

Legionellosis rev Jan 2018

BASIC EPIDEMIOLOGY

Infectious Agent

Legionella species are Gram-negative bacilli commonly found in water. There are over 50 species and approximately 70 serogroups currently recognized. *L. pneumophila* serogroup 1 is primarily responsible for human disease followed by *L. micdadei*, *L. bozemanii*, *L. dumoffii*, and *L. longbeachae*.

Transmission

Transmission occurs by inhaling aerosols from a water source contaminated with the *Legionella* bacteria. An example is breathing in steam or mist from a contaminated hot tub. Transmission may also occur by aspirating contaminated water. (See [Legionella Ecology and an Introduction to Environmental Health and Engineering](#) video for more information.)

Incubation Period

The incubation period for Legionnaires' disease is 2–10 days with most infections occurring 5–6 days after exposure. Pontiac Fever can occur in 5–72 hours after exposure, but most often occurs 24–48 hours after exposure.

(Note: The incubation period for Legionnaires' disease is most commonly 2–10 days, with an average of 5–6 days, but has been reported to be up to 19 days in rare cases. For routine surveillance purposes, exposure histories are collected for the 10 days prior to onset. However, in outbreak settings where it is important to consider a wide range of possible sources, use of a 14-day incubation period is often desirable.)

Communicability

No human-to-human transmission occurs.

Clinical Illness

- **Legionnaires' disease** is a common cause of pneumonia. Symptoms may include a high fever, shortness of breath, chills, non-productive cough, muscle aches and headache. Chest pain, altered mental status, abdominal pain, nausea, vomiting and diarrhea are also common.
- **Pontiac Fever** presents as a self-limited febrile illness that does not result in pneumonia. Symptoms may include fever, cough, headaches and muscle aches. Complete recovery usually occurs within a week without antibiotics.

Severity

Almost all patients with Legionnaires' disease require hospitalization, and the case fatality rate of Legionnaires' disease is 5% to 30%. The case fatality rate is often higher in nosocomial cases. Pontiac fever does not result in death and hospitalization is rarely required.

DEFINITIONS

Clinical Case Definition

Legionellosis is associated with two clinically and epidemiologically distinct illnesses: Legionnaires' disease, which is characterized by fever, myalgia, cough and clinical or radiological pneumonia; and Pontiac Fever, a milder illness without pneumonia.

Laboratory Confirmation

A clinically compatible case that meets at least one of the confirmatory laboratory criteria:

- Isolation (culture) of any *Legionella* organism from respiratory secretions, lung tissue, pleural fluid or other normally sterile fluid
- Detection of *Legionella pneumophila* serogroup 1 antigen in urinary using validated reagents
- Demonstration of seroconversion by a fourfold or greater rise in specific serum antibody titer between paired acute and convalescent phase serum specimens to *Legionella pneumophila* serogroup 1 using validated reagents

Note: DFA and PCR tests for *Legionella* are not considered confirmatory for determining the case classification of Legionellosis cases.

Case Classifications

- **Confirmed:** A clinically compatible case that meets at least one of the confirmatory laboratory criteria
- **Probable:** No probable case definition for Legionellosis

Case Categories (Confirmed cases of Legionellosis may be further categorized to describe type of exposure.)

- Travel-associated case
 - A case that has a history of spending at least one night away from home, either in the same country of residence or abroad, in the 10-day incubation period
- Healthcare-associated (nosocomial) case
 - Definitely: A case that has a history of spending the entire 10-day incubation period in a hospital or a long-term care facility
 - Possibly: A case that had exposure to a healthcare facility for any portion of the 10-day incubation period

Cluster and Outbreak Definitions

- Cluster:
 - Two or more cases linked by areas of residence (building, street block, neighborhood, etc.), work or places visited, with sufficient closeness in dates of onset of illness to warrant further investigation
- Outbreak:
 - Two or more cases associated with the same facility (e.g., hotel, gym, etc.) or other common location (e.g., amusement park) within 1 year, OR
 - One definitely healthcare-associated case or two or more possibly healthcare-associated cases within 1 year associated with the same healthcare facility

SURVEILLANCE AND CASE INVESTIGATION

Case Investigation

Local and regional health departments should investigate all reports of clinically suspected Legionellosis. Investigations should **always** include an interview of the case-patient or a surrogate to obtain a detailed exposure history. Please use the Legionellosis Investigation Report Form available on the DSHS website: <http://www.dshs.texas.gov/idcu/investigation/>.

Case Investigation Checklist

- Confirm that the laboratory results meet the case definition.
 - Urinary antigen and respiratory culture are preferred testing methods for clinical *Legionella* confirmation.
 - If only one antibody test was performed and symptoms are consistent with Legionellosis, consider requesting that the attending physician order a convalescent antibody test or a urinary antigen test, especially in an outbreak setting.
- Review medical records or speak to an infection preventionist or physician to verify demographics, symptoms, underlying health conditions and course of illness.
- Interview the case-patient (or surrogate).
 - Use the Legionellosis Investigation Report Form available on the DSHS website: <http://www.dshs.texas.gov/idcu/investigation/>.
 - If cruise ship exposure is reported during the incubation period, interview the patient with the DSHS Legionellosis Investigation Report Form AND the Legionellosis Cruise Ship Questionnaire at <http://www.cdc.gov/legionella/health-depts/inv-tools-single/index.html>.
 - Jurisdictions that are experiencing a significant increase in Legionellosis cases should interview patients with the DSHS Legionellosis Investigation Report Form AND also consider completing the Legionellosis Hypothesis-Generating Questionnaire (<http://www.cdc.gov/legionella/health-depts/inv-tools-single/index.html>)
 - Determine the patient's onset date. This may be difficult for patients with complex medical histories or those with atypical symptoms. When onset date is uncertain for these reasons, consult all of the following sources:
 - Patient or surrogate interview
 - Medical summaries and progress reports, consultations, radiology (chest x-ray) reports, and medication records (specifically antibiotics) for all medical facilities visited in the 2-4 weeks prior to suspected symptom onset
 - For the 10 days prior to illness onset, identify risk factors, travel history and other potential exposures such as hospital, dental and long-term care facility visits/stays or visits to any other location where aerosolization of water may have occurred (e.g., gyms, saunas, restaurants with outdoor misters or fountains, truck stops with showers, etc.).
 - Obtain detailed information on travel or facility exposures including exact dates, room numbers, the name of the facility, and the facility's complete physical address (since facilities may have similar names and multiple locations).
 - If at least three, unsuccessful attempts were made to contact the case-patient or surrogate, please complete the case investigation form with available information and indicate the reason for missing information (e.g., lost to follow-up – patient did not return call; multiple messages left).
 - If initially the patient is unable to communicate for interview due to severity of illness, conduct the initial interview with the patient's surrogate and interview the patient when the patient is able to communicate.
- Implement control measures for cases, contacts and/or facilities in the assigned jurisdiction (see list of control measures below).

- If suspected healthcare-associated, travel-related or other exposures are identified, notify DSHS and other jurisdictions, if necessary, in which the possible exposure occurred, using appropriate notification channels.
 - **Notify DSHS within 1 business day of when a healthcare-associated or travel-related exposure is identified.**
 - DSHS tracks potential Legionellosis exposures in Texas.
 - DSHS will share all out-of-state exposures and in-state exposures that may affect out-of-state residents with the Centers for Disease Control and Prevention (CDC) who will notify other states/jurisdictions as needed.
- When cases report travel or exposure to healthcare facilities or other institutions during their incubation periods, or in the event of a cluster or outbreak, complete the applicable steps in the Managing Special Situations section.
- In the event of a death, a copy of the discharge summary, death certificate, or autopsy report should be obtained.
- Complete the investigation form(s) and fax or send a secure email to DSHS.
- Copies of the medical records (admission report, history and physical, progress notes, laboratory results, radiology reports, discharge summary, etc.) accompanying completed case investigation form(s) is strongly recommended.
- Enter all confirmed Legionellosis case investigations and submit a notification in the NEDSS Base System (NBS).
 - Please refer to the *NBS Data Entry Guidelines* for disease-specific entry rules.

Prevention and Control Measures

Cases, contacts and the general public

- Provide education on Legionellosis as needed. Emphasize the following:
 - Low risk of Legionnaires' disease for most healthy individuals
 - No human-to-human transmission
 - Close contacts of the case at risk only if exposed to the same source as the case
 - Increased risk of infection for individuals who are immunosuppressed, have chronic obstructive pulmonary disease (COPD) or have other risk factors such as diabetes or history of smoking
- Recommend using sterile water for respiratory therapy devices. Do not use tap water.
- Recommend that high risk sources such as hot tubs are maintained properly including:
 - Maintenance of appropriate pH (7.2–7.8) and disinfectant levels
 - Removal of slime or biofilm
 - Replacement of filters as recommended by the manufacturer
 - For more information, see <http://www.cdc.gov/legionella/about/prevention.html> and www.cdc.gov/healthywater/swimming/rwi/illnesses/legionella.html.
- Recommend that anyone experiencing symptoms be evaluated by a medical provider.
 - Collect demographic information and symptom history on ill contacts.
- No environmental testing of water is recommended for a single case that is only possibly associated with a facility/exposure.
- General prevention messages include:
 - Don't smoke.
 - Don't use hot tubs or whirlpools that are not well maintained.
 - Don't use tap water in humidifiers or respiratory therapy devices.
 - Thoroughly clean and maintain any humidifiers, respiratory therapy devices, hot tubs, fountains or other devices or equipment that can aerosolize water per the manufacturer's directions.

- Women planning a water birth
 - Women who are planning a water birth should educate themselves on the process, carefully considering the documented benefits and risks of water birth at different stages of labor.
 - Research birth providers and facilities to ensure that infection prevention plans are in place for water births and are actively in use to protect patients.
 - Read the DSHS Midwifery Board's Waterbirth Guidelines: "Information for Client Discussion Regarding the use of Water during Labor and Birth", "Guidelines for Water Immersion and Waterbirth", and "Pool Setup and Cleaning Recommendations" (combined document) at <http://www.dshs.texas.gov/idcu/disease/legionnaires/links/>.

Healthcare providers and facilities (healthcare and non-healthcare)

- Remind local healthcare providers to consider Legionellosis as a cause of pneumonia and report confirmed or clinically suspected cases.
 - Indications for *Legionella* testing (<http://www.cdc.gov/legionella/clinicians/clinical-features.html>):
 - Patients who have failed outpatient antibiotic therapy for community-acquired pneumonia
 - Patients with severe pneumonia, in particular those requiring intensive care
 - Immunocompromised patients with pneumonia
 - Patients with pneumonia in the setting of a Legionellosis outbreak
 - Patients with a travel history in the two weeks prior to illness onset
 - Patients suspected of healthcare-associated pneumonia
- Notify the director of any facility that the case-patient stayed at or visited during the incubation period.
- Request that the facility notify the health department if any guest/customer/resident/patient complains of respiratory illness or pneumonia after staying/visiting there.
 - If there were additional complaints of illness, collect suspected case-patient names, room numbers and contact information.
- Remind the facility of the importance of proper maintenance.
 - See CDC's Water Systems Maintenance website: <http://www.cdc.gov/legionella/water-system-maintenance.html>
 - Facilities should take steps to minimize the risk of Legionellosis associated with building water systems. Refer to the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) current guidance (ASHRAE Guideline 12-2000 and ANSI/ASHRAE Standard 188-2015) and the CDC toolkit "Developing a Water Management Program to Reduce Legionella Growth and Spread in Buildings: A Practical Guide to Implementing Industry Standards" for more information.
 - Recommend review of maintenance procedures of hot tubs, pools, whirlpools, birthing tubs, cooling towers, decorative fountains or any other sources of possible aerosolization of water. Important features in maintenance plans include procedures for:
 - Maintaining appropriate hot and cold water temperatures
 - Maintaining and monitoring pH and disinfectant levels including residual free chlorine
 - Replacing filters per manufacturer's recommendations
 - Performing emergency disinfection/remediation as needed
 - For more information, see www.cdc.gov/legionella/about/prevention.html.
 - Encourage the facility to hire a professional maintenance company for their equipment (e.g., hot tubs, pools) if the facility employees are unfamiliar with proper maintenance procedures.

- Remind the facility to enforce the maximum bather load for pools and hot tubs/spas.
- Encourage facilities to educate physicians to heighten their suspicion for cases of healthcare-associated Legionellosis and to use appropriate methods for its diagnosis. Facilities should also educate patient-care, infection-control and engineering personnel about measures to control healthcare-associated Legionellosis.
- Facilities should ensure that nebulizers and other semicritical respiratory care equipment are cleaned with sterile water. Enteral tubes should be flushed with sterile water and enteral feedings should be diluted with sterile water.
 - Providers should make sure that patients who use these devices are aware of these recommendations.
- Each hospital and long-term care facility should form a team of representatives from various departments to develop and write a Legionellosis control plan. The team should be led by a hospital epidemiologist or an infection control professional.
 - This operational plan should encompass several components including:
 - Surveillance strategies
 - Whether environmental culturing is recommended
 - Remediation strategies (if and when necessary)
 - Reporting procedures
 - Hospitals and long-term care facilities should regularly review and update their Legionellosis control plans.
 - For more information, see the Report of the Texas Legionnaires' Disease Task Force.
- Point-of-use filtration (0.2 micrometer) may be used at specific faucets, showerheads and other outlets as an added control measure. (This is more commonly recommended in an outbreak setting.)
- Water testing is generally not recommended in response to single cases that are only possibly associated with a facility.
- For additional information specific to facilities review the Managing Special Situations section.

Providers and facilities that offer water birthing

- For a complete list of recommendations see the DSHS Midwifery Board's Waterbirth Guidelines at <http://www.dshs.texas.gov/idcu/disease/legionnaires/links/>
- Be aware of the potential risks of water birth-associated infections and educate expectant parents on these risks.
- Provide written procedures and guidelines to expectant parents regarding water birth, and document acknowledgment of procedures.
- Ensure the use of proper equipment for water birthing.
- Create written procedures for cleaning and maintaining birthing tubs and associated components.
- Maintain, disinfect, and properly store equipment used for water birthing.
- Maintain recommended water quality of tubs utilized by the facility during water birthing. Water quality measures should be guided by the instructions provided by the manufacturer.
- Document equipment maintenance, chemical additives used to maintain water quality, and preparation and use of equipment for each birth.
- Train all staff midwives and anyone involved in the use of water during labor and/or birth on all facility specific procedures developed for waterbirth and retain records of employee training.

School/Daycare Exclusion Criteria

No exclusion from work, school or daycare is required for disease control purposes.

MANAGING SPECIAL SITUATIONS

TRAVEL-ASSOCIATED CASES

One travel-associated case

If a **single** confirmed case of Legionellosis reported staying at a hotel for at least one day/night during the incubation period, the hotel should be notified. Do not share the patient's name or exact date of stay. With only one confirmed case, the exposure may or may not have occurred at the hotel.

For a **single** confirmed case, the local/regional health department should:

- Notify the hotel in writing of the case and
 - Request that the hotel notify the health department if any guest complains of respiratory illness or pneumonia after staying there.
 - Recommend that the hotel review their maintenance procedures for their cooling system, decorative fountains, pools and any hot tubs/whirlpools.
 - Recommend review of American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) Guideline 12-2000, ANSI/ASHRAE Standard 188-2015, the Model Aquatic Health Code, and other resources at <http://www.cdc.gov/legionella/water-system-maintenance.html>
 - A sample letter is available from EAIDB upon request.
 - Note: Do not share enough details for the hotel to identify the case.
- Environmental (water) sampling and testing is not recommended for a single case staying at a hotel.

Multiple travel-associated cases

If **two or more** unrelated, confirmed cases of Legionellosis reported staying at least one night/day at the same hotel within a one-year period, notify EAIDB at (800) 252-8239 or (512) 776-7676. (Cases are considered related if they are members of the same household, traveling together, staying in the same room and otherwise spending significant amounts of time together outside of suspected travel exposure. For example, a husband and wife staying in the same room and traveling together would count as related but members of the same sports team staying in different rooms would not be related.)

For **two or more** unrelated confirmed cases, the local/regional health department should:

- Notify the hotel in writing of the cases and
 - Request that the hotel notify the health department if any guest complains of respiratory illness or pneumonia after staying there.
 - Recommend that the hotel review their maintenance procedures for their cooling system, decorative fountains, pools and any hot tubs/whirlpools.
 - Recommend review of ASHRAE Guideline 12-2000, ANSI/ASHRAE Standard 188-2015, the Model Aquatic Health Code, and other resources at <http://www.cdc.gov/legionella/water-system-maintenance.html>
 - A sample letter is available from EAIDB upon request.
 - Note: Do not share enough details for the hotel to identify the cases.
- Consider posting an Epi-X call for cases to notify other state and local health departments of the cluster and to encourage reporting of additional cases.

- Work with the hotel to conduct an environmental assessment to determine possible sources of exposure and to verify maintenance procedures are being followed. The environmental assessment should be completed by the health department or by an independent contractor familiar with water systems and with documented *Legionella* remediation experience.
 - Note: the environmental assessment is a way to gain a thorough understanding of a facility's water systems and assist facility management with minimizing the risk of Legionellosis. It is not the same as environmental sampling.
 - Use the CDC's *Legionella* Environmental Assessment Form (<http://www.cdc.gov/legionella/health-depts/inv-tools-cluster/environmental-inv-tools.html>) to conduct the assessment. The form should be completely filled out. (Videos providing information and instruction on environmental assessment and sampling are available at <http://www.cdc.gov/legionella/videos.html>).
 - Ask the facility to provide maps of the hotel and water system in order to identify exposure locations and to select sites for environmental sampling (if planned).
- Recommend that the hotel take measures to reduce/eliminate *Legionella* from its water system.
 - The hotel should follow ASHRAE Guideline 12-2000 and ANSI/ASHRAE Standard 188-2015 for controlling and preventing Legionellosis associated with building water systems. The CDC developed a toolkit aimed to provide an easy-to-understand interpretation of ASHRAE Standard 188 (<https://www.cdc.gov/legionella/maintenance/wmp-toolkit.html>).
 - Recommend that the hotel hire an environmental consultant familiar with water system assessment and with documented *Legionella* remediation experience.
 - The hotel owner should work with the consultant to minimize any risks of *Legionella* colonization and transmission associated with the facility, including addressing any modifiable issues identified by public health or the consultant.
 - CDC's instructions on "Disinfection of Hot Tubs Contaminated with *Legionella*" may be found at <http://www.cdc.gov/legionella/downloads/hot-tub-disinfection.pdf>.
- Recommend environmental sampling (i.e., collection of water and biofilm swab samples to test for *Legionella*), if warranted.
 - Environmental sampling should be considered when more than one case of Legionellosis is associated with a hotel within a one-year period and the epidemiological investigation or environmental assessment identifies potential exposures or sources of infection.
 - Environmental sampling should be done if remediation efforts were implemented and a new case is identified with exposure occurring after remediation was done.
 - Please see the Environmental Sampling and Testing section near the end of this chapter for sample sites, collection protocols, and testing instructions.
 - Do not delay interventions necessary to prevent additional cases of Legionellosis (e.g., closing a hot tub to bathers) pending the results of environmental sampling.
 - If environmental sampling is done, the hotel should provide a copy of the testing results to the health department.

HEALTHCARE-ASSOCIATED CASES

One possibly healthcare-associated case

If **one confirmed, possibly healthcare-associated case** of Legionellosis reported exposure to a healthcare facility during his/her incubation period, the healthcare facility should be notified. With only one possibly healthcare-associated case, the exposure may or may not have occurred at the facility. Consult with EAIDB if it is an outpatient exposure at (800) 252-8239 or (512) 776-7676.

Note: The healthcare-associated Legionellosis recommendations may be used for cases associated with closed, non-healthcare institutions (e.g., correctional facilities). Recommendations may need to be modified slightly to reflect differences in healthcare facilities and non-healthcare facilities.

For **one possibly healthcare-associated case**, the local/regional health department should:

- Notify (in writing) the infection preventionist or medical director of the healthcare facility at which the case-patient stayed to verify that the facility is aware of the case and
 - Request that the facility notify the health department if additional nosocomial Legionellosis cases are suspected or identified.
 - Recommend that the facility implement active surveillance to identify new cases if the confirmed case reported an inpatient/resident stay at the facility (during the incubation period).
 - At minimum, active surveillance should include daily review of chest x-rays, sputum cultures and new diagnoses of pneumonia.
 - All patients who develop pneumonia two or more days after admission over the next 60 days should be tested by urinary antigen test; culture testing is also recommended in addition to urinary antigen testing.
 - Once implemented in response to a possible or definite case, active surveillance should continue for at least six months.
 - Recommend that the facility review their maintenance procedures for any possible sources of aerosolized water (including cooling towers, evaporative condensers, water heaters, pools/hot tubs/whirlpools, decorative fountains, respiratory therapy equipment, etc.).
 - Review of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) Guideline 12-2000 ANSI/ASHRAE Standard 188-2015, and the CDC toolkit “Developing a Water Management Program to Reduce Legionella Growth and Spread in Buildings: A Practical Guide to Implementing Industry Standards,” is also recommended (see <http://www.cdc.gov/legionella/water-system-maintenance.html>).
 - Recommend that the facility review and update (if necessary) the facility’s Legionellosis control plan (see Report of the Texas Legionnaires' Disease Task Force for more information).
- Environmental (water) testing is not recommended when a facility has only one possibly healthcare-associated case.

One or more definitely healthcare-associated case OR multiple possibly healthcare-associated cases

If **one or more definitely healthcare-associated or two or more possibly healthcare-associated cases** occur in patients of the same dental or healthcare provider, hospital, residential care facility or other long-term care facility AND the cases have no other identified plausible source of infection OR if other circumstances suggest the possibility of healthcare-associated infection, notify EAIDB at (800) 252-8239 or (512) 776-7676. If there are outpatient visits in the cluster, please consult with EAIDB before declaring it a cluster.

For **≥ 1 definitely healthcare-associated case or ≥ 2 possibly healthcare-associated cases**, the local/regional health department should:

- Notify the infection preventionist or medical director of the healthcare facility at which the case-patients stayed to verify that the facility is aware of the cases.
 - If any of the patients reported exposures to multiple facilities during their incubation periods, make sure that all facilities are notified.
 - Notify facilities of cases and public health recommendations, in writing.

- Work with the facility to conduct retrospective and prospective surveillance to identify potentially missed or new cases for a minimum of 6 months before the earliest onset date and after the most recent onset date, respectively.
 - Retrospective surveillance should include a review of patient medical records and laboratory results from the past 6 months to identify clinically compatible cases.
 - Active surveillance should include daily review of chest x-rays, sputum cultures and new diagnoses of pneumonia.
 - Once implemented in response to a possible or definite case, active surveillance should continue for at least 6 months following the onset date of the most recent healthcare-associated case.
 - Request that the facility notify the health department if additional healthcare-associated Legionellosis cases are suspected or identified.
- Recommend testing of patients with compatible symptoms at least 60 days before the earliest onset date of a healthcare-associated case and at least 60 days after the onset date of the most recent healthcare-associated case.
 - All patients who developed pneumonia in the last 60 days should be tested with a urinary antigen test.
 - All patients who develop pneumonia two or more days after admission over at least 60 days after the latest onset date of a health-care associated case should be tested by both culture **and** urinary antigen. This testing should be extended beyond 60 days when there is evidence of ongoing transmission or when recommended prevention and control measures have not been completed.
 - Testing may be done in-house or by a commercial laboratory.
 - Clinical *Legionella* isolates/cultures should be retained (not discarded) by the hospital/lab or sent to the state public health lab (with approval from the public health lab).
- Remind the facility to report to its regulatory authority as appropriate.
- Notify facility staff about the outbreak so that medical personnel consider Legionellosis in the differential diagnosis for patients with nosocomial and community-acquired pneumonia, and test and report suspected cases as directed.
- Consider clinically-compatible illnesses in facility staff.
- Review the facility's infection control measures to prevent Legionellosis exposures and work with the facility to identify potential gaps.
 - Review and update (if necessary) the facility's Legionellosis control plan. Refer to the Report of the Texas Legionnaires' Disease Task Force for detailed Legionellosis response measures in acute care hospitals and long-term care facilities.
- Recommend that the facility review their maintenance procedures for any possible sources of aerosolized water (including cooling towers, evaporative condensers, water heaters, pools/hot tubs/whirlpools, decorative fountains, respiratory therapy equipment, etc.).
- Review of the ASHRAE Guideline 12-2000 and ANSI/ASHRAE Standard 188-2015 is also recommended.

- Work with the facility to conduct an environmental assessment to determine possible sources of exposure and to verify that maintenance procedures are being followed. The environmental assessment should be completed by the health department or by an independent contractor familiar with water systems and with documented *Legionella* remediation experience.
 - Note: the environmental assessment is a way to gain a thorough understanding of a facility's water systems and assist facility management with minimizing the risk of Legionellosis. It is not the same as environmental sampling.
 - Use and complete the CDC's *Legionella* Environmental Assessment Form (<http://www.cdc.gov/legionella/health-depts/inv-tools-cluster/environmental-inv-tools.html>) to conduct the assessment. (Videos providing information and instruction on environmental assessment and sampling are available at <http://www.cdc.gov/legionella/videos.html>).
 - Ask the facility to provide maps of the facility and water system (if available) in order to identify exposure locations and to select sites for environmental sampling (if planned).
- Consider using methods to limit exposure of high-risk patients to potentially contaminated water sources, pending successful reduction in levels of *Legionella* colonization within the facility's water system including:
 - Restrictions on showering
 - Restrictions on use of potable hot water: shift to using sterile water for bathing, drinking, oral hygiene, wound care, and dilution of drinks (bottled water may also be an option for some activities)
 - Installing point-of-use filtration at faucets and showerheads
 - Suspending water births (until water restrictions are lifted)
- Recommend that the facility take measures to reduce/eliminate *Legionella* from its water system.
 - The facility should follow ASHRAE Guideline 12-2000 and ANSI/ASHRAE Standard 188-2015 for controlling and preventing Legionellosis associated with building water systems. The CDC developed a toolkit aimed to provide an easy-to-understand interpretation of ASHRAE Standard 188 (<https://www.cdc.gov/legionella/maintenance/wmp-toolkit.html>).
 - Recommend that the facility hire an environmental consultant familiar with water system assessment and with documented *Legionella* remediation experience. The facility owner should work with the consultant to minimize any risks of *Legionella* colonization and transmission associated with the facility, including addressing any modifiable issues identified by public health or the consultant.
- Recommend environmental sampling (i.e., collection of water and biofilm swab samples to test for *Legionella*), if warranted.
 - Water testing should be considered when one definite healthcare-associated case or two or more possible healthcare-associated cases of Legionellosis are associated with a facility within a one-year period.
 - Sampling should only be performed after a thorough environmental assessment has been done and a sampling plan has been made. The sampling plan should be approved by the health department.
 - Water testing should be done if remediation efforts were implemented and a new case is identified with exposure occurring after remediation was done.
 - Please see the Environmental Sampling and Testing section near the end of this chapter for sample sites, collection protocols, and testing instructions.
 - Do not delay interventions necessary to prevent additional cases of Legionellosis (e.g., cleaning equipment, implementing water restrictions, installing point-of-use filters) pending the results of environmental sampling.
 - If environmental sampling is done, the healthcare facility should provide a copy of the testing results to the health department.
- If needed, conduct a case-control study to identify specific exposures within the facility.

CASES ASSOCIATED WITH A GYM, SPA, OR OTHER “OPEN” FACILITY

One facility-associated case

If **one confirmed case** of Legionellosis reported exposure to a source of aerosolized water (pool, whirlpool, hot tub, mister, etc.) at a public/communal facility during at least one day/night during the incubation period, the facility should be notified. Do not share the patient’s name or exact date of exposure. With only one confirmed, possibly facility-associated case, the exposure may or may not have occurred at the facility.

For a **single case**, the local/regional health department should:

- Notify the facility in writing of the case and
 - Request that the facility notify the health department if any customer complains of pneumonia after visiting the facility.
 - Recommend that the facility review their maintenance procedures for any possible sources of aerosolized water (including pools, hot tubs/whirlpools, misters, etc.).
 - Recommend review of American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) Guideline 12-2000, ANSI/ASHRAE Standard 188-2015, the Model Aquatic Health Code, the CDC toolkit “Developing a Water Management Program to Reduce Legionella Growth and Spread in Buildings: A Practical Guide to Implementing Industry Standards,” and other resources at <http://www.cdc.gov/legionella/water-system-maintenance.html>
 - A sample letter for hotels is available from EAIDB upon request. This letter can be modified for any facility.
 - Note: Do not share enough details for the facility to identify the case.
- Environmental (water) sampling and testing is not recommended for a single case reporting exposure to the facility.

Multiple facility-associated cases

If **two or more confirmed cases** of Legionellosis reported exposure to a source of aerosolized water (pool, whirlpool, hot tub, mister, etc.) at a facility during at least one day/night during the incubation period* within a one-year period, notify the EAIDB at (800) 252-8239 or (512) 776-7676.

For **multiple cases**, the local/regional health department should:

- Notify the facility in writing of the cases and
 - Request that the facility notify the health department if any customer complains of pneumonia after visiting the facility.
 - Recommend that the facility review their maintenance procedures for any possible sources of aerosolized water (including pools, hot tubs/whirlpools, misters, etc.).
 - Recommend review of ASHRAE Guideline 12-2000, ANSI/ASHRAE Standard 188-2015, the Model Aquatic Health Code, the CDC toolkit “Developing a Water Management Program to Reduce Legionella Growth and Spread in Buildings: A Practical Guide to Implementing Industry Standards,” and other resources at <http://www.cdc.gov/legionella/water-system-maintenance.html>
 - A sample letter for hotels is available from EAIDB upon request. This letter can be modified for any facility.
 - Note: Do not share enough details for the facility to identify the case.
- Contact local hospital infection control staff and emergency room staff to determine whether they have observed an increase in community-acquired pneumonia patients admitted to the facility.
 - If cultures/isolates or respiratory specimens are available on potential cases, these should be held (i.e., not discarded) in case further testing is requested.

- Inform primary care physicians, emergency room staff and radiologists in the potential outbreak area and any other locations necessary of the following:
 - That there is a cluster of Legionellosis cases
 - The signs and symptoms of Legionellosis
 - The recommended lab tests to confirm Legionellosis
 - Reporting requirements and contact information for the health department
- Consider clinically-compatible illnesses in staff of the affected facility.
- Work with the facility to conduct an environmental assessment to determine possible sources of exposure and to verify maintenance procedures are being followed. The environmental assessment should be completed by the health department or by an independent contractor familiar with water systems and with documented *Legionella* remediation experience.
 - Note: the environmental assessment is a way to gain a thorough understanding of a facility's water systems and assist facility management with minimizing the risk of Legionellosis. It is not the same as environmental sampling.
 - Use and complete the CDC's *Legionella* Environmental Assessment Form (<http://www.cdc.gov/legionella/health-depts/inv-tools-cluster/environmental-inv-tools.html>) to conduct the assessment. (Videos providing information and instruction on environmental assessment and sampling are available at <http://www.cdc.gov/legionella/videos.html>).
 - Ask the facility to provide maps of the facility and water system (if available) in order to pinpoint exposure locations and to select sites for environmental sampling (if planned).
- Recommend that the facility take measures to reduce/eliminate *Legionella* from the water system.
 - The facility should follow ASHRAE Guideline 12-2000 and ANSI/ASHRAE Standard 188-2015 for controlling and preventing Legionellosis associated with building water systems.
 - CDC's toolkit "Developing a Water Management Program to Reduce Legionella Growth and Spread in Buildings: A Practical Guide to Implementing Industry Standards" is an easy-to-understand interpretation to ASHRAE 188 (<https://www.cdc.gov/legionella/maintenance/wmp-toolkit.html>).
 - Recommend that the facility hire an environmental consultant familiar with water system assessment and with documented *Legionella* remediation experience. The facility owner should work with the consultant to minimize any risks of *Legionella* colonization and transmission associated with the facility, including addressing any modifiable issues identified by public health or the consultant.
 - CDC's instructions on "Disinfection of Hot Tubs Contaminated with *Legionella*" may be found at <http://www.cdc.gov/legionella/downloads/hot-tub-disinfection.pdf>.
- Recommend environmental sampling (i.e., collection of water and biofilm swab samples to test for *Legionella*), if warranted.
 - Environmental sampling should be considered when more than one case of Legionellosis is associated with a facility within a one-year period and the epidemiological investigation or environmental assessment identifies potential exposures or sources of infection.
 - Sampling should only be performed after a thorough environmental assessment has been done and a sampling plan has been made. The sampling plan should be approved by the health department.
 - Environmental sampling should be done if remediation efforts were implemented and a new case is identified with exposure occurring after remediation was done.
 - Please see the Environmental Sampling and Testing section near the end of this chapter for sample sites, collection protocols, and testing instructions.
 - Do not delay interventions necessary to prevent additional cases of Legionellosis (e.g., closing a hot tub to bathers) pending the results of environmental sampling.
 - If environmental sampling is done, the hotel should provide a copy of the testing results to the health department.

CASES ASSOCIATED WITH A COMMUNITY

If **multiple confirmed cases** of Legionellosis (e.g., in residents, visitors/travelers, etc.) are reported within a one-year period with exposure to the same community AND no potential common source has been identified, notify EAIDB at (800) 252-8239 or (512) 776-7676.

A cluster of Legionellosis cases with a common exposure can involve both Legionnaires' disease and Pontiac fever and health departments should be alert to this possibility. Questions regarding ill contacts of Legionnaires' disease case patients should not be limited to persons with symptoms of pneumonia.

The local/regional health department should:

- Identify the investigation team and available resources
 - Contact DSHS if assistance is needed.
- Establish the existence of an outbreak
 - Acquire and examine baseline data, if available
 - Verify that the “outbreak” is not a reporting or surveillance artifact
- Verify the diagnosis
 - Obtain clinical records and lab reports
 - Conduct additional clinical testing if needed
 - Ask facilities to retain *Legionella* isolates/cultures (if culture was performed)
- Construct a case definition (define person, place and time)
- Find cases systematically and develop a line listing
 - Promptly initiate case finding in the community.
 - Inform primary care physicians, emergency room staff and radiologists in the potential outbreak area and any other locations necessary of the following:
 - That there is a cluster of Legionellosis cases
 - The signs and symptoms of Legionellosis
 - How a case of Legionellosis is diagnosed
 - Preferred testing methods to identify Legionellosis cases
 - Recommendations for which patients to test (e.g., patients with community-acquired pneumonia)
 - Reporting requirements and contact information for the health department
 - Contact local hospital infection control staff and emergency room staff to determine whether they have observed an increase in community-acquired pneumonia patients admitted to the facility.
 - Cultures should be requested to be sent to the public health laboratory and held appropriately.
 - Consider notifying state and national partners, providers and healthcare facilities of the increase (e.g., Epi-X notification).
 - Case finding will involve passive and active surveillance.
 - All cases should be interviewed* with the Legionellosis Investigation Report Form or with a Legionellosis hypothesis-generating form.
- Perform descriptive epidemiology/develop hypotheses
 - Interview the cases with a hypothesis-generating questionnaire or other extensive, open-ended questionnaire in order to identify common exposures.
 - The CDC’s hypothesis-generating questionnaire for Legionellosis is available at <http://www.cdc.gov/legionella/health-depts/inv-tools-single/index.html>.
 - Map cases to identify commonalities in location or proximity to possible environmental sources.
 - Create an epidemic curve.

- Evaluate hypotheses/perform additional studies as necessary
 - Conduct epidemiologic studies (e.g., case-control study) necessary to identify the source(s) of the outbreak.
 - Conduct an environmental investigation
 - Assess the community to identify possible sources of exposure (e.g., cooling towers, chiller units, supermarket/restaurant misters, swamp coolers, decorative fountains, whirlpool spas, municipal water system, wells and streams)
 - Collect and test environmental samples for *Legionella* as appropriate.
 - Ask environmental testing labs to retain cultures/isolates that are outbreak-related so that these may be compared to clinical isolates.
- Implement control measures
 - General control measures should be implemented immediately.
 - Control measures for source control should be implemented as soon as a likely source is identified.
 - Do not wait for laboratory results on suspected sources before implementing control measures.

*Note: The incubation period for Legionnaires' disease is most commonly 2-10 days, with an average of 5-6 days, but has been reported to be up to 19 days in rare cases. For routine surveillance purposes, exposure histories are collected for the 10 days prior to onset. However, in outbreak settings where it is important to consider a wide range of possible sources, use of a 14-day incubation period is often desirable.

REPORTING AND DATA ENTRY REQUIREMENTS

Provider, School, Child-Care Facility, and General Public Reporting Requirements

Confirmed and clinically suspected cases of Legionellosis should be reported **within 1 week** of suspicion to the local or regional health department or to DSHS EAIDB at **(800) 252-8239** or **(512) 776-7676**.

Local and Regional Reporting and Follow-up Responsibilities

Local and regional health departments should:

- **Notify DSHS within 1 business day of when a healthcare-associated or travel-related exposure is identified.**
- Notify facilities (e.g., hotels, long-term care facilities, hospitals, etc.) within the LHD/HSR's jurisdiction when these facilities are identified by an investigation of a confirmed Legionellosis case-patient as possible sources of exposure during the case's incubation period.
- Enter the case into NBS and submit an NBS notification on all confirmed cases to DSHS within 30 days of receiving a report of confirmed Legionellosis.
 - Please refer to the *NBS Data Entry Guidelines* for disease-specific entry rules.
- Fax, securely e-mail, or mail a completed investigation form **as soon as the investigation is complete.**
 - DSHS compares reported exposure information on investigation forms to that of previously reported Legionellosis cases in order to identify clusters and outbreaks. Since exposure history is not captured in NBS, the investigation form is the only way in which this information is usually reported.
 - Investigation forms may be faxed to **512-776-7616**, securely emailed to the IRID Epidemiologist I or IRID team lead, or mailed to:
 - Infectious Disease Control Unit
 - Texas Department of State Health Services
 - Mail Code: 1960
 - PO Box 149347
 - Austin, TX 78714-9347

When an outbreak is investigated, local and regional health departments should:

- Report outbreaks within 24 hours of identification to the regional DSHS office or to EAIDB at **512-776-7676**.
- Submit a completed **National Outbreak Reporting System (NORS)** outbreak form at the conclusion of the outbreak investigation.
 - Enter into NORS online reporting system at <https://wwwn.cdc.gov/nors/login.aspx>
 - Forms, training materials, and other resources are available at <http://www.cdc.gov/nors/>
 - To request a NORS account, please email FoodborneTexas@dshs.state.tx.us
 - Please put in Subject Line: NORS User Account Request
 - Information needed from requestor: name, email address, and agency name
 - After an account has been created a reply email will be sent with a username, password and instructions for logging in.
- Submit a completed **Respiratory Disease Outbreak Summary Form** at the conclusion of the outbreak investigation.
 - Please include a copy of the completed environmental assessment and *Legionella* environmental testing results, if done.
 - Fax or send a secure email of a copy to the DSHS regional office and/or to EAIDB at 512-776-7676. The secure email should be sent to the IRID Epidemiologist I or IRID team lead at EAIDB.
 - The Respiratory Disease Outbreak Summary Form is available at <http://www.dshs.state.tx.us/idcu/investigation/>.

CLINICAL LABORATORY PROCEDURES

Specimens and isolates associated with Legionellosis cases are not routinely submitted to the DSHS laboratory in Austin. When multiple Legionellosis cases are associated with a single facility, DSHS will accept **isolates** from other laboratories conducting environmental testing if patient isolates (*Legionella* culture from clinical specimens) are available for comparison.

Contact EAIDB at 512-776-7676 for approval:

- When submitting clinical or environmental isolates to the DSHS Austin lab that are related to an outbreak
- To request molecular typing at CDC's lab to confirm that isolates from cases are identical (case-patients are exposed to the same source)

Specimen Collection

Clinical specimen

- Acceptable specimens: sputum, bronchial washing, tracheal aspirate, or lung biopsy
- Bronchial washing or tracheal aspirate:
 - Collect washing or aspirate using sterile water, not saline
 - 2mL minimum volume needed
 - Refrigerate at 2°–8 °C. Do not freeze.
- Sputum, expectorated:
 - Collect in a sterile container
 - Collect specimen under the direct supervision of a nurse or physician
 - Have patient rinse or gargle with water first to remove excess oral flora
 - Instruct patient to cough deeply to produce a lower respiratory specimen (not postnasal fluid)
 - For pediatric patients unable to produce a sputum specimen, a respiratory therapist should collect a specimen via suction. The best specimen should have <10 squamous cells/100X field (10X objective and 10X ocular).
 - Refrigerate at 2 °–8 °C. Do not freeze.
- Sputum, induced:
 - Collect in a sterile container
 - Have patient rinse mouth with water after brushing gums and tongue
 - With the aid of a nebulizer, have patient inhale approximately 25 ml of 3-10% sterile saline
 - Refrigerate at 2 °–8 °C. Do not freeze.
- Lung biopsy:
 - Collect during surgery or cutaneous biopsy procedure
 - Place in an anaerobic transport system or sterile, screw-cap container
 - Add several drops of sterile saline to keep small pieces of tissue moist
 - Always submit as much tissue as possible. If excess tissue is available, save a portion of surgical tissue at -70°C in case further studies are needed. Never submit a swab that has been rubbed over the surface of a tissue.
 - Refrigerate at 2°–8°C. Do not freeze.
 - Do not suspend the specimen in formalin or other preserving liquid.

Clinical isolates (pure cultures)

- Submit a pure culture on a BCYE slant
- May be kept at ambient temperature

Laboratory Submission Form

- For clinical specimens and isolates, use the DSHS Laboratory G-2B Submission Form.
 - For clinical specimens: On the form under “Section 5. BACTERIOLOGY” check the box for “Aerobic isolation” under “*Clinical Specimen*” and write “Legionella” in the open space.

Section 5. BACTERIOLOGY			
<u>Clinical specimen:</u>		<u>Definitive Identification:</u>	
<input checked="" type="checkbox"/>	Aerobic isolation	<i>Legionella</i>	<input type="checkbox"/> Bacillus <input type="checkbox"/> Campylobacter
<input type="checkbox"/>	Anaerobic isolation		<input type="checkbox"/> Enteric Bacteria
<input type="checkbox"/>	Culture, stool		<input type="checkbox"/> Gram Negative Rod
<input type="checkbox"/>	Diphtheria Screen		<input type="checkbox"/> Gram Positive Rod
<input type="checkbox"/>	GC/CT, amplified RNA probe		<input type="checkbox"/> Group B Streptococcus (Beta Strep)
<input type="checkbox"/>	Haemophilus, isolation		<input type="checkbox"/> Haemophilus
<input type="checkbox"/>	Toxic shock syndrome toxin I		<input type="checkbox"/> Legionella
<input type="checkbox"/>	<u>assay (TSST 1)</u>		<input type="checkbox"/> Neisseria
<input type="checkbox"/>	Pure culture:		<input type="checkbox"/> Pertussis / Bordetella
<input type="checkbox"/>	Anaerobic identification		<input type="checkbox"/> Staphylococcus
<input type="checkbox"/>	Organism suspected: _____		<input type="checkbox"/> Streptococcus <input type="checkbox"/> Other

- For clinical isolates: On the form under “Section 5. BACTERIOLOGY” check the box for “Legionella” under “*Definitive Identification*”.

Section 5. BACTERIOLOGY			
<u>Clinical specimen:</u>		<u>Definitive Identification:</u>	
<input type="checkbox"/>	Aerobic isolation	<input type="checkbox"/> Bacillus	<input type="checkbox"/> Campylobacter
<input type="checkbox"/>	Anaerobic isolation	<input type="checkbox"/> Enteric Bacteria	
<input type="checkbox"/>	Culture, stool	<input type="checkbox"/> Gram Negative Rod	
<input type="checkbox"/>	Diphtheria Screen	<input type="checkbox"/> Gram Positive Rod	
<input type="checkbox"/>	GC/CT, amplified RNA probe	<input type="checkbox"/> Group B Streptococcus (Beta Strep)	
<input type="checkbox"/>	Haemophilus, isolation	<input type="checkbox"/> Haemophilus	
<input type="checkbox"/>	Toxic shock syndrome toxin I	<input checked="" type="checkbox"/> Legionella	
<input type="checkbox"/>	<u>assay (TSST 1)</u>	<input type="checkbox"/> Neisseria	
<input type="checkbox"/>	Pure culture:	<input type="checkbox"/> Pertussis / Bordetella	
<input type="checkbox"/>	Anaerobic identification	<input type="checkbox"/> Staphylococcus	
<input type="checkbox"/>	Organism suspected: _____	<input type="checkbox"/> Streptococcus	<input type="checkbox"/> Other

- For clinical specimens and isolates, make sure the patient's name and approved secondary identifier on the form exactly match what is written on the specimen tube. Make sure to fill in the date of collection, date of onset and diagnosis/symptoms.
 - An approved secondary identifier should be one of the following: date of birth, medical record number, social security number, Medicaid number, or CDC number.

Specimen Shipping

- Transport temperature for clinical specimens: Keep at 2°–8°C (refrigerated/ice packs). Do not use dry ice.
- Transport temperature for isolates (pure culture): May be shipped at ambient temperature. Do not use dry ice.
- Ship specimens via overnight delivery on cold packs or wet ice (double bagged) within 24 hours of collection if possible.
 - Note: While *Legionella* may survive extended transport, their isolation may be compromised by overgrowth of commensal bacteria in the specimens; therefore, specimens should arrive at the laboratory as soon as possible for the best results.
- DO NOT ship specimens on a Friday or the day before a state holiday unless special arrangements have been made with the DSHS Laboratory.
- Ship specimens to:

Laboratory Services Section, MC-1947
 Texas Department of State Health Services
 Attn. Walter Douglass (512) 776-7569
 1100 West 49th Street
 Austin, TX 78756-3199

Frequent Causes for Rejection:

- Sputum specimen consists of saliva only
- Insufficient quantity submitted for testing
- Discrepancy between name on specimen container and name on submission form
- Container broken in transport
- Expired media used

Results Available:

- Culture results typically available in 3–21 days (15 days of no growth = negative result)

ENVIRONMENTAL SAMPLING AND TESTING

Inhalation of aerosols containing *Legionella* is presumed to be the primary means of acquiring Legionellosis. Aerosolized waters from cooling towers, evaporative condensers, showers and humidifiers have been identified as sources of infection. *Legionella* species have been recovered from a wide variety of domestic water systems and are ubiquitous in freshwater environments. Domestic water systems are complex environments in which concentrations of legionellae can fluctuate considerably depending upon water temperature, biocide levels and presence of natural hosts (i.e., protozoa) for legionellae to parasitize.

Recommendations for Environmental SamplingWhen to Sample:

- Hotels, gyms, spas and other similar facilities
 - Baseline environmental sampling (in the absence of associated cases) is not recommended.
 - Environmental testing is not recommended for a single case whose illness may be associated with a hotel or similar facility.
 - Environmental sampling should be considered when more than one case of Legionellosis is associated with a hotel or similar facility within a one-year period and the epidemiological investigation or environmental assessment identifies potential exposures or sources of infection.
 - Environmental sampling should be done if remediation efforts were implemented and a new case is identified with exposure occurring after remediation was done.

- Sampling should only be performed after a thorough environmental assessment has been done and a sampling plan has been made. The sampling plan should be approved by the health department.
- Healthcare facilities
 - Baseline environmental sampling for *Legionella* (no patient cases detected)
 - All healthcare facilities should, in implementing their Legionellosis control plan, assess their risk of *Legionella* transmission. Each facility should evaluate environmental, engineering and patient population factors to determine whether there is a reasonable potential for nosocomial transmission.
 - Baseline water distribution system cultures should be performed if the results of the risk assessment indicate the facility has a significant risk of *Legionella* transmission.
 - For more information on assessing a facility's risk of *Legionella* transmission, see the Report of the Texas Legionnaires' Disease Task Force (www.dshs.texas.gov/idcu/disease/legionnaires/taskforce/) and ANSI/ASHRAE Standard 188-2015.
 - Environmental sampling in the context of a patient case(s)
 - Water testing should be considered when one definite healthcare-associated case or two or more possible healthcare-associated cases of Legionellosis are associated with a facility within a one-year period.
 - Water testing should be done if remediation efforts were implemented and a new case is identified with exposure occurring after remediation was done.

Sampling Considerations and Procedures:

- Purpose of sampling: To determine the source of transmission and extent of colonization
- Sampling should only be performed after a thorough environmental assessment has been done and a sampling plan has been made. The sampling plan should be approved by the health department.
- If environmental sampling is pursued, the samples should be collected and processed in a way that maximizes the recovery of *Legionella*.
- Instructional/training videos: “How to Make a Sampling Plan”, “How to Sample Potable Water”, “How to Sample Cooling Towers”, and “How to Sample Spas and Fountains” at <http://www.cdc.gov/legionella/videos.html>
- **Choosing Sites for Sampling:**
 - See CDC's “Sampling Procedure and Potential Sampling Sites” document: <http://www.cdc.gov/legionella/health-depts/inv-tools-cluster/environmental-inv-tools.html>
 - Potential sampling sites for hotels include hot tubs/whirlpools (including filters, jets, tanks, water lines, etc.); swimming pools (including skimmer baskets); showerheads and faucets in pool showering facilities, if applicable; decorative fountains; potable water supply to and within the facility (including hot water heaters, holding tanks, water returns, etc.); cooling towers; sprinkler systems; and potential sources of exposure in guest rooms (faucets, showerheads, etc.).
 - Potential sampling sites for healthcare facilities include potable water supply to and within the facility (including hot water heaters, holding tanks, water returns, etc.); potable water outlets (faucets, showers, etc.), especially those in or near patient rooms; ice machines; cooling towers and evaporative condensers; humidifiers (e.g., nebulizers) and other respiratory therapy equipment; and other potential sources of exposure (e.g., decorative fountains, whirlpools, safety showers and eyewash stations, etc.).
 - All showers and faucets in all case rooms (primary room where case stayed and other rooms where case exposures may have occurred [e.g., surgical recovery rooms]) should be sampled, along with showers and sink faucets in additional rooms.

- Choose rooms proximal and distal to risers or hot water heaters and on various floors based on the results of the environmental assessment.
- Ideally, sample at least a couple of outlets on every floor and/or wing. Some sites should also be selected at random for sampling.
- In most situations, it is appropriate to sample only the hot water. However, there are situations where taking some cold water samples is helpful.
 - For example, in hot climates (like Texas!), the cold water may be warm enough for rapid *Legionella* amplification (>77°F).
 - Note: In most recent *Legionella* outbreak investigations in Texas, some cold water samples were collected in addition to hot water samples.
 - Desalination may elevate cold water temperature.
 - Cold water could be warm due to lack of insulation between hot and cold water pipes.
 - The results of the environmental assessment (if done properly/completely) can help to determine if cold water samples should be collected.
- **Number of Samples to Collect:**
 - The number of samples to be collected should be based on a plan (to limit the expense and time associated with sample collection and testing)
 - The sampling plan should be based on the findings of the environmental assessment and available epidemiologic data (i.e., water sources and locations where patients may have been exposed)
 - The number of samples to collect may depend on:
 - The size and design of the facility (e.g., number of floors, wings, rooms, buildings, etc.)
 - The design and configuration of the water system including the presence of dead legs, number and type of components, types of heating systems, etc.
 - The facility's sources of possible aerosolized or aspirated water (e.g., cooling towers, air handling systems, showers, faucets, decorative fountains, ice machines, whirlpools, etc.)
 - The number of Legionellosis cases associated with the facility and their reported exposures in/near the facility
 - The facility's patient population
 - Other factors specific to the facility
 - In the smallest facilities, at least 10 environmental samples should be collected; however, in most cases 10 samples will not be sufficient for representative sampling. In larger or more complex facilities, 100+ samples may need to be collected in order to be representative and increase the odds of detection of *Legionella* that may be in the water system.
 - See CDC's "Sampling Procedure and Potential Sampling Sites":
<http://www.cdc.gov/legionella/health-depts/inv-tools-cluster/environmental-inv-tools.html>
 - DSHS Austin and CDC can offer assistance in determining the number of samples and locations of sample sites.

- **Collection Recommendations and Procedures:**
 - Environmental sampling should be a joint effort by the facility (particularly building systems staff/facilities engineers), the facility's *Legionella* consultant, the testing laboratory and the local health department (epidemiologist and environmental health specialist).
 - Environmental sampling should be well planned in advance to ensure that all required staff and supplies are present.
 - For sample collection procedures, please refer to CDC's "Sampling Procedure and Potential Sampling Sites" document (<http://www.cdc.gov/legionella/health-depts/inv-tools-cluster/environmental-inv-tools.html>). This document covers:
 - Materials (required and optional)
 - Safety precautions
 - Sampling procedures:
 - Potable water at the points of use
 - Additional note on collection of water from handheld showerheads:
 - Handheld showerheads differ from traditional fixed showerheads because water may stagnate in the tubing increasing the risk for *Legionella* growth.
 - If the facility has handheld showerheads, collect a sample from the handheld showerhead tubing before collecting the bulk water sample. Collect a swab sample (if feasible) from the tubing and collect a water sample by capturing the water from the tubing.
 - Sampling from handheld showerheads will result in additional samples (2 biofilm swabs [1-flexible tubing, 1-water pipe], 2 bulk water [1-tubing residual, 1-bulk water from pipe]).
 - Potable water at the hot water heaters
 - Whirlpool spas
 - List of potential sampling sites (from potable water, cooling towers, whirlpool spas, and other sources)
- Collection of 1 (one) liter (1 L) of water is preferred.
 - If a liter cannot be collected from a sample source, the **minimum acceptable sample size during an active investigation is 250 ml**.
 - Larger volumes of water (1 to 10 liters) are needed to detect legionellae in water that has very low concentrations of these bacteria such as municipal water supplies.
- In addition to water samples, biofilm swabs should be taken from most sites, when possible.
- The sampling team should also test the water quality (i.e., residual chlorine, temperature and pH) at sampling sites.
- All samples should be transported to the laboratory in insulated coolers as protection against extreme heat or cold.
 - Samples that will not reach the laboratory within 72 hours should be refrigerated before shipping.
 - Samples that reach the laboratory but cannot be processed within 72 hours of collection should be refrigerated.
- For more information, see <http://www.cdc.gov/legionella/health-depts/inv-tools-cluster/lab-inv-tools/procedures-manual.html>

- Recommended minimum frequency of (environmental) retesting, in an outbreak setting:
 - Once interventions are in place, culture water to detect any legionellae:
 - Every 2 weeks for 3 months; if cultures are negative, then
 - Once per month for the next 3 months
 - If legionellae are detected the 6 month process must be restarted.

Laboratory Testing of Environmental Specimens

- Testing of environmental samples should be performed by an ELITE-certified laboratory capable of culturing *Legionella* species. A list of ELITE-certified laboratories is available at <https://wwwn.cdc.gov/elite/Public/MemberList.aspx>.
- Inform the testing laboratory that the testing is being performed as part of an outbreak investigation. (Some laboratories have different protocols for collecting and testing specimens for non-outbreak purposes.)
- The traditional ISO spread plate method should be used for testing during outbreak investigations (i.e., during initial detection and throughout remediation and repeat testing cycles).
- *Legionella* isolates from environmental testing related to clusters or outbreaks should be speciated, serotyped and retained for future studies.
 - If isolates cannot be retained by the testing laboratory, they may be forwarded to the DSHS Austin lab once approval is received from EAIDB.
- The DSHS laboratory will accept isolates (for speciation and serogrouping) from environmental sources if there is also an isolate available from a human case associated with the facility for comparison.
- Molecular typing of *Legionella* isolates is available from CDC (contact DSHS to request this testing) and can be helpful to:
 - Confirm that isolates from cases are identical (i.e., case-patients were exposed to the same source)
 - Compare clinical to environmental isolates to narrow down the list of potential environmental sources

ADDITIONAL RESOURCES

Training and Informational Videos

- CDC's *Legionella* Environmental Investigation Videos (<http://www.cdc.gov/legionella/videos.html>):
 - *Legionella* Ecology and an Introduction to Environmental Health and Engineering
 - Conducting and Interpreting the Environmental Assessment
 - How to Make a Sampling Plan
 - How to Sample Potable Water
 - How to Sample Cooling Towers
 - How to Sample Spas and Fountains
- CDC *Legionella* training videos and presentations that were part of the Water, Sanitation, and Hygiene (WASH) webinar series in 2010 are available from DSHS upon request:
 - WASH Webinar #1: Legionellosis Outbreak Investigations; Environmental Assessment
 - WASH Webinar #3: Public Health Response; Importance of Molecular Typing

National Guidance for Environmental and Laboratory Investigation

- Additional resources for environmental sampling and testing are available from CDC's Legionella Epidemiologist Investigation Tools website at <http://www.cdc.gov/legionella/health-depts/inv-tools-cluster/index.html>.
- Occupational Safety and Health Administration (OSHA) Legionnaires' disease eTool (sources identification and control procedure, and water sampling guidelines for *Legionella*—Section II): <https://www.osha.gov/dts/osta/otm/legionnaires/>

Water System Maintenance

- CDC's Water System Maintenance website: <http://www.cdc.gov/legionella/water-system-maintenance.html>
- Model Aquatic Health Code (for swimming pools, hot tubs/whirlpool spas, interactive fountains, waterparks): <https://www.cdc.gov/mahc/index.html>
- American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)-Guideline 12-2000--Minimizing the Risk of Legionellosis Associated with Building Water Systems: www.techstreet.com/cgi-bin/detail?product_id=232891
- ANSI/ASHRAE Standard 188-2015--Legionellosis: Risk Management for Building Water Systems: <http://www.r2j.com/wp-content/uploads/2017/10/ASHRAE-188-2015.pdf>
- CDC's FAQ for ASHRAE 188-2015: <http://www.cdc.gov/legionella/health-depts/ashrae-faqs.html>
- CDC's toolkit -- Developing a Water Management Program to Reduce Legionella Growth and Spread in Buildings: A Practical Guide to Implementing Industry Standards: <https://www.cdc.gov/legionella/downloads/toolkit.pdf>
- Operating Public Hot Tubs: <http://www.cdc.gov/healthywater/pdf/swimming/resources/operating-public-hot-tubs-factsheet.pdf>
- Disinfection of Hot Tubs Contaminated with *Legionella*: <http://www.cdc.gov/legionella/downloads/hot-tub-disinfection.pdf>
- Other pool and hot tub operation recommendations: <http://www.cdc.gov/healthywater/swimming/pools/design-operation-pools-hot-tubs.html>
- EPA's -- Technologies for Legionella Control in Premise Plumbing Systems: Systematic Review: <https://www.epa.gov/ground-water-and-drinking-water/technologies-legionella-control-premise-plumbing-systems>

UPDATES

January 2018

- **Definition:** removed the definitely and possibly travel-associated case categories and their definitions and created a single travel-associated case category definition
- **Surveillance and Case Investigation:** updated web addresses, added a request for health departments (regional and local) to send in medical records for a legionellosis case with the completed case investigation form, and added that case investigation forms may be sent to DSHS by secure email
- **Reporting and Data Entry Requirements:** added that completed case investigation forms and the Respiratory Disease Summary Outbreak Form may be sent to the IRID Epidemiologist I or IRID team lead by secure email
- **Clinical Laboratory Procedures:** updated the pictures of the G-2B form
- **Environmental Sampling and Testing:** updated web address
- **Additional Resources:** updated the Model Aquatic Health Code web address