

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

A PRACTICAL GUIDE TO IMPLEMENTING INDUSTRY STANDARDS



U.S. Department of Health and Human Services
Centers for Disease Control and Prevention



Foreword

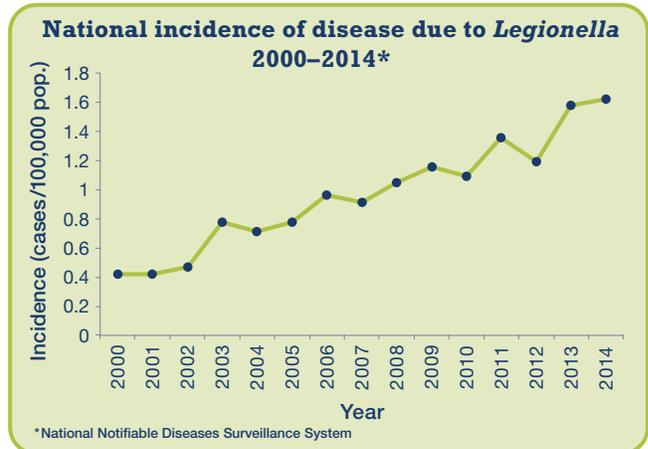
Legionnaires' disease is a serious type of pneumonia caused by bacteria, called *Legionella*, that live in water. *Legionella* can make people sick when they inhale contaminated water from poorly maintained building water systems. Unfortunately, Legionnaires' disease is on the rise in the United States. To reverse this trend, we are asking for your help to make sure the water in your building is safe from *Legionella*.

Your building may need a water management program to minimize the risks for Legionnaires' disease associated with your building water system and devices. This water management program should identify areas or devices in your building where *Legionella* might grow or spread to people so that you can reduce that risk. *Legionella* water management programs are now an industry standard for large buildings in the United States (ASHRAE 188: *Legionellosis: Risk Management for Building Water Systems* June 26, 2015. ASHRAE: Atlanta).

This toolkit will help you develop and implement a water management program to reduce your building's risk for growing and spreading *Legionella*. If you already have a program, this toolkit will help you assess and strengthen it. Included are practical resources to help you ensure that your water management program is comprehensive, effective, and in line with industry standards. This toolkit also highlights special considerations for healthcare facilities.

Because building water systems vary in their design and complexity, examples in this toolkit are only meant to help you understand the process. You should develop a water management program to reduce *Legionella* growth and spread that is specific to your building.

Feedback on this toolkit can be provided by emailing RDB@cdc.gov. For additional information about Legionnaires' disease, visit www.cdc.gov/legionella.



In the United States, reported cases of Legionnaires' disease have increased nearly 300% since 2000. More illness occurs in the summer and early fall but can happen any time of year.

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How to Use This Toolkit

If you've never developed a *Legionella* water management program (a plan to reduce the risk of *Legionella* growth and spread), you might not be sure where or how to start. This toolkit will provide guidance to help you develop, implement, and evaluate a *Legionella* water management program for your building. Be sure to follow all relevant federal, state, and local laws, regulations, and ordinances. If anything in this toolkit conflicts with these policies, always adhere to the policies.

Where do we start?

The first step is to determine if you even need a program. You can use the worksheet on page 2 to find out if your entire building or parts of it are at increased risk for *Legionella* growth and spread. If you learn that you need to develop a program, this toolkit will explain what steps you should take and give several examples to clarify the process.

Do we really need a water management program to prevent *Legionella* growth and spread?

If you answer **YES** to any of the questions on page 2, then yes! Developing and implementing a program means that you are helping to protect people who walk past the outside of or enter your building from getting Legionnaires' disease, a serious type of pneumonia (see Appendix A for more information on this disease).

Is this toolkit full of scientific terms?

You might come across some technical terms that are unfamiliar. The glossary on page 3 and the introduction to *Legionella* on pages 4–5 should help you with these terms.

Will this toolkit tell us everything that we need to do?

No. Because every building is unique, only you have access to all the information that is needed to develop and implement a program specific to your building. An example of a building is included to help illustrate some of the steps. It's important to know that these examples are not comprehensive and you will need to create a program specific to your building water system and devices.

This toolkit looks really long. What's the bottom line?

You need to actively manage hazardous conditions for growth and spread of *Legionella*. As you work through the toolkit, you'll learn about the importance of identifying and controlling hazardous conditions that increase the chance of *Legionella* growth and spread. The bottom line is that you need to:

- ◆ Identify hazardous conditions in your building water system
- ◆ Assess how much of a risk the hazardous conditions pose
- ◆ Apply control measures to the hazardous conditions, whenever possible, to prevent *Legionella* growth and spread

Is there anyone who can help us develop our program?

Yes. As you'll learn in the toolkit, it's recommended that you form a water management team. Your team should include a variety of people who bring different skills to the table (learn more on page 7). You might already have all the expertise you need on staff, but sometimes you will need to get outside help. Don't forget about your friendly plumber, who may be able to help you identify how your building water system and devices function.

What do all of the gray boxes mean?

Gray boxes throughout the document highlight program elements that are especially relevant for healthcare facilities.

Identifying Buildings at Increased Risk

Survey your building (or property) to determine if you need a water management program to reduce the risk of *Legionella* growth and spread.

If you answer **YES to any of questions 1 through 4, you should have a water management program for *that building's* hot and cold water distribution system.**

Healthcare Facilities

Yes ___ No ___ 1. Is your building a healthcare facility where patients stay overnight or does your building house or treat people with chronic and acute medical problems[†] or weakened immune systems?

Yes ___ No ___ 2. Does your building primarily house people older than 65 years (like a retirement home or assisted-living facility)?

Yes ___ No ___ 3. Does your building have multiple housing units and a centralized water-heater system (like a hotel)?

Yes ___ No ___ 4. Does your building have more than 10 stories (including basement levels)?

Devices in buildings that can spread contaminated water droplets need a water management program even if the building itself does not. If you answer **NO to all of questions 1 through 4 but **YES** to any of questions 5 through 8, you should have a water management program for *that device*.**

Yes ___ No ___ 5. Does your building have a cooling tower*?

Yes ___ No ___ 6. Does your building have a hot tub (also known as a spa) that is not drained between uses?

Yes ___ No ___ 7. Does your building have a decorative fountain?

Yes ___ No ___ 8. Does your building have a centrally-installed mister, atomizer, air washer, or humidifier?

On properties with multiple buildings, prioritize buildings that house or treat people who are at increased risk for Legionnaires' disease (see Appendix A to learn who is at increased risk).

Single-family or small multiple-family residences (e.g., duplexes), even those with the devices in questions 6 through 8, do NOT need water management programs, but residents do need to take steps to protect themselves from waterborne diseases.

Homeowners should follow local and state guidelines for household water use, and owners of the devices in questions 6 through 8 should follow the manufacturer's instructions regarding cleaning, disinfecting, and maintenance. Learn more about healthy water at cdc.gov/healthywater.

Reference: ASHRAE 188: *Legionellosis: Risk Management for Building Water Systems* June 26, 2015. ASHRAE: Atlanta. www.ashrae.org

[†]Burns, cancer, solid organ or bone marrow transplant, renal disease, diabetes, or chronic lung disease

*For a definition of a cooling tower, visit www.cti.org/whatis/coolingtower.shtml.

Glossary

Biofilm (slime): Germs and the slime they secrete that stick to and grow on any continually moist surface; provides housing, food, and security for many different types of germs, including *Legionella*

Building water systems: Includes hot and cold water distribution and all devices that use water people can be exposed to, such as cooling towers, hot tubs, and decorative fountains

Control: To manage the conditions within your building according to your water management program

Control measures: Things you do in your building water systems to limit growth and spread of *Legionella*, such as heating, adding disinfectant, or cleaning

Control limits: The maximum value, minimum value, or range of values that are acceptable for the control measures that you are monitoring to reduce the risk for *Legionella* growth and spread

Control points: Locations in the water systems where a control measure can be applied

Contingency response: Reaction to control measures that are persistently outside of control limits or events that pose an immediate risk to control of your building water systems; required for all instances when Legionnaires' disease occurs, but may also be appropriate for unexpected events such as equipment failure or acts of nature that disrupt the water system

Corrective action: Steps taken to return control measures to acceptable levels

Dead legs: Piping that is subject to low or no flow due to design or decreased water use such as capped pipes or unused faucets

Disinfectant: Chemical or physical treatment used to kill germs, such as chlorine, monochloramine, chlorine dioxide, copper-silver ionization, ultraviolet light, or ozone

Hazardous conditions: Anything that, if not controlled, would contribute to the growth and spread of *Legionella* to a person

Heterotrophic plate counts: A measure of the number and variety of bacteria that are common in water; a high count may indicate the need for corrective action

***Legionella*:** Bacteria that can cause Legionnaires' disease

Legionnaires' disease: A serious type of pneumonia caused by *Legionella*

Residual: The amount of disinfectant available in water to kill germs

Scale and sediment: The mineral build-up in a water system that uses up disinfectant and supports germ growth and/or survival

Stagnation: When water does not flow well; areas of stagnant water encourage biofilm growth, reduce temperature and level of disinfectant, and are sometimes known as 'dead legs'

Introduction to *Legionella*

Legionella is found naturally in freshwater environments, like lakes and streams, but generally the low amounts in freshwater do not lead to disease. *Legionella* can become a health problem in building water systems when water is aerosolized and people inhale the droplets. To pose a health risk, *Legionella* first has to **grow**. Then it has to be **aerosolized** so people can breathe in small, contaminated water droplets.

Factors internal to buildings that can lead to *Legionella* growth

- **Biofilm:** Protects *Legionella* from heat and disinfectant; provides food and shelter to germs; grows on any surface that is constantly moist and can last for decades
- **Scale and sediment:** Uses up disinfectant and facilitates growth of germs
- **Water temperature fluctuations:** Provide conditions where *Legionella* grows best (77°F–108°F)

Many things can cause the hot water temperature to drop into the range where *Legionella* can grow, including low settings on water heaters, heat loss as water travels through long pipes away from the heat source, mixing cold and hot water within the plumbing system, heat transfer (when cold and hot water pipes are too close together), or heat loss due to water stagnation. In hot weather, cold water in pipes can heat up into this range.

- **Inadequate disinfectant:** Does not kill or inactivate *Legionella*

Even if the water entering your building is of high quality, it is still NOT sterile. In some buildings, processes such as heating and storage can degrade the quality of the water. These processes use up the disinfectant the water entered with, allowing the few *Legionella* that entered to grow into a large problem if not controlled.

- **Water stagnation:** Encourages biofilm growth and reduces temperature and levels of disinfectant

Common issues that contribute to water stagnation include renovations that lead to ‘dead legs’ and reduced building occupancy, which can occur in hotels during off-peak seasons, for example. Stagnation can also occur when fixtures go unused, like a rarely used shower in a hospital room.

Where can *Legionella* grow?

Legionella can grow in many parts of building water systems that are continually wet, including:

- Hot and cold water storage tanks
- Water heaters
- Water-hammer arrestors
- Expansion tanks
- Water filters
- Electronic faucets
- Aerators
- Faucet flow restrictors
- Shower heads and hoses
- Nonsteam aerosol-generating humidifiers
- Infrequently used equipment, including eyewash stations
- Ice machines

What spreads *Legionella*?

Examples of devices that can spread contaminated water droplets include:

- Hot tubs
- Cooling towers
- Decorative fountains
- Showers
- Centrally-installed misters, atomizers, air washers, and humidifiers
- Medical devices (such as CPAP machines, hydrotherapy equipment, bronchoscopes)

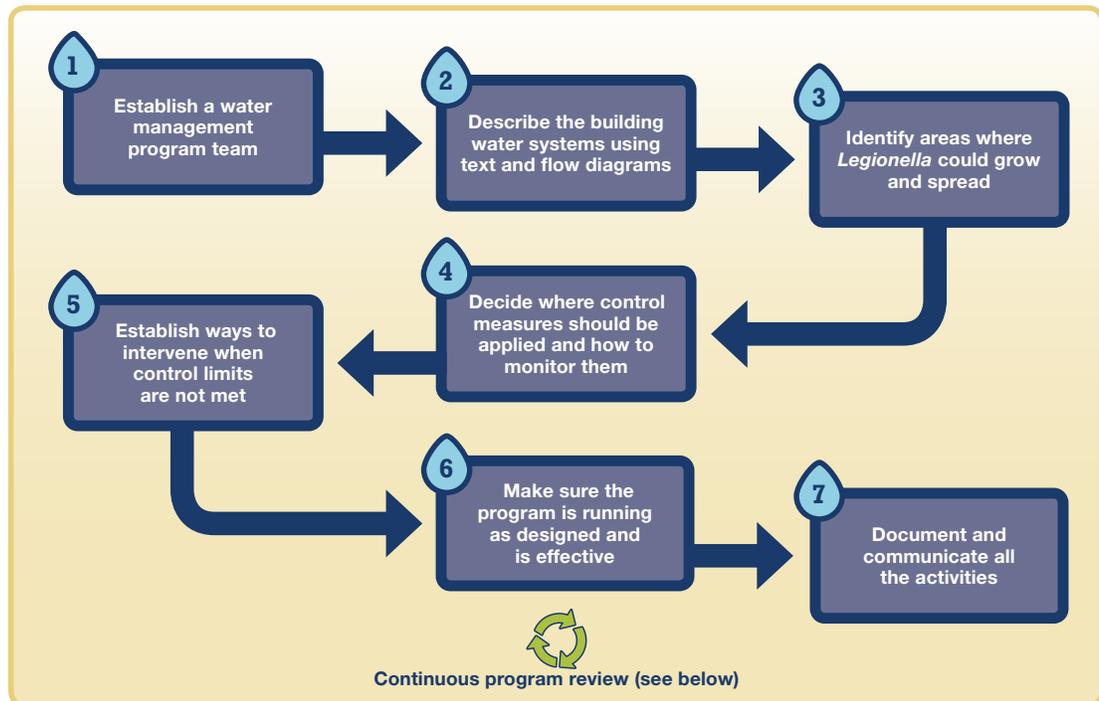
Factors external to buildings that can lead to *Legionella* growth

- ◆ **Construction:** Vibrations and changes in water pressure can dislodge biofilm and free *Legionella* into the water entering your building.
- ◆ **Water main breaks:** Changes in water pressure can dislodge biofilm and free *Legionella* into the water, while dirt and other materials can be introduced into the water and use up disinfectant.
- ◆ **Changes in municipal water quality:** Increases in dirt and other material can use up disinfectant. Broken pumps or delivery systems can reduce the level of disinfectant in the water entering your building. Changes in disinfectant type can impact how you should monitor your program.



Elements of a Water Management Program

Developing and maintaining a water management program is a multi-step, continuous process. The key steps, listed here, are explained in more detail throughout the toolkit with the associated step number appearing on the page where the specific step is discussed.



Program Review

You need to **review** the elements of your program at least once per year. Make sure you also review and revise your program when any of the following unplanned events occur:

- 💧 Data review shows control measures are persistently outside of control limits
- 💧 A major maintenance or water service change occurs, such as:
 - New construction
 - Equipment changes (e.g., new cooling tower)
 - Changes in treatment products (e.g., disinfectants)
 - Changes in occupancy (e.g., high and low season for hotel)
 - Changes in the municipal water supply
- 💧 One or more cases of disease are associated with your system(s)

If an event triggers you to review and update your water management program, remember to:

- 💧 Update the process flow diagram, associated control points, control limits, and corrective actions
- 💧 Update the written description of your building water systems
- 💧 Train those responsible for implementing and monitoring the updated program



Establish a Water Management Program Team

Certain skills, described in the diagram below, are needed to develop and implement your water management program. These skills would typically be provided by a combination of people, some of whom may have multiple skills (examples shown below).



Consider who among your employees and partners can provide these skills so that you can develop the most effective program possible. You may need to get additional help from outside experts.

- Building owner
- Building manager/administrator
- Maintenance or engineering employees
- Equipment or chemical suppliers
- Contractors
- Consultants

Healthcare Facilities

The team should also include:

- Someone who understands accreditation standards
- Someone with expertise in infection prevention
- An infectious disease clinician
- Risk and quality management staff



2

Describe Your Building Water Systems Using Text

EXAMPLE: BUILDING A

You will need to write a description of your building water system and devices you answered YES to on page 2. This description should include details like where the building connects to the municipal water supply, how water is distributed, and where cooling towers, pools, hot tubs, and water heaters or boilers are located. An existing as-built diagram of the plumbing system and fixtures may be useful in developing this description. Below is a description of the water systems for an example building (Building A). You will see how this text gets turned into a diagram in the next section (page 10).

1. **Water enters** the basement of the property via a 4-inch main from the municipal water line at Maple Street. Water is immediately drawn off to charge the fire suppression system. The rest of the water is sent through cold water distribution. There is backflow prevention throughout the system, including between the cold water distribution and the city water main and between the cold water distribution and the fire suppression system.

Note: *Problems with entering water are usually beyond the building manager's control, such as main breaks or construction that disrupts water service. However, an essential part of a water management program is monitoring water and responding to changes coming in from the municipal water line. You can check in with your drinking water provider to report changes in quality to your building's water supply.*

2. **Cold water is distributed** directly to the lit decorative fountain in the lobby, the cooling tower on the roof, the hot tub and pool on the first floor, ice machines on floors 2, 4, 6, 8, and 10, and shower and faucet fixtures in rooms on all 12 floors. All internal plumbing consists of 2-inch copper and polyvinyl chloride (PVC) piping. There is backflow prevention between cold water distribution and the utility lines that serve the cooling tower and hot tub/pool room.

Note: *In warm climates, cold water may reach a temperature that allows for growth of Legionella. Detectable residual disinfectant added by your water provider helps to limit growth of Legionella and other germs. Additionally, decorative fountains with submerged lighting and devices such as cooling towers and ice machines may contain areas where cold water can be heated to temperatures that allow Legionella to grow. Swimming pools and toilets do not usually generate hazardous conditions because they rarely reach adequate temperature for growth or generate water droplets small enough to be inhaled.*

3. **Cold water is heated** to 140°F by two joined 120-gallon heaters. The heaters supply a 500-gallon storage tank. Cold water is also delivered to an 80-gallon heater in the basement that serves the kitchen and staff break room.

Note: *Even water heaters set to the correct temperature may contain zones of lower temperature water where cold and hot water mix or where excessive sediment blocks heating elements. Most residual disinfectants are reduced by heating the water.*

Healthcare Facilities

Be sure to include descriptions of water sources relevant to:

- Patient care areas
- Clinical support areas
- Components and devices that can expose patients to contaminated water

You should also develop an ongoing dialogue with your drinking water provider so that you are aware of changes that may affect your building's water supply.

Disclaimer: Example content is provided for illustrative purposes only and is not intended to be relevant to all buildings.

Reference: ASHRAE 188: *Legionellosis: Risk Management for Building Water Systems* June 26, 2015. ASHRAE: Atlanta. www.ashrae.org

4. **Hot water is distributed** to fixtures in the basement through floor 5 from the joined water heaters in the basement on a direct (non-recirculating) line. Hot water is distributed to floors 6 through 11 from the storage tank with a recirculating line designed to return to the joined water heaters in the basement. Note that hot water is tempered (mixed with cold water) at the fixtures by thermostatic mixing valves.

Note: *Water in direct hot and cold water pipes can pose multiple hazardous conditions. First, the process of heating the water can reduce disinfectant levels. Second, if hot water is allowed to sit in the pipes (stagnation), it might reach a temperature where Legionella can grow and could encourage sediment to accumulate or biofilm to form. With recirculating hot water pipes, the greatest risk is that returning water with reduced or no disinfectant cools to a temperature where Legionella can grow. If this happens, Legionella in the return line can travel to central distribution points and contaminate the entire plumbing system of the building.*

5. **Hot, cold, and tempered waste water is discarded** through the sanitary sewer line.

Note: *It is not known at this time if Legionella can grow and spread in sources such as harvested rainwater or reclaimed graywater (i.e., bath, laundry).*



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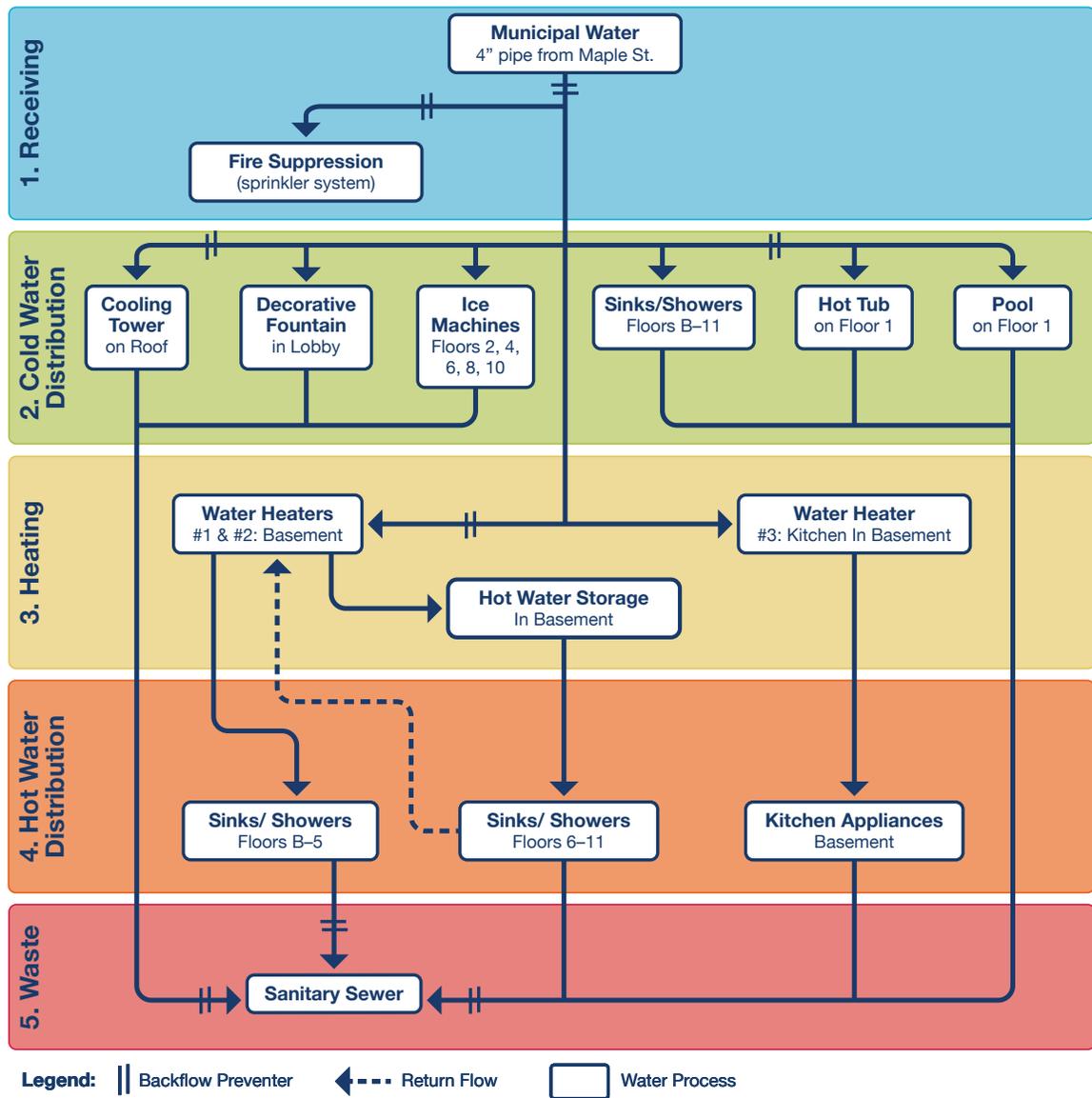
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2

Describe Your Building Water Systems Using a Flow Diagram

EXAMPLE: BUILDING A

In addition to developing a written description of your building water systems, you should develop a process flow diagram. Below is an example of a process flow diagram for Building A. Note that this diagram does not need to be as detailed as your building plans. In fact, it's best if the process flow diagram can be understood easily by all members of your team.



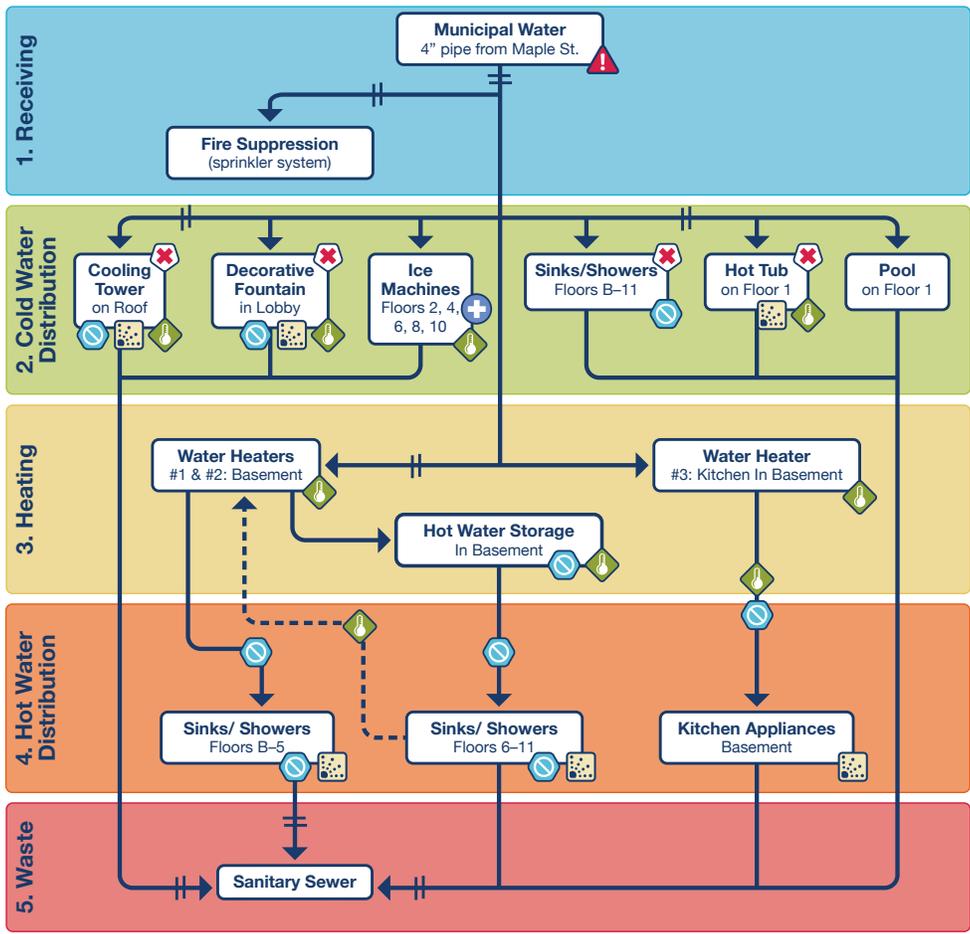
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Identify Areas Where *Legionella* Could Grow & Spread

EXAMPLE: BUILDING A

Once you have developed your process flow diagram, identify where potentially hazardous conditions could occur in your building water systems. The below diagram points out locations and types of hazardous conditions you could expect in Building A.



Healthcare Facilities
Think about:

- Areas where medical procedures may expose patients to water droplets, such as hydrotherapy
- Areas where patients are more vulnerable to infection, such as bone marrow transplant units or oncology floors

In Building A, the ice machine is included to illustrate that patients with problems swallowing may be at increased risk for *Legionella* spread by aspiration.

Legend:

- || Backflow Preventer
- ←--- Return Flow
- Water Process
- 🌡️ Temperature Permissible
- 🕒 Stagnation
- ❌ No Disinfectant
- 📍 Conditions for Bacteria Spread
- ⊕ Special Considerations for Healthcare Facilities
- ⚠️ External Hazards (eg., construction, main break)

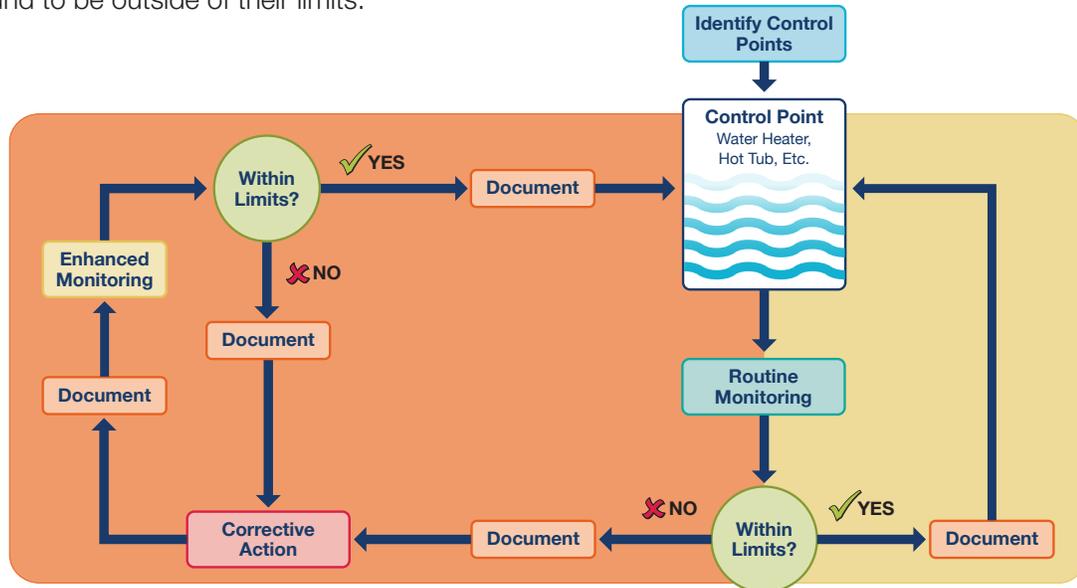
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3

Control Measures & Corrective Actions: The Basics

The diagram below shows the process of implementing and monitoring control measures. If you find that a control limit (i.e., temperature levels, disinfectant levels) is not being met, you need to take corrective actions. The right side, in yellow, illustrates the routine process of monitoring control measures to make sure they are within limits. The left side, in orange, shows the process of what to do if control measures are found to be outside of their limits.



Remember, any time there is a suspected case of Legionnaires' disease associated with your building you should:

- 💧 Contact your local and/or state health department or work with them if they contact you
- 💧 Notify anyone who could be affected by the growth and spread of *Legionella* in your building if the health department asks you to
- 💧 Decontaminate the building water systems as necessary (you may need to get additional help from outside experts)
- 💧 Review the water management program and revise it, if necessary

Healthcare Facilities

In addition to the steps you would take in all buildings, if a case of healthcare-associated Legionnaires' disease is discovered in a healthcare facility:

- Make sure the person with expertise in infection prevention on your team is aware
- **Important:** Tell clinicians so they can test patients with healthcare-associated pneumonia for Legionnaires' disease with both a urinary antigen test and a culture from a lower respiratory specimen
- Report the case to your local and/or state health department; a full investigation may be needed
- Review the water management program and revise it, if necessary

For more details on identifying and investigating Legionnaires' disease cases in healthcare facilities, see page 24.

Decide Where Control Measures Should Be Applied



Control measures and limits should be established for each control point. See the diagram on the next page for the types of monitoring that could occur in Building A. You will need to monitor to ensure your control measures are performing as designed. Control limits, in which a chemical or physical parameter must be maintained, should include a minimum and a maximum value.

Examples of chemical and physical control measures and limits to reduce the risk of *Legionella* growth:

- Water heaters should be maintained at appropriate temperatures.
- Disinfectant and other chemical levels in cooling towers and hot tubs should be continuously maintained and regularly monitored. Surfaces with any visible biofilm (i.e., slime) should be cleaned.
- Decorative fountains should be kept free of debris and visible biofilm.
- Heterotrophic plate counts can serve as an indicator of control within devices.
- Water quality should be measured throughout the system to ensure that changes that may lead to *Legionella* growth (such as drops in chlorine levels) are not occurring.

Healthcare Facilities

Clinicians should be testing all patients with healthcare-associated pneumonia for Legionnaires' disease using both a urinary antigen test and culture of a lower respiratory specimen. This is especially important if any of the following are identified in your facility:

- Patients with Legionnaires' disease, no matter where they acquired the infection
- Positive environmental tests for *Legionella*
- Changes in water quality that may lead to *Legionella* growth (such as low chlorine levels)

Additionally, certain commonly-encountered changes in building water system design or management might require increasing the number and frequency of monitoring. It's a good idea to anticipate additional hazardous conditions that could be associated with scheduled or unanticipated changes in water quality, such as:

- System start up
- System shut down
- Regularly scheduled maintenance
- Renovations, construction, and installation of new equipment on your property
- Equipment failure
- Water main break or other service interruptions

Anti-scald Regulation



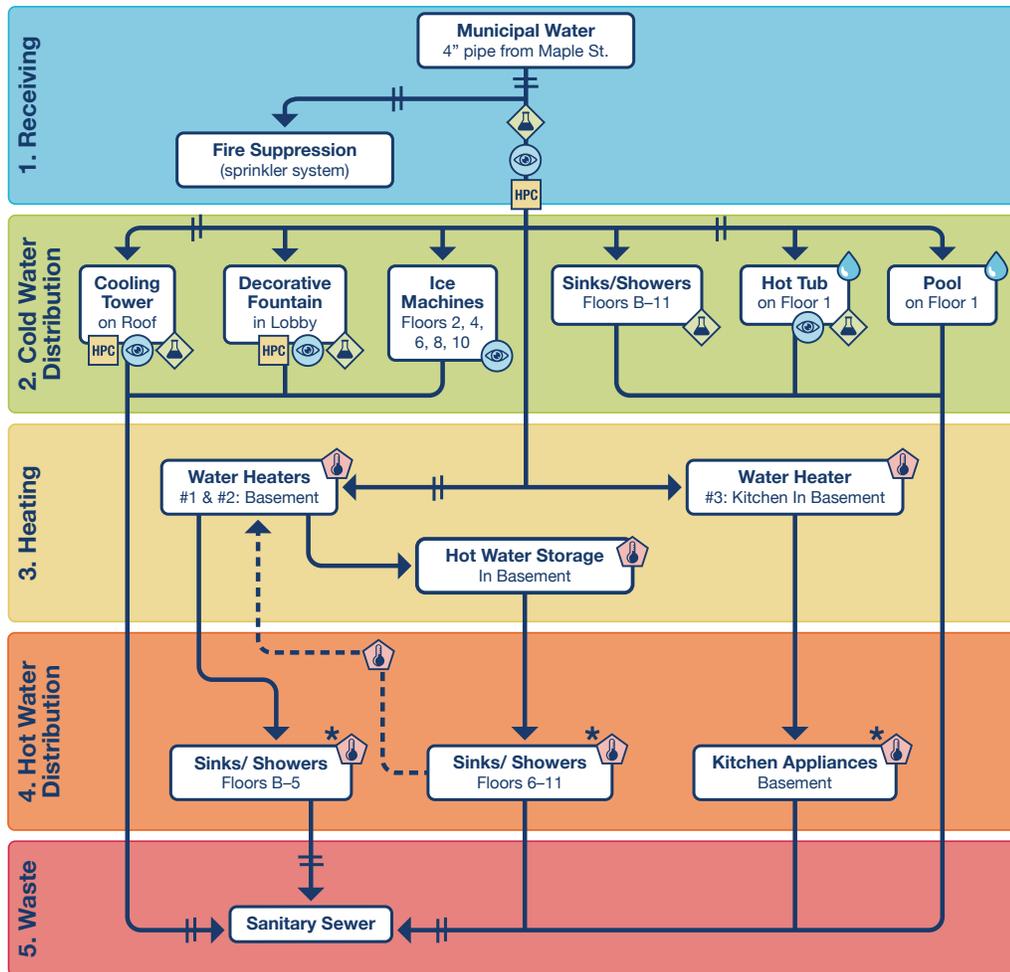
You should follow local and state anti-scald regulations. However, maximum temperatures allowed by your state may be too low to limit *Legionella* growth. Engineering controls that mix hot and cold water together at the source can reduce the risk of scalding while allowing water in pipes to remain hot enough to limit *Legionella* growth.

4

Decide How to Monitor Your Control Measures

EXAMPLE: BUILDING A

The diagram below shows which types of monitoring could occur at different locations within Building A's water system to reduce the risk of growth and spread of *Legionella*.



Legend: || Backflow Preventer ←--- Return Flow ◻ Water Process
 👁 Visual Inspection HPC Heterotrophic Plate Count 🧪 Check Disinfectant Levels 🌡 Check Temperature

★ Monitoring at representative fixtures close to and far from the central distribution point is recommended. It is not necessary to routinely monitor water conditions at every tap.

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Reference: ASHRAE 188: *Legionellosis: Risk Management for Building Water Systems* June 26, 2015. ASHRAE: Atlanta. www.ashrae.org

Note: In addition to whatever you do to prevent Legionella, state and local regulations may exist that govern the design, construction, operation, and maintenance of public aquatic facilities (e.g., pools and hot tubs). See CDC's Model Aquatic Health Code at www.cdc.gov/mahc/index.html for helpful information, but this document is not a substitute for state and local regulations.

Establish Ways to Intervene When Control Limits Are Not Met

CORRECTIVE ACTION EXAMPLES

Building water systems are dynamic. You should plan for your monitoring results to vary over time and be prepared to apply corrective actions. **Corrective actions** are taken in response to systems performing outside of control limits. The following are examples of corrective actions.

Example 1—Biofilm growth in the fountain



1. During her weekly inspection of the fountain in the first floor lobby, Michelle Patterson notes that the fountain walls have accumulated a slimy growth.



2. As dictated by her water management program, Michelle immediately shuts off the fountain, drains it, and scrubs it with a detergent recommended by the manufacturer.



3. She then follows the program's start up procedure to refill the fountain with water and checks the residual disinfectant levels to make sure that they are within control limits.



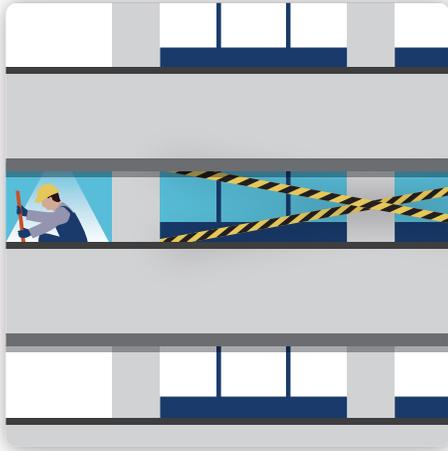
4. Michelle documents her observations and the performance of interim cleaning in her log book. She informs her supervisor.

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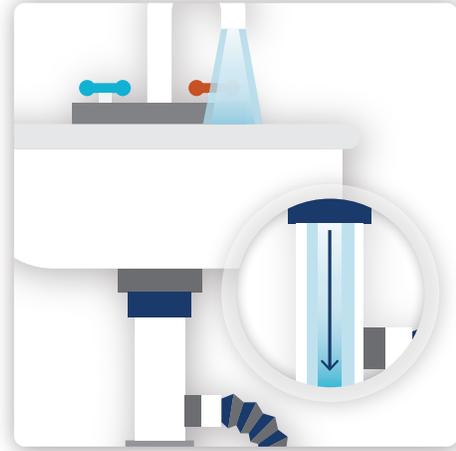
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5

Example 2—Unoccupied floor



1. The eighth floor of the building is being renovated and is closed to the public. Jason Hernandez understands that this may cause a temporary hazardous condition because water usage will decrease, which means that stagnation is possible.



2. After discussing the issue with his supervisor, Jason counteracts the potential for stagnation by daily flushing of the sinks and fixtures with hot and cold water in several rooms including those at the end of the hall, which are furthest from the vertical pipe serving that floor (riser).



3. Jason also increases monitoring of temperature and chlorine levels on the eighth floor from weekly to daily for the duration of the renovation.



4. He documents the method and duration of flushing and records his daily temperature and chlorine readings in his log book. He reviews his documentation with his supervisor.

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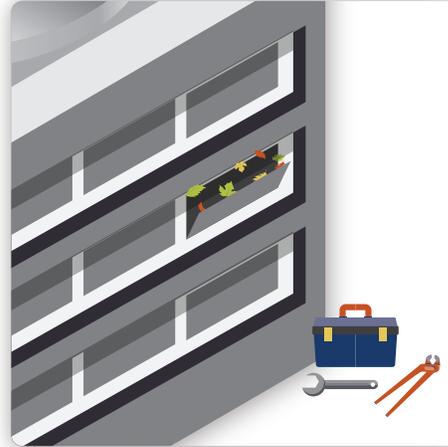
Reference: ASHRAE 188: *Legionellosis: Risk Management for Building Water Systems* June 26, 2015. ASHRAE: Atlanta. www.ashrae.org



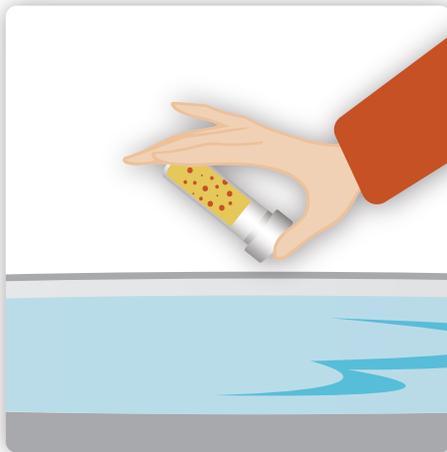
Example 3—Debris in the cooling tower



1. During weekly inspection of the cooling tower, Michelle discovers that leaf litter has accumulated in the reservoir.



2. Upon further investigation, she finds that a panel has become dislodged, allowing windblown debris to enter.



3. After replacing the panel and skimming out the debris, Michelle checks the disinfectant levels and performs a heterotrophic plate count to find that the conditions are still within control limits.



4. She documents her actions in her log book. She also makes a note to check the disinfectant levels daily for a week to make sure that the cooling tower remains within control limits. She reviews her actions and documentation with her supervisor.

Disclaimer: Example content is provided for illustrative purposes only and is not intended to be relevant to all buildings.

Reference: ASHRAE 188: *Legionellosis: Risk Management for Building Water Systems* June 26, 2015. ASHRAE: Atlanta. www.ashrae.org



5

CONTINGENCY RESPONSE EXAMPLES

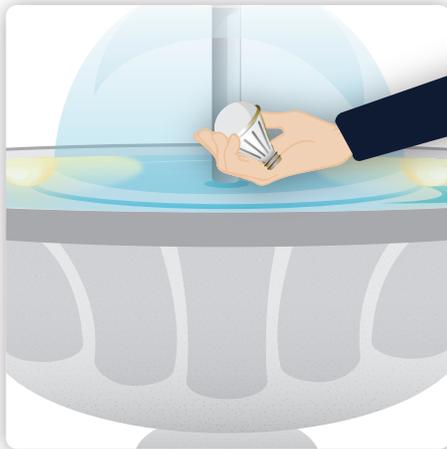
Even the most closely monitored systems will sometimes require adjustments, as shown in the following examples. You should be prepared to respond, even to unexpected problems, based on your knowledge of the building water systems and how *Legionella* grows and spreads. You may need to initiate a customized contingency response to gain control of a building water system. **Contingency responses** may involve several steps and often require follow up. A contingency response is always required when a case of Legionnaires' disease has been linked to a building and is also appropriate in other situations.

Example 1—Biofilm growth in the fountain

1. During the annual review of the water management program, supervisor Anson Cho notes that Michelle and Jason performed six interim cleanings of the lobby fountain due to excessive biofilm growth in the past year.



2. Upon further review of the logs, he discovers that the biofilm growth was observed near the inner wall where incandescent lighting illuminates the water.



3. Anson decides to replace the incandescent bulbs with LED bulbs to prevent the lights from heating the water to a temperature that allows biofilm to grow.



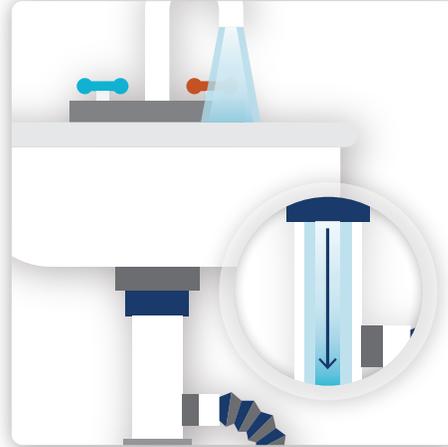
4. After three months of routine inspections show that this corrective action reduces biofilm growth and eliminates the need for interim cleaning, Anson amends the water management program to specify use of only LED bulbs in the fountain and he informs the owner.

Disclaimer: Example content is provided for illustrative purposes only and is not intended to be relevant to all buildings.

Reference: ASHRAE 188: *Legionellosis: Risk Management for Building Water Systems* June 26, 2015. ASHRAE: Atlanta. www.ashrae.org



Example 2—Water main break



1. Jason receives several complaints from building occupants of foul-tasting water. He also notes a brownish tint to the water entering the building during his daily visual inspection. Jason immediately contacts the water provider and discovers that there was a water main break nearby but that a boil water advisory was not issued. He sends a notice to building occupants about the main break and that they should limit water usage for the next 4 hours while facilities clear the line.
2. To improve building water quality, Jason flushes the water at multiple sinks and fixtures near the entry until the water runs clear and falls within established water quality parameter control limits, which takes approximately 30 minutes. He also flushes fixtures in areas where he received taste and odor complaints and at pre-determined flushing locations per the water management program.



3. Jason increases the frequency of chlorine monitoring at the taps from weekly to daily to ensure that adequate residual disinfectant is moving through the system.
4. Jason informs his supervisor, documents his actions, and records chlorine readings in his log book.

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Reference: ASHRAE 188: *Legionellosis: Risk Management for Building Water Systems* June 26, 2015. ASHRAE: Atlanta. www.ashrae.org



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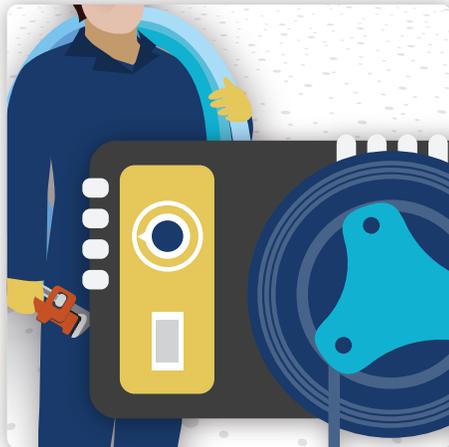
Example 3—Broken chlorinator in the hot tub



1. Michelle notes chlorine levels of zero within the hot tub and biofilm growth during her daily inspection. On further inspection she notices that disinfectant in the automatic delivery system reservoir is full.



2. Michelle immediately closes the hot tub and calls the pool contractor.



3. The contractor arrives the next day to discover that the chlorinator pump has malfunctioned and replaces the unit.



4. Michelle documents the action and follows the water management program's protocol for start up, which includes cleaning the hot tub, shocking it with a high dose of disinfectant, and back-flushing the filter. Michelle also recommends that the supervisor amend the water management program to include a daily check of equipment operation and disinfectant levels in the reservoir, in addition to the daily visual inspection and chlorine measurements, so that such equipment failures may be detected more quickly in the future.

Disclaimer: Example content is provided for illustrative purposes only and is not intended to be relevant to all buildings.

Reference: ASHRAE 188: *Legionellosis: Risk Management for Building Water Systems* June 26, 2015. ASHRAE: Atlanta. www.ashrae.org

Make Sure the Program Is Running as Designed & Is Effective

6

Verification: Are we doing what we said we would do?

Your program team should establish procedures to confirm, both initially and on an ongoing basis, that the water management program is being implemented as designed. This step is called “verification.” For example, if you said you would test the hot tub daily for chlorine and record and communicate those results, have you been doing that? If you found a problem, did you take the action included in your program?

People should not verify the program activity for which they are responsible. For example, if one person is responsible for maintaining the hot tub and another is responsible for the cooling tower, they could verify each other’s work, not their own.

Validation: Is our program actually working?

Now that you have a water management program, you need to be sure that it is effective. Your program team should establish procedures to confirm, both initially and on an ongoing basis, that the water management program effectively controls the hazardous conditions throughout the building water systems. This step is called “validation.”

The program team should determine if environmental testing for *Legionella* should be performed and, if so, how test results will be used to validate the program. Factors that might make testing for *Legionella* more important include:

- ◆ Having difficulty maintaining the building water systems within control limits
- ◆ Having a prior history of Legionnaires’ disease associated with the building water systems
- ◆ Being a healthcare facility that provides inpatient services to people who are at increased risk for Legionnaires’ disease

Healthcare Facilities

Healthcare facilities may also choose to conduct active surveillance to validate their program, meaning that all patients with healthcare-associated pneumonia are tested for Legionnaires’ disease.

Testing directly for *Legionella* in the building water systems can help you to validate your program. If the program team decides to test for *Legionella*, then the testing protocol should be specified and documented in advance. You should also be familiar with and adhere to local and state regulations and accreditation standards for this testing.

7

Document & Communicate All the Activities of Your Water Management Program

Documentation

Now that you have done all of the work required to create your water management program, write it down. Your written program should include at least the following:

- ◆ Building description, including location, age, uses, and occupants and visitors
- ◆ Program team, including names, titles, contact information, and roles on the team
- ◆ Water system description, including general summary, uses of water, aerosol-generating devices (e.g., cooling towers, hot tubs, showers), and process flow diagrams
- ◆ Control measures, including points in the system where critical limits can be monitored and where control can be applied
- ◆ Confirmatory procedures, including verification steps to show that the program is being followed as written and validation to show that the program is effective

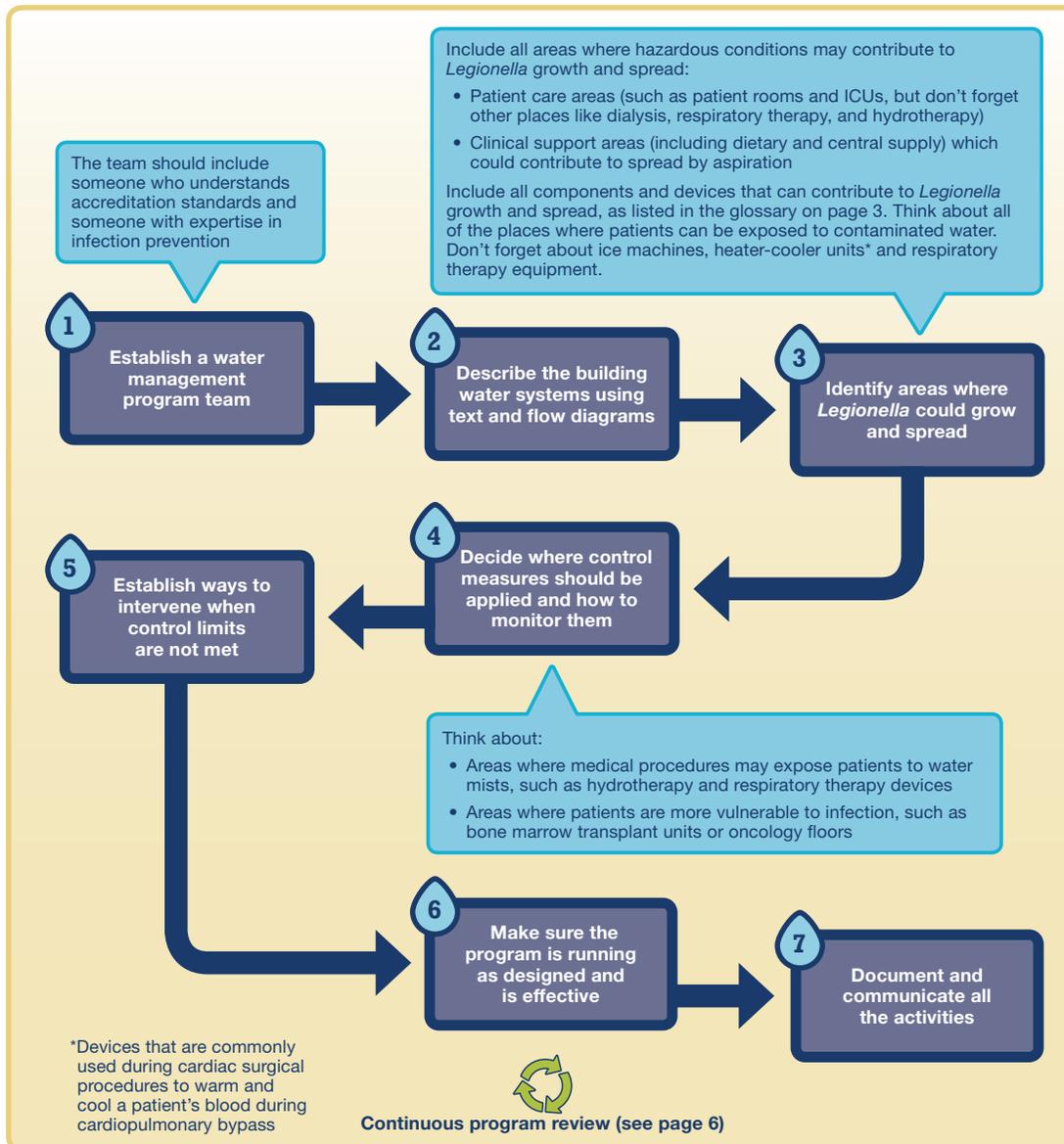
Communication

You have worked hard to develop your water management program and you have carefully documented all aspects of it. Resist the temptation to put it on a shelf and walk away. Consider notifying building occupants that you have a plan in place to keep the building water systems safe, just as you would for an elevator inspection. Be sure to communicate with your employees and colleagues about your program on a regular basis and train those responsible for implementing and monitoring the program. Use this communication as an opportunity to identify strategies for improving the management and efficiency of your water systems.

Special Considerations for Healthcare Facilities

ELEMENTS OF A WATER MANAGEMENT PROGRAM

Developing and maintaining a water management program in healthcare facilities requires a few more considerations than the ones explained on page 6.



Reference: ASHRAE 188: *Legionellosis: Risk Management for Building Water Systems* June 26, 2015. ASHRAE: Atlanta. www.ashrae.org

Note: ASHRAE 188 Normative Annex A applies to accredited healthcare facilities that have a Certification Board of Infection Control and Epidemiology (CBIC) certified infection preventionist or a master's-level epidemiologist.

IDENTIFYING & INVESTIGATING LEGIONNAIRES' DISEASE CASES

Healthcare facilities are often uniquely positioned to identify and respond to cases of Legionnaires' disease. A healthcare facility's water management program to limit *Legionella* growth and spread should include the actions to take when a patient is diagnosed with Legionnaires' disease or environmental triggers occur. If you decide to conduct a full investigation of the source of an infection, key elements should be included, as noted below. A full investigation following a diagnosis of Legionnaires' disease can help determine whether the infection was acquired in the facility or the community.

Clinicians should be testing all patients with healthcare-associated pneumonia for Legionnaires' disease using both a urinary antigen test and culture of a lower respiratory specimen. This is especially important if any of the following are identified in your facility:

- ◆ Patients with Legionnaires' disease, no matter where they acquired the infection
- ◆ Positive environmental tests for *Legionella*
- ◆ Changes in water quality that may lead to *Legionella* growth (such as low chlorine levels)

Perform a full investigation for the source of *Legionella* when:

- ◆ 1 case of **definite** healthcare-associated Legionnaires' disease (a case in a patient who spent the entire 10 days prior to onset of illness in the facility) is identified
- ◆ ≥2 cases of **possible** healthcare-associated Legionnaires' disease (cases in patients who spent part of the 10 days before symptoms began at the same facility) are identified within 6 months of each other

Key elements of a full investigation include:

- ◆ Working with local and/or state health department staff
- ◆ Reviewing medical and microbiology records
- ◆ Actively identifying all new and recent patients with healthcare-associated pneumonia and testing them for *Legionella* using both a urinary antigen test and culture of a lower respiratory specimen
- ◆ Developing a line list of cases
- ◆ Evaluating potential environmental exposures
- ◆ Performing an environmental assessment
- ◆ Performing environmental sampling
- ◆ Subtyping clinical and environmental isolates
- ◆ Decontaminating environmental source(s)
- ◆ Reviewing and possibly revising the water management program

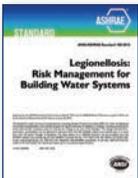
Reference: ASHRAE 188: *Legionellosis: Risk Management for Building Water Systems* June 26, 2015. ASHRAE: Atlanta. www.ashrae.org

Note: ASHRAE 188 Normative Annex A applies to accredited healthcare facilities that have a Certification Board of Infection Control and Epidemiology (CBIC) certified infection preventionist or a master's-level epidemiologist.

References & Resources

There are many references and resources that can help you develop and implement your *Legionella* water management program, some of which are listed below.

Standard



Standard 188—Legionellosis: Risk Management for Building Water Systems (ANSI Approved)

ASHRAE

Published 2015

www.techstreet.com/ashrae/products/1897561

Guidelines



Guideline 12—Minimizing the Risk of Legionellosis Associated with Building Water Systems

ASHRAE

Published 2000

www.techstreet.com/ashrae/products/232891

(currently under revision)

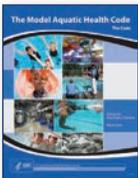


Legionellosis Guideline: Best Practices for Control of *Legionella*

Cooling Technology Institute

Published 2008

www.cti.org/downloads/WTP-148.pdf



Model Aquatic Health Code Guidance

Centers for Disease Control and Prevention

Published 2014

www.cdc.gov/mahc/index.html

Laboratory Resources



CDC's ELITE Program

Centers for Disease Control and Prevention

wwwn.cdc.gov/ELITE/Public/EliteHome.aspx

Planning Guides & Toolkits



Emergency Water Supply Planning Guide for Hospitals and Healthcare Facilities

Centers for Disease Control and Prevention, American Water Works Association

Published 2012

www.cdc.gov/healthywater/pdf/emergency/emergency-water-supply-planning-guide.pdf

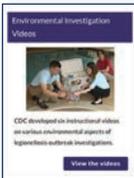


Drinking Water Advisory Communication Toolbox

US Department of Health & Human Services, Centers for Disease Control and Prevention, Environmental Protection Agency, American Water Works Association

Published 2013

www.cdc.gov/healthywater/pdf/emergency/drinking-water-advisory-communication-toolbox.pdf



Investigation Tools for Clusters and Outbreaks of Legionnaires' Disease

Centers for Disease Control and Prevention

www.cdc.gov/legionella/outbreak-toolkit

Healthcare Resources



Sehulster LM, Chinn RYW, Arduino MJ, Carpenter J, Donlan R, Ashford D, et al. **Guidelines for environmental infection control in health-care facilities. Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC).** *MMWR*. 2003;52(RR-10): 1–42.

www.cdc.gov/mmwr/preview/mmwrhtml/rr5210a1.htm



Tablan OC, Anderson LJ, Besser R, Bridges MD, Hajjeh R. **Guidelines for preventing health-care-associated pneumonia, 2003: Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee.** *MMWR*. 2004;53(RR-3):1–36.

www.cdc.gov/mmwr/preview/mmwrhtml/rr5303a1.htm

Legionnaires' Disease Information



Legionnaires' Disease Website

Centers for Disease Control and Prevention

www.cdc.gov/legionella

Appendix A

LEGIONNAIRES' DISEASE

Legionnaires' (LEE-juh-nares) disease is a very serious type of pneumonia (lung infection) caused by bacteria called *Legionella*. If you develop pneumonia symptoms and may have been exposed to *Legionella*, see a doctor right away. Be sure to mention if you have used a hot tub, spent any nights away from home, or stayed in a hospital in the last two weeks.

Legionnaires' Disease Can Cause Pneumonia Symptoms

Signs and symptoms of Legionnaires' disease can include:

- ▶ Cough
- ▶ Shortness of breath
- ▶ Muscle aches
- ▶ Headache
- ▶ High fever

Doctors use chest x-rays or physical exams to check for pneumonia. Your doctor may also order tests on a sample of urine and sputum (phlegm) to see if your lung infection is caused by *Legionella*.

Legionnaires' Disease Is Serious, but Can Be Treated with Antibiotics

Legionnaires' disease is treated with antibiotics (drugs that kill bacteria in the body). Most people who get sick need care in a hospital but make a full recovery. However, about 1 out of 10 people who get Legionnaires' disease will die from the infection.

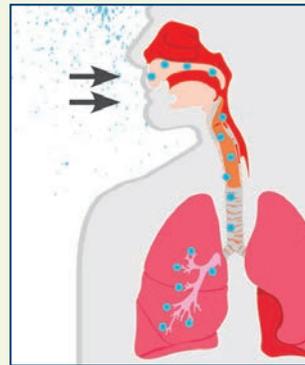
Certain People Are at Increased Risk for Legionnaires' Disease

Most healthy people do not get Legionnaires' disease after being exposed to *Legionella*. Being 50 years or older or having certain risk factors can increase your chances of getting sick. These risk factors include:

- ▶ Being a current or former smoker
- ▶ Having chronic lung disease, such as emphysema or chronic obstructive pulmonary disease (COPD)
- ▶ Having a weakened immune system from diseases like cancer, diabetes, or kidney failure
- ▶ Taking medication that weakens your immune system

Legionella Are Usually Spread through Water Droplets in the Air

In nature, *Legionella* live in fresh water and rarely cause illness. In man-made settings, *Legionella* can grow if water is not properly maintained. These man-made water sources become a health problem when small droplets of water that contain the bacteria get into the air and people breathe them in. In rare cases, someone breathes in *Legionella* while they are drinking water and it "goes down the wrong pipe" into the lungs. In general, Legionnaires' disease is not spread from one person to another. However, this may be possible in rare cases.



Legionnaires' disease, a type of severe pneumonia, is caused by breathing in small droplets of water that contain *Legionella*.

Common Sources of Infection

Outbreaks of Legionnaires' disease are often associated with large or complex water systems, like those found in hospitals, hotels, and cruise ships.

The most likely sources of infection include:

-  **Water used for showering (potable water)**
-  **Cooling towers (parts of large air conditioning systems)**
-  **Decorative fountains**
-  **Hot tubs**



