LiquiTech

MAY 15, 2026

# Reducing HAIs with Smarter Water Management Strategies

# Presenter


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# OBJECTIVES

MAY 15, 2026

01 Explain why addressing building water is critical to reducing healthcare-associated infections.

02 Discuss the relationship to HAIs of common waterborne pathogens in plumbing systems.

03 Describe best practices for maintaining plumbing systems to prevent HAIs.

04 Explore water management solutions that reduce waterborne pathogen-related HAIs.

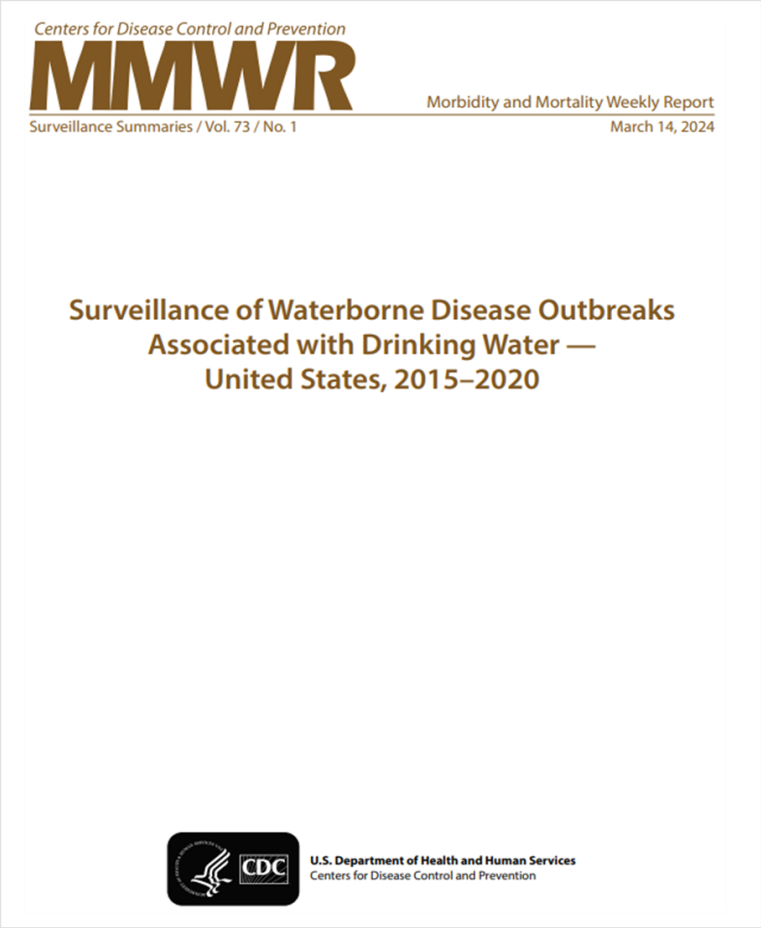
05 Examine case studies of hospitals successfully mitigating waterborne pathogen risks.

# Role of plumbing in hospital safety

# Importance of plumbing for IPs

- Legionella and other bacteria can thrive in water systems, especially stagnant water.
- A well operating plumbing system ensures continuous water flow, reducing risks.
- Water management activities act as a primary defense against the spread of  waterborne diseases.
- Water is essential for hygiene, cleaning, and patient care.
- Directly impacts overall patient health and recovery.
- IPs must understand the systems to address these potential risks

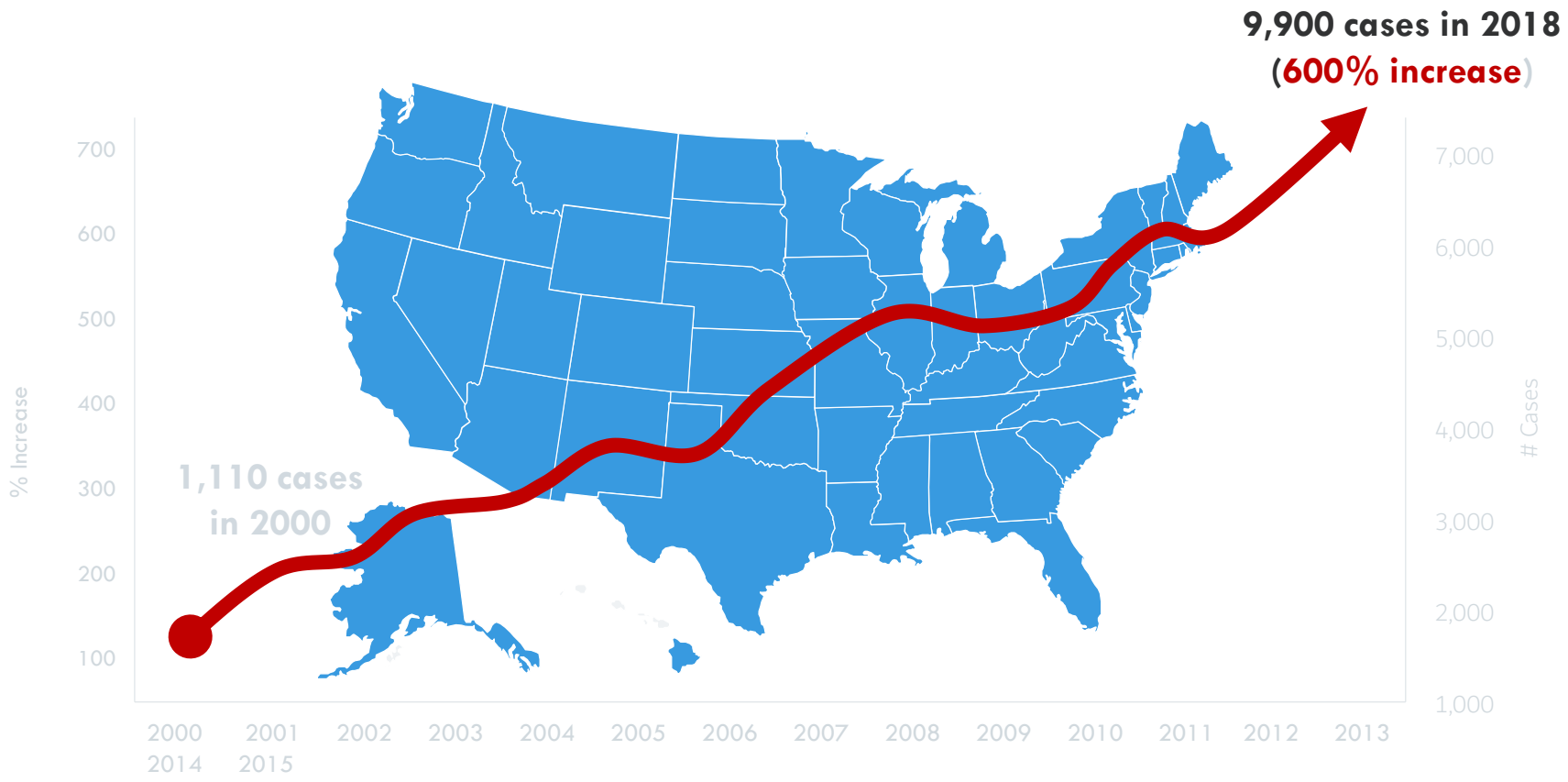
# Waterborne outbreaks




- 214 drinking water outbreaks reported, 87% were biofilm associated
- Plumbing systems were the most cited contributing factor for biofilm-associated outbreaks
- Healthcare facilities were setting for exposure in 53% of outbreaks
- Drinking water-associated outbreaks resulted in at least 2,140 cases of illness, 563 hospitalizations and 88 deaths
- Legionella caused 98% biofilm-associated outbreaks, followed by nontuberculous mycobacteria (NTM) at 1% and Pseudomonas at 0.5%.

# 82,000+ cases reported in last 20 years

*CDC estimates this only represents 5-10%* | Reference: Legionnaires' Disease Surveillance Summary Report, United States—2018 and 2019



# Outbreaks in the US

*3 Die Amid Outbreak of Legionnaires' Disease at an Assisted Living Home*

Twenty-five people connected to the home, in Albany, N.Y., have been hospitaliz

Environment & Climate Health

Legionnaires' disease: 'Not just a New York City

U.S.

**Health officials investigating cluster of se cases in New**

HEALTH

**Legionnaires' disease outbreal reported in central Iowa. What the symptoms?**

Kate Kealey
Des Moines Register

Sept. 5, 2025, 8:04 a.m. CT

Local News

**Legionnaires' outbreak linked to Chicago-area nursing facility, prompting health officials' alert**

By Marissa Perlman

Updated on: October 2, 2025 / 6:08 PM CDT / CBS Chicago

# There's a source water problem

- Aging infrastructure / water main breaks
- Extreme weather
- Increasing ambient temperatures
- More sediment in the water supply
- Greater biological activity in cold water
- EPA found that 40% of inspected systems failed to fully comply with the Safe Water Drinking Act

# Sediment in our water supply

- Sediment is naturally occurring in source water from soil run off and other organics
- Sediment in our buildings can occur from:
  - Routine enter from the incoming water supply
  - Water main breaks and weather-related events such as heavy rain and floods
  - Aging pipes and equipment
  - Corrosion and scale
  - **Construction and renovation events**

# How do waterborne pathogens get in our buildings?

## Naturally occurring

- Water is sourced from lakes, rivers, and groundwater
- Pathogens such as Legionella are naturally occurring and survive municipal treatment

## Municipal water changes

- Water quality changes can affect sediment levels and disinfection
- Seasonal temperature variations can provide favorable growth conditions

## Construction and renovation

- Vibrations and water pressure changes during construction can dislodge biofilm and sediment, releasing Legionella and other pathogens.

## Water main breaks

- Can cause pressure changes, dislodging biofilm.
- May introduce contaminants that deplete disinfectants.

# Buildings are designed to grow waterborne pathogens

## Complex plumbing systems

- High surface area to volume
- Sediment, corrosion, biofilm accumulation

## Warm water environments

- Potable hot water
- Nonpotable systems (cooling towers, fountains)
- Temperatures regulated by code and scald protection

## Increased water age

- Water conservation efforts
- Low flow and sensor faucets

## Low disinfection residual

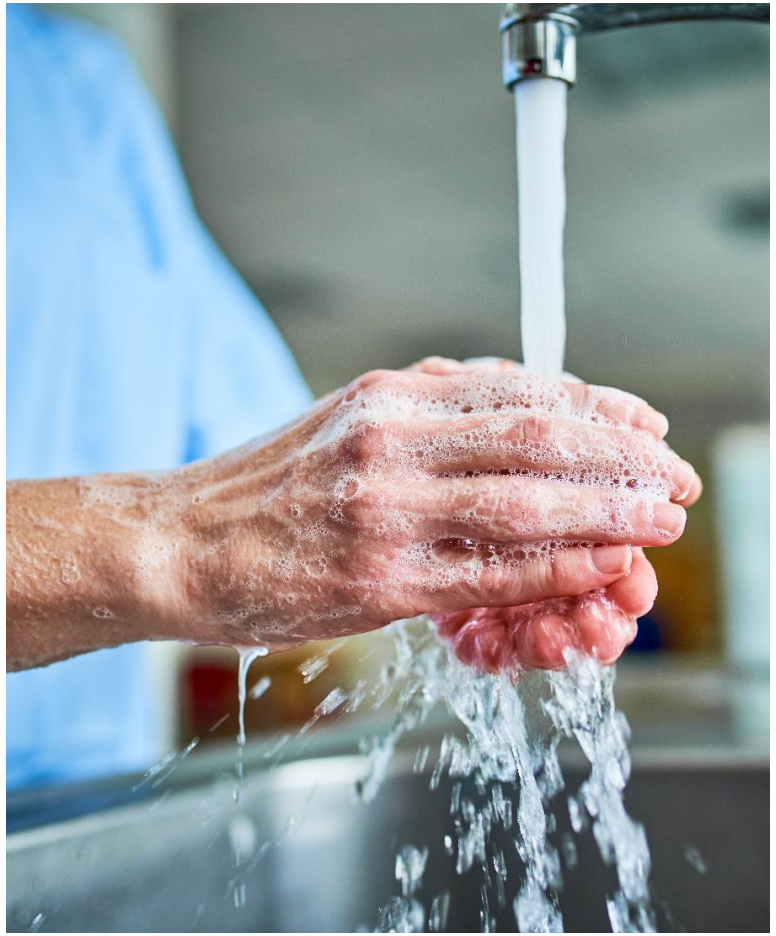
- Municipal disinfection is not effective at typical incoming residuals

# From plumbing to patients

- Water is vital, but in healthcare, exposure to water areas can elevate infection risks.
- Tap water is generally safe but contains waterborne pathogens.
- Patients in healthcare are more vulnerable to waterborne infections.
- Plumbing systems can provide environmental conditions that can boost harmful microbial growth.
- Water systems need careful monitoring for pathogens

# Types of water in a healthcare setting

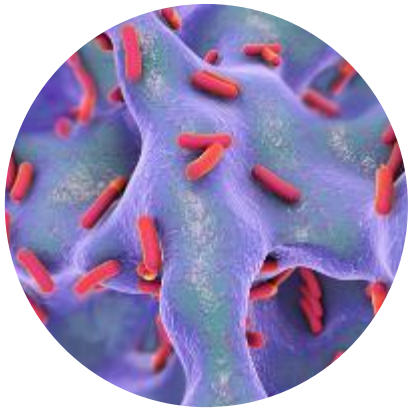
- Potable water suitable for drinking, handwashing, and showering
- Wastewater containing sewage
- De-ionized water for sterile processing and labs
  - Purified water that has had charged ions removed
- Reverse osmosis water for dialysis and sterile processing
- Patient equipment usages
- Utility water for cooling towers and mechanical processes



# Water and HAIs

# Not just Legionella in our water

Legionella



Pseudomonas

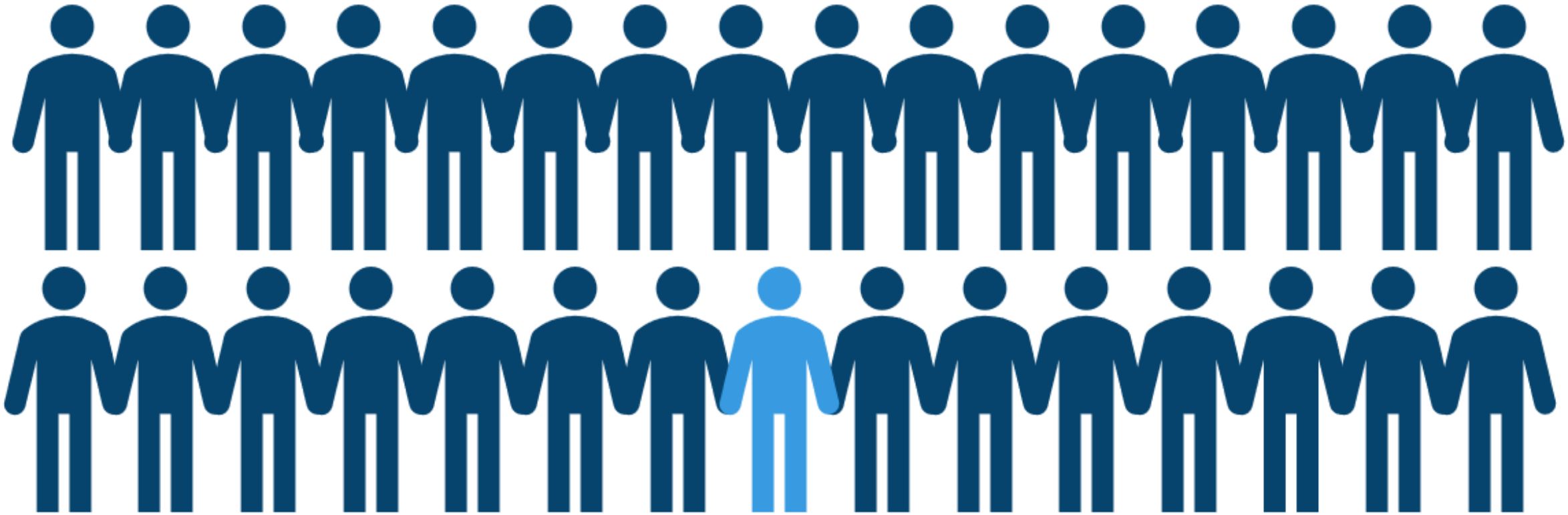
Mycobacterium

Stenotrophomonas

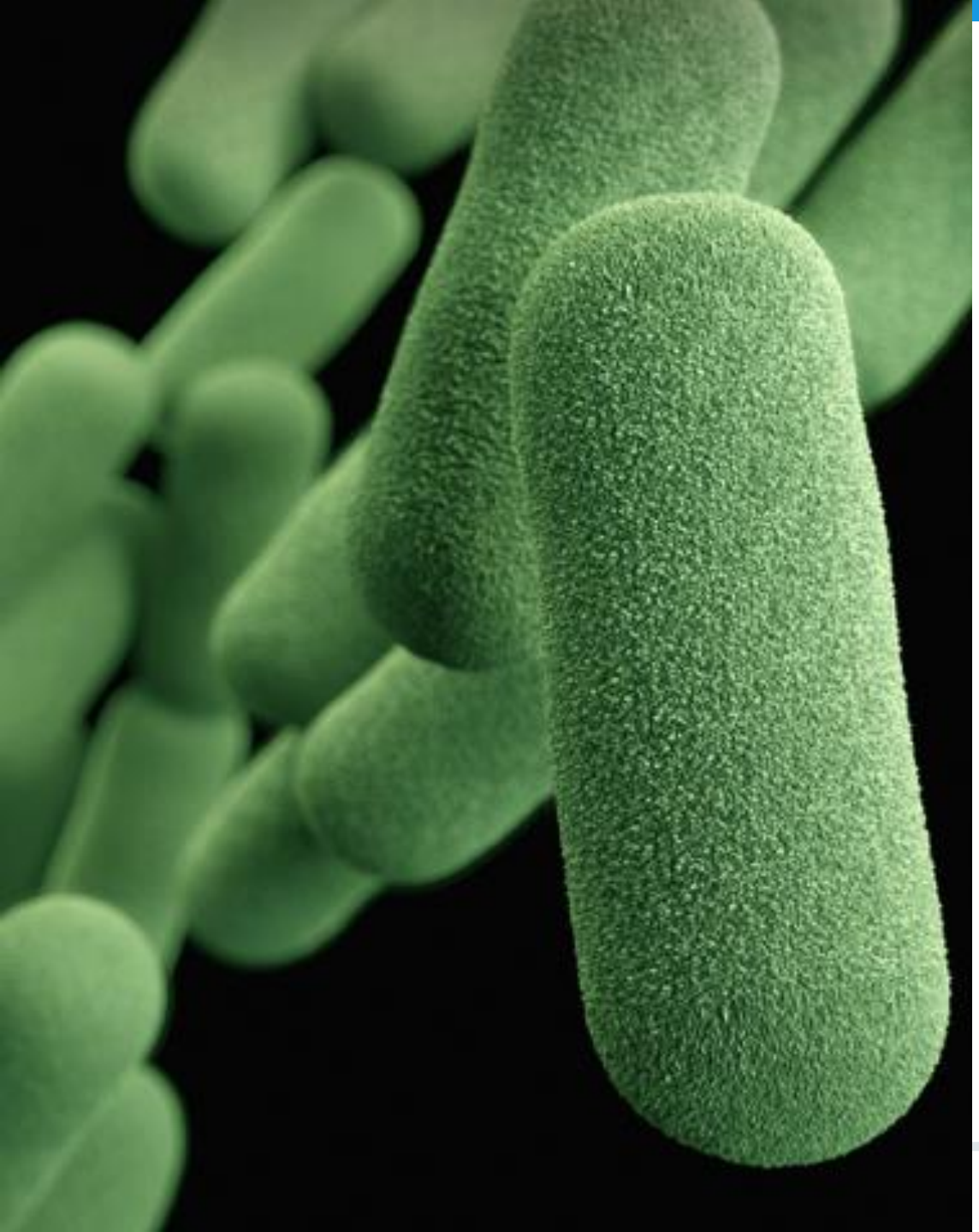
Acinetobacter

Burkholderia

# About 1 in every 31 patients have a HAI on any given day



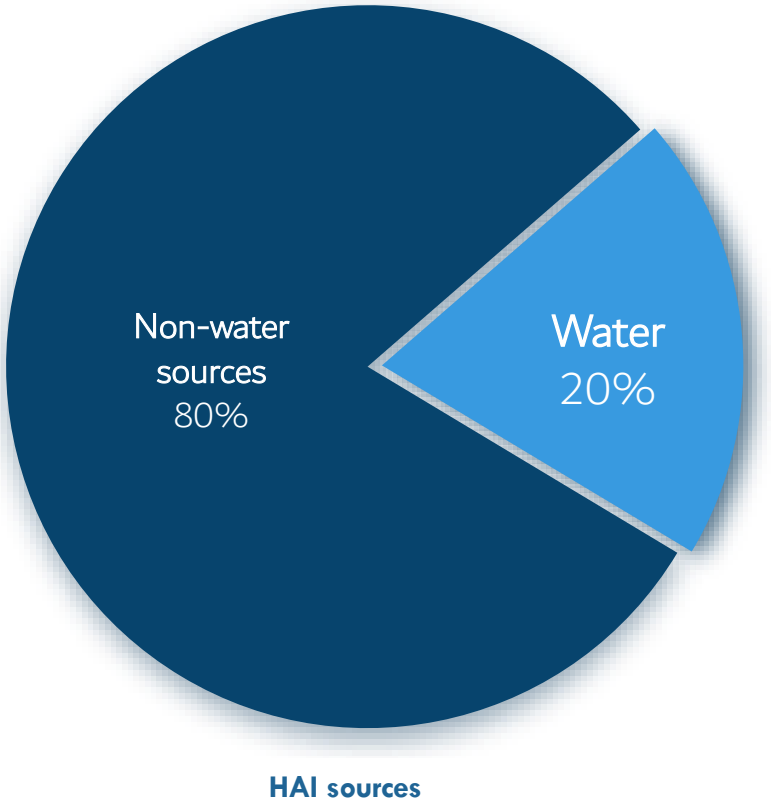
Source: CDC. "Health Topics – Healthcare-associated Infections (HAI)."



*Perhaps the most overlooked, important, and controllable source of nosocomial infections is hospital water.*

*– Investigation report, Archives of Internal Medicine*

# Hospital Water Causes Up To 20% of HAIs




HAI sources

Many HAIs are caused by organisms known to spread through water and biofilms:

» Legionella (HAP, VAP)[2]

» Pseudomonas (CAUTI, CLABSI, SSI, HAP, VAP)[3]

» Acinetobacter (CAUTI, CLABSI, VAP)[4]

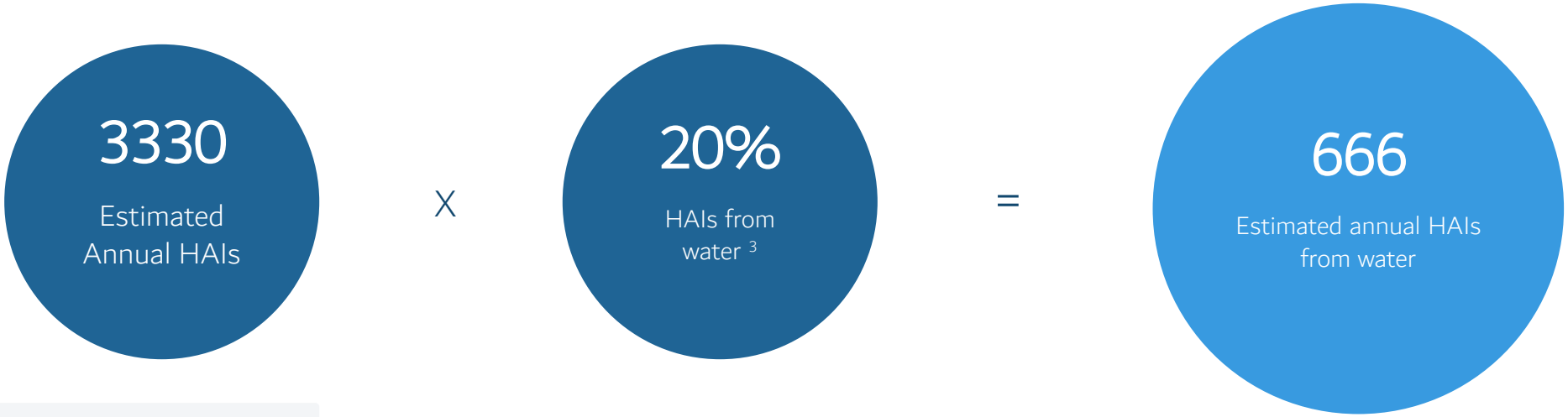
» Burkholderia (CAUTI, CLABSI, SSI, HAP, VAP)[5]

» Stenotrophomonas (CAUTI, CLABSI, SSI, HAP, VAP)[6]

» Mycobacteria (HAP)[7]

*Sources: 1 Perkins, Reddy, Fagan, Arduino, and Perz, "Investigation of healthcare infection risks from water-related organisms: Summary of CDC consultations." 2 CDC, "Legionella (Legionnaires' disease and Pontiac fever): Fast facts." 3 Reynolds, Kollef, "The Epidemiology and Pathogenesis and Treatment of Pseudomonas aeruginosa Infections: An Update." 4 CDC, "Acinetobacter in Healthcare Settings." 5 CDC, "Burkholderia cepacian in Healthcare Settings." 6 Ince, Yekenkurul, Danış, Çalışkan, Akkaş, "An evaluation of six-year Stenotrophomonas maltophilia infections in a university hospital." 7 CDC, "Nontuberculous Mycobacteria (NTM) infections."*

# Example Hospital's Estimated Annual HAIs From Water




103,300 discharges system-wide in 2023[1]

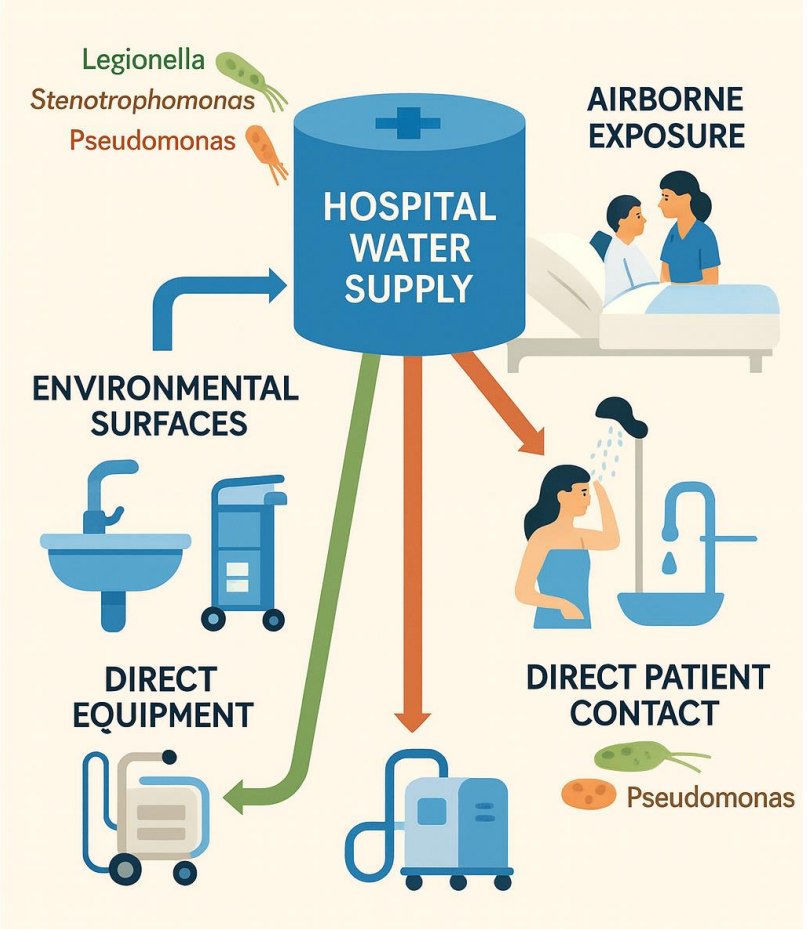
1 in 31 patients have a HAI on any given day[2]



Sources: 1 Example Hospital, "Example Hospital Hospital System 2023 Financial Statements." 2 CDC, "HAI Data." 3 Perkins, Reddy, Fagan, Arduino, and Perz, "Investigation of healthcare infection risks from water-related organisms."

# How are waterborne pathogens transmitted?

- **Direct contact** with water through showering, bathing, rinsing, and hydrotherapy
- **Medical equipment** rinsed or filled with tap water
- **Environmental surfaces** (sinks, drains, splash zones)
- **Aerosolization** from showers, faucets, and ice machines
- **Healthcare worker cross-contamination**
- **Ingestion** of contaminated water



# A Legionella control program presents a greater opportunity


Waterborne pathogens have a significant impact on patient quality of care

- Prevalence of antibiotic-resistant organisms
- Sepsis risks
- Increased readmission rates
- Increased bed days related to HAIs

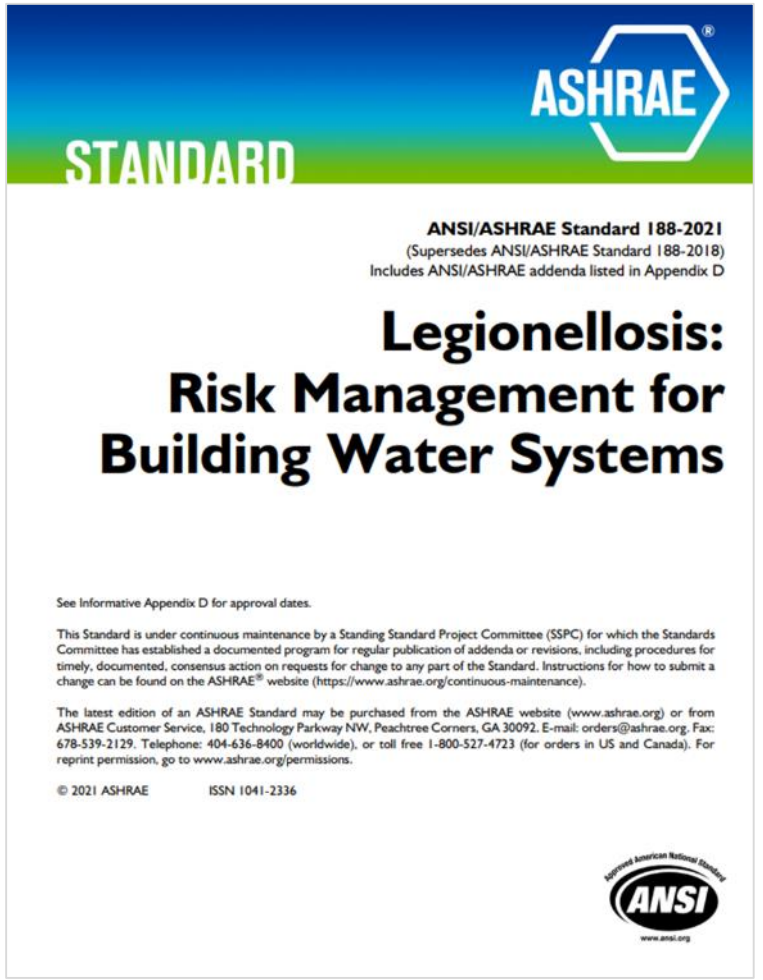
# Role of healthcare water management

# Water in healthcare

- Approximately 20% of HAIs are caused by water
- Everywhere in the healthcare facility
- Necessary to provide patient care throughout the continuum of care
- Exposure to high-risk immunocompromised patients
  - Cancer, HIV, transplant, diabetes, burns, kidney disease, elderly
  - Increased risk for WPB infection
- Not sterile! Pathogens live and grow in water/plumbing, creating risk

# What is a water management program?

- A water management program is a proactive approach to preventing the growth/spread of Legionella bacteria in building water systems.
- Implementing a program is a multi-step process that should involve a cross-functional team including IPs and Facilities
- ASHRAE Standard 188 provides the framework and additional standards and regulations have adopted this approach, such as
  - CMS and The Joint Commission
  - State Regulations including NY, NJ, Michigan, Illinois, Ohio

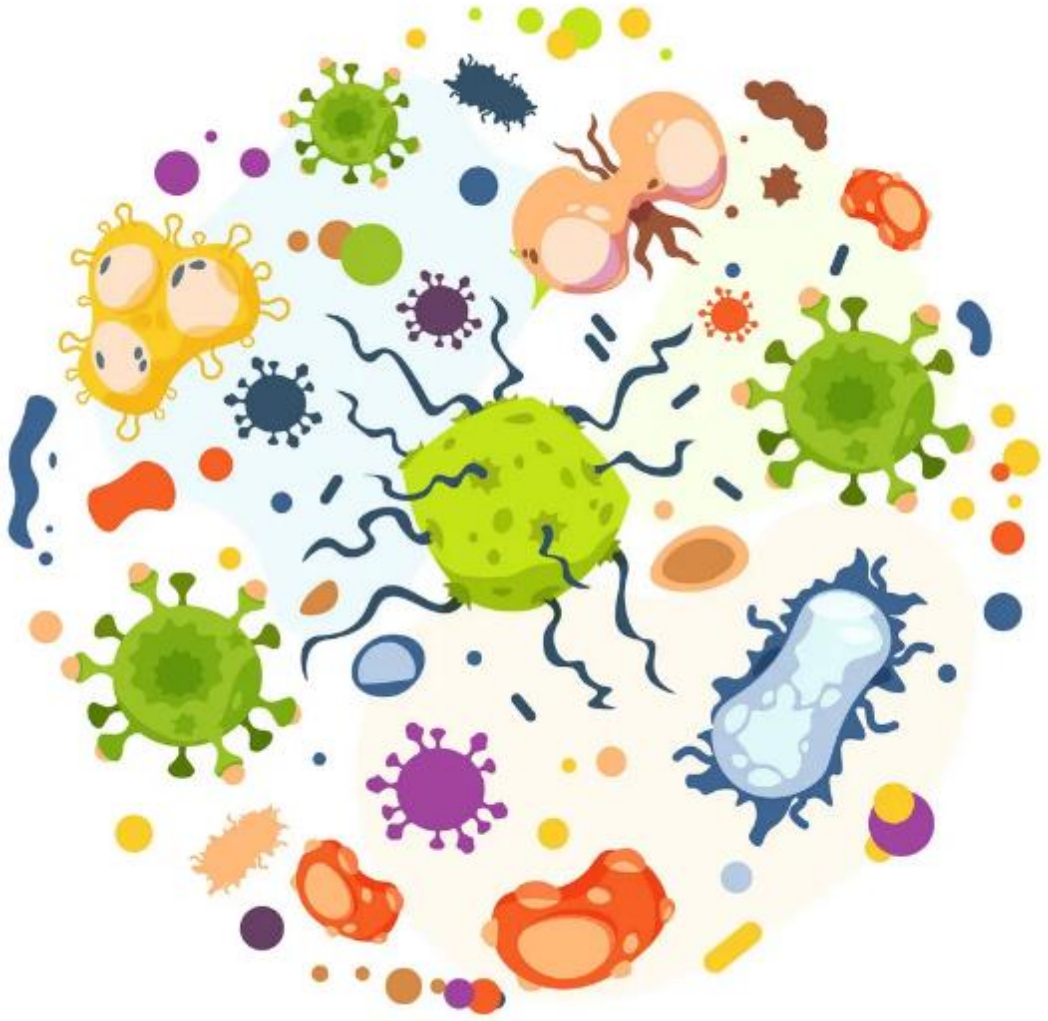


# Healthcare water management


**ASHRAE Standards 188 and 514**


**The Joint Commission Standards**

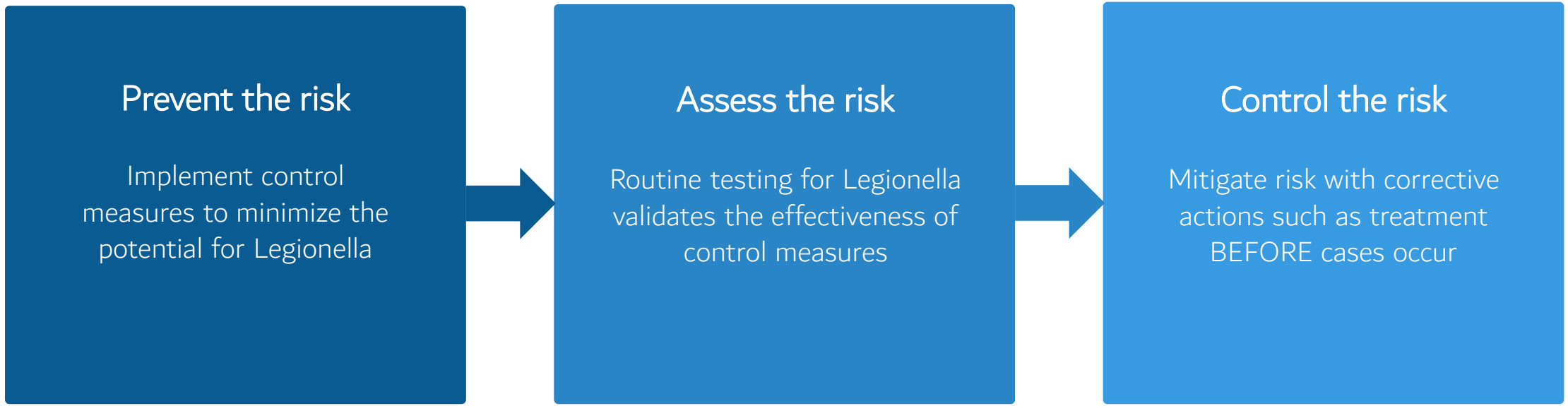

**Centers of Medicare and Medicaid Standards**



# Infection prevention and water management

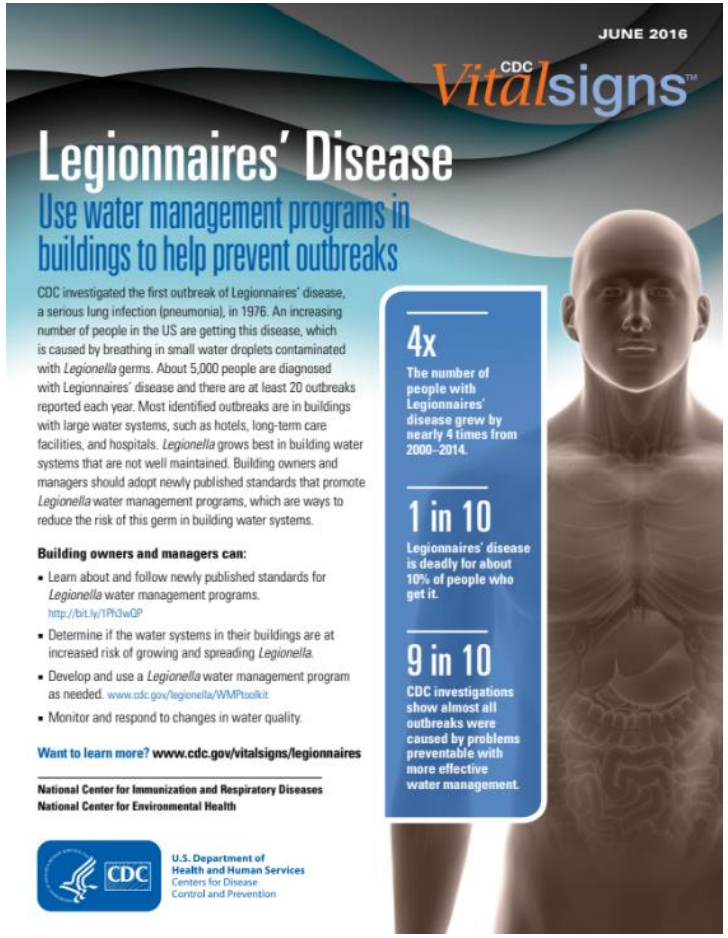
- Responsible for surveillance, analyzing and reporting HAIs
- Education for patients, staff and visitors
- Liaisons with health departments
- Emergency and regulatory preparedness
- Members/lead IP committees and water management committees
- Construction/renovation risk assessment
- Subject matter expert

# Role of effective water management



# Prevention through water management

- **9 in 10 CDC outbreak investigations were caused by problems preventable with more effective water management.**
- CDC Legionnaires' disease investigation summary reported:
  - **About 65% of outbreaks are due to process failures**, like not having a Legionella water management program.
  - **About 52% are due to human error,** such as a hot tub filter not being cleaned or replaced as recommended by manufacturer.
  - **About 35% are due to equipment failures,** such as a disinfection system not working.
  - **About 35% are due to changes in water quality** from reasons external to the building itself, like nearby construction




Centers for Disease Control and Prevention. Legionnaires' disease: use water management programs in buildings to help prevent outbreaks. CDC Vital Signs June 2016.

# Commonly identified deficiencies

- Missing records of plan monitoring
- Monitoring results exceed control limits ranges, but no corrective action documentation
- Failure to respond to exceedances
- Water management plan did not include validation of water management effectiveness (testing for Legionella)
- Implementation practices didn’t match plan details
- Plan wasn’t updated when changes to the water systems were made
- 😫 😫 😫 **Failure to prevent disease!!**😫 😫 😫

# Effective water management

# Water management principles

Risk assessment

Prevention and control measures

Monitoring and documentation

Interventions and corrective actions

# Factors promoting biofilm growth

**S**

**Sediment**

**T**

**Temperature**

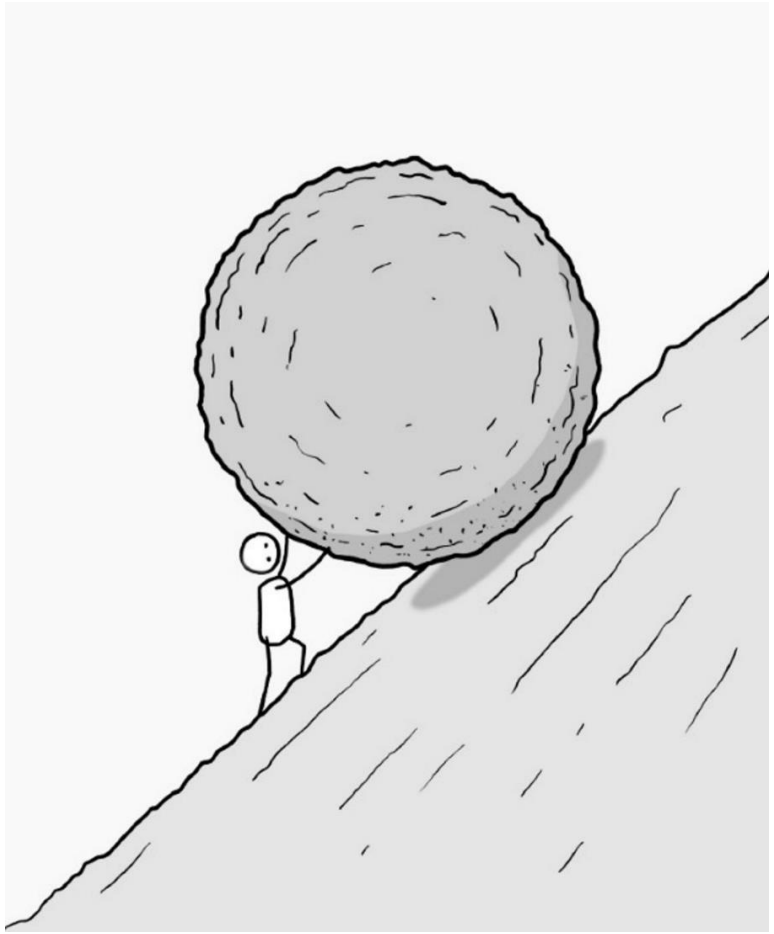
**A**

**Water Age**

**R**

**Lack of Disinfectant Residual**

# Common water management



- Requires a lot of time and effort to implement, manage, and document practices such as flushing, temperature monitoring, and corrective actions
- Don’t provide trending of results or actionable insights
- May have little impact on risks associated with water systems
- Smarter water management can reduce the burden of implementation  by providing:
  - Automated control measure monitoring and corrective action alerts
  - Data logging for compliance
  - Predictive and prescriptive monitoring

# Common control measures to address growth factors

Temperature

Flushing/Flow

Disinfection residuals

Equipment and maintenance

# Challenges with common control measures

## Temperature

- Biofilm and sediment protect Legionella
- Can not deliver hot enough water at the point of use
- Temperature alone is not an effective control measure
- Cold water is overlooked

## Municipal disinfection

- Overreliance can lead to misinterpretation of water system risk
- Incoming residuals at recommended levels are not effective at mitigating risk

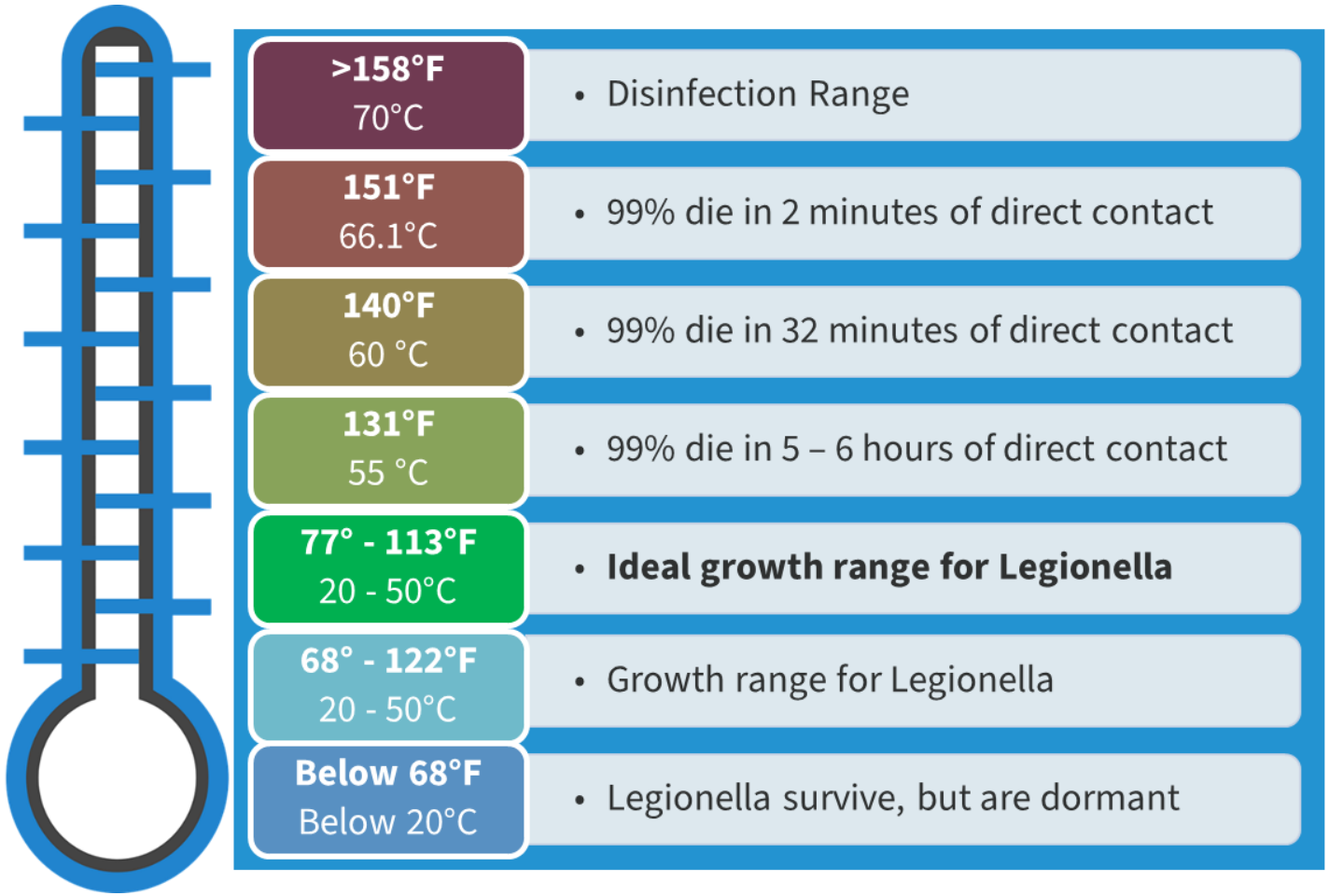
## Flushing

- Temporarily reduces favorable growth conditions
- Time and energy intensive
- Minimal ongoing impact if an active, effective disinfectant is not present

# Hot water

- For waterborne pathogen control, standard recommendations are to generate hot water >140°F and circulate >120°F
- Typical strategies include:
  - Generating water >140°F and tempering at the point of use to circulate temperatures outside growth ranges
  - Generating water >140°F and centralized tempering to >120°F
- BUT.... delivering water temperatures to maintain Legionella control water system can be practically challenging and virtually impossible.

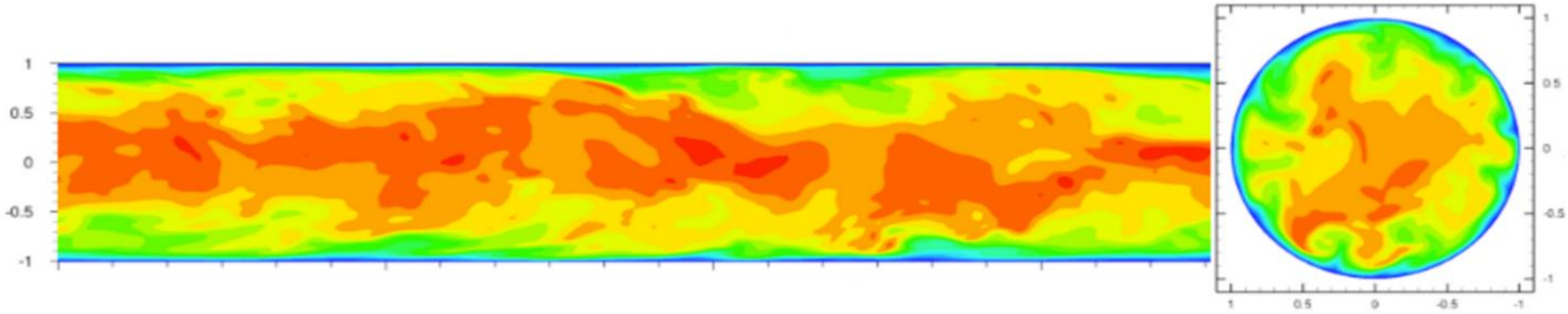
# Legionella growth range




- Based on lab data, not applicable to building water systems
  - Does not account for scale, biofilm, water quality
  - Scale and biofilm can act as insulators for bacteria
- There are no field tests that support Legionella death at ≤140°F
  - In buildings, higher temps may be needed for longer periods of time

# Challenges with temperature control

- Biofilm, scale, and sediment provide insulation sufficient for Legionella to survive, even when the water temperature is outside the optimum temperature range
- Challenges to temperature control in building water systems include uninsulated pipes, dead legs, long pipe runs, areas for potential heat exchange, and stagnant or low use areas
- Can not deliver water at scalding temperatures so water mixing becomes point of contamination and stagnation
- Typically focuses only on hot water, ignoring risks of the cold water system



# Cold water risks

- **Cold water is frequently overlooked in water management**
- Legionella is naturally occurring in the source water; all it requires to amplify are a specific set of growth conditions
  - Correct temperature
  - Lack of disinfection residual
  - A food source
  - Stagnant water
- Legionella is well documented to resist the municipal treatment process
- Water that generates hot water Legionella amplification is also used for cold.
- Elevated source water temperatures, cold water contamination, or building conditions that warm the cold water elevate risk in the cold-water systems

# Flushing programs

- Flushing replaces aging water and can purge accumulated sediment and deposits in the water system
- Flushing programs should include distal outlets (hot and cold), low use equipment or areas, drain valves, tanks, recirculation, high risk units, etc.
- Effective flushing programs can reduce favorable growth conditions by increasing residuals, maintaining temperatures, reducing the potential for stagnation.

# Treatment programs

- UV disinfection can provide a first line of defense against pathogens and biofilm contributors in a plumbing system
- Supplemental disinfection systems provide a proactive approach to risk management and provide a residual throughout the building BUT…
  - Select systems that are effective at penetrating biofilms and effective against pathogens
  - Ensure compatibility with of plumbing materials and components and don’t contribute to corrosion
  - Don’t contribute additional hazardous chemicals and disinfection byproducts

# Sediment filtration

- Removes sediment and biofilm deposits from incoming water – before it enters your plumbing systems
- Remove the food source and protection for waterborne pathogens and biofilm
- Improve disinfection efficacy (municipal and supplemental)
- Protect the building occupants and water-bearing equipment from unexpected changes in building water quality
- Enhance the efficacy of sterile processing (RO, DI) and improves utility water

# Microbial Filtration

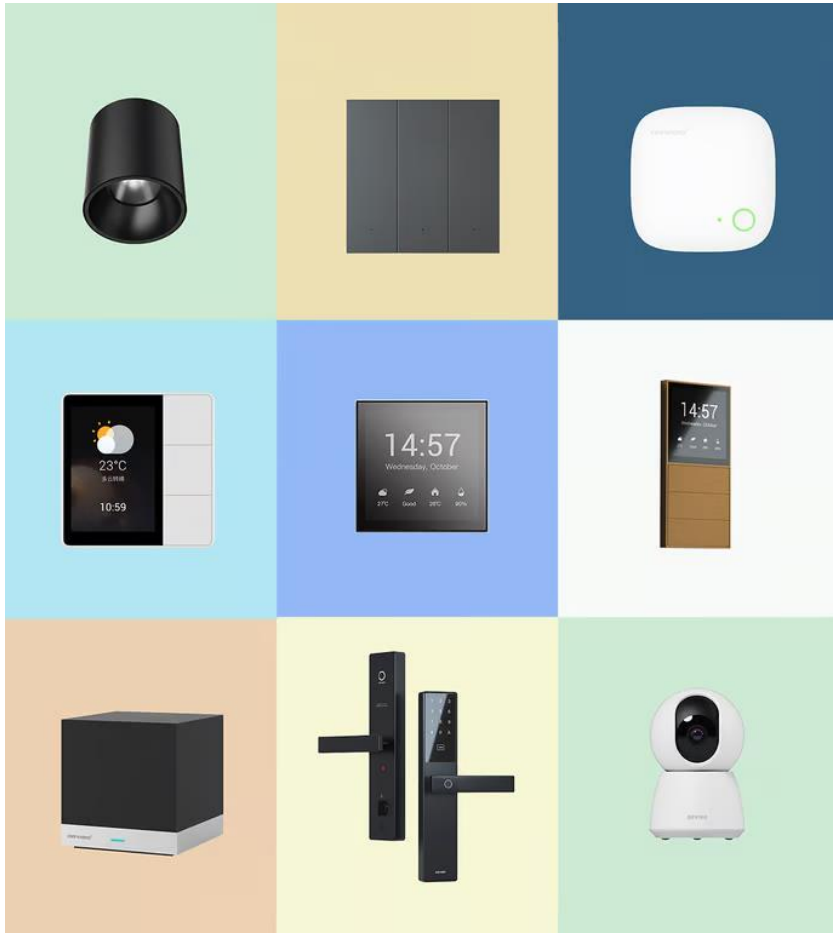
- Provide a barrier that prevents exposure to waterborne pathogens at the point of use
- Can be used at point of use (faucets, showers) and inline (ice machines)
- Often used for emergency protection
- Others use routinely in high-risk areas, even if other control measures are in place, including:
  - Bone marrow/organ transplant units
  - NICUs
  - Hematology/Oncology Units

# Continually identify and minimize risks

- Listen to your plumbing system and make adjustments to your programs and water systems based on the data
- Listen to your plumbing system and adjustment to your programs based on the data
  - Identify potential risks, implement control measures, corrective actions and validate effectiveness
  - Consider risk based long term remediation strategies
- Routine waterborne pathogen risk assessments, including testing for Legionella to validate the program's effectiveness
- Allows the team to evaluate and mitigate the risk **BEFORE** cases of disease

# Smarter plumbing systems

- Everything we use is smarter (or at least try to be)
- Our homes have smart ecosystems
  - Lights, speakers, heating/cooling
- Our plumbing systems need to be smart as well
  - Automation monitoring and interventions
  - Data logging/alerts
  - Trending
- Smarter water management can simplify implementation, corrective actions, and compliance



# Smart sensors

- Wireless sensors that can be installed in targeted areas throughout plumbing system to meet water management strategies – water entry, risers, wings, etc.
- Sensors record temperature continuously and can identify and alert when risks are present
  - Changes in incoming water temperatures
  - Areas of poor circulation or low use
  - Warming cold water conditions
- Provides data that can be used to implement targeted corrective actions, such as flushing programs

# Smart treatment monitoring


- System adjustments are made remotely based on performance and operational data
  - Ensures optimal supplemental disinfection system output and consistent performance
- Alarms notify instantly of performance issues, equipment malfunctions, or improper settings
  - Significantly reduces labor, time to resolution, system downtime, and disruptions
- Aids in proactive identification of irregularities that may indicate issues
- Predictive, data-driven recommendations based on trends and insights

# Smart flushing devices

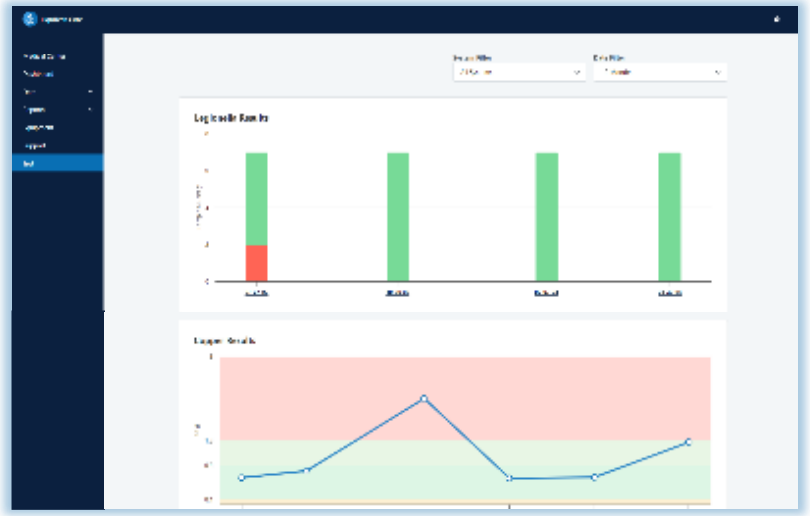
- Automatic flushing of fixtures, branches, risers, and mains **reduces labor**
- Provides programmable methods of flushing based on time, temperature, and usage
- Custom flush frequencies, durations, and volumes
- Can target specific areas of a water system to relieve stagnation and distribution issues to **mitigate water quality concerns**
- Automates and logs water management activities which **ensures compliance**
- **Prevents risk**, improves performance, occupant experience, and water safety

# Cloud-based analytics

- Connects and captures relevant data across your water system infrastructure
- Intelligent real-time monitoring of consumption, quality, efficiency, and water system operation
- Predictive and prescriptive monitoring of water infrastructure equipment life and functionality
- Verification of equipment maintenance
- Rapid execution of corrective actions based on system performance and water testing data
- Valuable documentation for legally defensible and ASHRAE 188-compliant water management program
- Dashboard with real-time performance data

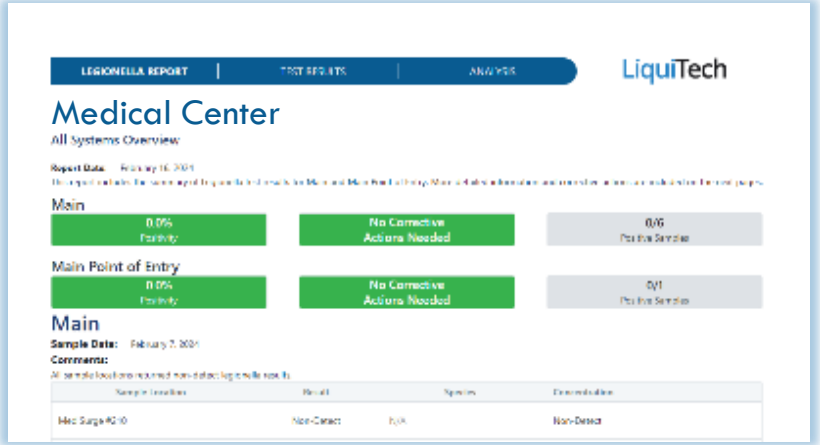
## Dashboard

Real-time performance data



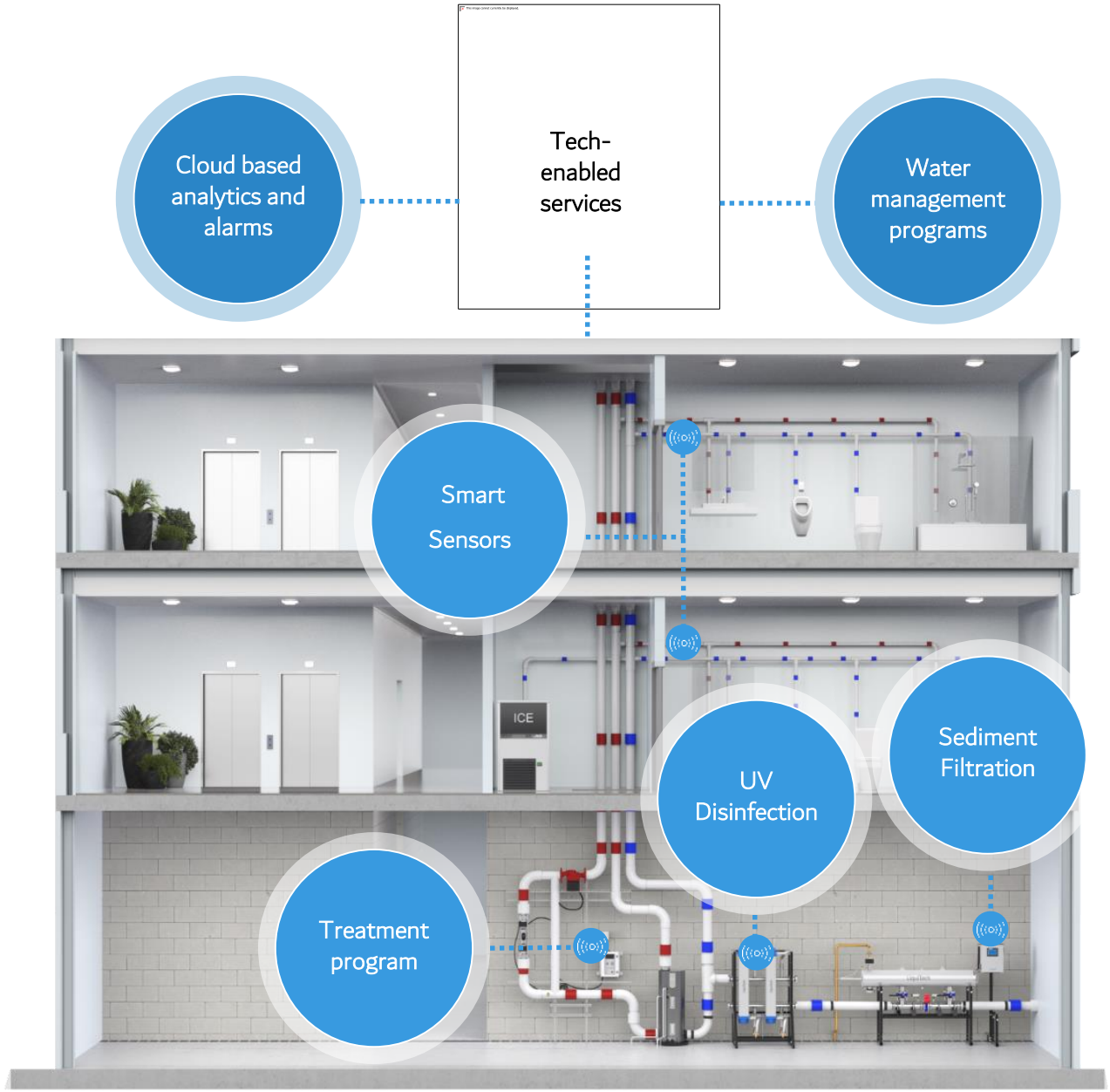
## Documentation

On-demand reports for water management program



# Multi-barrier solution

- Mix of technology and service for the highest level of efficacy and safety on cold and hot water
- Protects water infrastructure from the point of entry to the point of use
- Analytical approach to improve water management



# Healthier and happier patients

- Mitigate HAIs caused by water
- Improve water quality and aesthetics for a positive user experience
- Mitigate water scald risks
- Can prevent contaminants from entering your facility during disruptive events
- Proactive automated monitoring and control of cold and hot water risks

# Cost savings with water management

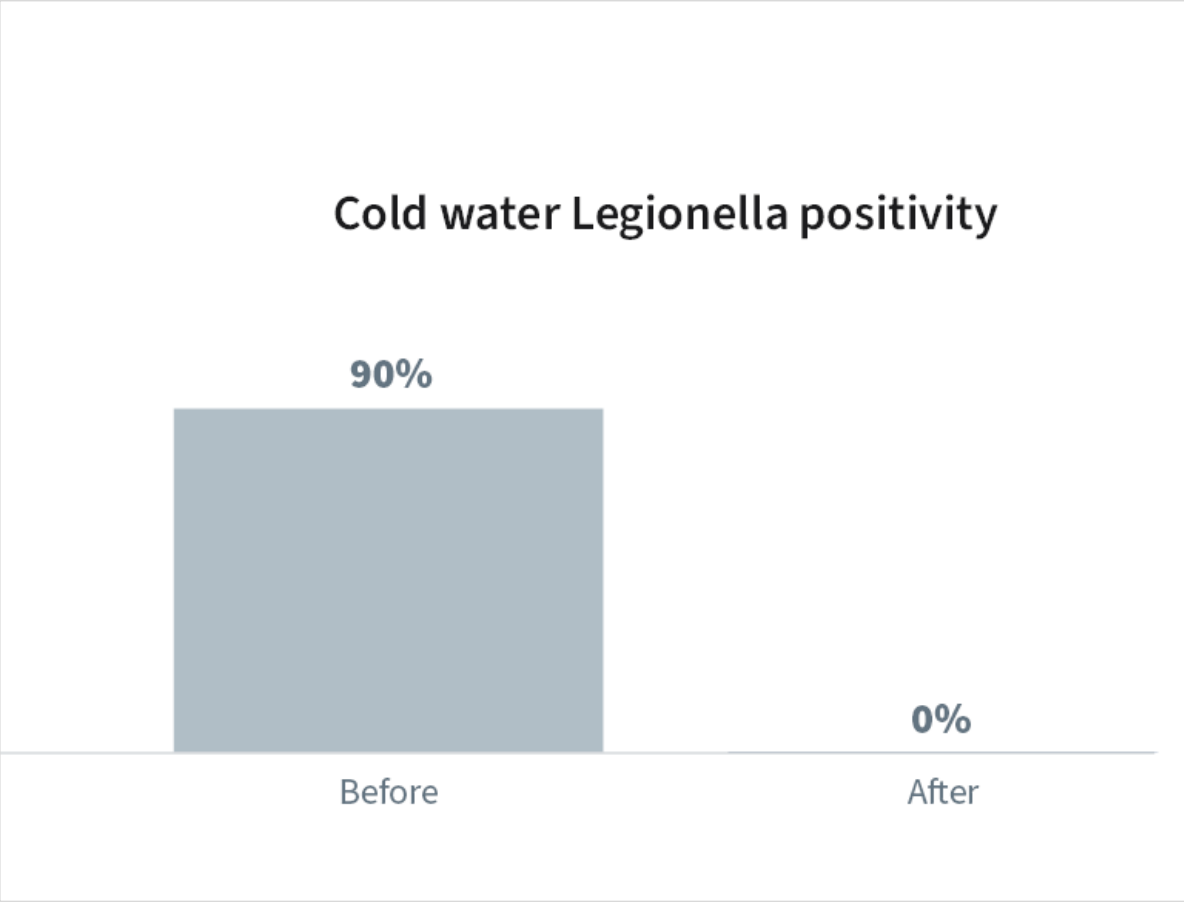
- Reduce HAI costs by preventing cases of disease from the water system
- Effective water management can increase the lifespan of equipment and plumbing materials
  - Facilities team = 😀
- Mitigate costs caused by poor water quality
  - Disruptions/shutdowns
  - Lawsuits, legal fees, and settlements
  - Emergency outbreak response
  - Brand/reputation management costs

# Effective water management provides legal defensibility

- Failure to comply and prevent disease can lead to lawsuits due to negligence
- Building owner can demonstrate compliance with standards and regulations by implementing a compliant water management plan
- Water management provides documentation of implementation, testing, and corrective actions
- Proactive compliance, and implementation with documentation, and validation by testing provides the strongest protection

# Case studies

# Legionella mitigation

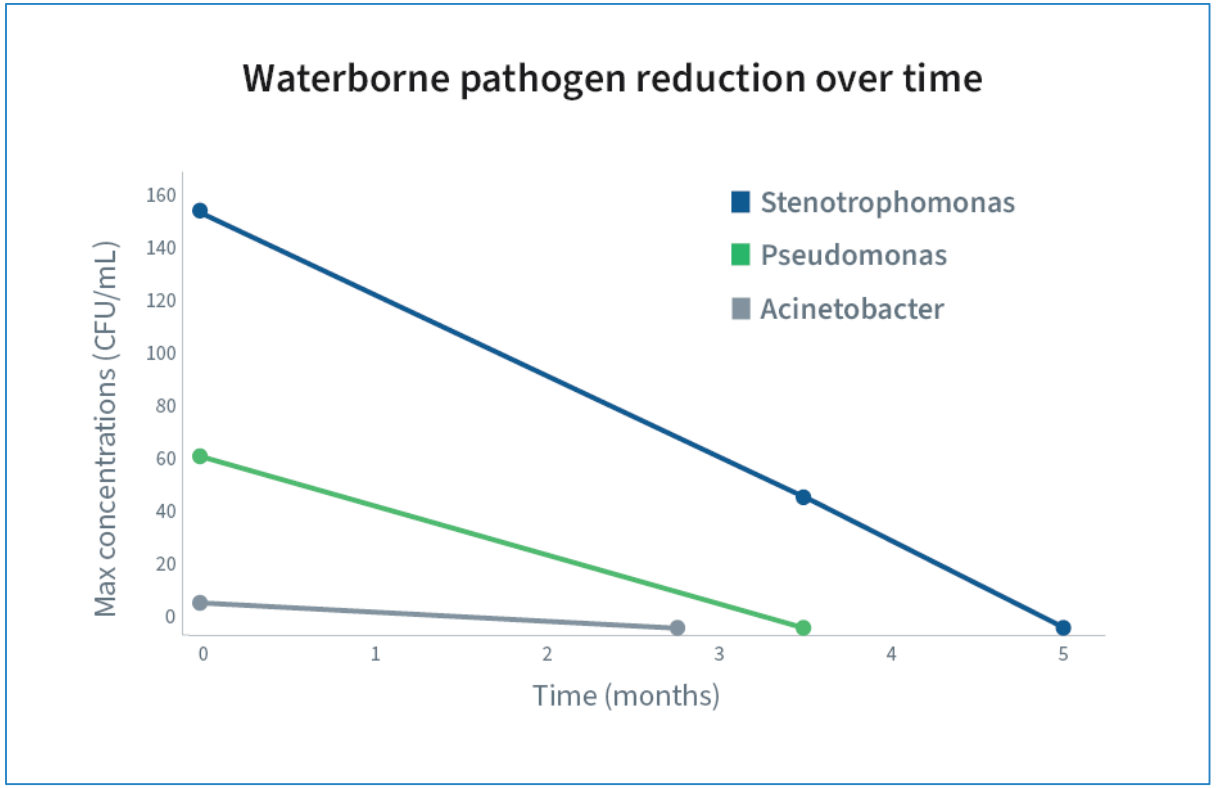



- Persistent Legionella contamination was traced to poor source water quality and sediment buildup.
- Sediment filtration resolved the issue by removing the bacteria's primary nutrient source.

**Results:**

- Legionella positivity reduced from 90% to 0% in the cold-water system.
- Sustained non-detect Legionella, ensuring long-term protection.

# Waterborne pathogen reduction




Routine water testing revealed Pseudomonas, Stenotrophomonas, and Acinetobacter in the building's water system.

Copper-silver ionization was implemented for broad-spectrum disinfection.

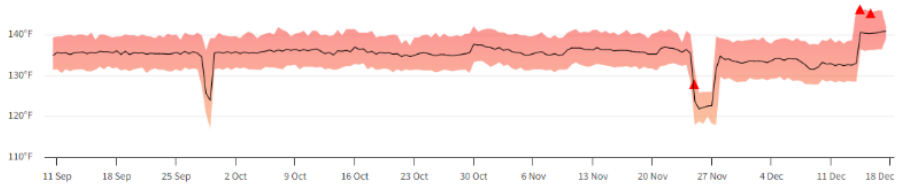
**Results:**

- 100% reduction in Pseudomonas, Acinetobacter, and Stenotrophomonas achieved within months.
- Continuous system-wide disinfection, reducing infection risks and supporting patient safety.

# Regional Medical Center

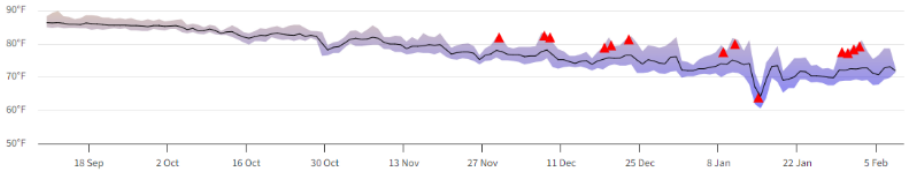
- Used temperature sensors in their building to identify areas of the building that were contributing to:
  - Poor occupant experience
  - Increased bacterial risk
  - Increased scald risk
- Investigation with sensors identified:
  - Variable source water quality
  - Buildings loops with poor circulation and cross connections
  - Failing equipment (pumps and mixing valves)
- By understanding their plumbing system, they were able to target specific areas of the building and equipment to achieve non-detect Legionella.

Temperature loss → Poor occupant experience



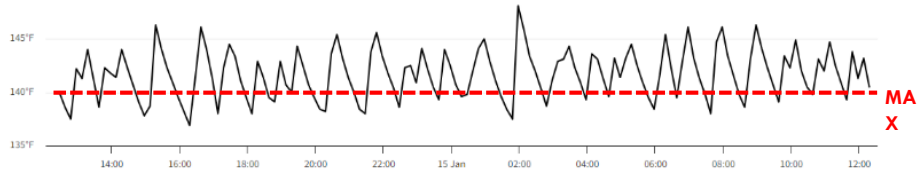

Hot Water Supply

Changes in source water → Increased bacterial risk




Cold Water Point of Entry

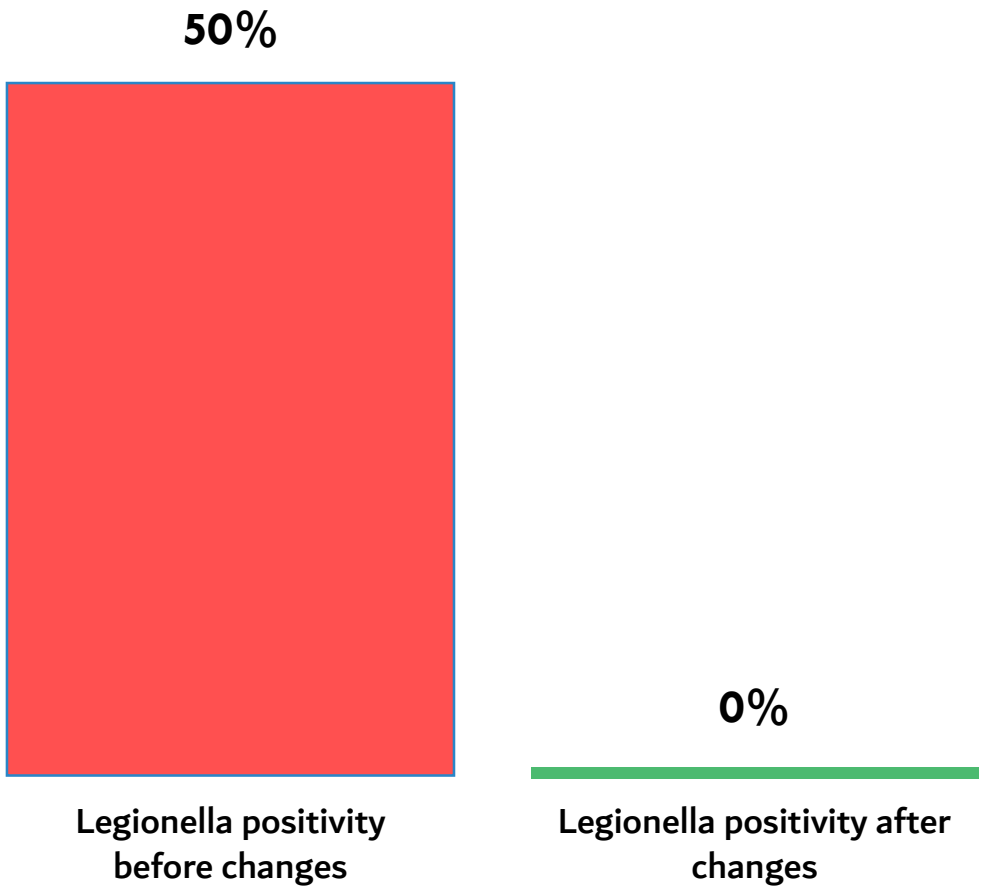
Large temperature variations → Equipment malfunctions
High temperatures → Increased scald risk



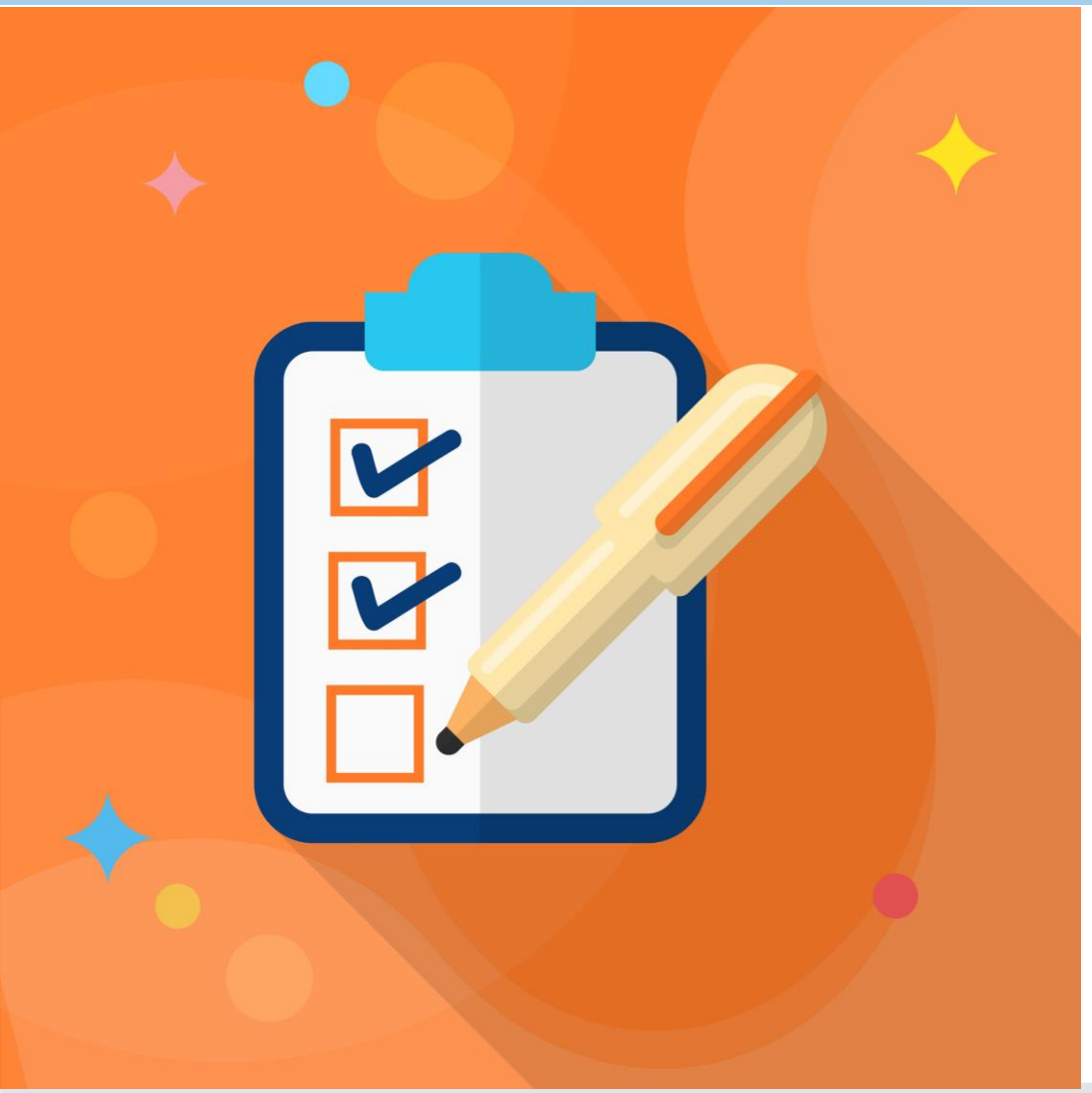

Hot Water Supply

# Regional Medical Center

- Used temperature sensors in their building to identify areas of the building that were contributing to:
  - Poor occupant experience
  - Increased bacterial risk
  - Increased scald risk
- Investigation identified:
  - Variable source water quality
  - Buildings loops with poor circulation and cross connections
  - Failing equipment including pumps and mixing valves
- By understanding their plumbing system, they were able to target specific areas of the building and equipment to achieve non-detect Legionella.



# Summary



- Understanding our building water systems and factors that lead to growth of waterborne pathogens is critical to reducing healthcare-associated infections.
- Water management requires continual evaluation of risk and a multibarrier approach to prevent HAIs.
- Smart water treatment strategies can simplify water management implementation and effectively reduce waterborne pathogen-related HAIs.