# Legionella – Strategies for Evaluation and Management

Rob Rottersman, MS, CIH
Kevin Aikman, PhD, CIH, FAIHA

RAMBOLL Bright ideas. Sustainable change.

# INTRODUCTIONS

# Rob Rottersman, MS, CIH

Rob is a Certified Industrial Hygienist and Principal at Ramboll. He has over 25 years of experience in industrial hygiene with emphasis on chemical and biological exposure evaluation and analysis. Rob has a Master of Science degree from Colorado State University where he specialized in epidemiology.

He has performed numerous risk assessments and developed control strategies for Legionella in buildings. Rob has led outbreak investigations and provided expert support and testimony in matters related to Legionnaires' disease and has worked on some of the largest, and most publicized, outbreaks in the United States.

# Kevin Aikman, PhD, CIH, FAIHA

Dr. Aikman earned his Ph.D. in Plant Biology from Southern Illinois University at Carbondale in 1992. He earned his ABIH certification as a Certified Industrial Hygienist in 1998 and was named an AIHA Fellow in 2014. Dr. Aikman has performed numerous indoor air and water quality assessments in commercial buildings and public schools and holds several mold, asbestos, and lead professional licenses in IL, IN, and FL. In his current role as Principal at Ramboll, he actively directs and provides technical support on projects in several Ramboll Health Sciences disciplines including Hazardous Building Materials (Asbestos, Lead, Universal Wastes, etc.), Industrial Hygiene Exposure Assessment, Indoor Environmental Quality, Mold & Moisture, Water Quality (Legionella, lead in drinking water, and other general water testing), Infectious Agents (COVID-19), and Expert Litigation services.

# History and Understanding of *Legionella* Associated Diseases


Photo from CDC

# History – Legionnaires' disease setting the stage

- July 1976: Philadelphia Bi-centennial
- Strains of flu similar to the 1918 Spanish flu
  - Heightened fear of another global pandemic
  - This news launched Michael Crichton's book Andromeda Strain to the best seller list
- More than 4000 WWII Vets in the city - American Legion's Convention
  - Approximately 600 staying at the Bellevue Stratford Hotel
- Participants started getting ill – fever, cough, difficulty breathing
  - 221 people were infected and 29-34 died

# Investigation and discovery

- Cause of disease elusive
  - Theories of communists trying to take out veterans.
  - A doctor claimed that the only real consensus to develop among scientists was that this was not a bacterial disease.
- The cause would not be known until early 1977
- Dr. Joseph McDade (CDC "backbencher") working to rule out Q Fever (caused by a bacteria and typically transmitted by arthropods like fleas, lice, and tick to animals and humans which causes a less serious pneumonia with flu-like symptoms)
  - Observed "insignificant" bacteria contaminating his samples
  - Awkward moments at a party, went to the lab injected chicken eggs without an antibacterial chemical
  - Legionella discovered and viewed as a classic case of the power of epidemiology

# Why was it hard to find and diagnose?

- Will not grow under typical conditions.
  - Demanding critter with specific requirements to culture in lab
  - Likes elevated temperatures, often higher than body temperature
- So – where did it come from?
  - 221 people got sick in Philadelphia but 72 were not involved with the convention
  - BUT….those 72 all walked by the Bellevue Stratford Hotel
  - Bacteria was found in the cooling tower
- The bacteria was traced back and found to be responsible for many unsolved outbreaks
  - Some as early as the 1950s.

# Terminology

- Legionella the bacteria that causes legionellosis
  - Legionella pneumophila serogroup 1 (LP1) – the type of Legionella most likely to cause disease
- Legionellosis – one of two types of illnesses caused by Legionella
  - Legionnaire's disease
    - A type of pneumonia.  Mortality rate about 10% but much higher in immune compromised
    - Tends to affect older population
  - Pontiac fever
    - Flu like symptoms.  Resolves untreated.  Not believed to be fatal
    - Tends to affect younger people

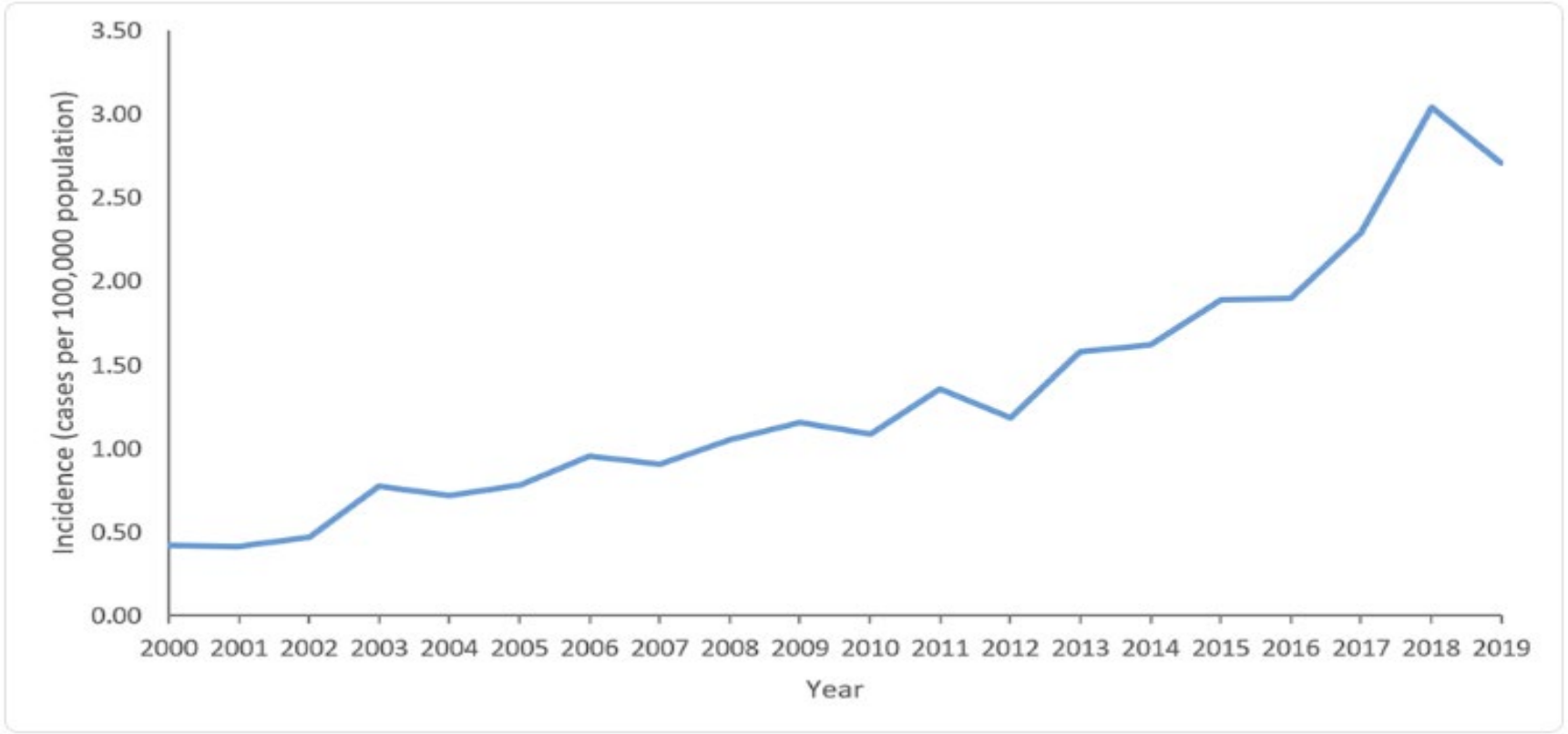
# Legionnaires' disease is on the rise in the United States

**10,000**
reported cases/year

**70,000 – 100,000**
actual cases/year

**10%**
mortality rate

Rate of reported confirmed cases increased 5.5 times (2000-2019)

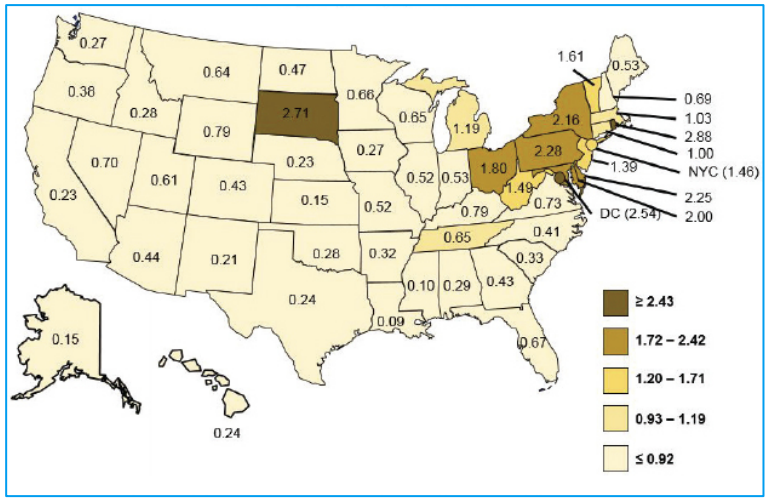




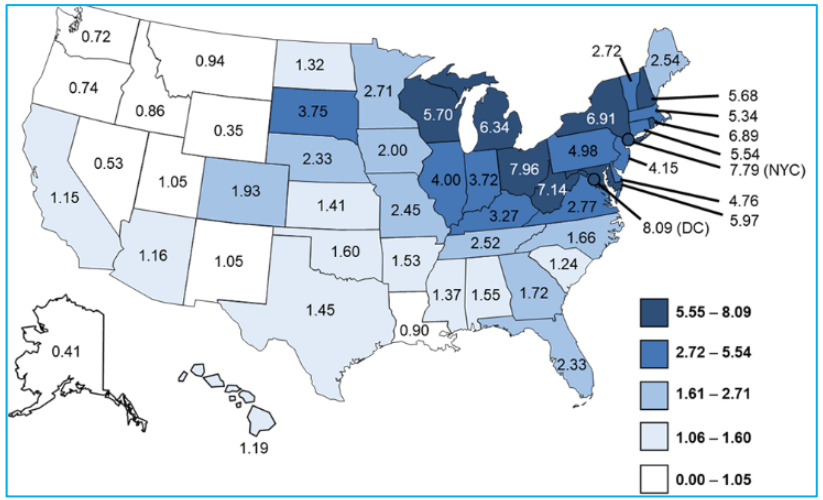

Source: National notifiable disease surveillance system

# Recent history of *Legionella* cases

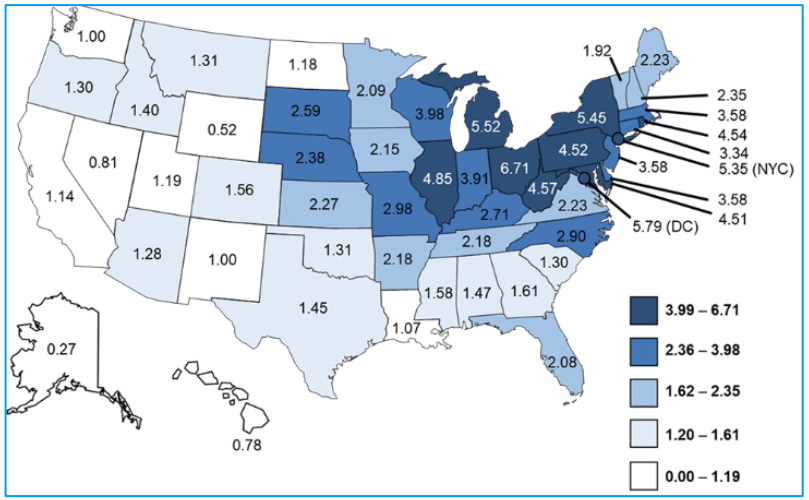
2005




2018




2019




Incidence rates per 100,000 populations

Note: 2000 – 2012 not all states reported cases to the CDC

Adapted from: CDC MMWR & WONDER Data

# Outbreaks that got attention

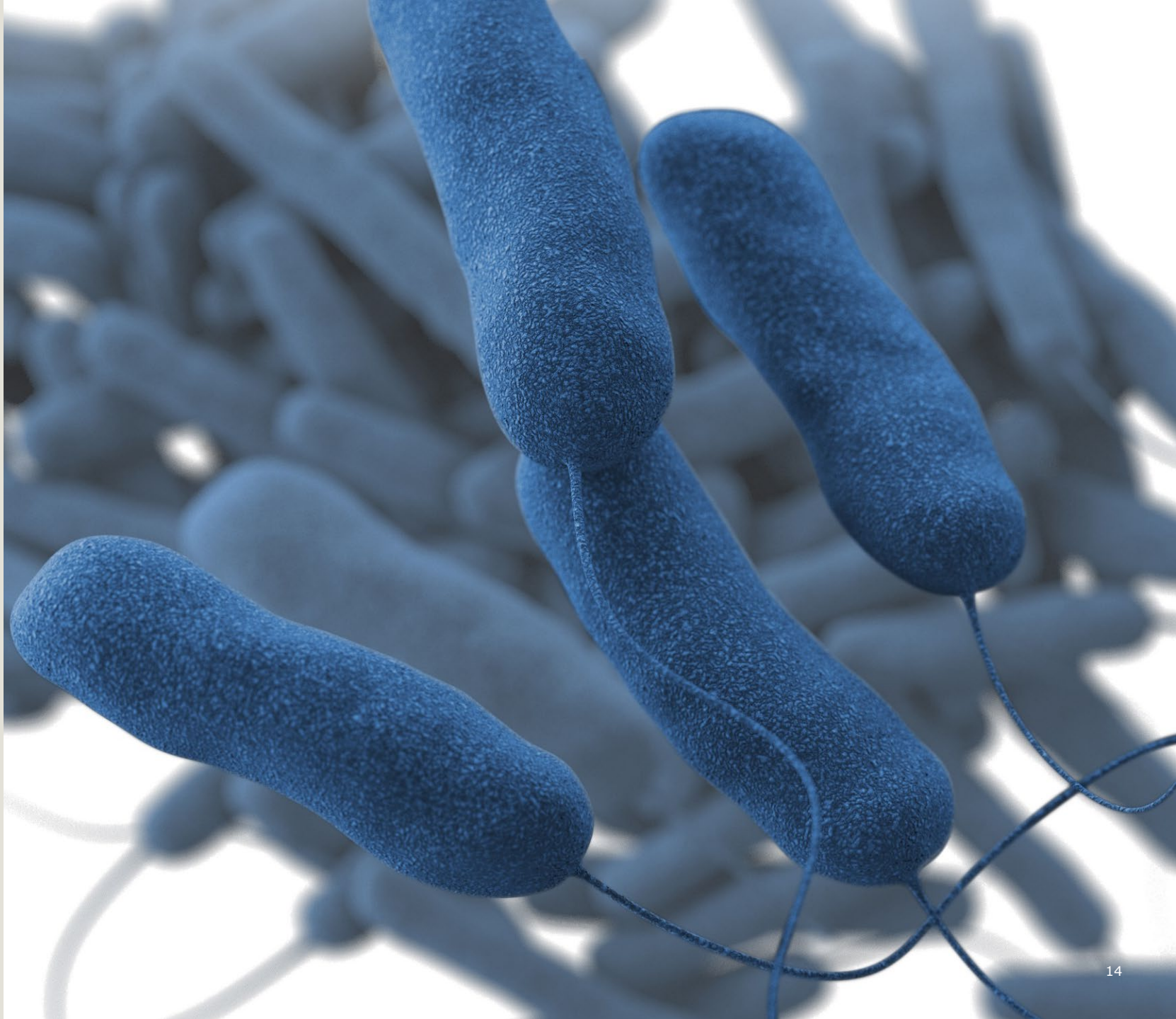
| Year | Location | Source | Cases | Deaths |
|---|---|---|---|---|
| 1999 | Bovenkarspel, Netherlands | Hot tub – at flower show | 318 | 32 |
| 2001 | Murcia, Spain | Cooling towers | 800 | 6 |
| 2012 | Chicago, IL | Lobby fountain | 10 | 3 |
| 2014 | Portugal | Unsure | 375 | 12 |
| 2014-2015 | Genesse, MI | Municipal water/Hospital | 87 | 10 |
| 2015 | Bronx, NY | Cooling towers | 113 | 12 |
| 2015* (2018) | Quincy, IL | Unsure | 54 | 12 |
| October 2019 | North Carolina State Fair | Hot tub | 136 | 4 |

# Requirements for disease

1. Legionella bacteria must be present
   - In sufficient quantity and
   - Pathogenic species
2. Water containing bacteria must be aerosolized into a fine mist
   - Respirable size droplets
3. The mist must be inhaled by a susceptible person
   - Risk factors: advanced age, suppressed immune system, smoking, cancer, male, diabetes

# Legionella reservoirs in buildings

Components of a quality *Legionella* evaluation and the competent professional.



# Legionella – Where it is and how does it grow

- Legionella Bacteria is common – low levels found in rivers, lakes, ponds, etc.
- Some survive water treatment and enter the potable water system
- Find a niche in building systems and multiply
  - Can live within amoeba or other protozoa
  - Grow within biofilm
- Temperature important factor in growth
  - 77 to 113 degrees F growth range – rapid growth can occur between 90 and 108 degrees
  - Starts to die at 122 degrees (slow death). Rapid disinfection above 150 degrees F
- Stagnant or aged water in pipes
  - Decreased water use during COVID-19 pandemic

# Where can Legionella grow or spread

- Water tanks
- Water heaters
- Water hammer arrestors
- Expansion tanks
- Water filters
- Faucets
- Aerators
- Faucet flow restrictors
- Showerheads/hoses
- Pipes/valves/fittings (dead legs)
- Misters/air washers
- Aerosol (non steam) humidifiers
- Infrequently used equipment
- Ice machines
- Hot tubs
- Decorative fountains
- Cooling towers
- Medical devices (CPAP, bronchoscopes, etc.)

# Overview of Applicable Standards and Guidelines



# Guidelines and Standard of Care

- Advisory in nature
- No federal regulations in the US
- Not sufficiently specific – variations in numerical concentration limits
- Consensus health-based guidelines do not currently exist
- Not widely followed except in healthcare industry
- Even routine testing is controversial, since environmental concentrations of *Legionella* alone cannot predict the probability of disease

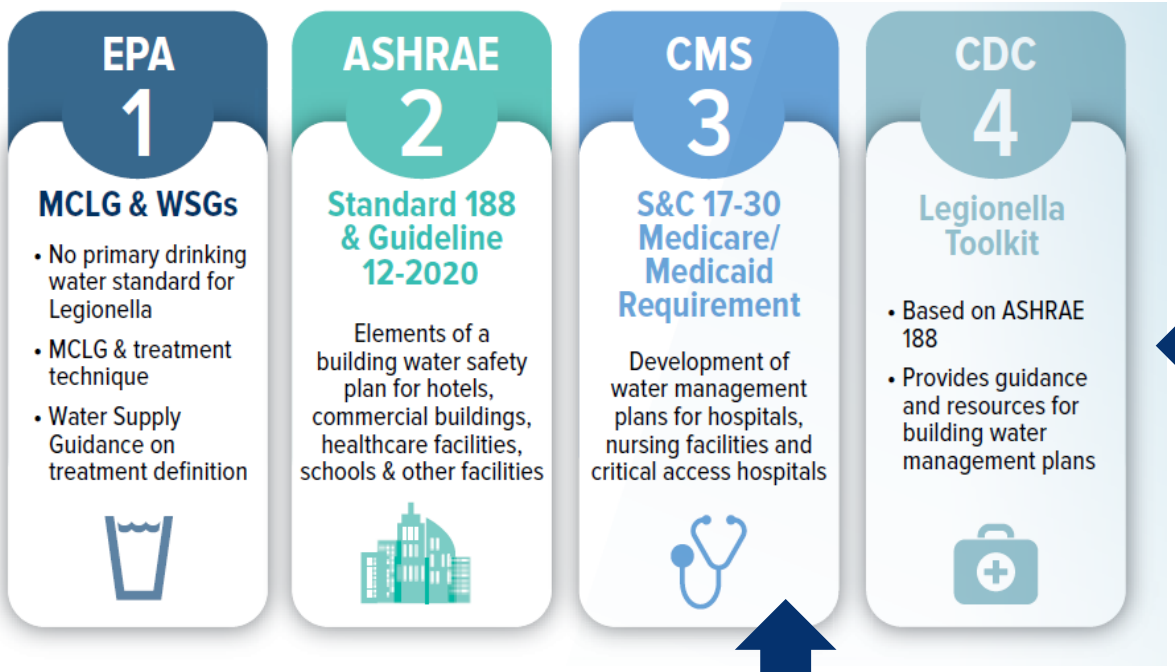
# Standards and guidelines

- Federal Clean Water Act (CWA) and Safe Drinking Water Act – National Primary Drinking water Regulations
- World Health Organization "Legionella and the prevention of legionellosis" 2007
- **ANSI/ASHRAE 188 - 2021 – "Legionellosis: Risk Management for Building Water Systems" (revised ANSI/ASHRAE 188-2018)**
- New York State Sanitary Code "Part 4 – Protection Against Legionella", July 2016
  - Replaced: New York State Department of Health: Emergency Regulation 10 NYCRR Part 4 "Protection Against Legionella", August 2015
  - New York City Cooling Tower Regulations requires Management Plan & Program, registration, and annual certification
- **CDC " Toolkit for Controlling Legionella Growth in Common Sources of Exposure (*Legionella* Control Toolkit)" (2021)**
- Center for Medicare and Medicaid Services "Requirement to Reduce Legionella Risk in Healthcare Facility Water Systems to Prevent Cases and Outbreaks of Legionnaires' Disease (LD)" June, 2017
- AIHA: *Recognition, Assessment and Control of Legionella in Building Water Systems*, 2nd Ed. (2022)
- OSHA e-Tool and Technical Manual Section III Chapter 7 [General Duty Clause – Section 5(a)(1)]
- National Institute for Occupational Safety and Health: *Preventing Occupational Exposure to Legionella* (2019)
- Wisconsin Division of Health - *Control of Legionella in Cooling Towers: Summary Guidelines* (1987)

# Federal Regulations & Industry Guidance: *Legionella* Control

There is no primary drinking water standard for *Legionella* and monitoring for *Legionella* is not required.

Currently listed by the EPA under the Surface Water Treatment Rule (SWTR) with a maximum contaminant level goal (MCLG) of zero *Legionella* organisms for drinking water.




CDC is not a regulatory agency: provides recommendations and resources for *Legionella* control, sample collection and interpretation.

CMS only applies to Healthcare facilities

Graphic courtesy of ASDWA, 2019

# AIHA 1st Edition Guidance and Recommended Actions

**Table 3.1** — Data Interpretation Guidelines

| Sample Source | Non Detectable | Acceptably Low* | Action | Possible Amplification | Action | Indicates Amplification | Action |
|---|---|---|---|---|---|---|---|
| Humidifiers & Misters | <1 CFU/mL | <1 CFU/mL | 1 | 1–10 CFU/mL | 2 | >10 CFU/mL | 3 |
| Decorative Fountains and Water Features | <1 CFU/mL | <1 CFU/mL | 1 | 1–10 CFU/mL | 2 | >10 CFU/mL | 3 |
| Hot Tubs, Whirlpools and Spas | <1 CFU/mL | <1 CFU/mL | 1 | 1–10 CFU/mL | 2 | >10 CFU/mL | 3 |
| Potable Water | <1 CFU/mL | <10 CFU/mL | 1 | 10–100 CFU/mL | 2 | >100 CFU/mL | 3 |
| Industrial Working Fluids | <1 CFU/mL | <10 CFU/mL | 1 | 10–100 CFU/mL | 2 | >100 CFU/mL | 3 |
| Cooling Towers & Evaporative Condensers | <10 CFU/mL | <100 CFU/mL | 1A | 100–1,000 CFU/mL | 2A | >1,000 CFU/mL | 3A |

*While the goal of *Legionella* Disease Bacteria (LDB) is zero (below detectable limits) building water systems may be limited by the levels in source water (i.e. municipal water supplies). In these instances the concentration of LDB in the source water (i.e., municipal water supply) represents the maximum allowable level in the system.

Sources:

1. OSHA eTools: Legionnaires' disease https://www.osha.gov/dts/osta/otm/legionnaires/
2. OSHA Technical Manual Section III. Chapter 7. 1999. Legionnaires' disease. https://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_7.html
3. **Morris, G.K. and B.G. Shelton:** *Legionella* Bacteria in Environmental Samples: Hazard Analysis and Suggested Remedial Actions. Technical Bulletin 1.5, P-2. Norcross, GA: Pathcon Laboratories, 1998.

# AIHA 2nd Edition – 2022 Updates

**Table 3.2:** Recommended Actions

| Action | Recommended Actions |
|---|---|
| **Humidifiers & Misters, Decorative Fountains & Water Features, Hot Tubs, Whirlpools & Spas** | |
| No Action Required | • Continue routine monitoring for *Legionella* levels, as scheduled per the site-specific plan, based on risk assessment results.<br>• Continue maintaining system and source.<br>• Consider reassessment if conditions change to favor *Legionella* colonization or amplification. |
| 1<br><1 CFU/mL | **MONITOR –**<br>1. Measure disinfectant levels, where appropriate, to determine if adequate to control *Legionella* growth; increase to effective control levels, if necessary.<br>2. Measure temperature, where appropriate, to determine if it is within a range that is permissive for *Legionella* growth and adjust accordingly.<br>3. Inspect system components for accumulated sediment, debris, scale, and biofilm.<br>4. Ensure maintenance and operation procedures are appropriate and are being followed.<br>5. Reassess treatment practices and consider cleaning and/or disinfection protocols if judged to be necessary.<br>6. Collect retest samples if any changes to the operation of the system or cleaning or disinfection actions were taken; if re-testing, wait for at least 48 hours, and no more than 7 days, after treatment. |
| 2<br>1 to <10 CFU/mL | **INVESTIGATE & MITIGATE RISKS OF GROWTH –**<br>Take the water system component out of service as soon as possible.<br>1. Implement Items 1–4 listed in Action 1 above.<br>2. Conduct remedial cleaning and/or disinfection protocols.<br>3. Reestablish normal biocide and pH levels.<br>4. Collect a retest sample. (Wait at least 48 hours, and no more than 7 days, after treatment to re-test.)<br>5. Based on professional judgment and the history of the water source, consider increasing the frequency and/or intensity of sampling efforts in order to identify any contributing amplification sources(s).<br>6. Wait until post-treatment sample results are reported and reviewed by a Competent Professional before returning system to operation.<br><br>**If one or more cases of legionellosis (either LD or PF) are suspected, take the following additional steps:**<br>• Notify appropriate management and public health authorities (if required) of test results and coordinate further efforts.<br>• Coordinate and implement cleaning and/or disinfection protocols with any proposed testing by public health officials, when applicable. |
| 3<br>>10 CFU/mL | **INVESTIGATE, MITIGATE RISKS OF GROWTH & REMEDIATE GROWTH –**<br><br>**IMMEDIATELY take the water system component out of service.**<br>• Implement Items 1–5 listed in Action 2 above.<br>• Wait until post-treatment sample results are reported and reviewed by a Competent Professional before returning the system to operation.<br><br>**If one or more cases of legionellosis (either LD or PF) are suspected, take the following additional steps:**<br>• Notify appropriate management and public health authorities (if required) of test results and coordinate further efforts. Coordinate and implement cleaning and/or disinfection protocols with any proposed testing by public health officials, when applicable. |

# CDC Guidance

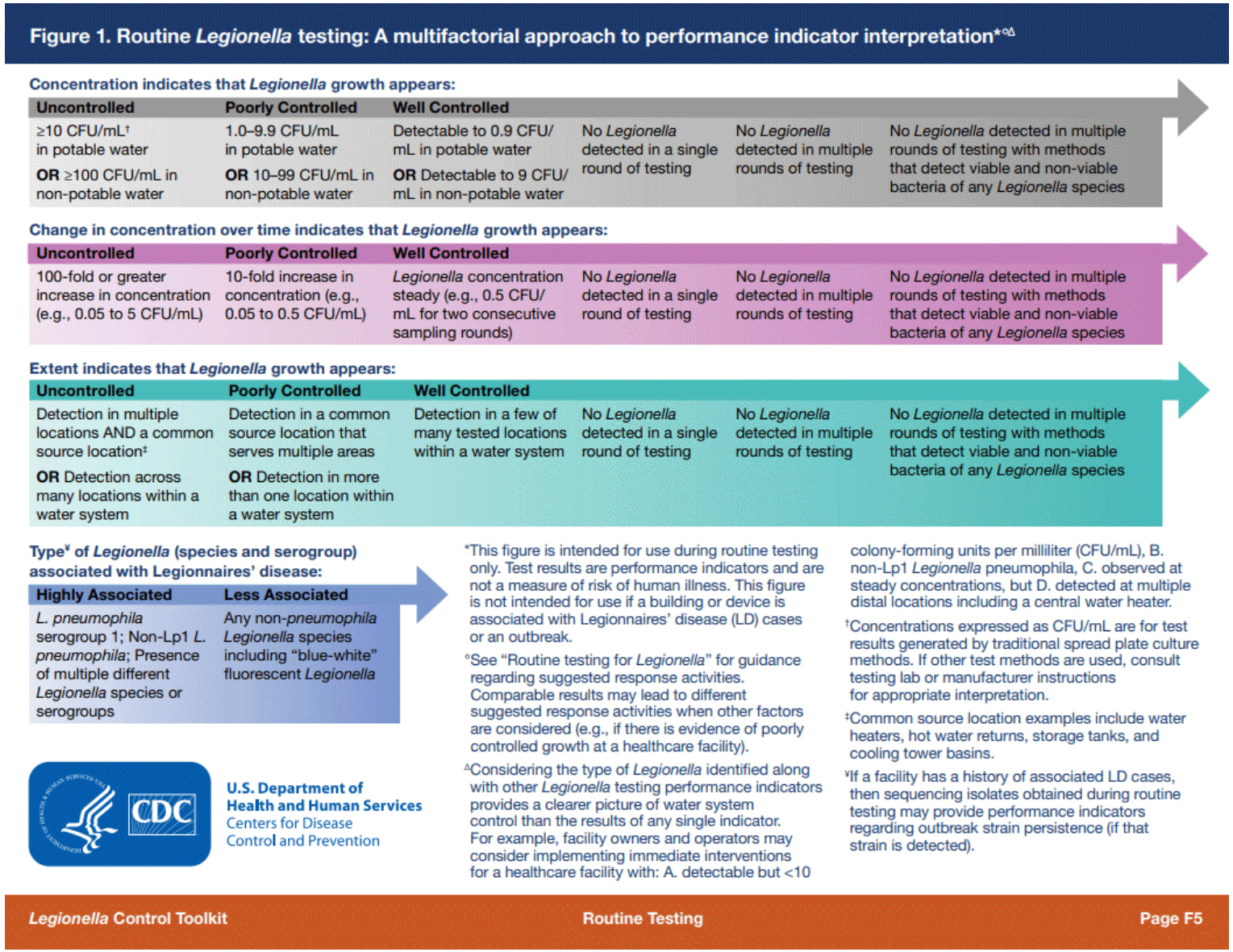


**Figure 1. Routine *Legionella* testing: A multifactorial approach to performance indicator interpretation*[φΔ]**

**Concentration indicates that *Legionella* growth appears:**

| Uncontrolled | Poorly Controlled | Well Controlled | | | |
|---|---|---|---|---|---|
| ≥10 CFU/mL[†] in potable water<br>**OR** ≥100 CFU/mL in non-potable water | 1.0–9.9 CFU/mL in potable water<br>**OR** 10–99 CFU/mL in non-potable water | Detectable to 0.9 CFU/mL in potable water<br>**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[‡]<br>**OR** Detection across many locations within a water system | Detection in a common source location that serves multiple areas<br>**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[ɣ] 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* |

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

*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.

°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).

ΔConsidering 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.

†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.

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

ɣIf 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).

*Legionella* Control Toolkit | Routine Testing | Page F5

# Source Identification

- The vast majority of cases are individual cases NOT from outbreaks
  - Overlooked & underdiagnosed
  - More potential sources of exposure (finger pointing) when compared to an outbreak with multiple cases

- Genetic testing (PCR)
  - Can (close to) definitely link case to source
  - Need sample from the person and the sources to get a match

- Outbreak investigations handled differently in different states, counties, municipalities
  - Some are very thorough others are not

- Diagnosis – sputum culture vs urine antigen

# Data interpretation and response

Establish criteria and actions **before** sampling

Will you follow:

CDC or AIHA guidelines?

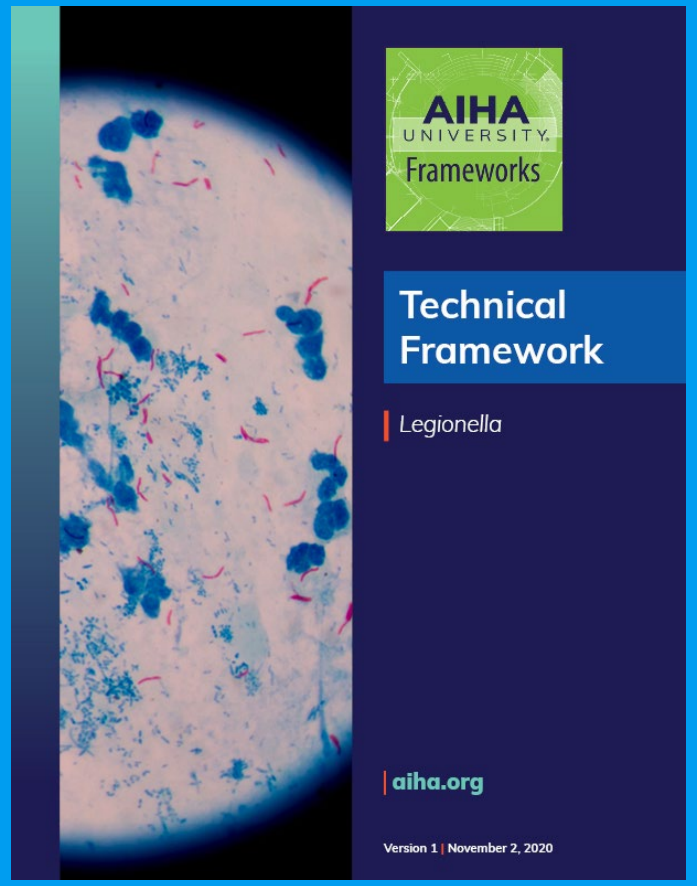
Perhaps a hybrid is better suited for your facility

What actions will you take when a threshold is exceeded?

# AIHA Technical Framework – Legionella (2020)

**Defines knowledge, skills and abilities (KSAs) for 3 levels of Legionella professionals:**

- **Competent Technician** – Monitors Building Water Systems/May Assist in Investigation
- **Program Professionals** – Develops risk assessments, establishes control measures and monitoring locations and developing or overseeing the water management program.
- **Responder Professionals** – Most likely to respond as an outside expert for a single case or cluster of *Legionnaires disease.*




**ASSE/IAPMO/ANSI 12080 Certification for Legionella Water Safety and Management Personnel (24 Hr Class plus exam)**

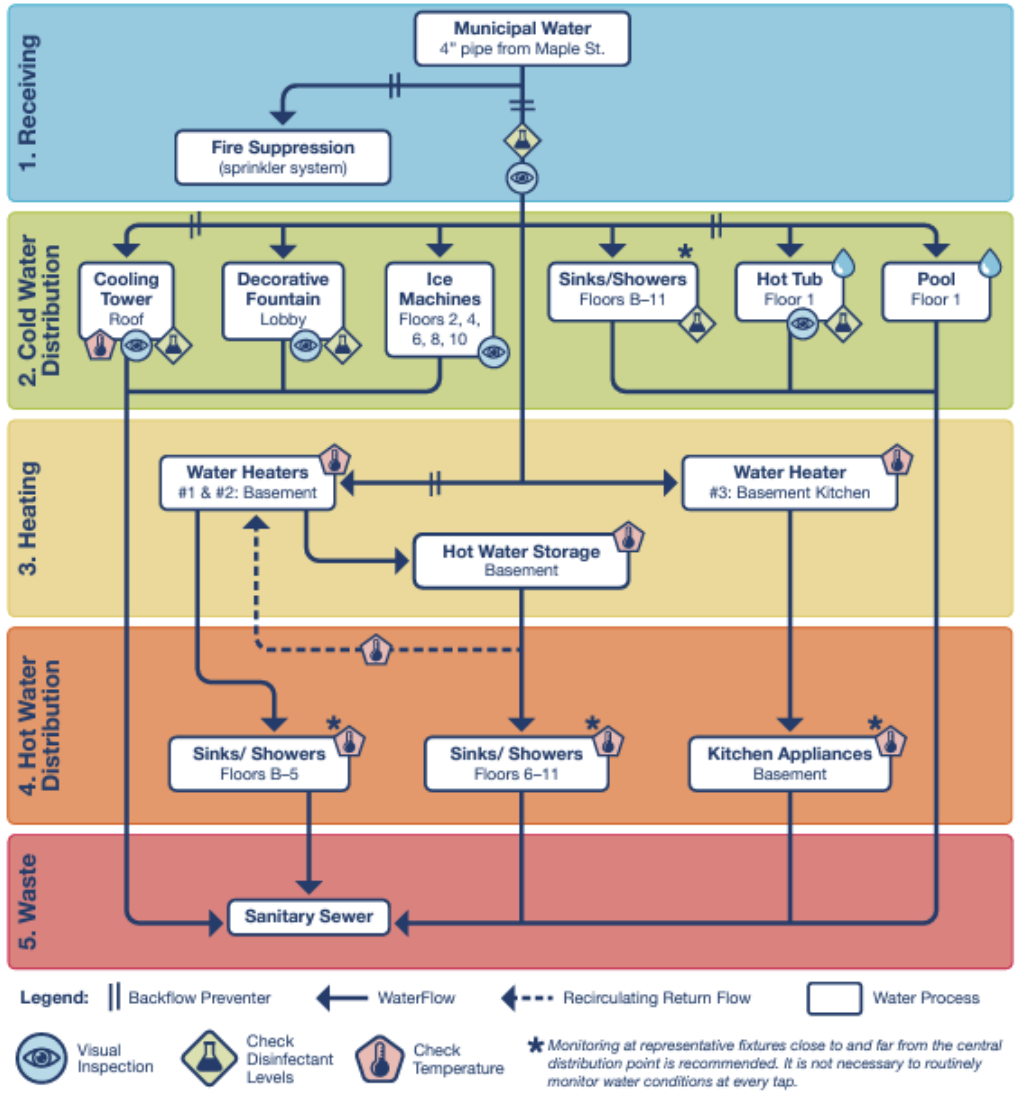
# Interpretation of Laboratory Results

- CDC guidance, the risk can be classified as “Well Controlled”, “Poorly Controlled”, or “Uncontrolled”
- Culture methods (CDC Elite Laboratory) – 8-14 days
- PCR methods that detected Legionella-specific RNA

- Interpreted based on various criteria
  - Concentration – CFU/mL
  - Percent Positive
  - LP serotype
  - Change in concentration over time
  - Contamination detected in multiple locations or single system
  - Other water quality parameters

- Establish performance indicators prior to sampling

# Discussion of mitigation and control strategies




*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

# Legionella Mitigation and Control

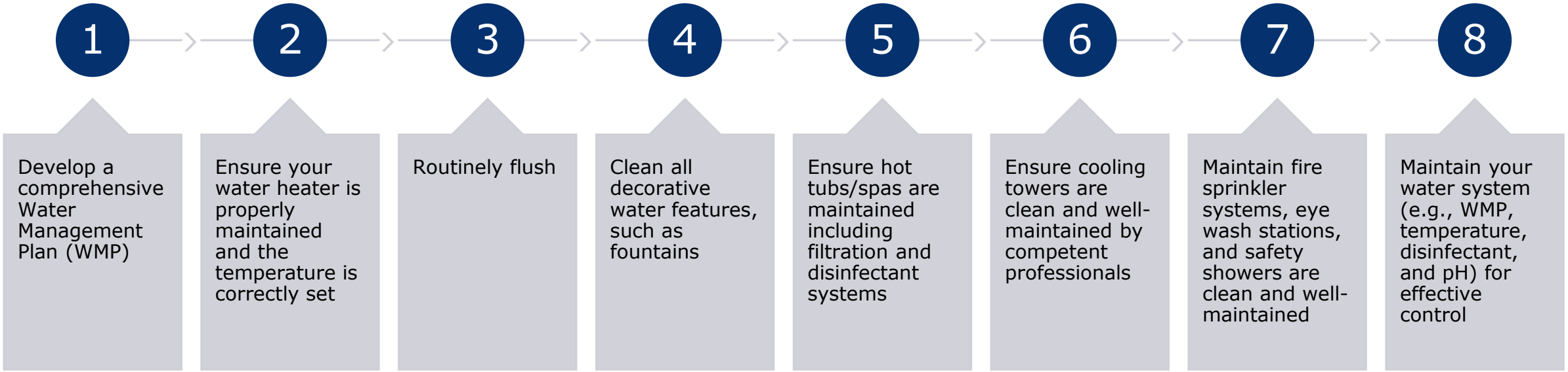
Unacceptable Sample Results – Next Steps

**Risk assessment for those performing remediation/collecting samples**

Identify and address potential source of bacteria.  Examples may include:

- Develop a comprehensive Water Management Program (WMP)
- Flush and clean hot water tanks
- Verify water temperatures and disinfectant concentrations
- Drain, clean and disinfect cooling towers, fountains, hot tubs
- Identify and remove dead legs
- Reduce residence time of water in the system, (problem during low occupancy – COVID 19)
  - Implement a flushing program
- Infrequently used fixtures (eye washes, sinks, that shower in the unused locker room)

# 8 Steps to Minimize *Legionella* Risk



# “Emergency” Remediation

These approaches might provide temporary reduction of bacteria to acceptable levels. **Each building and situation is different.**

**Superheat and Flush** – heat water to approximately 149º F or hotter and flush so this temperature water is drawn through all pipes and fixtures. Scalding risk. Labor intensive. No chemicals or odors.



**Shock Hyperchlorination –** typically 20 to 50 ppm of free chlorine the flush through every fixture. Often used when superheat cannot reach sufficient temperature at distal sites. Concerns with odors, potential exposure to chlorine and possible damage to pipes.

**Point of use Filters –** installed at the fixture where exposure is a concern. Requires a filter (typically a membrane) that can remove bacteria, often 1 micron or less. Easier than superheat or hyperchlorination but may not be practical in facility with many fixtures. *Legionella* remains in the system and the filters provide protection…lower on the hierarchy of controls.

# Longer term Strategies for Ongoing Control of *Legionella*

**Temperature control**

Maintain temperatures greater than 140⁰ F throughout the hot water distribution system

- Advantages – no chemicals and existing equipment
- Disadvantages – scalding risk, maintaining this temperature in infrequently used pipes

**Chlorine**

- Advantages – widely used, effective against "free swimming" bacteria, likely already used by water provider
- Disadvantages – may not adequately penetrate biofilm, dissipates, pH dependent

**Monochloramine**

- Advantages – penetrates biofilm better and more persistent than free chlorine. Low odor.
- Disadvantages – equipment needed onsite create monochloramine. Not as strong an oxidizer as free chlorine, might be better with Legionella but possibly less effective against other bacteria. Concern/uncertainty with disinfectant by-products (DBP), but this is also the case with other disinfectants.

# Longer term Strategies for Ongoing Control of *Legionella*

**Chlorine dioxide**

- Advantages –high oxidation potential, effective against *Legionella* and other microorganisms, can penetrate biofilm, not pH dependent
- Disadvantages – need to mix/generate on site with potentially hazardous materials, possible corrosion or damage to pipes, DBPs

**Copper/Silver-ion**

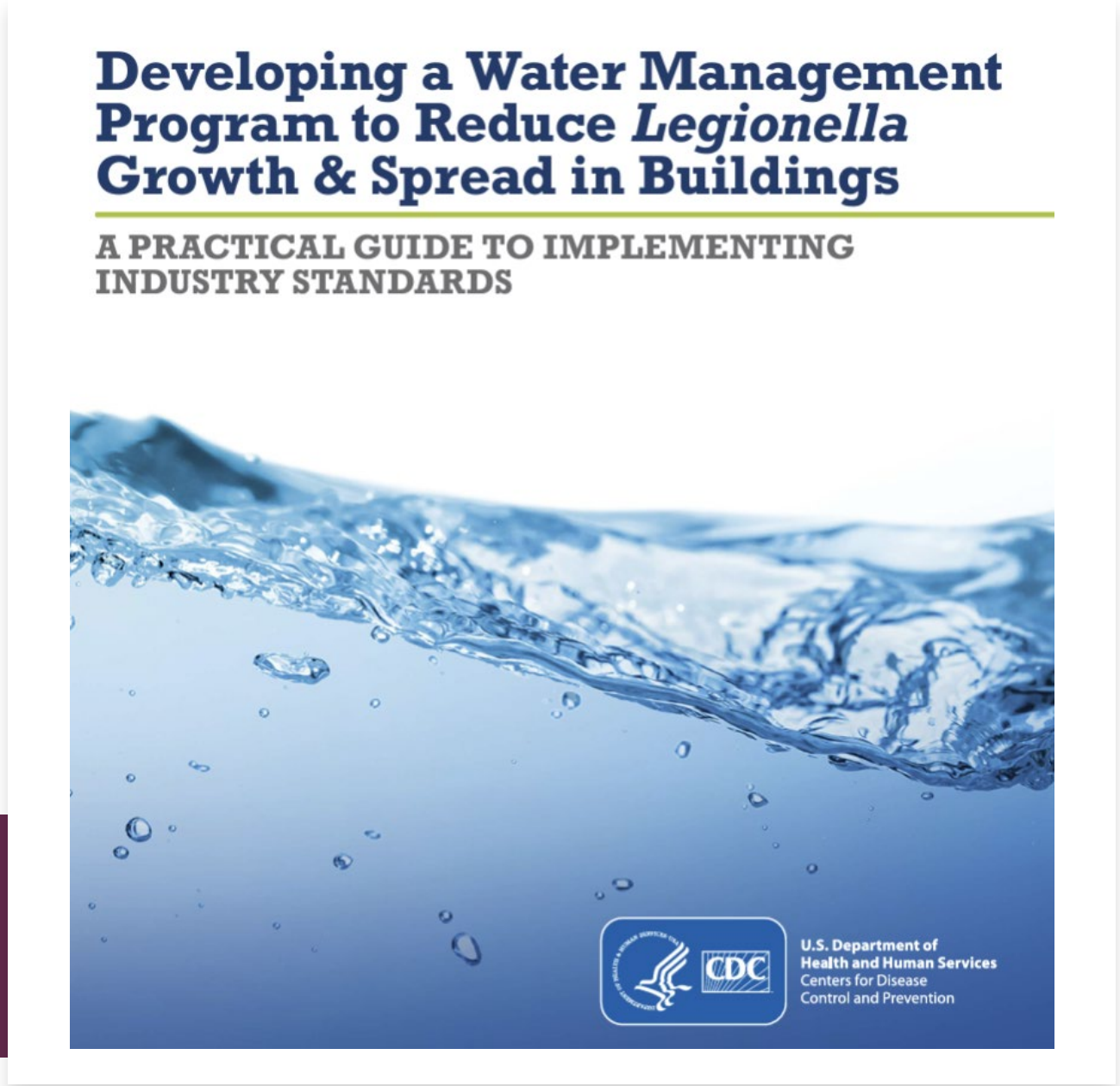
- Advantages – relatively easy to install, does not require various forms of chlorine.
- Disadvantages – might not adequately penetrate biofilm, possible aesthetic effects (water taste, odor, color), possible corrosion

**Other technologies – UV, Ozone**

# Verification of Controls

Define and include in Water Management Plan:

- What to monitor or test (pH, temperature, disinfectant levels, *Legionella,* other bacteria)
- When (how frequently) to evaluate each parameter
- Define thresholds for follow-up for each parameter
- Describe actions to be taken when thresholds are exceeded



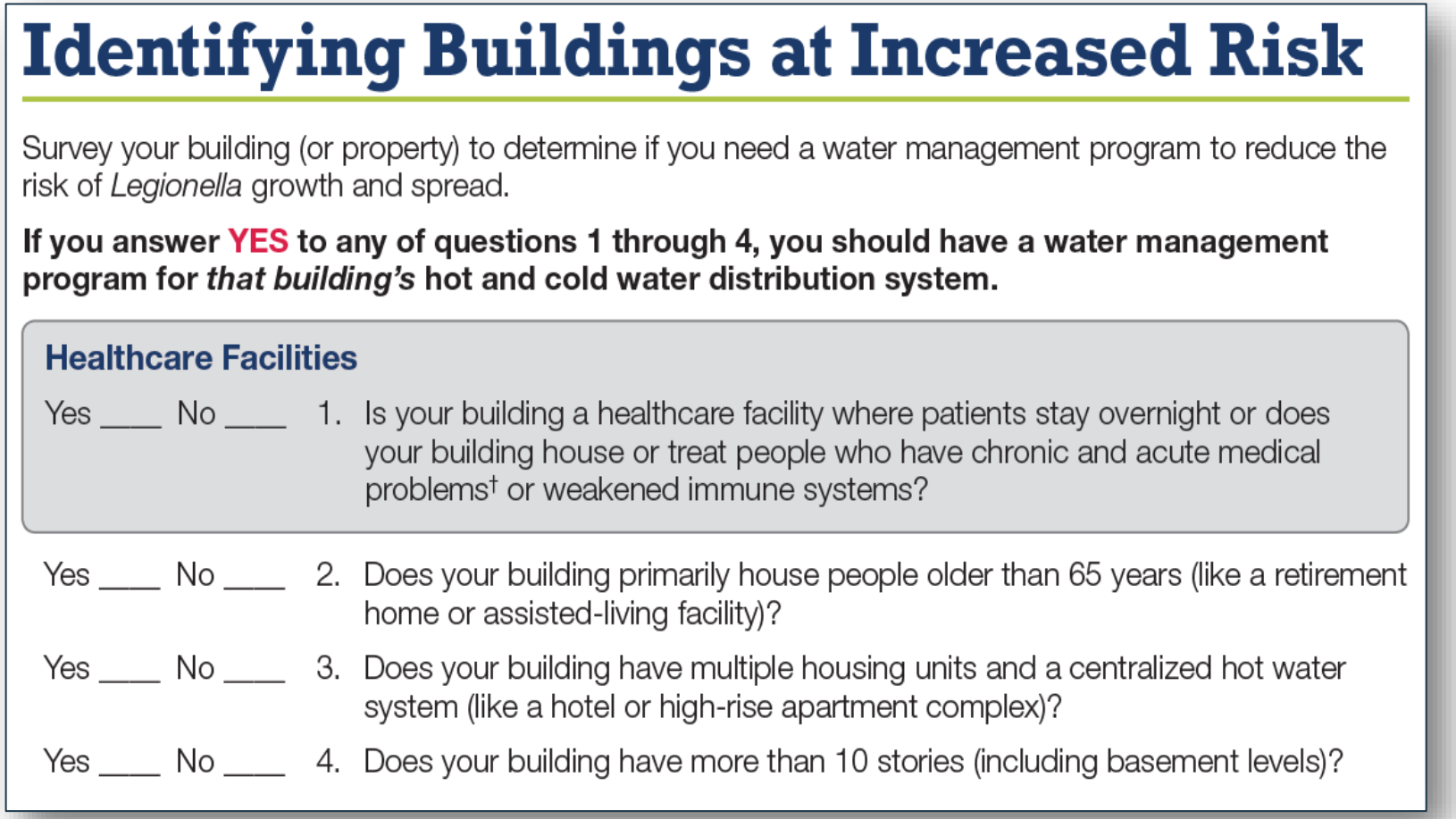

# Components of a Water Management Program – CDC Toolkit

https://www.cdc.gov/legionella/maintenance/wmp-risk.html

# Does Your Building Need a WMP?

CDC Guidance:

- Step 1 = “Develop a comprehensive water management program (WMP) for your water system and all devices that use water”
- References CDC Toolkit & Modules
- Does not apply to single-family homes



## 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 who have 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 hot water system (like a hotel or high-rise apartment complex)?

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

# Does Your Building Need a WMP?

- **CDC Toolkit Questions:**
- **"NO" to 1-4 but "YES" to**
  - **cooling tower,**
  - **hot tub/spa,**
  - **decorative fountain or**
  - **other aerosol-generating device**
  - **--> YES, you need a WMP**

- **CDC Toolkit Questions:**
- **"NO" to 1-8?**
  - **Still need to maintain systems & address high-risk occupants**

**Devices in buildings that can spread contaminated water droplets should have 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*?

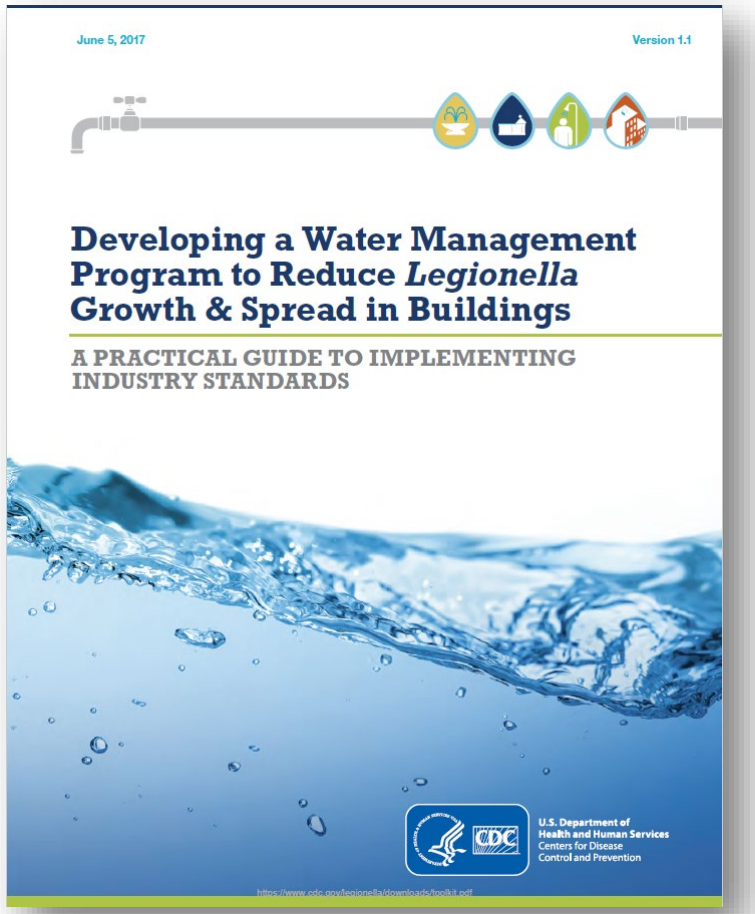
Yes ____ No ____ 6. Does your building have a hot tub (also known as a spa) that is not drained between each use?

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?

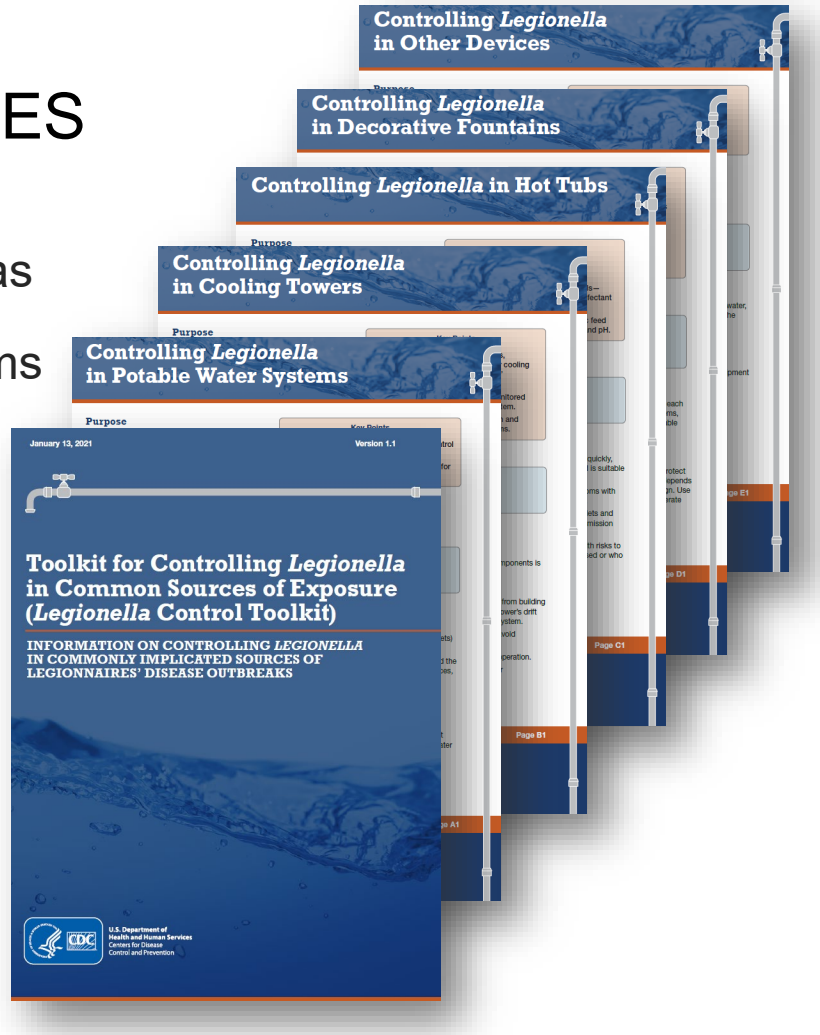
**If you answer NO to questions 1 through 8, you should still maintain water systems according to manufacturer recommendations.** On properties with multiple buildings, prioritize buildings that house or treat people who are at increased risk for Legionnaires' disease (see Appendix A to learn who is at increased risk).

# What is Included in a WMP, if necessary?




## CDC TOOLKIT & SUPPLEMENTAL MODULES

- Focused on **ASHRAE 12-2023** as implementation standard for centralized building water systems
- "Routine Sampling" Guidance
- Individual Modules for:
  - Potable water systems
  - Cooling towers
  - Hot tubs
  - Decorative fountains
  - Other devices



# When to Collect Samples

## Prior to any sampling event:

- Develop a sampling plan
  - Locations, types (hot & cold water), volume, laboratory method?
  - How will results be interpreted?
  - Corrective actions?

**Determine through discussion with WMT, laboratory, water treatment vendor, Qualified Consultant**

***Legionella***

- NO REQUIREMENT TO SAMPLE
  - Outbreak or Case Response
  - Direction from Local Public Health Department
- Following a ***stable cycle*** of ***verified WMP implementation***

# WHAT WE LEARNED?

Develop a team, communicate, and document actions – follow requirements of the WMP

Don’t sample first and hope for favorable results, have a plan

Remember the 5 P’s
- Prior
- Preparation
- Prevents
- Poor
- Performance

# THANK YOU

Bright ideas. Sustainable change.

**Rob Rottersman**
**rrottersman@ramboll.com**

**Kevin Aikman**
**kaikman@ramboll.com**

**Ramboll Health Sciences**
**333 West Wacker Drive, Suite 1050**
**Chicago, IL 60606**

# Case Studies

RAMBØLL

Bright ideas.
Sustainable change.

# Case Study – Hotel Outbreak Investigation

Large Hotel

Multiple cases after a conference

- Cases from different states

More than 700 guest rooms

Hot tub,

2 decorative fountains,

Swimming pool

Cooling tower on the roof

Conference center

Restaurant and kitchens

# Initial Response

**Decision made to close hotel – relocate guests**

**Immediate sampling – culture method**

**Low concentrations in decorative fountains (<1 CFU/ml)**

**Map the building water system**

**Develop a plan for follow-up (comprehensive testing)**

**Review nearby/neighboring sources**

# The Journey to find the Source

- Hundreds of samples collected over weeks, then months
- No “hits” that would explain outbreak
- Hotel re-opens with no additional cases
- Comprehensive monitoring continues
- Frustration

# The Source Identified…Not Really..Until

Isolates retained and sequency from samples from fountains and case specimens were genetically “close”

Health officials believed source was the fountains

(Fountains were removed….but doubt remained)

Until, ongoing sampling found high levels in hot tub, had previously been non-detect many times.  Match with case specimans.

WHY?

# Found It!

- Contractor scanned the building and found an abandon pipe buried in concrete slab.  Previous fill line for the hot tub
  - Gate valve had been installed to shut this pipe off

- Found the pipe was still connected to the hot tub…and had a slow trickle
  - Old gate valve had failed
  - Long pipe run with almost no flow, dripping into the hot tub

  Have theories – but never found out why this resulted in non-detect samples for months then a sudden spike in concentrations

  Hot tub removed