.

Suspected Outbreak or Increase in Cases

An outbreak is defined as two or more cases who have been exposed to the same hospital, long-term care facility, hotel, or job site, for example, at about the same time.[1] All LHJs should follow an outbreak response protocol and a suspected outbreak should be reported within 24 hours of detection to MDHHS (Regional Epidemiologist or MDHHS Legionellosis subject matter experts). If an LHJ is seeing an increase in reported cases from baseline levels, the "Supplementary Epidemiologic Information" tab in the case report form in MDSS can be used to collect additional information on potential common exposures. If there is a marked increase in cases in a county, MDHHS recommends the LHJ notify providers in their area (via the Michigan Health Alert Network (HAN) and blast fax) to emphasize the collection of accurate onset dates along with *Legionella*-specific culture specimens concurrently with a urine antigen test. A positive *Legionella* culture is necessary to perform WGS testing and may be used to potentially link clinical and environmental specimens in identifying the likely source of an infection.

[1]The timeframe for defining an outbreak may vary depending upon circumstances. MDHHS and the CDC define outbreaks associated with:

- *Travel*
- *Healthcare*
- *Potable and non-potable water systems in other buildings at increased risk for Legionella growth and transmission as two or more cases associated with the same possible source during a 12-month period. This definition increases sensitivity of outbreak detection, especially for outbreaks involving potable water, and helps account for periodic changes in risk (i.e., due to seasonality).*
    - *Under certain circumstances, the timeframe under consideration may be shorter, such as cooling tower outbreaks, which tend to be more explosive and of shorter duration (e.g., 3 months).*

Determine the jurisdictional lead for the outbreak

i. **Localized jurisdiction outbreaks** (for example, involving 1-2 LHJ) - These are typically point source events or otherwise contained (small-to-moderate) numbers of cases associated with a common water exposure.

Lead Agency

- The LHJ in whose jurisdiction the outbreak is occurring (where the suspected exposure is located) takes the lead role in the investigation. As all outbreaks are reportable, the outbreak should be reported to MDHHS and an initial draft of the NORS Waterborne form should be completed by the LHJ where the suspect exposure occured within 60 days of the first onset of illness. Additional case information may need to be collected from partner LHJs. The NORS Waterborne form must be finalized and submitted at the conclusion of the investigation. The NORS Waterborne (CDC 52.12 form) and guidance can be found at https://www.cdc.gov/nors/forms.html.
- Perform epidemiologic investigation.
- Perform environmental investigations as indicated by epidemiologic information.
- Develop and distribute public messaging regarding identified outbreak.

Role of MDHHS

- MDHHS provides specific technical support and resources to LHJs but does not assume lead role in the investigation.
- When notified by an LHJ that a local outbreak is identified or suspected, MDHHS staff will provide technical consultation and recommendations (if requested) to the LHJ but will not act as a consultant for the facility under investigation.
- Ongoing information sharing and follow-up communications with the LHJ are sought and encouraged by MDHHS staff for outbreak monitoring, coordination of specimen collection and testing, and the associated control actions taken by the LHJ. Additional assistance or guidance, including some of the steps listed below for more complex outbreaks, may be necessary on a situational basis.

- Review laboratory status of each case to determine whether all laboratory-confirmed cases have applicable specimens forwarded to the MDHHS Bureau of Laboratories for further analyses and characterization. Coordinate with the LHJ and MDHHS Bureau of Laboratories to contact clinical or reference laboratories and facilitate shipping of any needed specimens. For cases that are not laboratory confirmed, assess feasibility and options for testing.
- Review WGS data as applicable. Provide epidemiologic and subject matter expertise regarding Legionellosis, such as baseline frequency, seasonal fluctuations in occurrence, natural reservoirs or known sources, information regarding historical outbreak associations, and other relevant information that may guide the initial investigation. Share information with LHJ investigation partners.
- If additional input is needed, contact subject matter experts at the CDC Legionellosis Surveillance & Outbreak Response NCIRD/DBD/Respiratory Diseases Branch.

ii. Outbreaks requiring joint investigation with MDHHS support (exceeding the resources of regional LHJs). These outbreaks include moderate or substantial numbers of cases in ≥ 2 jurisdictions, or alternatively an outbreak with cases within one community, but the exposure occurred outside of that local jurisdiction (i.e., ill persons residing in one LHJ, but exposure in another). These scenarios may necessitate a comprehensive supporting, but ***non-leading,*** role by MDHHS.

Lead Agency/Agencies

- Generally co-led by 1–2 LHJs where the outbreak is initially centered and/or where the exposure has occurred. Primary LHJ lead is generally where the suspected exposure occurred.
- As all outbreaks are reportable, the outbreak should be reported to MDHHS and an initial draft of the NORS Waterborne form should be completed by the LHJ where the suspect exposure occurred within 60 days of the first onset of illness. The NORS Waterborne form must be finalized and submitted at the conclusion of the investigation. The NORS Waterborne (CDC 52.12 form) and guidance can be found at https://www.cdc.gov/nors/forms.html.
- Perform epidemiologic investigation.

- Perform environmental investigations as indicated by epidemiologic information.
- Develop and distribute public messaging regarding identified outbreak.

Role of MDHHS

- MDHHS provides specific technical support and resources to LHJs but does not assume lead role in the investigation.
- This may transition to include a joint lead with MDHHS if the situation becomes more extensive, or at the request of the LHJs involved.
- Upon request, MDHHS will host an initial conference call or meeting with the LHJ agencies involved to share available information and to collaboratively determine the next steps and which agencies will be responsible for each action. A schedule of additional calls (if needed) can be decided during the initial call along with which agency will host and coordinate the subsequent call(s).
- Liaise with other partners to coordinate interagency communication and share pertinent information.
- Assist with review and analysis of collected data as requested by the LHJs involved.
- The role of the MDHHS Regional Epidemiologists include: (1) helping to assess which LHJs may request or need assistance with timely case follow-ups and questionnaire administration, (2) providing necessary assistance and resources as part of the MDHHS response, and (3) creating an outbreak identifier in the MDSS for all cases identified during an outbreak.
- Review laboratory status of each case to determine whether all laboratory-confirmed cases have applicable specimens forwarded to the MDHHS Bureau of Laboratories for further analyses and characterization. Coordinate with the LHJ and MDHHS Bureau of Laboratories to contact clinical or reference laboratories and facilitate shipping of any needed specimens. For cases that are not laboratory confirmed, assess feasibility and options for testing.
- Review WGS data as applicable. Provide epidemiologic and subject matter expertise regarding Legionellosis, such as baseline frequency, seasonal fluctuations in occurrence, natural reservoirs or known sources, information regarding historical outbreak associations, and other relevant information that

may guide the initial investigation. Share information with investigation partners.

- If additional input is needed, contact subject matter experts at the CDC Legionellosis Surveillance & Outbreak Response NCIRD/DBD/Respiratory Diseases Branch.

See additional steps under **Widespread: Multijurisdictional/Multistate outbreaks**, which may apply depending on the outbreak scenario.

iii. Widespread: Multi-regional/Multi-state outbreaks (requiring multilevel coordination)

Lead Agency

- The MDHHS may assume the lead role in overseeing and coordinating the epidemiologic investigation among multiple Michigan LHJs.

Role of MDHHS

- Per agreement between all involved LHJs, MDHHS can arrange and lead outbreak conference calls with the participating investigation teams, as needed (e.g., LHJs, healthcare facilities).
- Work with LHJ investigative partners to expand surveillance for additional cases by conducting the following steps: a) enhanced or targeted review of the existing Surveillance Systems; b) issue interagency, medical community, and public notifications to stimulate reporting of potentially related cases; and c) triage calls from the lay public about compatible illnesses that may be linked to the outbreak.
- Review laboratory status of each case to determine whether all laboratory-confirmed cases have applicable specimens forwarded to the MDHHS Bureau of Laboratories for further analyses and characterization. Coordinate with the LHJ and MDHHS Bureau of Laboratories to contact clinical or reference laboratories and facilitate shipping of any needed specimens. For cases that are not laboratory confirmed, assess feasibility and options for testing.
- Review WGS data as applicable. Provide epidemiologic and subject matter expertise regarding Legionellosis, such as baseline frequency, seasonal fluctuations in occurrence, natural reservoirs or known sources, information

regarding historical outbreak associations, and other relevant information that may guide the initial investigation. Share information with investigation partners and medical community.

- Develop case definition(s). For laboratory-confirmed outbreaks, include outbreak strain characteristics such as pathogen typing and molecular subtyping in the case definition algorithm.
- Work with LHJs to develop a working outbreak hypothesis based on information collected, and update/revise with new information as needed.
- Establish an "outbreak identifier" used in the MDSS record for each case matching the case definition. This identifier code will typically be the WGS pattern designation or name of the suspected source.
- Develop and implement investigative tools and methods as needed. These typically involve use of an outbreak-specific questionnaire. Disseminate the tools to the investigative team(s) in each agency.
- Assist LHJs with interviews and case investigations upon request and as resources allow. Verify that completed outbreak and supplemental questionnaires have been uploaded to the MDSS. MDHHS will contact LHJ regarding any cases without an uploaded supplemental questionnaire within three business days of MDSS case report.
- As appropriate, notify subject matter experts at the CDC Legionellosis Surveillance & Outbreak Response NCIRD/DBD/Respiratory Diseases Branch.
- For multijurisdictional outbreaks with coordination needs, outbreak investigation materials may be posted to a dedicated HAN folder [Documents/Local Health/CD Investigations/Name of outbreak] for easy access for LHJ investigators (communicable disease nurses, Health Officers, Medical Directors, and Emergency Preparedness Coordinators). The materials will include the outbreak questionnaire, a listing of outbreak-related cases reported by jurisdiction, and an aggregate outbreak summary. An epi curve and map may also be provided.
- Work with Regional Epidemiologist network to assess which LHJs may request or need assistance with timely case follow-ups and questionnaire administration.
- Coordinate data collection, analyze case questionnaire data, and summarize relevant findings. Share findings among stakeholders.

- Prepare updates for MDHHS Administration and Public Information Officer, as needed, and coordinate messaging with other investigative partners (CDC, LHJs, healthcare facilities, hotels).

General Control and Prevention Measures

The risk of *Legionella* infection can be reduced through implementation of control measures to reduce the risk of *Legionella* amplification and exposure from building water systems. High-risk facilities or buildings with high-risk devices should develop and utilize water management programs to reduce the risk of *Legionella* colonization and transmission within their facilities*.

High-risk facilities:

- Healthcare facilities where patients stay overnight or treat people with chronic and/or acute medical problems or weakened immune systems.
- Buildings that house people older than 65 years (retirement home/senior living or assisted-living).
- Building with multiple housing units and a centralized hot water system (like a hotel or high-rise apartment complex).
- Building with more than 10 stories—including basement levels.

High-risk devices:

- Cooling towers
- Hot tub or spa that is not drained between each use
- Decorative Fountains
- Centrally-installed mister, atomizer, air washer, or humidifiers
- Ice Machines

**In June 2017, the Centers for Medicare & Medicaid Services released memorandum QSO17-17-30. The memorandum required hospitals, critical access hospitals, and long-term care facilities to develop and adhere to policies and procedures that inhibit microbial growth in building water systems that reduce the risk and growth and spread of Legionella and other opportunistic pathogens in water.*

PreventLD – Water Management Program Training

CDC and partners created an online water management program training to align with industry standards (ASHRAE 188) on managing risk for *Legionella*. The training was designed to appeal to public health professionals (including infection preventionists), building managers, maintenance/engineering staff, safety officers, equipment and water treatment suppliers, and consultants. In general, PreventLD Training:

- Outlines how to reduce risk for Legionella in facilities
- Helps water management programs align with ASHRAE 188 on reducing risk in potable water, cooling towers, hot tubs, and decorative water features
- Is free and available online—continuing education units are available from the National Environmental Health Association (NEHA)
- Helps build common language between all professionals engaged in water management
- Includes case studies, templets, and other practical resources.

Additional water management resources that address building water system risks can be found at: https://www.cdc.gov/legionella/wmp/index.html or **Appendix B**.

Environmental Samples for Testing

Legionella bacteria are commonly isolated from all types of natural water sources, but these sources are typically not implicated in direct transmission. The amplification and aerosolization of *Legionella* bacteria occur in human-made building water systems. Collection of environmental samples from these building water systems is important to understand the quality of the water being supplied by those water systems. Additionally, environmental water isolates are used to compare with clinical specimen isolates utilizing Whole Genome Sequencing. These comparisons are conducted to determine possible building water system exposures that the case(s) may have had. Without clinical specimen isolates from case-patients it is difficult to implicate a building water system's water as a source of infection for any case-patient. With the coordination of MDHHS Legionellosis subject matter experts, an outbreak requires that the respective LHJ where the suspected exposure occurred collect environmental water samples for culturing and characterization at MDHHS Bureau of Laboratories (BOL). Environmental water samples should be collected after an appropriate epidemiologic assessment, environmental assessment, and environmental sampling plan have been completed.

MDHHS cannot recommend specific private laboratories to perform environmental testing at citizens' residences. MDHHS advises individuals that there are private environmental labs that can perform this testing for a fee. The individuals should be educated that Legionella bacteria are common in water environments at low levels. The potential for transmission of legionellosis infections depends on the strain of bacteria, level of bacterial contamination (CFUs), mode of transmission, and any underlying health conditions that may make an individual more susceptible. Larger building water systems are more likely to be colonized, amplify, and transmit the bacteria causing infections than single-family residences. The CDC maintains a website with ELITE certified laboratories in the United States that have demonstrated proficiency in the isolation of *Legionella*. ELITE certified laboratories can be found at: https://wwwn.cdc.gov/elite/Public/EliteHome.aspx

For more direction that discusses environmental water sampling during an investigation or outbreak, please see guidance from Part II: Investigation and Outbreak Protocol below.

Part II:

Investigation and Outbreak Protocol

Purpose

The following protocol was created as a reference for local health during a legionellosis investigation or outbreak. Be aware that each legionellosis investigation or outbreak is unique and can differ in approach depending on the facility and population affected. Many of the steps in this document may be completed by routine surveillance. Depending on the size of the facility, it may be appropriate for a facility to hire a consultant while the local health jurisdiction supervises testing and implementation of legionellosis prevention strategies. Please refer to the CDC's Considerations When Working with Legionella Consultants for choosing a consultant with the proper expertise.

What Warrants a Public Health Investigation?

The Centers for Disease Control and Prevention (CDC) and MDHHS recommends the local health jurisdiction perform a full investigation into the source of *Legionella* exposure upon identification of:

- ≥1 case of presumptive healthcare-associated Legionnaires' disease.
- ≥2 cases of possible healthcare-associated Legionnaires' disease associated with one facility within **12 months**.
- ≥2 cases reporting exposure 14 days prior to illness onset to a high-risk facility[1] and/or device[2] within **12 months***.

***Note: under certain circumstances, the timeframe under consideration may be shorter, such as during cooling tower outbreaks, which tend to be more explosive and of shorter duration (e.g., 3 months).**

[1] **High-risk facilities:** buildings that primarily house people older than 65 years (Senior/Assisted Living), have multiple housing units and a centralized hot water system (hotel or high-rise apartment complex), and/or have more than 10 stories (including basement levels).

[2] **High-risk devices**: hot tub that is not drained between each use, decorative fountain, cooling tower, centrally installed mister, atomizer, air washer, or humidifiers.

Healthcare-associated Legionnaires' disease is defined as:

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

Please note that available epidemiologic evidence may not warrant a full investigation after a possible healthcare-associated legionellosis case has been identified. However, the local health jurisdiction may consider—or have the healthcare facility staff consider—conducting an environmental assessment (see section below) to determine if conditions exist for *Legionella* growth and transmission in the facility's building water system.

Steps Involved in a Full Investigation

Once the local health jurisdiction determines that a full investigation is warranted, the LHJ should:

- Develop a line list of possible cases associated with the facility within the past year (and current potential exposures in the facility).
- Request a copy of the facility's Water Management Program (WMP), including water parameter logs (pH, temperature, biocide levels) and environmental sampling results. For non-healthcare facilities without a WMP, provide the facility a copy of, or link to, the CDC Water Management Program Toolkit and ASHRAE 188-2018. Additionally, MDHHS can provide a water management program template if desired.
- Consider recommendations for restricting water exposures in the facility (e.g., use of bottled water, sponge baths instead of showering, removing aerators from sinks, installation of point-of-use filters, etc.)
- Facilitate the completion of an environmental assessment and analyze epidemiological interviews for information that can be used to evaluate possible environmental exposures.
- Facilitate environmental sampling if supported by environmental and epidemiological assessments.
- If remediation is indicated, direct facilities management to contact an environmental consultant and/or *Legionella* remediation expert.
- Develop a risk communications plan (e.g., HAN, press release, and/or patient, staff and family notification).
- Determine how long enhanced disease surveillance and environmental sampling should continue.
- Work with the facility staff to review and possibly revise the water management program.
- Follow up with the facility to assess the effectiveness of implemented control measures.

Healthcare-Associated Considerations:

- Initiate active prospective surveillance for 6 months after last case onset of symptoms, testing all patients with healthcare-associated pneumonia using **both** culture of lower respiratory secretion on *Legionella* specific media (BCYE) and the *Legionella* urinary antigen test.
- Work with the healthcare facility staff to identify all new and recent (patients with exposure to a healthcare facility within 14 days or develop pneumonia ≥48 hours after admission) with possible healthcare-associated pneumonia and test them for *Legionella* using both culture of lower respiratory secretions on *Legionella* specific media and the *Legionella* urinary antigen test concurrently.

Drinking Water Control Measures

If the local health jurisdiction believes a healthcare facility's internal potable water system is a source of *Legionella* transmission, implementation of water restrictions and/or installation of 0.2µm (micron) point-of-use (POU) filters by the facility should be considered immediately. Water control measures should take into consideration the structural characteristics of the building. Water restrictions and point-of-use filters do not remove the need for remediation actions to address the growth and amplification of *Legionella* bacteria in a facility's building water systems.

Examples of Water Restrictions and Control Measures

- Restrict the use of showers and whirlpools tubs/hot tubs (use sponge baths)
- Bottled water restrictions for individuals with swallowing difficulty—including no ice from ice machines
- Remove aerators from sink faucets or avoid use of water from sink faucets to avoid creating aerosols
- For immunocompromised patients, using sterile water for tooth brushing, drinking, and flushing feeding tubes; for other susceptible patients, using bottled water
- For patients with swallowing difficulties, restrict the use of ice machines and non-sterile ice consumption
- Confirm that contingency responses and corrective actions are implemented according to the facility's water management program
- Shut down decorative fountains or other sources of aerosolization
- Install 0.2µ POU water filters and replace them according to the manufacturer's recommendations.

Note: In healthcare settings, sterile water should be used to fill reservoirs of respiratory equipment intended for nebulization/aerosolization under all circumstances (not just during an outbreak).

Environmental Assessment

The purpose of conducting an environmental assessment is to gain a thorough understanding of a facility's building water systems and to assist facility management with minimizing the risk of legionellosis. The assessment can be used along with epidemiologic information to determine whether to conduct *Legionella* environmental sampling and to develop a sampling plan. An environmental assessment includes visual inspections and monitoring of water quality parameters (e.g., water temperature, pH, residual disinfectant) and should be conducted by individuals with experience in environmental health, water management, and/or conducting *Legionella* assessments.

Before arriving on site, the LHJ should make the following requests of the facility:

- Request the attendance of the lead facility manager as well as others who have a detailed knowledge of the facility's water systems, such as facility engineer or industrial hygienist.
- Request that they have maintenance, and cooling tower water treatment logs in addition to plumbing blueprints available for the meeting.
- Bring a plastic bottle, thermometer, pH test kit, and a chlorine test kit that can detect a wide range of residual disinfectant (<1 for potable water and up to 10 ppm for whirlpool spas)
- If the epidemiologic information available suggests a particular source (e.g., whirlpool spa, cooling tower) request that they shut it down for use and secure the blowers/fans from use (but do not drain or disinfect) to prevent transmission.

The following environmental assessment tools and videos are available from the Centers for Disease Control and Prevention to assist in the environmental assessment component of legionellosis disease outbreak investigations:

- Conducting and Interpreting the Environmental Assessment
  Learn how to conduct an environmental assessment and interpret the results.
  Running Time: 10:12 minutes Released: 10/5/2015
- *Legionella* Environmental Assessment Form [13 pages]

Environmental Sampling

Completing an environmental assessment is required before creating a sampling plan.

The environmental assessment, epidemiologic information, and plumbing/floor plans should be used to determine whether to conduct *Legionella* environmental sampling in a facility. These documents are also utilized to develop a comprehensive sampling plan.

The following tools and videos were designed by the Centers for Disease Control and Prevention to assist in developing sampling plans and how to sample:

- Sampling Procedure and Potential Sampling Sites [6 pages]
  CDC's protocol for collecting environmental samples for *Legionella* culture during a cluster or outbreak investigation or when cases of disease may be associated with a facility.
- Sample Data Sheet [1 page]
  Use this form to keep track of bulk water and swab samples taken for *Legionella* culture during an investigation.
- MDHHS BOL Non-Human Specimen Requisition Form [1 page]

If MDHHS BOL is utilized for environmental *Legionella* water sample culturing during a legionellosis outbreak investigation a completed laboratory requisition form DCH-1052 must be completed and submitted with the sample(s) to the lab.

- How to Make a Sampling Plan
  Learn how to choose the number of samples to take and where to take them.
  Running Time: 5:14 minutes Released: 10/5/2015
- How to Sample Potable Water
  Learn CDC's procedure for collecting potable water samples for *Legionella* culture.
  Running Time: 7:11 minutes Released: 10/5/2015
- How to Sample Cooling Towers
  Many hospitals and some long-term care facilities have evaporative cooling towers. Learn the CDC's procedure for collecting environmental samples from a cooling tower.
  Running Time: 5:15 minutes Released: 10/5/2015
- How to Sample Spas and Fountains
  Learn CDC's procedure for collecting environmental samples from spas (hot tubs) and decorative fountains.
  Running Time: 7:32 minutes Released: 10/7/2015

List of Potential Sampling Sites

Site	Approximate number of samples	Type of samples
Potable Water		
Incoming water main (where water enters the facility/campus/building from the municipality)	1	1L Bulk Water
Every well and water tower that supplies water to the facility/campus/building	1 per well or water tower	1L Bulk Water
Every holding tank or cistern	1 per holding tank/cistern	1L Bulk Water
Centralized water heater	1	1L Bulk Water (a biofilm swab if drained)
Expansion Tank for hot water (absorbs excess water pressure caused by thermal expansion within the hot water heater)	1	1L Bulk Water
Hot and Cold water returns	1 each for hot and cold	1L Bulk Water
For buildings with water softeners, special filters and disinfections systems, sample water before and/or after these processes		1L Bulk Water
Shower	2 per shower	1 biofilm swab and 1L Bulk Water
Faucet	2 or 3 per faucet	1 biofilm swab inside the faucet, (1 biofilm swab of the of the inside of the aerator if visual inspection indicates it's overgrown with biofilm), 1 L Bulk Water
Whirlpool baths (i.e. Jacuzzis)	1	1 biofilm swab inside the jets
Ice machines	2 - 4	1 bulk water ice sample collected in two one liter bottles (equals one liter when melted), 1 bulk water sample from water dispenser (if equipped with one), 1 biofilm swab from ice discharge opening or the edges of the ice make tray, 1 biofilm swab of the water dispenser discharge tube
Hot Tubs		
Water in the tub	1	1 L Bulk Water
Biofilm at the water line	2	Biofilm swabs (the quantity depends on the size of the tub)
Water jets	2	Biofilm swabs of several jets
Filter	1 per/filter	1 L Bulk Water with a combination of water and filter material (sand in sand filters, diatom powder in DE filters or polyester filter media in cartridge filters) to keep the filter material moist during transport
Compensation Tank	1	1 L Bulk Water
Cooling Towers		
Make-up water (water added to replace water loss because of evaporation, drift, or leakage)	1	1 L Bulk Water
Collection basin (an area below the tower where cooled water is collected and directed to the sump)	2	1 L Bulk Water and a biofilm swab at the waterline

Storage tank or reservoir in the system	1	1 L Bulk Water
Drift Eliminators or other surfaces that remain moist	1	1 biofilm swab
Heat sources (e.g. chillers)	1	1 L Bulk Water
Other Sources		
Decorative fountains	2	1 L Bulk Water and a biofilm swab (number of swabs dependent on size and complexity of the fixture)
Sprinkler systems	>2	1 L Bulk Water and one or several biofilm swab(s) of the sprinkler jets
Safety showers and eye wash stations	2	1 L Bulk Water and a biofilm swab
Humidifiers	2	Bulk water (as close to 1 L as possible) and at least one biofilm swab of moist surface
Nebulizers, hand-powered resuscitation bags, intermittent positive pressure breathing ventilators, and other respiratory care equipment that uses water for filling or cleaning	>2	1 L Bulk Water used to clean the device and biofilm swabs of moist surfaces

All showers and faucets in all case rooms should be sampled with biofilm swabs in addition to both first draw and post-flush 1-Liter bulk water samples. Similarly, it is important to sample showers and sink faucets in additional rooms that are proximal, medial, and distal to risers or hot water heaters. These samples should include point-of-use devices (especially showers) on various floors based on environmental assessment findings. Ideally, a sample will be collected at point-of-use outlets on every floor and/or building wing.

If a consultant was hired by the facility to sample and culture the water, the positive culture isolates resulting from environmental sampling should all be sent to the State Bureau of Laboratories for whole genomic sequencing and further characterization. MDHHS Epidemiology should be notified and the isolates should be shipped in Buffered Charcoal Yeast Extract (BCYE) slants with a MDHHS BOL Microbiology/Virology Test Requisition form filled out for each isolate. Isolates should be sent to MDHHS BOL microbiology at:

Michigan Dept of Health and Human Services
Bureau of Laboratories
3350 N. Martin Luther King Jr. Blvd
Lansing, MI 48906
Attn: Microbiology

Sampling Supplies

- Sterile plastic 1 L bottles (glass bottles are not recommended due to the risk of breakage during transport).
- Sterile plastic 15 mL screw top tubes (with a tube rack) for biofilm swabs.
- Disposable Dacron/polypropylene-tipped swabs with wooden or plastic stems. Do NOT use cotton-tipped swabs as they inhibit *Legionella* growth.
- Labels.
- 0.1N solution of sodium thiosulfate ($Na_2S_2O_3$) (15.81 g/L in distilled water. Replace every 12 months) **MDHHS BOL will prepare sampling supplies with sodium thiosulfate if their supplies are used during an investigation.**
- Pipettes and bulbs for adding 0.5 mL of 0.1N sodium thiosulfate solution into 1 L samples.
- Sterile plastic 500 mL or 1 L bottle for testing chlorine level, pH and temperature.
- pH test kit
- Chlorine test kit sensitive enough to detect chlorine level from 0-10 ppm (may need two kits). Free chlorine may be measured when it is known that chlorine is the method of disinfection (as opposed to monochloramine, bromine, or another disinfectant). Otherwise, measure total chlorine.
- Thermometer.
- Sample data sheets and pens
- Large cooler, preferably with wheels. A 70 quart (66.2 L) horizontal cooler (a standard large picnic cooler) should fit twenty-five 1 L bottles, twenty-five 15 mL plastic tubes for biofilm swabs, thermometer, pH and chlorine test kits. For sampling of a larger facility (60-100 samples total), a second cooler that holds nothing, but bottles, swabs and tubes may be needed. The cooler may be packed ahead of time and stored at ambient temperature for an unlimited time if the sodium thiosulfate solution is replaced every twelve months.
- Copies of BOL form DCH-1052, Multiple Patient/Sample – Same Test – Requisition Form. Be sure to completely fill out the LHJ contact information including a fax number. The BOL positive results will be forwarded via fax.

Environmental Sampling Procedures

Sampling Hot and Cold Potable Water at the Points of Use

Perform an Environmental Assessment and create a sampling plan before collecting samples.

1. *Swab sampling of showers/faucets*

   When sampling showers with a swab remove shower heads, then turn on hot or cold water for a couple seconds to moisten the interior of the pipe. Collect 3-5ml of the first flush in a sterile plastic tube, then turn off the water. Insert a sterile swab deep into the shower pipe and swab around various surfaces inside the pipe (careful to not break the swab stick). Also swab the inside of the shower head if it has visible biofilm growth. Place the swab in the plastic tube with the first flush water and snap off (cut if necessary) the swab stick about one inch from the top of the tube, make sure there is enough water to cover the swab during transportation. Then add .1 ml Normal sodium thiosulfate solution (to neutralize residual disinfectants), install tube cap and label the tube with a unique identifier. Place the tube in a cooler for storage and transportation, then record the sample on the Sample Data Sheet.

   These same steps can be taken to collect a swab sample from a faucet by removing the faucet aerator.

2. *Bulk water pre-flush sampling of water (hot or cold water)*

   Collecting a pre-flush 1-liter bulk water samples of hot water lines turn on and immediately collect the water into the sterile 1-liter plastic sample bottle. Add .5 ml Normal Sodium Thiosulfate solution to neutralize the residual disinfectant, and then cap the bottle. Label the bottle with a unique identifier, record the type and location of the sample on the sample data sheet then place the bottle into the cooler for storage and transportation.

3. *Bulk water post-flush sampling of water (hot or cold water)*

   When collecting a post-flush 1-liter bulk water sample of hot water turn on the water and run until warm (a couple minutes). The goal is to collect water currently in the distribution system along with any material shed from the biofilm. Collect 1 liter of this water into a sterile plastic sample bottle, leaving one inch of space at the top of the bottle, then add .5 ml Normal Sodium Thiosulfate solution to neutralize the residual disinfectant, and cap the bottle. Label the bottle with a unique identifier, record the

type and location of the sample on the sample data sheet then place the bottle into the cooler for storage and transportation.

Measure hot water parameters in conjunction with each environmental sample collected (See Measuring Hot Water Parameters below).

Sampling Potable Water at the Hot Water Heaters

Perform an Environmental Assessment and create a sampling plan before collecting samples.

Collect 1-liter bulk water samples. Fill a sterile 1-liter bottle from the hot water heater/tank drain valve leaving one inch of space at the top of the bottle. Add .5 ml normal sodium thiosulfate solution to neutralize the residual disinfectant, and then cap the bottle. Label the bottle with a unique identifier and place in cooler for storage and transportation.

1. *Measure Hot Water Parameters in Hot Water Heater & Water Storage Tanks*

Use a 1-liter bottle for all sample locations. Run the water until it is as hot as it will get then collect water in the bottle and perform the following:

- Measure temperature
- Measure pH with color indicator strips or a digital pH meter
- Measure total chlorine residual

For tankless water heaters samples need to be taken from a pipe as near as possible to the heater outlet.
For a building with a recirculating hot water piping system, the hot water pipe sample should be taken as the water returns to the hot water storage/heater tank.

2. *Measure Hot Water Parameters*

Use a 1-liter bottle for all sample locations. Run the water until it is as hot as it will get then collect some water in the bottle and perform the following:

- Measure temperature
- Measure pH with color indicator strips or a digital pH meter
- Measure total chlorine residual

Label the bottle with a unique identifier and place in cooler for storage and transportation.

3. *Measure Cold Water Parameters*

   Use the same bottle used for hot water parameter testing and perform tests for the same parameters. Record the results on the data sheet.

Hot Tubs

Perform an Environmental Assessment and create a sampling plan before collecting samples.

1. *Secure Hot Tub*

   Call ahead and instruct the facility to turn off spa (i.e., blowers or jets) but **DO NOT** drain or shut off the pumps or the heater for the spa. This will limit the risk of aerosolization and exposure to the hot tub but allow samples to be collected in normal operating conditions. Instruct the facility to close off the spa to the public (i.e., out of service tape) and post visible signs stating that the spa is out of order. When aerosol producing devices cannot be secure, wear half face respirators equipped with N95 filter. Follow OSHA standard 29 CFR 1910.134.

2. *Bulk Water Sample Collection*

   Fill sterile one-liter bottle to within 1" of the top with water from the spa and add .5 ml of sodium thiosulfate to sample. If the sampling supplies were provided by MDHHS BOL, the bottles are prefilled with the appropriate amount of sodium thiosulfate. Label the bottle with unique identifier (that matches the MDHHS BOL lab requisition form), and place in cooler with ice packs.

   If spa was partially drained, a 15 ml swab tube may be used to collect remaining water. If spa has been completely drained, ask facilities maintenance for access to the compensation tank for collection of overflow water and take a bulk water sample. Then add .5 ml of sodium thiosulfate to sample, cap, label with unique identifier, and place in cooler.

3. *Biofilm Swab Collection*

   Collect several swabs from the jets and at the waterline of the spa in addition to a bulk water sample from the spa. Collect 3-5 ml of water from the spa into a 15 ml sterile plastic tube and place each individual swab into a sterile tube with .1N sodium thiosulfate (one drop), cap tube, label tube with unique identifier, record on data sheet, and place in cooler for transportation to the lab. Repeat for all swab samples.

Helpful tip: when completing the Sample Data Sheet, draw a diagram of the hot tub on the back with locations of jet and waterline samples. This will facilitate consistent sampling if a repeat sampling event is warranted.

4. *Filter Media Sample Collection*

Facilities maintenance personnel should provide access to equipment room(s) and open any filter assemblies. Collection of a sample from the filter assembly is very important. Gloves should be worn due to the high organic load and the abrasive or caustic nature of some filter media. Ask the facilities' maintenance personnel to open the filter assemblies for inspection and sampling.

The three types of filters likely to be encountered:

a. Sand - collect sand and enough water to cover it in a 1-liter bottle.
b. Cartridge - Cut some filter material, place in a test tube 1-liter bottle with enough water to cover it.
c. Diatomaceous earth - collect of water from filter chamber into a sterile one-liter bottle, use a sterile swab to scrape diatomaceous powder from the grid. Be sure the powder is covered by at least 1" of water.

With each sample add .5 ml of 0.1N Sodium Thiosulfate, cover, label with a unique identifier and place in cooler.

5. *Water Parameters Collection*

Collect water in a separate plastic bottle, that is not being utilized for *Legionella* bacteria sample collection, and measure temperature, pH, residual biocide and temperature. Spa's may use bromine as a biocide instead of chlorine. Log this important information on the Sample Data Sheet. If the residual biocide levels exceed the maximum limit of the test kit, perform serial dilutions to bring the sample within the test kit's range. If there is a very small amount of disinfectant in the water use the potable water test kit as its test range is much lower. Record all data on the sample data sheet.
Remember it is possible for a hot tub to pass a routine environmental health inspection yet still harbor *Legionella*.

Cooling Towers

Perform an Environmental Assessment and create a sampling plan before collecting samples.

1. *Secure Cooling Tower Fans*
    a. If it is not possible to secure the fans, then attending personnel should don NIOSH N95 respirator filter masks.
    b. Use of some form of waterproof glove should also be considered.

2. *Bulk Water Sample Collection*

    Collect a 1-liter water sample from the cooling tower basin. This sample should be collected as far away from the cooling tower make up water discharge line as possible, and preferably with the condenser or circulating pump in operation. Add 0.5 mL of a 0.1N sodium thiosulfate solution to the bulk water sample, put a lid securely on the bottle, label the bottle with a unique identifier, record the sample and unique identifier on the sample data sheet and place the bottle in a cooler with ice packs for storage/transportation to the lab.

3. *Biofilm Swab Collection*

    Collection of biofilm samples should occur at various locations throughout the cooling tower. These are locations to consider when collecting biofilm swab samples:

    a. Basin waterline
    b. Tower fill
    c. Drift eliminators
    d. Distribution tray, and associated nozzles

    Run swabs firmly along the wetted surfaces and collect 3-5 mL of associated cooling tower water in the 15 mL tube, place the swab into the tube with water and snap off the tip of the swab into the tube about one inch from the top of the tube. Add a drop of 0.1N sodium thiosulfate to water in the tube and cap the tube. Label the tube with a unique identifier, log the sample and its associated identifier on the sample data log sheet and place in the tube rack of the cooler. The water will keep the swab tip moist during storage and transportation to the lab for culturing.

4. *Water Parameter Collection*

    Collection of cooling tower environmental parameters should include biocide residual (either in ppm or ORP mV), pH and temperature. The ORP mV readings would be taken from the cooling tower biocide controller.

To perform these tests, collect basin water in a separate 1-liter bulk sample bottle, that is not being utilized for *Legionella* bacteria sample collection, making sure to collect the water as far away as possible from the make-up water discharge into the cooling tower basin. Perform tests and record the data on the sample data sheet.

Decorative Fountains

Perform an Environmental Assessment and create a sampling plan before collecting samples.

1. *Secure Fountain Operation*

   Call facility ahead of visit and ask to have fountain secured from operation to minimize the risk of exposure to aerosolized water being generated. Clearly state that the fountain should not be drained, nor should any remediation practices be conducted like chemical shocking or draining of the fountain water.

2. *Bulk Water Sample Collection*

   Fill a sterile one liter bottle with fountain water to within an 1" of the top of the bottle and add .5 ml of Sodium Thiosulfate to sample. If the fountain was partially drained, a 15 ml swab tube may be used to collect any remaining water. If fountain has been completely drained, ask facilities maintenance for access to the compensation tank or filter assembly for collection of water and take a bulk water sample at that location. If it is possible always collect bulk water or swab filter samples. Then add .5 ml of Sodium Thiosulfate to sample, cap, label with unique identifier, and place in cooler.

3. *Biofilm Swab Collection*

   Collect several swabs at the waterline of the fountain in addition the bulk water sample. Collect 3-5 ml of water from the fountain in a 15 ml sterile plastic tube and place each individual swab into that sterile tube with 0.1N Sodium Thiosulfate (one drop), cap tube, label tube with unique identifier, record on data sheet, and place in cooler for transportation to the lab. Repeat for all swab samples.

4. *Water Parameter Collection*

   Collect water in a separate plastic bottle, that is not being utilized for *Legionella* bacteria sample collection, and measure temperature, pH, residual biocide and temperature. fountains may use bromine as a biocide instead of chlorine. Log this important information on the data sheet. If the residual biocide levels exceed the maximum limit of the test kit, perform serial dilutions to bring the sample within the test kit's range. If there is a very small amount of disinfectant in the water use the potable water test kit as its test range is much lower. Record all data on the sample data sheet.

Post-Remediation Environmental Sampling

Sampling may be conducted by a facility's hired consultant, the LHJ, or by MDHHS (if resources allow) in coordination with the LHJ. In follow-up to the first emergency remediation event, culturing can be conducted by MDHHS BOL. Most larger facilities will have consultants conduct the sampling with all cultured isolates being sent to the State Bureau of Laboratories for whole genome sequencing and characterization.

Recommendations regarding the frequency of environmental sampling and parameter testing after an outbreak include sampling every two weeks for the first three months post remediation. If no cases are identified and no positive samples are cultured during the 3-month time frame the sampling frequency can be extended to once a month for another 3-month time frame. Again, if no further cases are identified and no further positive samples are cultured during this 3-month time frame the facility can fall back to the sampling frequency outlined in their water management program.

If at any time during the previously described 6-month enhanced sampling schedule a new case is identified, or a sample culture is positive for *Legionella* the 6-month clock begins again after repeat remediation efforts are completed.

MDHHS Bureau of Laboratories (BOL)

MDHHS BOL is certified by the CDC in the Environmental *Legionella* Isolation Techniques Evaluation (ELITE) Program. The ELITE program issues certificates to laboratories that have demonstrated success in isolating *Legionellae* from simulated environmental samples by culture. In the event of an outbreak or investigation, BOL will accept environmental water samples with the approval of MDHHS legionellosis subject matter experts. Generally, BOL will test environmental samples before remediation occurs to determine the extent of colonization of *Legionella* in a building water system or device—and once after emergency remediation to determine if remediation efforts were successful.

Repeat testing after further remediation or for routine surveillance purposes must be conducted by private laboratory at the facility's expense. MDHHS recommends that laboratories testing water for *Legionella* be ELITE certified. A list of CDC ELITE certified laboratories can be found at https://wwwn.cdc.gov/elite/Public/MemberList.aspx.

Remediation

Emergency Remediation

Following environmental sampling (and finalized *Legionella* culture results), remediation may be required to minimize the risk of *Legionella* growth and transmission in the facility's water system. MDHHS does not provide or expect the local health jurisdiction leading an outbreak investigation to provide consultation for remediation. If remediation is necessary, the facility must hire a consultant with *Legionella*-specific environmental expertise to help make decisions about and/or perform remediation. Please refer to the CDC's Considerations When Working with Legionella Consultants for choosing a consultant with the proper expertise.

Before remediation is conducted, request a copy of the remediation plan from the consultant or facility for review. Remediation options can include:

- Hyperchlorination
- Flushing the potable water system and unused plumbing outlets
- Draining and scrubbing devices
- Consider removing aerosolizing devices that are not necessary for the function of the facility (e.g., decorative fountains, waterfalls, hot tubs)
- Targeted disinfection for hot tubs, decorative fountains, and cooling towers

Continuous Water Treatment Systems

Installation of continuous water treatment systems (secondary treatment) may reduce, but not eliminate, the need for emergency disinfection of the water system. Should a facility decide to install a secondary treatment system, consider the following:

- Selection of these measures is complex and must be individualized. The facility must seek expert advice by consulting a water engineer with *Legionella* control experience. Consultants must assess corrosion, scaling, biofilm, pH, temperature, and other physical parameters that may negatively affect the continuous disinfection system performance. A continuous water treatment system may not be recommended for every building.
- If a continuous water treatment (secondary treatment) system is installed, building owners or manager must work in conjunction with the Department of Environment, Great Lakes, and Energy (EGLE) develop a plan for monitoring system performance. If the local health jurisdiction discovers a facility is using a secondary water treatment system on a potable water system, EGLE must be informed. Ideally, building owners and managers should consult with EGLE before a continuous water treatment is installed.

Risk Communication During an Outbreak

National efforts are underway to develop a toolkit to create consistent messaging during legionellosis outbreaks. However, this toolkit is not expected to be available until summer or fall of 2021. Until this toolkit is available, MDHHS recommends the following risk communication strategies for each type of outbreak:

Healthcare-Associated Outbreaks

- MiHAN message from LHJ to healthcare providers with attached clinical guidance.
    - Hospitals: statewide MiHAN distribution
    - Long-term care/skilled nursing/rehabilitation: local or regional MiHAN distribution
- Current and recent patient notification
    - All patients/residents discharged within the past 2 weeks and current patients/resident must receive notification from the facility that *Legionella* is a concern with the facility's water system (or specific device). This messaging should be reviewed by the LHJ prior to distribution by the facility.
    - If the facility refuses to notify current and recent patients/residents, LHJ should issue a press release that names the facility and advising appropriate healthcare follow-up for individuals who develop Legionellosis-consistent illness.

Travel-Associated Outbreaks

- Guest and/or resident notification
    - If a specific device has been linked to an outbreak (e.g., hot tub) – closure of the device to the public is sufficient.
- If warranted, LHJ Press Release
- If requested/warranted, MDHHS can submit an Epi-X notification as a call for cases to alert other states and request that they immediately report any additional cases associated with the accommodation to the investigation state/local health department.

Community-Associated Outbreaks or General Increase in Cases

- LHJ should consider a press release notifying public of clustering or increase in cases in specific geographic location and advising appropriate healthcare follow-up for those with Legionellosis-consistent illness.
- LHJ should consider MiHAN message notifying local healthcare providers of clustering or increase of cases with attached clinical guidance.

Determining When Outbreak or Investigation is Concluded

Local Health Jurisdiction(s) leading an outbreak investigation determine when an outbreak is completed on a case-by-case basis. General recommendations to consider when ending the status of outbreak include:

- No new cases of Legionnaires' disease or Pontiac Fever identified during 6 months of enhanced surveillance.
- No detection of *Legionella* during post-remediation enhanced environmental sampling routines.
- Facility has a fully functional water management plan documented and in operation.

Appendix A: Outbreak Response Checklist

Below is a list of requests and activities for an LHJ(s) to perform with input from the facility before environmental sampling occurs. The information collected—in conjunction with an environment assessment, if appropriate—will provide the necessary information to establish a sampling plan and reduce the risk of transmission to other residents, guests, or employees. Some requests on this checklist may not apply to every investigation.

Case-patient Specific Requests

1. ***Confirm exposure time of case-patient at facility (during the 14 days prior to illness onset)***
    a. Hotels/rental units: number of days with overnight stay and exact dates and duration of pool and hot tub exposure(s) (if applicable)
    b. Healthcare: outpatient/inpatient/visitor exposure and total time spent at facility (see healthcare case definitions)
    c. Senior-Living/Assisted-Living: resident/employee/visitor and total time spent at facility
    d. Workplace: identify number of hours worked and specific days worked
2. ***Confirm specific locations or day-to-day activities of the case-patient at facility under investigation***
    a. Identify potential exposures to high-risk devices within facility
3. ***If a healthcare facility is under investigation:***
    a. Perform retrospective review of residents/patients to create a list of pneumonia cases.
    b. Test all patients diagnosed with pneumonia within the past two months with the urinary antigen test for *L. pneumophila* serogroup 1
    c. Initiate active clinical surveillance: test all patients presenting with pneumonia via the urinary antigen and lower-respiratory specimen for culture on *Legionella* specific media. Active clinical surveillance should remain in place for six months after the last reported case of Legionnaires' disease (or at the local health jurisdiction's discretion). If the healthcare facility collecting the clinical specimen cannot perform a *Legionella* specific culture, the clinical specimen can be sent to MDHHS BOL for culture (contact MDHHS Epidemiology for details).
4. ***Confirm if case showered at facility***
    a. Identify date(s), frequency, and location of shower(s)
5. ***Identify locations case-patient receives drinking water and ice from (is there a common meal area where they might be served water or ice from different devices?)***

6. ***Create a risk communications plan (see Risk Communication During an Outbreak)***

Facility Specific Requests

7. ***Request water management program documents and/or policies the facility may use to manage their potable and non-potable water systems***

8. ***Request copy of floor plans and hot/cold water plumbing diagrams***

9. ***Recent results of any bacterial water sampling and/or water parameter testing activities***

10. ***Cooling Tower maintenance and water treatment logs for the past six months and bacterial water sampling results for the past six months (if applicable)***

11. ***Hot tub maintenance and water treatment logs for the past six months and bacterial water sampling results for the past six months (if applicable)***

12. ***Decorative fountain maintenance, water treatment logs and bacterial water sampling results for the past six months (if applicable)***

13. ***Have the facility complete the Environmental Assessment form prior to the on-site visit and environmental sampling routine (sit down with facility and go over responses before sampling to confirm information is correct)*** (https://www.cdc.gov/legionella/downloads/legionella-environmental-assessment.pdf)

14. ***Implement water restrictions, immediately:***
    a. Restrict showering in facilities until 0.2-micron filters are installed (i.e., sponge baths)
    b. Remove all sink aerators
    c. Use only bottled drinking water for residents/patients with dysphagia
    d. Restrict consumption/use of ice from the facility's ice machines for residents/patients with dysphagia
    e. Restrict/shut down implicated high-risk devices (see hot tub specific recommendations below)
    f. Assure that all CPAP/BiPAP units are cleaned according to manufacturer's recommendations and that only distilled water is used to fill their associated humidifier water tanks

15. ***Discontinue the use of hot tub(s):***
    a. Secure the hot tub blower from use, **but leave the circulating pump running and water heater on**
    b. **DO NOT** drain water from hot tub or chemically shock the hot tub water

16. ***Shutdown any decorative fountain(s):***
    a. If possible, circulate water in the fountain basin, if not, shut pump(s) off
    b. **DO NOT** drain water from the fountain or chemically shock the fountain water

Investigation and Sampling (See Environmental Assessment and Sampling Sections Above)

17. ***Review completed environmental assessment and if necessary, complete the environmental assessment***

18. ***Create a sampling plan utilizing the facility's water management program, environmental assessment, plumbing/floor plans, and case-specific exposures***

19. ***As needed, work with MDHHS and/or facility consultants to facilitate sampling and sampling frequency***

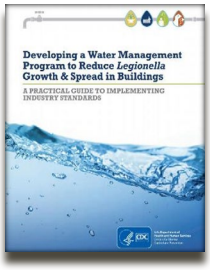
20. ***Review data and trends from Legionella sampling and water parameter testing***

21. ***Water management program review:***
    a. Over the course of the investigation, the facility should update their WMP to meet the standard requirements outlined in ASHRAE 188-2018.

22. ***Conclude investigation – the facility may fall back on their sampling routines as presented in their WMP***
    a. The facility must have favorable environmental sampling results, a WMP meeting the standards of ASHRAE 188-2018, and no additional cases of Legionnaires' disease or Pontiac fever over the course of the investigation.

Appendix B: References and Resources

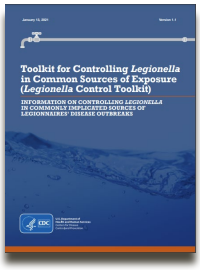
Water Management Program Resources



CDC Toolkit –

Developing a Water Management Program to Reduce Legionella Growth & Spread in Buildings

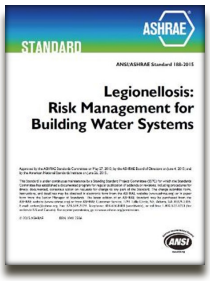
Published 2017 (Version 1.1), Free online



CDC Legionella Control Toolkit –

Toolkit for Controlling Legionella in Common Sources of Exposure

Published 2021, Free online



ANSI/ASHRAE Standard 188 –

Legionellosis: Risk Management for Building Water Systems

Published 2018, available for purchase

ASHRAE Guideline 12 –

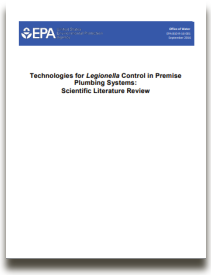
Minimizing the Risk of Legionellosis Associated with Building Water Systems

Published 2020, available for purchase

Cooling Tower Institute (CTI) –

Legionellosis Guideline GDL 159 – Practices to Reduce the Risk of Legionellosis from Evaporative Heat Rejection Equipment Systems

Published 2020, available for purchase



Technologies for Legionella Control in Premise Plumbing Systems

Environmental Protection Agency

Published 2016, Free online

Management of Legionella in Water Systems

National Academies of Sciences, Engineering, and Medicine

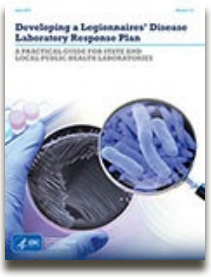
Published 2020, Free online

Laboratory Resources

CDC ELITE Program

Centers for Disease Control and Prevention and Wisconsin State Laboratory of Hygiene

List of ELITE Certified labs for environmental testing



Toolkit: Developing a Legionnaires' Disease Laboratory Response Plan

Centers for Disease Control and Prevention

Published 2017, Free online

MDHHS Bureau of Laboratories

Lab requisition forms, specimen processing guidelines, and laboratory services

Legionellosis Information

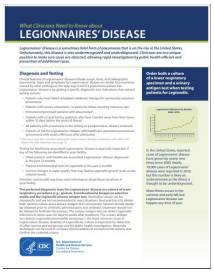
Legionnaires' Disease Website

Centers for Disease Control and Prevention

Free online

MDHHS Communicable Disease Information and Resources

Updates to surveillance and outbreak protocol, building reopening guidance, fact sheets, and other tools



What Clinicians Need to Know about Legionnaires' Disease

Centers for Disease Control and Prevention

Free online

Laws

Safe Drinking Water Act

Environmental Protection Agency

Free online