Developing an Effective Water Managemnt Plan

3701-16-12 Compliance

IWM Industrial Water Management

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Presenter:

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- ASSE International Certified Water Safety Expert
- 25+ Years of Skilled Nursing, Assisted Living, and CCRC Operational Experience

IWM manages over 150 healthcare facilities: Assisted Living, Skilled Nursing, Acute Care Hospitals, Continuing Care Retirement Communities

We assist both public and private sectors with Water management and water systems risk assessments

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Reference: Indusrty Standards

ASHRAE GUIDELINE

ASHRAE Guideline 12-2023

Managing the Risk of Legionellosis Associated with Building Water Systems

- ASHRAE 12-2023: Managing the Risk of Legionellosis Associated with Building Water Systems
- ASHRAE 188-2020: Legionellosis – Risk Management for Building Water Systems
- CDC Legionella Control Toolkit, January 2021
- CDC Developing a Water Management Program to Reduce Legionella Growth, June 2021
- CDC Guidelines for Infection Control in Health Care Facilities, July 2019
- Veteran Administration Directive 1061

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What we are battling

Legionella and other waterborne pathogens (e.g.: Pseudomonas, Acinetobacter, Burkholderia).

- Gram negative bacteria
- U.S. Centers for Disease Control reports that 66% of all waterborne disease outbreaks associated with potable water systems are attributable to legionella (2011 to 2012)
- Legionella is naturally occurring; present in ground soil, rivers, streams, lakes, ponds, etc.
- 60 species of Legionella with L. pneumophila, serogroup 1 causing over 90% of legionella related disease
- Most often contracted through inhalation
- Can be contracted through aspiration or installation

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Know what you are battling!!

Legionella bacteria:

- Require conducive temperatures to proliferate
- Need a food source
- Dislike disinfecting agents
- Thrive in stagnating water
- Duplicate every 12 hours
- Live within the biofilm that adheres to the interior walls of pipework and other water system components

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Key Factors that contribute to Legionella survival and growth:

Sediment: The accumulation of scale, dirt, and/or mineral deposits provide the high-surface-area for biofilm to grow. Sediment is a food source and becomes a protective living environment for the bacteria.

Temperature: Water temperature is the most significant factor influencing legionella growth. Legionella grows well at temperatures of 77°F to 113°F. Growth slows at lower temperatures. Legionella survives, but does not duplicate, at temperatures <68°F. Legionella begins to die at temperatures of 114°F to 120°F. As water temperatures increase, the time for legionella to die becomes shorter, and Legionella dies rapidly at temperatures ≥158°F.

Water age/stagnation: The residence time of water in one or more locations is an important factor in Legionella growth. The probability of colonization (bacteria harboring within biofilm) increases as water ages. Low flow and stagnant conditions create a favorable environment for growth. Examples include renovations, new construction, repurposing an area to storage, vacant rooms, vacant wings, unoccupied floors, etc.

Disinfectant residual: Water treatment facilities add secondary chemical disinfection (e.g.: chlorine, monochloramine, or chloramine) to water. The disinfecting agent is intended to persist & control microbial growth while water travels through the distribution system. The disinfectant residual begins to decline as soon as it leaves the treatment facility. Lower concentrations of disinfectant create conditions more conducive for microbial growth. Heating water can reduce the disinfectant residual significantly. Water that enters a structure may lack sufficeint disinfectant to control pathogens in the building water system(s). Ohio EPA permits 0.2 – 4.0ppm of free chlorine at the incoming water main.

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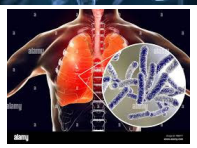

Legionella growth in building water systems

Legionella is a single-celled organism that lives within a host cell (other single celled organisms) protozoa. The protozoa provide shelter for the legionella from extreme temperature and disinfectants.

Biofilm: This living and non-living structure provides a protective environment for legionella, shielding it from heat and disinfecting agents. Biofilm can serve as a food source, trapping sediment and other single celled organisms. These cells can become host cells for the legionella.

Duplicates: Legionella generally duplicates every 12 hours. Conducive temperatures 77°F to 113°F and the optimal growth range for Legionella pneumophila, serogroup 1 of 95°F to 99°F provides peak growth temperatures, accelerating growth.

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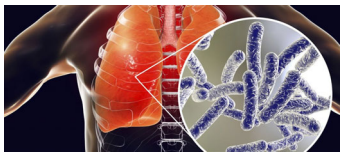

We know Legionella is a single-celled organism that lives within a host cell. The cells in our lungs (alveolar macrophages) are phagocytic cells. These cells are designed to remove debris and pathogens from the lungs.

Alveolar macrophages are single celled organisms that are part of the immune system. Legionella infects and replicates within them. Legionella also interacts with alveolar epithelial cells, which line the air sacs in the lungs.

The infection causes inflammation and damage, resulting in Legionaires' disease, a serious type of pneumonia.

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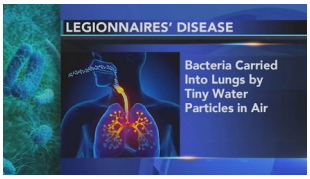

Legionnaires Disease (LD):

- Kills 10% of those that contract it in the community
- Frequently requires hospitalization (around 95%).
- Health Care Acquired LD kills 30% of those infected
- Some experience long term impairment after recovery
- The immunocompromised population is at the greatest risk (over 50, smokers, former smokers, oncology patients, diabetics, transplant patients, COPD, CHF, dialysis patients, etc.)

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Now that we know what we are battling. Let's start building the Plan

Water Management Plans – Nine (9) Required Components

1. Identify a Water Management Team
2. Identify Hazards / Water System Risk Assessment
3. Narrative Description of the Water System(s)
4. Process Flow Diagram of the System(s)
5. Define Control Limits
6. Define Control Measures
7. Verification Process
8. Validation Protocol
9. Create the Recordkeeping System

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Identify the Water Management Team Members

- Facility staff, consultants, and building owners that are familiar with the water systems, the components, the water source (municipal provider, well water, locally treated water).
- Qualified members with an education in water management and legionella control.
- These qualified members will be responsible for developing and implementing the plan.
- Capable of understanding, defining, and applying system parameters to reduce the likelihood of legionella growth

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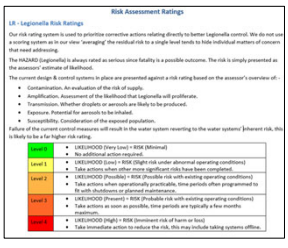

Complete a Water System Risk Assessment/Survey

Determine if the building has the following:

1. Open- and closed-circuit cooling tower or evaporative condenser
2. Closed or open loop heating system (boiler heat)
3. Whirlpool or spas
4. Decorative fountain(s)
5. Landscape irrigation systems
6. Humidification systems, atomizers, misters, other non-potable equipment that aerosolizes water in or around the building site

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Water System Risk Assessment, continued

How is the building characterized? Is the building a healthcare setting? Over night stays? Does it house an at-risk population?

- Healthcare facility
- Burn patients receiving care
- Dialysis patients
- Chemotherapy patients
- Organ transplant patients
- Smokers or former smokers
- Houses people over the age of 50
- Immunocompromised tenants (includes individuals taking immunocompromising medication)
- Diabetics, renal disease, chronic lung disease, cardiac patients

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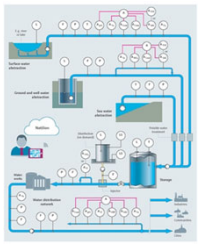
Define Control Limits & Control Measures



- **Control Limit:** *a maximum value, a minimum value, or a range of values to which a chemical or physical parameter associated with a control measure must be monitored and maintained in order to reduce the occurrence of a hazardous condition to an acceptable level.*
- **Control Measure:** *the disinfection, heating, cooling, filtering, flushing, or other means to maintain the physical or chemical conditions of water within the control limits.*

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Systematically Analyze the Building Water System for Hazardous Conditions

<u>Potable water systems maintained at poor temperatures*</u>
a) Recirculating potable water at 77°F to 113°F
b) Cold water systems >68°F
c) Hot Water Heaters operating at temperatures below 140°F

<u>Catalog Outlets and Equipment that Aerosolize Water*</u>
a) Shower, faucets, spray arms
b) Misters, humidifiers, etc.

<u>Test Disinfectant Residual and determine how well it persists throughout the system</u>

**Lists are not exhaustive*

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Systematic Review Continues

Evaluate the inherent risk of water system components and determine control limits and control measures to be applied

- Include provisions to respond to common water events, such as: water service disruptions, water main breaks, boil alerts
- Define and assign control limits (operational parameters) to the hazardous components of the system
- Determine and list control measures, which are actions applied to the system that restore it to acceptable parameters (control limits)
- The analysis must include the vulnerability of the building occupants

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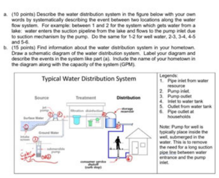

a. (10 points) Describe the water distribution system in the figure below with your own words by systematically describing the event between two locations along the water flow system. For example: between 1 and 2 for the system which gets water from a lake: water enters the suction pipeline from the lake and flows to the pump inlet due to suction mechanism by the pump. Do the same for 1-2 for well water, 2-3, 3-4, 4-5 and 5-6.
b. (15 points) Find information about the water distribution system in your hometown. Draw a schematic diagram of the water distribution system. Label your diagram and describe the events in the system like part (a). Include the name of your hometown in the diagram along with the capacity of the system (GPM).

Describe the Buidling Water System, both potable and non-potable

Create a narrative description of the water system from entry point to end point.

Describe the locations of water processing equipment and components (e.g.: hot water heaters, water softeners, thermostatic mixing valves, recirculating loops, water storage tanks, etc.)

Identify where legionella could grow.

Determine appropriate naming and labeling conventions; these naming and labeling conventions will be utilized in the process flow diagram.

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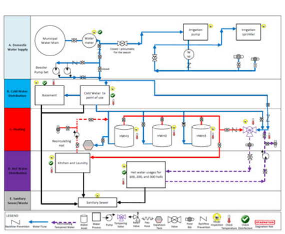

Process Flow Diagram(s)

Graphically produce a step-by-step *process flow diagram(s)*.

The Water Management Team must confirm that the *process flow diagram(s)* represent the system as built.

Visually identify risk areas relative to legionella growth; temperature, disinfectant residual, stagnation, low flow, tempered loops, components that require routine maintenance (descale, clean, disinfect)

Ensure the labeling and naming conventions are consistent with the narrative description.

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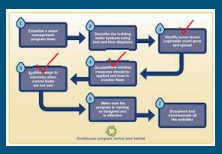
Control Limits = Operational Parameters

Control Measures = Action to Apply



List Control Limits & Control Measures

Review the conditions that are favorable for growth and establish parameters that eliminate or reduce at-risk conditions

1. Define control limits for at-risk components of the water system; operational parameters (e.g. temperature range)
2. Outline control measures, such as: descaling, cleaning, and disinfecting procedures for at-risk components (e.g.: TMV, expansion tanks, hot water storage tanks, etc.)
3. Specify locations for testing disinfectant residual, define the parameters (e.g. free chlorine 0.2 to 4.0ppm)
4. Define the frequency of inspection
5. Define the frequency of control measure application: routine tasks, preventative maintenance, descaling/cleaning/disinfecting
6. Establish ways to intervene when control limits are not met.

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Recordkeeping System

Create standardized forms to record routine actions.

Customize an electronic building management system to record actions (e.g.: TELS®, or other BMS)

Log all actions taken to maintain, restore, correct, repair, and/or improve the system(s) *Example: a corrective action log.*

Document the response to common water occurrences: boil alerts, water main breaks, outside factors (road construction, jack hammering)

Verification Component: The Water Management Team must ensure the program/plan is implemented and applied as intended. Create a process/form to document verification that the plan is functioning as designed.

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Define a Validation Component

The Water Management Program/Plan must have a confirmation component.

The Water Management Team determines the validation component.

Clinical validation: monitor healthcare acquired pneumonia and test for legionella, when clinically indicated. The urine antigen test screens for legionella pneumophila, serogroup 1 only. Culture of lower respiratory secretions screens for all other legionella species.

Prepare a contingency response for positive environmental results or positive clinical screening.

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RESPONSE

Contigency Response Plan

Clinical Surveillance: If a clinical diagnosis, suspected case, or presumptive case are present notify appropriate authorities: Medical Director, Attending Physicians, Local Health Authority.

Legionnaires' Disease is a reportable disease to the CDC, the appropriate authority having jurisdiction must be notified, most typically this is the Local Health Department.

Positive Environmental Sample: Water samples must be analyzed by a CDC ELITE Certified Lab. Positive results will require facility response, no external notification is necessary. The Water Management Team defines the response to positive environmental samples.

Define how the facility will respond to active disease.

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Other Non-Potable Water Systems

The Water Management Team defines:
- New System Start-Up Procedures, may be provided by a qualified third-party vendor
- Shutdown and Start-Up procedures
- Routine/Preventative System Maintenance
- Routine monitoring of disinfecting, biocides, corrosion inhibitors, etc.
- Monitor microbial growth routinely, example cooling tower and evaporative condensers

Examples of Non-Potable Water Systems
a) Landscape Irrigation Systems
b) Decorative Fountains
c) Humidifiers
d) Cooling Towers & Evaporative Condensers
e) Other water features with aerosolizing components

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Routine Monitoring of Water Quality, includes

- Check pH
- pH – 6.5 to 8.5, chlorine becomes less effective as pH rises above 8.
- Free Chlorine – the EPA specifies free chlorine to be 0.2 to 4.0ppm at the incoming water main. Most municipal water systems provide chlorine at 1.0ppm to 1.4ppm. Microbial control is dependent on the health of the private water system.
- Water free of odor and turbidity.
- Water free of debris and particulate

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Memo of Understanding for Legionella Event

CDC defines legionella association with structures:

- Presumptive healthcare-associate Legionnaires' disease
  A case with 10 or more days of continuous stay at a healthcare facility during the 14 days prior to symptom onset.
- Possible healthcare-associated Legionnaires' disease
  A case that spent a portion of the 14 days before date of symptom onset in one or more healthcare facilities, but does not meet the criteria for presumptive healthcare-associated Legionnaires' disease

60 Legionella Outbreaks in the state of Ohio in 2022. 45 were associated with healthcare facilities, 8 were senior or subsidized apartment complexes.

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Let's Review

Water Management Plans – Required Components

1. Identify a Water Management Team
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Who is responsible?

The Water Management Program Team is responsible for:

1. Developing an effective water management plan.
2. Ensuring all actions, interventions, maintenance, etc. are documented.
3. Defining Control Limits & Control Measures
4. Verifying the plan is implemented as intended
5. Developing and implementing a validation plan to confirms the effectiveness of the WMP
6. Developing contingency response plans

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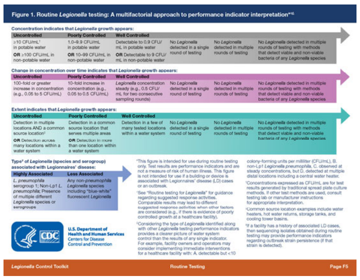

Figure 1. Routine *Legionella* testing: A multifactorial approach to performance indicator interpretation*[a,b]

Concentration indicates that *Legionella* growth appears:

Uncontrolled	Poorly Controlled	Well Controlled			
≥10 CFU/mL[c] in potable water **OR** ≥100 CFU/mL in non-potable water	1.0–9.9 CFU/mL in potable water **OR** 10–99 CFU/mL in non-potable water	Detectable to 0.9 CFU/mL in potable water **OR** Detectable to 9 CFU/mL in non-potable water	No *Legionella* detected in a single round of testing	No *Legionella* detected in multiple rounds of testing	No *Legionella* detected in multiple rounds of testing with methods that detect viable and non-viable bacteria of any *Legionella* species

Change in concentration over time indicates that *Legionella* growth appears:

Uncontrolled	Poorly Controlled	Well Controlled			
100-fold or greater increase in concentration (e.g., 0.05 to 5 CFU/mL)	10-fold increase in concentration (e.g., 0.05 to 0.5 CFU/mL)	*Legionella* concentration steady (e.g., 0.5 CFU/mL for two consecutive sampling rounds)	No *Legionella* detected in a single round of testing	No *Legionella* detected in multiple rounds of testing	No *Legionella* detected in multiple rounds of testing with methods that detect viable and non-viable bacteria of any *Legionella* species

Extent indicates that *Legionella* growth appears:

Uncontrolled	Poorly Controlled	Well Controlled			
Detection in multiple locations AND a common source location[d] **OR** Detection across many locations within a water system	Detection in a common source location that serves multiple areas **OR** Detection in more than one location within a water system	Detection in a few of many tested locations within a water system	No *Legionella* detected in a single round of testing	No *Legionella* detected in multiple rounds of testing	No *Legionella* detected in multiple rounds of testing with methods that detect viable and non-viable bacteria of any *Legionella* species

Type[e] of *Legionella* (species and serogroup) associated with Legionnaires' disease:

Highly Associated	Less Associated
L. pneumophila serogroup 1; Non-Lp1 *L. pneumophila*; Presence of multiple different *Legionella* species or serogroups	Any non-*pneumophila* *Legionella* species including "blue-white" fluorescent *Legionella*

*This figure is intended for use during routine testing only. Test results are performance indicators and are not a measure of risk of human illness. This figure is not intended for use if a building or device is associated with Legionnaires' disease (LD) cases or an outbreak.

[a]See "Routine testing for *Legionella*" for guidance regarding suggested response activities. Comparable results may lead to different suggested response activities when other factors are considered (e.g., if there is evidence of poorly controlled growth at a healthcare facility).

[b]Considering the type of *Legionella* identified along with other *Legionella* testing performance indicators provides a clearer picture of water system control than the results of any single indicator. For example, facility owners and operators may consider implementing immediate interventions for a healthcare facility with: A. detectable but <10 colony-forming units per milliliter (CFU/mL), B. non-Lp1 *Legionella pneumophila*, C. observed at steady concentrations, but D. detected at multiple distal locations including a central water heater.

[c]Concentrations expressed as CFU/mL are for test results generated by traditional spread plate culture methods. If other test methods are used, consult testing lab or manufacturer instructions for appropriate interpretation.

[d]Common source location examples include water heaters, hot water returns, storage tanks, and cooling tower basins.

[e]If a facility has a history of associated LD cases, then sequencing isolates obtained during routine testing may provide performance indicators regarding outbreak strain persistence (if that strain is detected).

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

Legionella Control Toolkit | Routine Testing | Page F5

The Water Mangment Plan must be Defensible

CDC provides a multifactorial decision tree for routine sampling:

- Evaluate concentration
- Examine concentration changes over time
- Assess the extent of positivity
- Review the legionella species for virulence

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