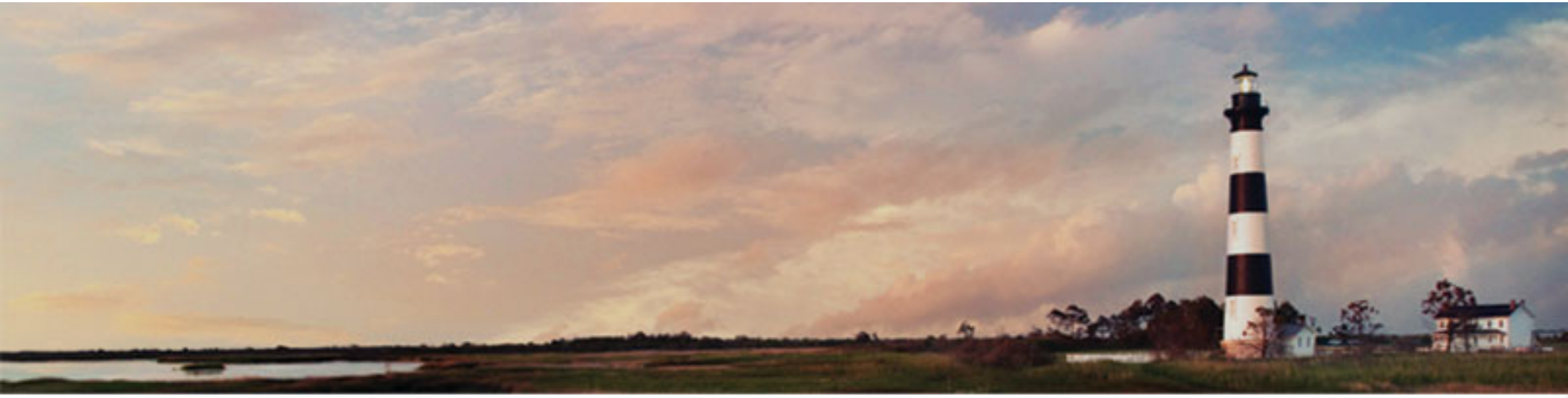


Nothing Compares
NORTH CAROLINA

Water Management Plans in Long term Healthcare

David Lipton, Industrial Hygiene Consultant

Occupational and Environmental Epidemiology Branch
North Carolina Division of Public Health

Water Management Plans

Policies, procedures, and practices that

- Limit the potential for *legionella* bacteria and other waterborne pathogens to amplify in building water systems
- Reduce potential for building occupants to be exposed to water containing *legionella* bacteria and other waterborne pathogens
- Operate building plumbing systems safely and efficiently

Goals for Water Management Plans (WMP) are driven by

- Hazard analysis – any physical, chemical, or microbial conditions that may cause harm.
  - Control points --- Places where water enters, is processed, and used and where hazards can be prevented, eliminated or reduced to an acceptable level
  - Control limits --something that can be monitored at a control point by measurement or observation and is scientifically or regulatory based. Temperature, pH, residual disinfectant level, and time.
- Risk characterization, probability and severity of harms from hazards
- Elements, and activities of WMP should focused on identifying control points, and monitoring control limits, documenting monitoring results, and implementing corrective actions when there are deviations

Legionnaires Disease

Causal agent is *Legionella pneumophila,* a ubiquitous gram-negative bacteria. Most cases are caused by inhaling *Legionella pneumophila* serogroup 1, at least 15 other serotypes

Not transmitted from person to person

Two clinical syndromes

- Pontiac fever-self limiting flu-like illness often under reported and diagnosed
- Legionnaires Disease aka Legionella Pneumonia--About 10% mortality rate
  - Onset 2-10 days after exposure
  - Severe cough, high fever, chest pain, nausea, vomiting and diarrhea, and confusion

Risk factors for Legionnaires disease include

- Age > 50
- Current or former smoker
- Chronic Lung Disease (emphysema or COP)
- Immune system disorders
- Other underlining chronic illness

Diagnosis based on clinical examination and laboratory tests

- Urinary Antigen Test
- Microbiological isolation of *legionella species* in sputum

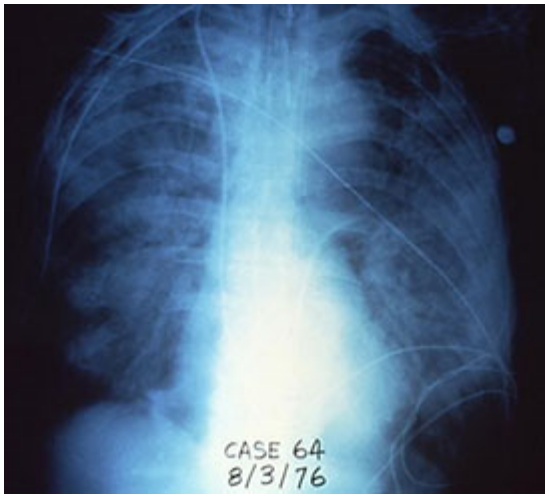
Legionnaires Disease is reportable

Reportable disease under § 130A-134 and 10A NCAC 41A .0101 (#36)

Communicable Disease Manual- contains instructions for entry into North Carolina Electronic Disease Surveillance System (NCEDS) and to investigate cases

- >85 % of cases are “sporadic” -- no link in time and space with other cases.
- Two or more cases, especially in health care, or are linked in time and space are considered an outbreak and trigger an environmental investigation
- One case in LTC may be considered as “sentinel”

Treatment by antibiotics either quinolones (ciprofloxacin, levofloxacin) and macrolides (azithromycin)



https://www.cdc.gov/legionella/about/signs-symptoms.html

https://www.webmd.com/lung/ss/slideshow-legionnaires-disease-overview

Sources of legionella in water systems

Low levels of *legionella* are often found in natural water bodies, especially those that are warm, stagnant, and have other microbial growth or biofilms

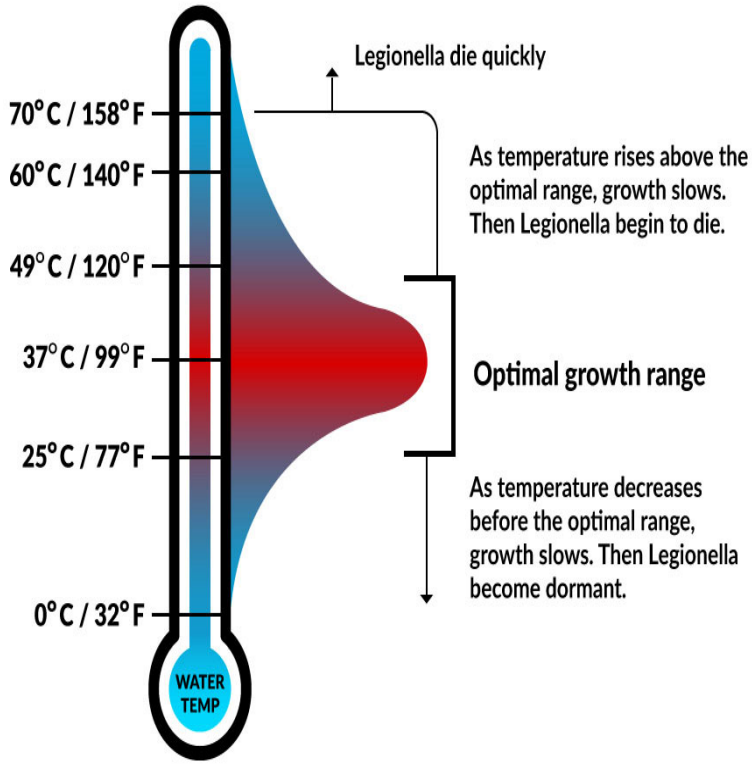
Building water systems-- excellent environments for legionella to amplify

- Temperature
- *Legionella* survives and multiplies in biofilms present in water systems and features
- Water systems provide mechanisms for dispersal or dissemination of legionella in aerosols

Outbreaks have been linked inhalation of aerosols from showers, hot tubs/spas, decorative fountains, misters, nebulizers, CPAP machines, and humidifiers

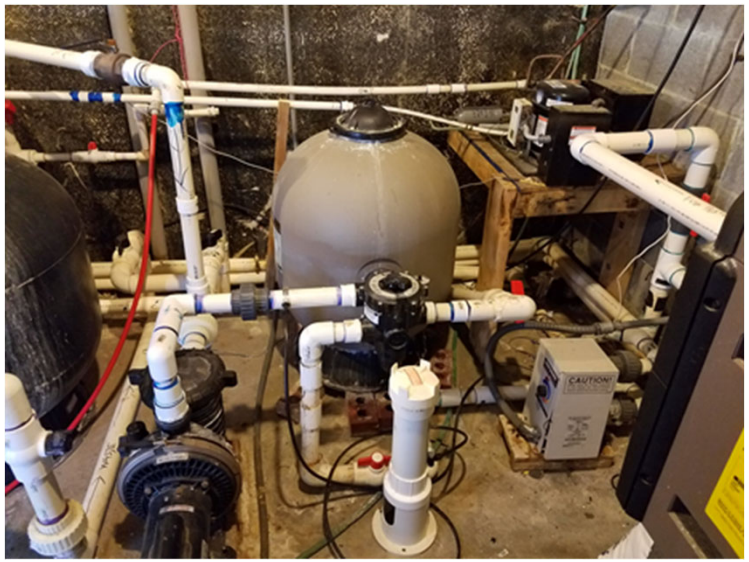
Other potential sources

- Inspiration of contaminated water from ice machines
- Inhalation of airborne potting soil or leaf compost
- Inhalation of aerosols from windshield washer fluid



Source: ASHRAE Guideline 12-2020 Figure 1 Temperature effects on survival and growth of Legionella in laboratory conditions

Hot tubs and spas



- Permitted -- must meet Rules Governing Public Swimming Pools 15A NCAC 18A .2500 plus additional requirements
- Certified pool operators
- Circulation turnover rate one every 30 minutes
- Continuous disinfection (2–4 ppm chlorine or 4-6ppm bromine)
- Maintain pH between 7.2–7.8.
- Record keeping for cleaning, shock disinfection, filter changes other routine maintenance, repairs, filter changes

Hot tubs at temporary events

Final report – Legionnaires Disease at Mountain State Fair September 2019

136 cases associated with hot tubs on display

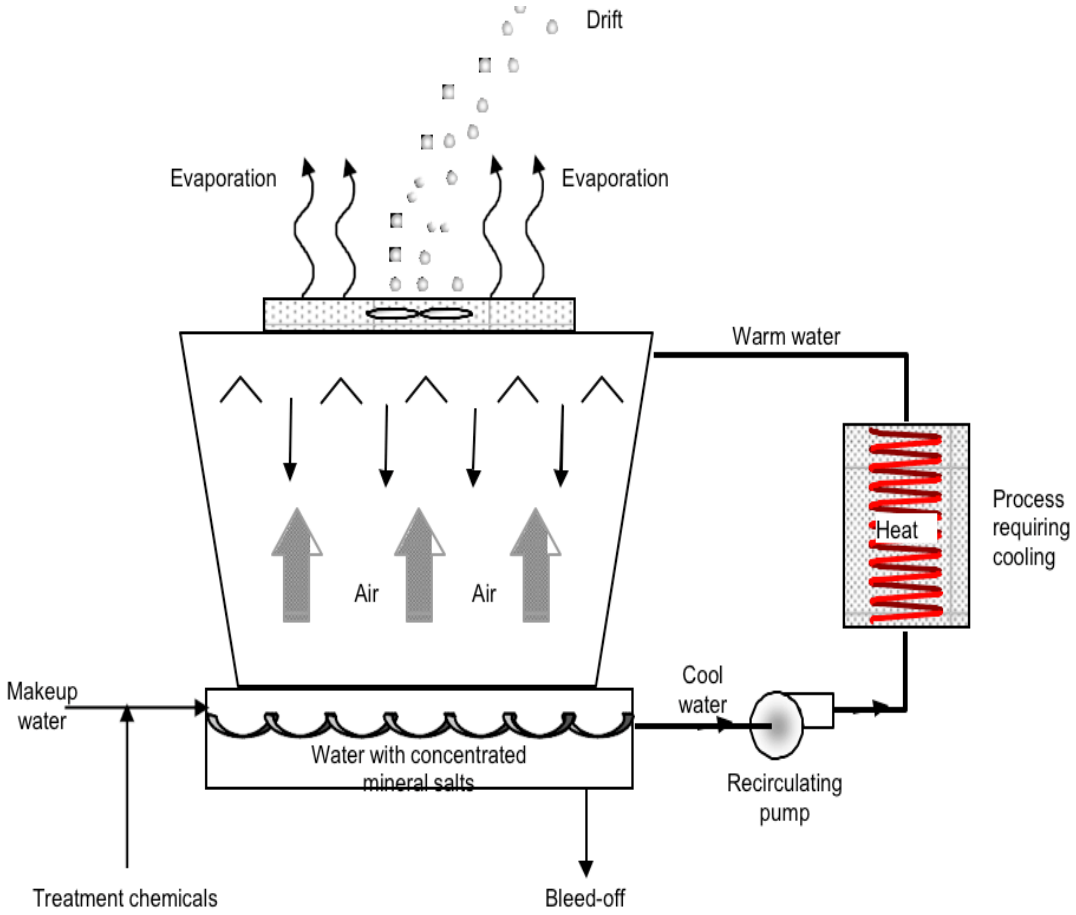
https://epi.dph.ncdhhs.gov/cd/legionellosis/MSFOutbreakReport_FINAL.pdf

https://emergency.cdc.gov/han/han00422.asp Hot Tub Displays and *Legionella* Risk—Guidance for Environmental and Public Health Practitioners

Increase awareness of event planners and hot tub vendors of hazards and risks of hot tubs at displays

- Training for operators and vendors
- Maintain free chlorine (2–4 parts per million or ppm) or bromine (4–6 ppm)
- Maintain the pH level of the water at 7.2–7.8.
- Test pH and disinfectant levels at least twice per day.
- After display is over cleaning, disinfecting, maintenance, and safe storage of hot tubs

Legionnaires Disease --often associated with cooling towers



Original 1976 outbreak traced to mist from a cooling tower cooling tower pulled into the building HVAC system 200 people ill and 34 fatalities

August 2015 Bronx New York 128 cases with 12 fatalities in the community traced to a cooling tower at Opera House Hotel

New York City became the first city to register and regulate cooling towers

https://www.globalspec.com/learnmore/manufacturing_process_equipment/heat_transfer_equipment/cooling_towers

Why Healthcare facilities need water management plans

CMS *requires* water management plans (WMP) in Hospitals, Critical Access Hospitals, and Long-Term Care https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/SurveyCertificationGenInfo/Downloads/Survey-and-Cert-Letter-17-30.pdf

VA Directive 1061, Prevention of Healthcare-Associated Legionella Disease and Scald Injury from Potable Water Distribution Systems
https://www.va.gov/vhapublications/ViewPublication.asp?pub_ID=3033

Joint Commission --Water Management Programs

- EC 02.05.01 and EC 02.05.02 and EP1 –EP4 and EP6
- Joint Commission Tip Sheet on Water Management Program Requirements in Nursing Care Centers

Industry Standard: Legionellosis: Risk management for building water systems
ANSI/ASHRAE standard 188–2018

CDC Toolkit for developing a Water Management Program
https://www.cdc.gov/legionella/wmp/toolkit/index.html

Why other large buildings need WMP

Government Recommendations -- CDC and other states

ASHRAE Standard 188 requires water management plans in buildings that meet any of these criteria

- Multi-housing units with one or more centralized circulating water heaters
- More than ten stories tall
- Health care or treatment of occupants that are immune compromised
- Intended for housing occupants > 65 years old

Costs from outbreaks associated with a facility

- Disruption of operations, shutdown or equipment, or closure of features or fixtures
- Water use restrictions
- Expensive and difficult to remediate and control hazards
- Liability and negative publicity
- Investigation of outbreaks by local or state health departments and CDC

Elements of a WMP

1. Form a Water management team
2. Develop Program goals
3. Describe and document water systems in detail
   - Water use audit
4. Water systems hazard analysis and risk assessment
5. Identify control limits-- quantitative or qualitative
6. Monitoring--how, when, and where
   - Recordkeeping and documentation
7. Develop pre-determined actions plans when there are deviations from control limits
8. Validate that plan is working
   - Update when appropriate
9. Verify that plan is meeting program goals

- Recordkeeping
- Documentation
- Communication
- Engagement

1. Water management team

Interdisciplinary across organization including external partners

Team members need to be "competent Persons"

- Knowledge skills and abilities to recognize hazards
- Ability to take prompt corrective actions

Main team

- Facility director
- Facility administrator
- Medical Director
- Health and safety
- Infection control
- Environmental services
- Chief engineer
- Maintenance director

Documentation and recordkeeping

Integrate into existing programs policies and procedures

As needed

- Finance
- Human resources
- Legal
- Public affairs
- Contractors & consultants
- Local water supplier
- Regulators

2. Program goals

Align program goals with main strategies to prevent *legionella* from amplification in water systems

- Water Temperature
- Prevent stagnation (time, flow, and dead legs)
- Maintain adequate disinfectant levels
- Maintenance and cleaning prevent sediment, scale and biofilms
- Pathways for exposure to droplets

Goals need to be realistic, feasible, achievable, defensible

Get the most from outside help

Water management is a growth industry, expect to be solicited by contractors and consultants offering products and services

Consultants and contractors are partners in the process with clearly defines roles and responsibilities specific to the facility

When selecting contractors or consultants consider

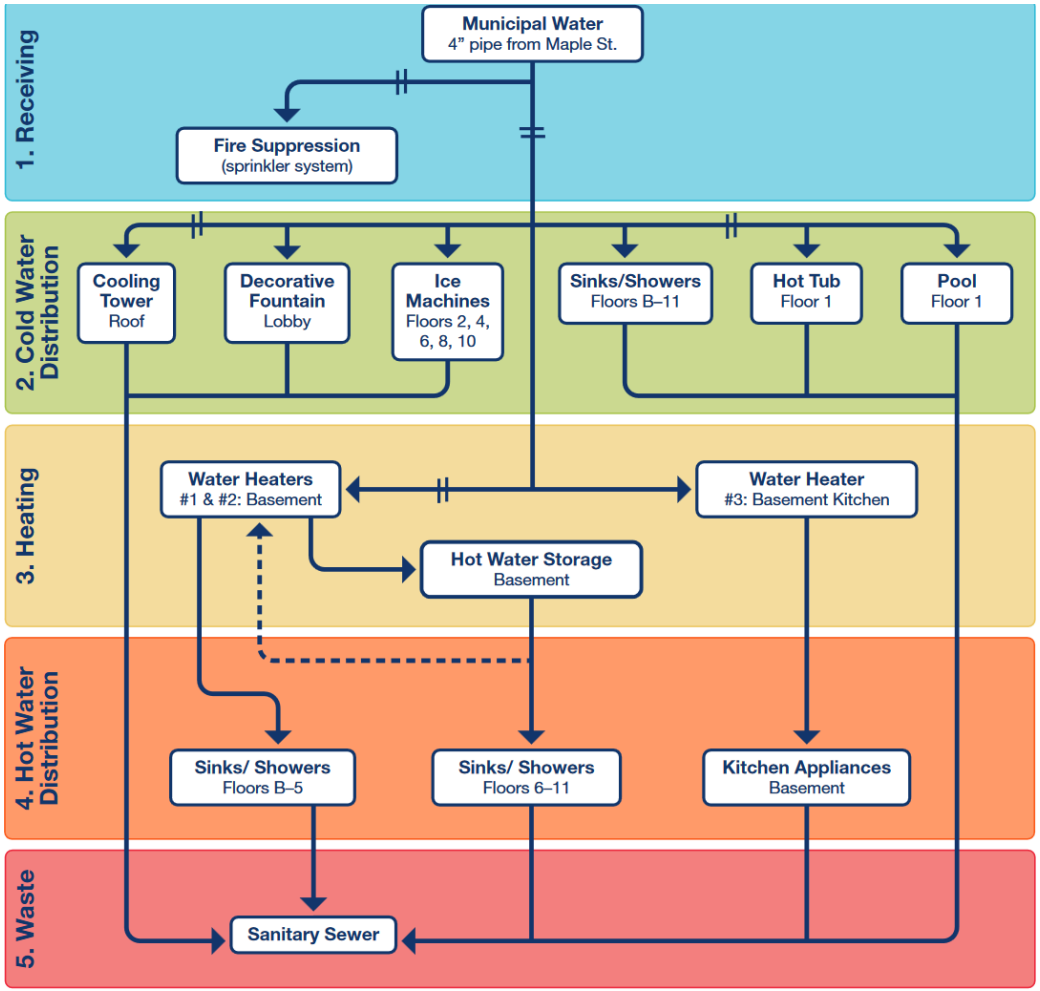
- Experience in developing and implementing WMP
- Expertise in design and operation of plumbing systems
- Knowledge of codes standards and regulations
- Conflicts of Interest

CDC, Considerations when working with Legionella Consultants
https://www.cdc.gov/legionella/maintenance/consultant-considerations.html

3. Describe water systems

Flow charts, architectural plans, engineering diagrams, written descriptions, interviews and other records

- Hot and cold potable water systems
- Process water systems
- Specialty water systems
- Wastewater
- Reused water



Describe and document

- Points where water enters the building
- How water is distributed and circulated
- How water is processed
- How water is used
  - Consider volume, duration and frequency that water is used, future uses, and installation of new equipment, replacement of old equipment

Describe Water Systems

Water meter and backflow prevention device

Recirculating hot water heaters in series

How water is processed

- Heated
- Cooled
- Stored
- Disinfected
- Distilled
- Purified

- Pressurized
- Filtered
- Mixed
- Or otherwise treated

Hot water for distribution

Thermostatic mixing valve

How water is used – water use audit

- Food preparation and sanitation
- General personal care, showering, bathing, handwashing
- Housekeeping and environmental services
- Laundry
- Drinking fountains and ice machines
- Fire suppression/emergency eyewash
- Process water, heating & cooling -- cooling towers
- Decorative fountains
- Pools, spas and hydrotherapy
- Landscaping
- Ultra clean water -- hemodialysis, surgical irrigation, laboratories, pharmacy, respiratory therapy, Nebulizers, CPAPs
- Dental
- How water is discarded – wastewater and sanitary sewer
- Others?

Thermostatic Mixing Valve?

4. Hazard and risk assessment

Occupant characteristics

- Age
- Pre-existing disease
- Immune status

Interactions with

- Accreditation
- Licensing requirements
- Building codes
- Infection control and Clinical services
- Construction, operations, maintenance
- Environmental services
- Safety and health
- Public relations
- Accounting

Building Characteristics

- Age/condition of building
- Age/condition of water systems
- Places in water systems where legionella could amplify, or biofilms could form
- Places in water systems that create aerosols
- Existing maintenance plans and activities
- Staff knowledge & expertise
- Variability of occupancy rates
- Future changes in use, additions, renovations

5. Control points

- Any place where hazards can be prevented, eliminated, or reduced to an acceptable level
- Point of Entry -- Coordinate with your utility
  - Request baseline data/historical data for compliance with the Safe Drinking Water Act at the nearest compliance sampling point upstream of your location for disinfectant residual, pH, temperature, and turbidity
  - Ask your utility if they would could install a compliance sampling point near your building
  - Consider capital/operational costs to install sensors to monitor water quality at the building point of entry
- Locations where temperature is within optimum range for range for legionella amplification
- Locations where water is recirculated or stored
- Places where water may stagnate, flow may be reduced, water is infrequently used, and “dead legs”
- Places where biofilms are may form
- Places and uses where droplets or aerosols are generated
- Construction activities that disrupt water system
- Other incidents that might disrupt water systems

6. Identify control limits

Control limits –monitoring, measuring, observing, and documenting activities – the most important element of WMPs.

- Prevent backflows, cross connections, or other sources of external contamination
- Limit places and duration where water temperature is optimal for legionella to amplify –circulating hot water systems
- Prevent scalding hazards -- water at Point of use (POU) must be 100-116°F in lavatories and bathing facilities
- Maintain pH and residual disinfectant levels throughout water systems
- Safe storage and use of chemical cleaners and disinfectants
- Keep decorative fountains clean, or eliminate them
- Routine cleaning and disinfection, shower heads, faucets, ice machines, drinking fountains
- Routine cleaning and disinfection of respiratory therapy and other medical equipment
  - Only use distilled water for respiratory therapy
- Follow Cooling Technology Institute guidance for operating and maintaining cooling towers

6. Monitoring -- Quantitative

If possible, routine measurements at point of entry for temperature, pH, residual disinfectant, and water pressure

Routine measurements at other control points and points of use

- Temperature
    - Hot water systems >140°F in storage tanks and >124°F in distribution piping
    - Temperature limits at point of use (100 to 116°F) for lavatories and bathing facilities
    - Cold water systems < 68°F minimum to extent practicable
- pH between 6.5 and 8.5
- Residual disinfectant levels
    - Safe Drinking Water Act disinfectants in drinking water at 0.2 mg/l and maximum of 2 mg/l .
- Residual disinfectant levels decrease with “age” of water and as temperature of water increases
- Water pressure
- Determine monitoring frequency based on hazards, risks, operations, costs of equipment and supplies, staff training, staff time recordkeeping, and documentation

Monitoring -- Qualitative

- Routine inspections for rust, sludge, organic matter, biofilms, sediment, scale, unusual turbidity and unusual odor
- Routine maintenance to plumbing system components
- Routine filter changing
- Routine flushing hot and cold-water outlets
- Routine, standardized, and documented protocols for cleaning and disinfecting fixtures (outlets) and equipment
- Identification and elimination of dead legs
- Identifying places where water is used infrequently
- Notification process for intended/unintended disruption of water supply
- Determine monitoring frequency based on hazards, risks, costs of equipment and supplies, staff training, staff time recordkeeping, and documentation

7. Predetermined actions when deviations from control limits occur

Tie into facility emergency water plan

Cleaning, disinfection, and flushing

Water use restrictions, shut down equipment or close facilities

Thermal shock treatment-- > 160° F in tank and flush each outlet for at least 30 minutes. Hot water > 140°F for at least 30 minutes at each outlet

Shock disinfection – increase residual chlorine to > 2 mg/liter at all outlets and maintain throughout the system by continuous flushing for at least two hours

Point of use filtration 0.2 µ filters

- Install on showers and faucets consider when other methods are not feasible and/or for high-risk patients

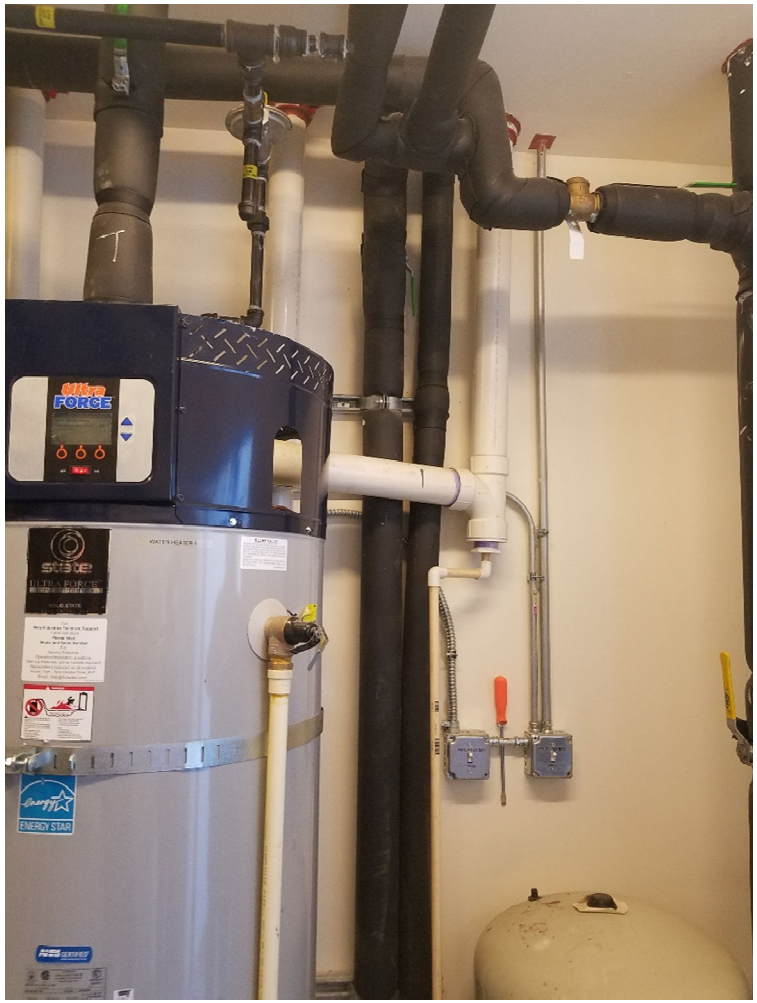
In extreme situations implement system-wide treatment and disinfection

- Facility must meet requirements for Non-transient, Non-Community Public Water System

https://www.cdc.gov/healthywater/emergency/pdf/emergency-water-supply-planning-guide-2019-508.pdf

Labels, record keeping, and documentation

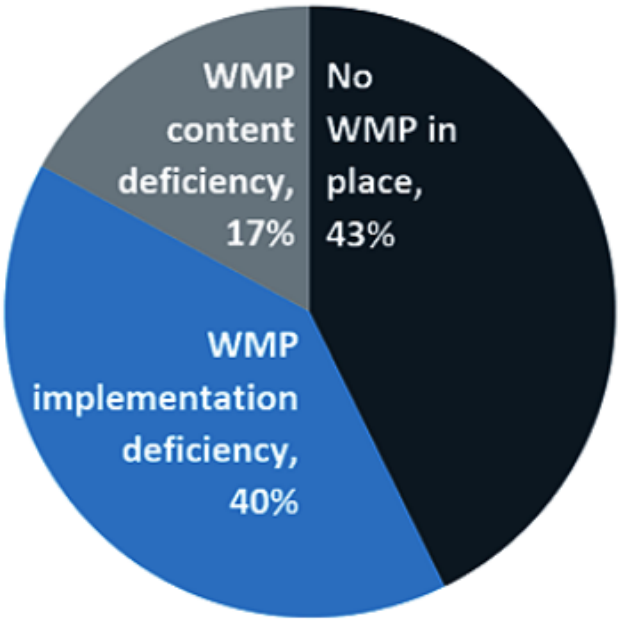
- Keep water networks, systems, components, equipment labelled in a clear and uniform manner
- Set up and use a record keeping system for inspections, as-needed and preventive maintenance, repairs, and when corrective actions are implemented
- Keep previous versions of water management plans as new plans are updated
- Keep water management team meeting minutes
- Training for workers implementing the plan – involve workers in quality improvement and verification
- Storage, handling and use of process chemicals



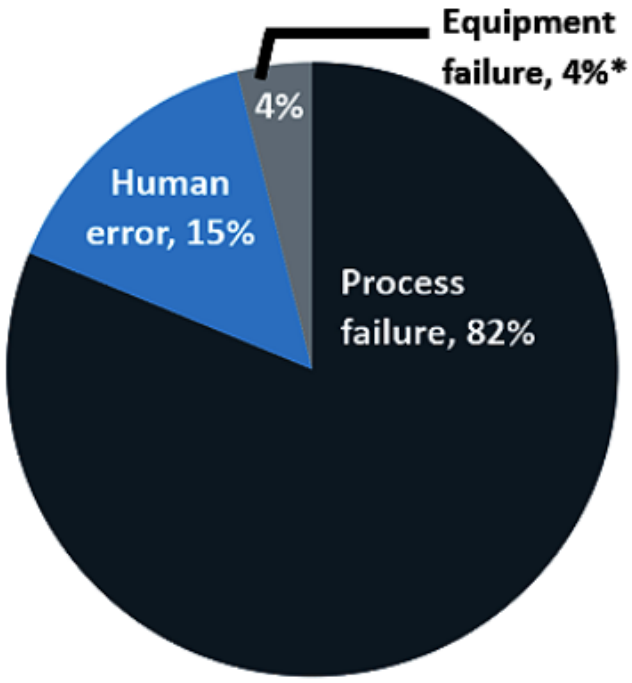
Water Management Plans and Disease Outbreaks

Findings from a review of CDC-led Legionnaires' disease outbreak investigations, 2015–2019

Most WMP deficiencies associated with outbreaks were due to missing or improperly implemented WMPs.



Most environmental deficiencies were due to process failure.



8. Verification

Is Water Management Plan working as intended?

- Recordkeeping and documentation
- Track incidents when deviations from control limits occur
- Investigations and after-action reviews to reduce number and severity of incidents when deviations control limits occur, or corrective actions occur
- Document costs for interventions when deviations from control limits occur
- Engage affected workers
  - Ask if practices and operations are feasible given available resources and workflow
  - Ask if resources, time, tools and equipment, worker training are adequate to meet program needs
  - Ask for recommendations for changes to practices & procedures to improve worker safety and efficiency

9. Validation

Is the program meeting the goals?

Should sampling for legionella be part of the verification process?

Sampling for Legionella

- Environmental sampling is the one way to verify the effectiveness of water management plan
- A decision to routinely sample for legionella as part of the water management plan should be carefully and deliberately considered by the water management team
- Keep records and documentation
- *Do not sample to "see what we have" or conduct unplanned, unsystematic or undirected sampling*

If routine sampling is part of the plan:

- *Go All out !!!*
- Nonrandom
- Part of a carefully designed sampling plan
- Set pre-determined thresholds to interpret results and implement corrective actions
- Set threshold limits for corrective actions
- Devote enough resources
- Work out technical concerns
- Select appropriate laboratories

Environmental Sampling

Potential sampling sites

- Point of entry
- Holding tanks
- Centralized hot water heaters supply & return
- Expansion tanks
- Before and after filters or water softeners
- Showers
- Faucets
- Whirlpools
- Cooling towers
- Decorative fountains
- At distal ends of hot and cold-water systems
- Ice machines
- Dead legs
- Frequently unused fixtures

Measure temperature, pH, and residual disinfectants wherever samples are collected

For outbreaks and sentinel case investigations --Follow CDC guidance for Sampling Procedure and Potential Sampling Sites
https://www.cdc.gov/legionella/downloads/cdc-sampling-procedure.pdf
1 liter water samples and biofilm samples with culture based analysis by CDC ELITE laboratory is the 'gold standard"

Other molecular tests (PCR) tests can be used for validation in the absence of outbreak or sentinel case, approved methods ISO 11731 Enumeration of *legionella*

Interpreting Results

Highly probable to find a few colony forming units at point of entry over multiple samples

Some Benchmarks to interpret sampling results

Source	Acceptable	Requires additional investigation and actions	Requires immediate action	reference
Cooling tower	<10CFU/ml	10-1000 CFU/ml	>1000 CFU/ml	New York City
Potable water	<1 CFU/ml	10-100 CFU/ml	>100CFU/ml	AHIA 2015
Decorative fountains	<1CFU/ml	1-10CFU/ml	>10CFU/ML	AIHA 2015
Hot tubs/spas	<1 CFU/ml	1-10 CFU/ml	>100CFU/ml	AIHA 2105

Sample results need to be interpreted in the context of the WMP goals

Final Remarks

- Very few facilities will devote resources, time and management commitment to implement a truly comprehensive water management plan that will eliminate all legionella from a water system all the time
- Facilities depend on their PWS to deliver high quality water with adequate residual disinfectants
- Facilities often depend on maintenance, cleaning, and preventing stagnation (time, flow, and dead legs) as main control methods
- *There will be places in every water system within the optimum temperature range for legionella to grow and amplify*
- In the absence of cases linked to the facility CMS expects that healthcare facilities have established a WMP Team and gone through the steps to implement a plan. CMS does not require sampling
- A verified WMP allows enables informed decisions to reduce hazards, risks, optimize costs, and improve efficiency

Online references

CDC vital signs– Legionnaires Disease a problem for health care facilities
https://www.cdc.gov/vitalsigns/legionella/index.html

Developing a Water Management Program to Reduce Legionella Growth & Spread in Buildings, A Practical Guide to implementing Industry Standards https://www.cdc.gov/legionella/downloads/toolkit.pdf

Considerations When Working with Legionella Consultants
https://www.cdc.gov/legionella/maintenance/consultant-considerations.html

Centers for Medicare & Medicaid Services, S&C 17-30, 06/09/2017 Requirement to Reduce Legionella Risk in Healthcare Facility Water Systems to Prevent Cases and Outbreaks of Legionnaires' Disease (LD)
https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/SurveyCertificationGenInfo/Downloads/Survey-and-Cert-Letter-17-30.pdf

Association of Water Technologies, Legionella 2019, A Position Statement and Guidance Document
https://www.awt.org/pub/?id=035C2942-03BE-3BFF-08C3-4C686FB7395C

Hot Tub Displays and *Legionella* Risk—Guidance for Environmental and Public Health Practitioners
https://emergency.cdc.gov/han/han00422.asp

Water Management Gaps and Legionnaires' Disease Outbreaks
https://www.cdc.gov/nceh/ehs/water/legionella/water-mgt-gaps-ld-outbreaks.html

Legionella Consultants

This list was compiled by the North Carolina Division of Public Health; however, our agency does not endorse, suggest, or recommend any specific consultant or company on this list. This list is not exhaustive, is intended for informational use only, and may not be up to date

Phigenics, https://info.phigenics.com/. Contact Scott Whip, Regional Manager (704) 236-1357 or swhipp@phigenics.com.

Bill Pearson, Chief Science Officer for Innovative Walter Consulting, Telephone number (919) 880-0829 Bpearson249@icloud.com.

Julie Lo, MS, CIH, Atlas Consulting julie.lo@oneatlas.com Office (919) 871-0999, (919) 348-5957 OneAtlas.com

Elaine Schulman, Nalco Environmental Hygiene Services, 1601 West Diehl Rd, Naperville, IL 60563-1198 (202) 834-0494 eschulman@nalco.com

Legionella Consultants, Inc 25030 Ramm Drive Naperville, Il 60564, (630) 689-5677 or (757) 299-7737 http://www.legionellaconsultantsinc.com

Chem-Aqua (Environmental Sampling Only – will subcontract with a Consulting firm) P.O Box 152170, Irving, TX 75015 800-476-4262, http://chemaqua.com

Point of Use Filters - Pall Filter Company
Christopher Connolly, North American Hospital Water Sales Manager, Pall Medical- Hospital Group, 973-632-1920 (cell) 215-383-4351 (fax) chris_connolly@pall.com www.pall.com/medical

Purologix Water Services, Inc, Russ Elmore, Water Specialist/Consultant/Manager
919-577-1178 x104 (office) 919-624-6569 (cell), russ@purologix.com www.purologix.com

AquaMedix LLC, J. Brady Benson CleanSpray Water Filtration Systems
952-479-0636 (office) 612-819-8005 (cell) bbenson@aquamedix.net, www.aquamedix.net

Questions?

Contact me:

David Lipton, CIH
Occupational and Environmental Epidemiology Branch
(919) 707-5900 (main)
(919) 707-5961 (direct)
David.lipton@dhhs.nc.gov
5505 Six Forks Road, Raleigh NC 27609
1912 Mail Service Center, Raleigh NC 27699-1912