Bill Pearson, CWT

EXPERTISE AND SKILL:

➢ WATER TREATMENT – Certified Water Technologist (CWT)
  • Cooling Towers/Process waters, Closed Loop Systems, Boiler Water Systems,
  • Water Treatment Chemistry: Formulations / Scale, Corrosion & Microbial Control

➢ LEGIONELLA – SME
  • Consultant / Expert Witness
  • ASHRAE SSPC-188 (Legionella Standard) / Committee Vice-Chair
  • AWT Legionella Task Force, Chair
  • AWT Legionella Guideline, author
  • CTI GDL-159 (Legionella Guideline) / Committee Chair
  • ASSE / Qualifications Standard committee: Legionella Water Management Specialist

PROFESSIONAL BACKGROUND:

➢ Special Pathogens Laboratory: Sr. VP Business Development / Apr 2016-Jan 2018
➢ AWT: Ray Baum Memorial Water Technologist of the Year Award (2005)
➢ ECU: BS Biology / Medical Biochemistry
Legionella
Water Management Program (WMP)

Bill Pearson, CWT
BPEARSON Consulting LLC
Legionnaires’ Disease is on the rise in the US!

Rate of reported US cases increased **5.5 times!** (2000-2017)

**CDC Source: National Notifiable Diseases Surveillance System**
Reported rates of legionellosis cases in the US ...

Reported cases by state

2007

Cases/100,000 population

CDC Source: National Notifiable Diseases Surveillance System
Reported rates of legionellosis cases in the US ...

Reported cases by state

2012

Cases/100,000 population

CDC Source: National Notifiable Diseases Surveillance System
Reported rates of legionellosis cases in the US...

Reported cases by state

2017

Cases/100,000 population

CDC Source: National Notifiable Diseases Surveillance System
Legionnaires’ disease cases are on the rise in the U.S. – as well as in the headlines … and in the courtrooms

Yet 9 out of 10 outbreaks could have been prevented … and one in four (25%) disease cases acquired in a healthcare facility are fatal?

Owners and administrators can protect the people who occupy their facilities – healthcare or otherwise – as well as their investments

How can you protect patients, employees and the public – and comply with regulations/laws concerning Legionnaires’ disease?
KEY LEARNING OBJECTIVE:

✓ With a good knowledge base of Legionella, we must then “THINK” about it as a waterborne pathogen

✓ Think about reasonable & good practices to put into a Water (Safety) Management Program to control this pathogen and prevent the disease it causes!
**Legionella** → **Legionnaires’ disease (knowledge base)**

**Legionella** lives in fresh water ...

1. Internal and external factors can lead to **Legionella** growth in building water systems.

Certainly conditions can lead to **Legionella** growth ...

2. **Legionella** grows best in large, complex water systems that are not adequately maintained.

www.cdc.gov/legionella/infographics/legionella-affects-water-systems.html
**Legionella → Legionnaires’ disease (knowledge base)**

**Certain devices can lead to aerosolization ...**

3. Water containing *Legionella* is aerosolized through devices.

**Legionella can be transmitted to susceptible people ...**

4. People can get Legionnaires’ disease when they breathe in mist or accidentally swallow water into the lungs containing *Legionella*. Those at increased risk are adults 50 years or older, current or former smokers, and people with a weakened immune system or chronic disease.

www.cdc.gov/legionella/infographics/legionella-affects-water-systems.html
TDFU = ‘Touch Down For U’

- **T = TEMPERATURE**: warm/hot water/90-110F/bacterial growth
- **D = DISINFECTANT**: in the water, low/none, degraded/lost, aged
- **F = FLOW**: water flow, low/stagnant/deadlegs, Biofilm, water age
- **U = USE** (water use, exposure, aerosols, sprays, inhaled, CPAP)

"Think Legionella …"
Water management programs can reduce the risk for Legionnaires’ disease

Vital Signs: Deficiencies in Environmental Control Identified in Outbreaks of Legionnaires’ Disease — North America, 2000–2014

Laurie E. Garrison, MPH; Jason M. Kunz, MPH; Laura A. Cook, MD; Matthew R. Moore, MD; Chandra Lucas, PhD; Stephanie Scheng, DPhil; John Jurasek, MPH; Cynthia G. Whitney, MD

CDC investigations show almost all outbreaks were caused by problems preventable with more effective water management.

#VitalSigns

2016 MMWR Vital Signs: [www.cdc.gov/vitalsigns/legionnaires](http://www.cdc.gov/vitalsigns/legionnaires)
ANSI/ASHRAE Standard 188-2018

Standard 188…

• First (still only) North American Legionellosis Standard

• Only ANSI-Accredited Standard

• Minimum risk requirements for managing Legionella in building water systems

• Compliance requires a Water Management Program (WMP)
ASHRAE 188 - Water Management Program …

Seven Steps

1. Establish Team
2. Describe System
3. Assess Risk
4. Identify Controls
5. Monitor/Correct
6. Verify/Validate
7. Document

Seven Core Activities

- **PROGRAM TEAM**—Identify persons responsible for Program development and implementation.
- **DESCRIBE WATER SYSTEMS/FLOW DIAGRAMS**—Describe the potable and nonpotable water systems within the building and on the building site and develop water-system schematics.
- **ANALYSIS OF BUILDING WATER SYSTEMS**—Evaluate where hazardous conditions may occur in the water systems and determine where control measures can be applied.
- **CONTROL MEASURES**—Determine locations where control measures must be applied and maintained in order to stay within established control limits.
- **MONITORING/CORRECTIVE ACTIONS**—Establish procedures for monitoring whether control measures are operating within established limits and, if not, take corrective actions.
- **CONFIRMATION**—Establish procedures to confirm that
  - the Program is being implemented as designed (verification), and
  - the Program effectively controls the hazardous conditions throughout the building water systems (validation).
- **DOCUMENTATION**—Establish documentation and communication procedures for all activities of the Program.
1. Establish a water management program team
2. Describe the building water systems using text and flow diagrams
3. Identify areas where Legionella could grow and spread
4. Decide where control measures should be applied and how to monitor them
5. Establish ways to intervene when control limits are not met
6. Make sure the program is running as designed and is effective
7. Document and communicate all the activities

Continuous program review (see below)

CDC Toolkit
(follows ASHRAE 188)
1. Establish Team
2. Describe System
3. Assess Risks
4. Identify Controls
5. Monitor/Correct
6. Verify/Validate
7. Document
WMP Team – Multiple Roles to Fill …

- Ability to oversee the program
- Knowledge of the water systems
- Ability to communicate regularly about the program
- Ability to confirm program performance
- Ability to monitor and document program performance
- Ability to identify control locations and control limits
- Ability to identify and take corrective actions

Source: CDC  Developing a Water Management Program to Reduce Legionella Growth & Spread in Buildings Version 1.1
ASHRAE 188 - Water Management Program

1. Establish Team
2. Describe System
3. Assess Risks
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7. Document

- Program Team—Identify persons responsible for Program development and implementation.
- Describe Water Systems/Flow Diagrams—Describe the potable and nonpotable water systems within the building and on the building site and develop water-system schematics.
- Analysis of Building Water Systems—Evaluate where hazardous conditions may occur in the water systems and determine where control measures can be applied.
- Control Measures—Determine locations where control measures must be applied and maintained in order to stay within established control limits.
- Monitoring/Corrective Actions—Establish procedures for monitoring whether control measures are operating within established limits and, if not, take corrective actions.
- Confirmation—Establish procedures to confirm that the Program is being implemented as designed (verification), and the Program effectively controls the hazardous conditions throughout the building water systems (validation).
- Documentation—Establish documentation and communication procedures for all activities of the Program.
Implement a Water Management Program for buildings that …

- Have centralized hot water system/s
- Are >10 stories (include subgrades)
- Are healthcare facility w/patient stays >24 hours or treat chronic/acute conditions
- Primarily house people >65 years old
Implement a Water Management Program for devices in buildings such as …

✓ Cooling Towers / Fluid Coolers
✓ Whirlpool spas / Hot Tubs
✓ Ornamental fountains / water features
✓ Misters, air washers, atomizers, humidifiers
✓ Other devices that aerosolize and release fine water droplets
WMP / Describe the building: Process Flow Diagrams…

Process Flow Diagram
(Potable & Nonpotable Water Systems)

(CDC Toolkit Legend)

- Backflow Preventer
- Return Flow
- Water Process
ASHRAE 188 - Water Management Program

1. Establish Team
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Identifying areas of risk ...

“… Biofilm is the Root of the Problem …”

- National Science Foundation

- Protects Legionella from disinfectant
- Provides Legionella food and shelter
- Allows Legionella to grow, multiply and spread
Identifying Risk Areas: Systems / Devices
Identifying areas of risk – temperature matters

*Legionella*: Temperature Range

<table>
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<tr>
<th>Celsius</th>
<th>25</th>
<th>35</th>
<th>42</th>
<th>45</th>
<th>55</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fahrenheit</td>
<td>77</td>
<td>95</td>
<td>108</td>
<td>113</td>
<td>131</td>
</tr>
</tbody>
</table>

Dormant | Growth | Decline
Describe the building: Process Flow Diagrams...

(CDC Toolkit Legend)

- Backflow Preventer
- Return Flow
- Water Process
Identifying areas of risk …
1. Establish Team
2. Describe System
3. Assess Risk
4. Identify Controls
5. Monitor/Correct
6. Verify/Validate
7. Document
Control measures to mitigate risk …

**General Principles** of effective *Lp* control measures:

- Maintain water temperatures outside the ideal range for *Legionella* growth – **keep the Hot/Hot! / keep the Cold/Cold!**
- Prevent water stagnation – remove “Dead Legs”
  - Example: deteriorated pipe that is capped and unused
- Ensure adequate disinfection – flush programs
- Maintain devices to prevent biofilm, scale, corrosion, which provide a habitat and nutrients for *Legionella* – **require treatment programs for cooling towers, pools, spas, fountains, etc.**
Identifying areas of risk ...

- Temperature Permissive
- Stagnation
- No Disinfectant
- Conditions for Bacteria Spread
- Special Considerations for Healthcare Facilities
- External Hazards (e.g., construction, main break)
Control measures to mitigate risk …
Control measures to mitigate risk – POU Filters

Legionella bacteria are …

Very, very, very, very, very ...

*small* bacteria

0.3–0.9 µm (by)

2–20 µm

- Choose the right size & type filter → 0.2 µm (microns)
- Proven extremely effective in scientific literature
- Widespread use of filters isn’t easily managed or always safer
- Managing multiple filters can be time consuming and expensive
Control measures: Secondary disinfection …

Temperature Control:
- <77°F (25°C)
- >140°F (60°C)
- >160°F (70°C) Remediate

Chemical Oxidation:
- Chlorine
- Chorine Dioxide (ClO₂)
- Monochloramine

Chemical Reduction:
- Cu: 400 ppb
- Ag: 40 ppb

Point of Use Filtration:
- 0.2 micron
ASHRAE 188 - Water Management Program

1. Establish Team
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- **Step 5**
  - **PROGRAM TEAM**—Identify persons responsible for Program development and implementation.
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  - **CONFIRMATION**—Establish procedures to confirm that
    - the Program is implemented as designed (verification), and
    - the Program effectively controls the hazardous conditions throughout the building water systems (validation).
  - **DOCUMENTATION**—Establish documentation and communication procedures for all activities of the Program.
Establish for Every Control Measure

1. Control Limits ... for each point where control is applied
2. Monitoring Method ... for each point where control is applied
3. Monitoring Frequency ... for each point where control is applied
4. Corrective Actions ... for control measures outside their limits
Control measures to mitigate risk …

Once established, whether tasks are completed by staff, vendors or a combination, WMPs require:

1. **Regular monitoring** of control strategies and key areas for potentially hazardous conditions

2. **Implementing planned responses** to correct out-of-control (ranges) monitoring any hazardous conditions detected

*A Water Management Program is not “Won & Done”*
Learn from the Experience (Mistakes) of Others…

Legionella contamination and outbreaks can occur:

- in **new buildings** during construction and existing buildings during **renovations**
- with ineffective building commissioning
- after installation of low-flow or electronic sensor faucets
- after dormant, long periods (months) before/between occupancy
- after changes in incoming water quality (water main breaks, etc.)
WMP – Corrective Actions / Contingency Response

Sec 7. Contingency Response Plan: for all systems in Sections 7.1-7.5, the Program documents shall include:

a. procedures to be followed if there are known or suspected cases of legionellosis associated with the use of potable water or devices from the building water systems;

b. directives issued by national, regional, and local health department authorities;

c. if the Program Team determines testing for Legionella shall be performed, the procedures shall include criteria for when and where the tests shall be performed;

d. procedures for emergency disinfection; and

e. procedures for other actions identified as necessary by the Program Team to prevent exposure to contaminated water.
Corrective Action Examples …

CDC Toolkit / ASHRAE Standard 188

(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”
Example 1: Corrective Actions / **Biofilm Growth in 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.
Example 1: Corrective Actions / Biofilm Growth in Fountain ...

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.
Example 2: Corrective Actions / 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.
ASHRAE 188 - Water Management Program

1. Establish Team
2. Describe System
3. Assess Risk
4. ID Controls
5. Monitor/Correct
6. Verify/Validate
7. Document

CONFIRMATION—Establish procedures to confirm that
- the Program is implemented as designed (verification),
- the Program effectively controls the hazardous conditions throughout the building water systems (validation).

DOCUMENTATION—Establish documentation and communication procedures for all activities of the Program.
Confirmation requirements → Verification & Validation

Verification:
To confirm that the WSM Program is *actually being done!?* (aka, an internal audit)

Validation:
To confirm the WSM Program is *actually working!?*
Verification ➔

The process and evidence used to support that compliance with the plan is being done; record-keeping, control monitoring, process procedures and other evaluations. It ensures that the WMP is being correctly followed in practice:

“Are We Doing what We Planned to Do?”

Validation ➔

The process or evidence used to support that the control strategies of the plan are effective. Testing for control of the hazard or assessment of technical, scientific, medical, and other data that can be used to show that control measures for the hazard are effective; no legionellosis:

“Are We Doing the Right Thing—Is It Working?”
Verification – Doing what you said you’d do

Team must confirm that the control measures of the WMP are being performed and appropriately responded to.

WSM Team must designate **who**, as well as **when**, **how** and **how often** to verify that control measures are being implemented as planned.

**Verification is like an internal audit.**
Validation demonstrates a WMP’s effectiveness

→ Validation determines if the WMP is working e.g. controlling the growth of *Legionella pneumophila* to prevent disease

- **Proactive validation**: Test water for *Legionella pneumophila* that could cause Legionnaires’ disease if not controlled

- **Reactive/passive validation**: Track Legionnaires’ disease cases to determine whether WMP has been working
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DOCUMENTATION—Establish documentation and communication procedures for all activities of the Program.
“If it isn’t documented... it didn’t happen!”
WHY Documentation …

*If you don’t write it down, it’s like it never happened!*
In conclusion...
Legionella pneumophila is a common bacteria in the environment and in building plumbing water systems and devices.

Disease stems from favorable conditions for Legionella → growth + means of transmission + exposure route (aerosols) to susceptible persons.

Cooling water and potable water systems are all important for reducing risk.

There is a ‘standard of care’ for Legionellosis Risk Management in Building Water Systems: ASHRAE Standard 188.
Remember: Legionnaires’ disease is highly preventable

You need consistent, reliable, data to insure your water safety plan is effective, initially and over time.

9 in 10
CDC investigations show almost all outbreaks were caused by problems preventable with more effective water management.

#VitalSigns

www.cdc.gov/vitalsigns/legionnaires
Water Management Plans ...

The secret of getting ahead is getting started.

Mark Twain

So → Get Started!!
Preventing Legionnaires’ Disease: A Training on Legionella Water Management Programs (PreventLD Training)

www.train.org/main/course/1081923

To access this content, you first need to create an account. If you already have an account, please login.

Are you involved in water safety for buildings? Take the new free training from CDC and partners on creating a water management program to reduce risk for Legionnaires’ disease. The training aligns with industry standards on managing risk for Legionella bacteria (ASHRAE 188).
Additional Water Safety Management resources:

- **ASHRAE**: Guidance on Reducing the Risk of Legionella [www.ASHRAE.org](http://www.ASHRAE.org)

- **CDC**: Overview Water Management Programs
  [www.cdc.gov/legionella/wmp/overview.html](http://www.cdc.gov/legionella/wmp/overview.html)


- **HC Info**: WMP Templates, checklists training & technical information [www.hcinfo.com/home/](http://www.hcinfo.com/home/)

- **Association of Water Technologies (AWT)** Certified Water Technologist list [www.AWT.org](http://www.AWT.org)

- **Cooling Technology Institute (CTI)**: [www.CTI.org](http://www.CTI.org)

Question and Answer Session