North Carolina SPICE
Statewide Program for Infection Control & Epidemiology

WATER MANAGEMENT PLAN

Marty Cooney, DrPH, MPH, ME, BSN, RN, CIC

Associate Director,

NC Statewide Program for Infection Control and Epidemiology (SPICE)

1

OBJECTIVES

- Discuss water safety, organisms and risks
- Review of Legionnaires' disease
- Identify water management program elements
- Identify Legionella risks and mitigation from building water systems and devices

2

WATER SAFETY

- Tap water is clean and safe to drink, but may have harmful germs that can spread to patients and cause infection.
- Tap water normally contains germs and should not be used when sterile water is needed (i.e., patient care, certain medical equipment).
- In healthcare settings, water uses are more varied, and patients are more vulnerable to infection.

https://www.cdc.gov/project-firstline/media/pdfs/Micro-Learns-EVS-Water-in-Healthcare-508.pdf

SPICE

3

COMMON GERMS THAT LIVE IN WATER

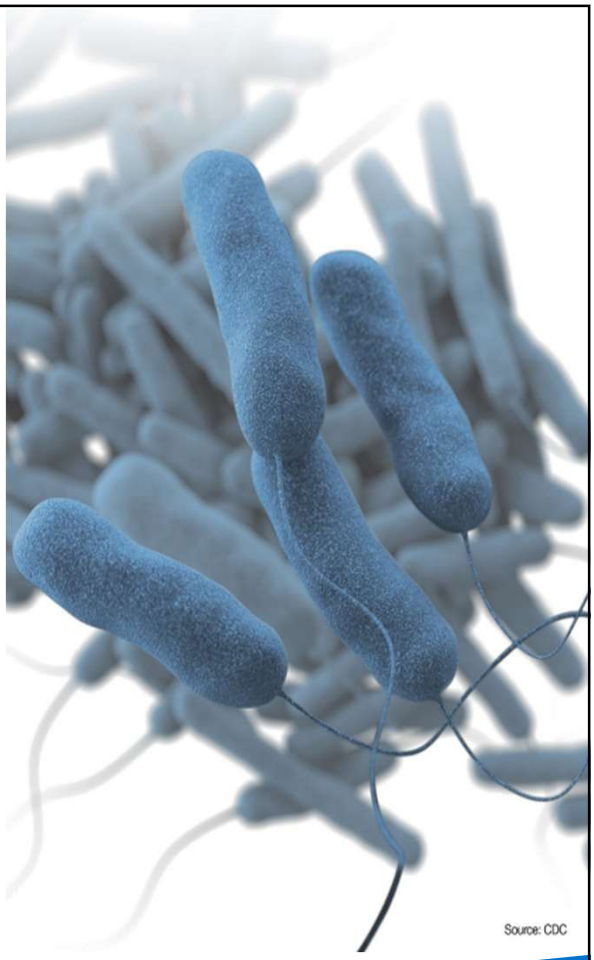
- Acinetobacter
- Serratia
- Pseudomonas
- Legionella
- Nontuberculosis Mycobacteria

https://www.cdc.gov/control-legionella/media/pdfs/toolkit.pdf

CDC Source: https://www.cdc.gov/drinking-water/causes/germs-that-can-contaminate-tap-water.html

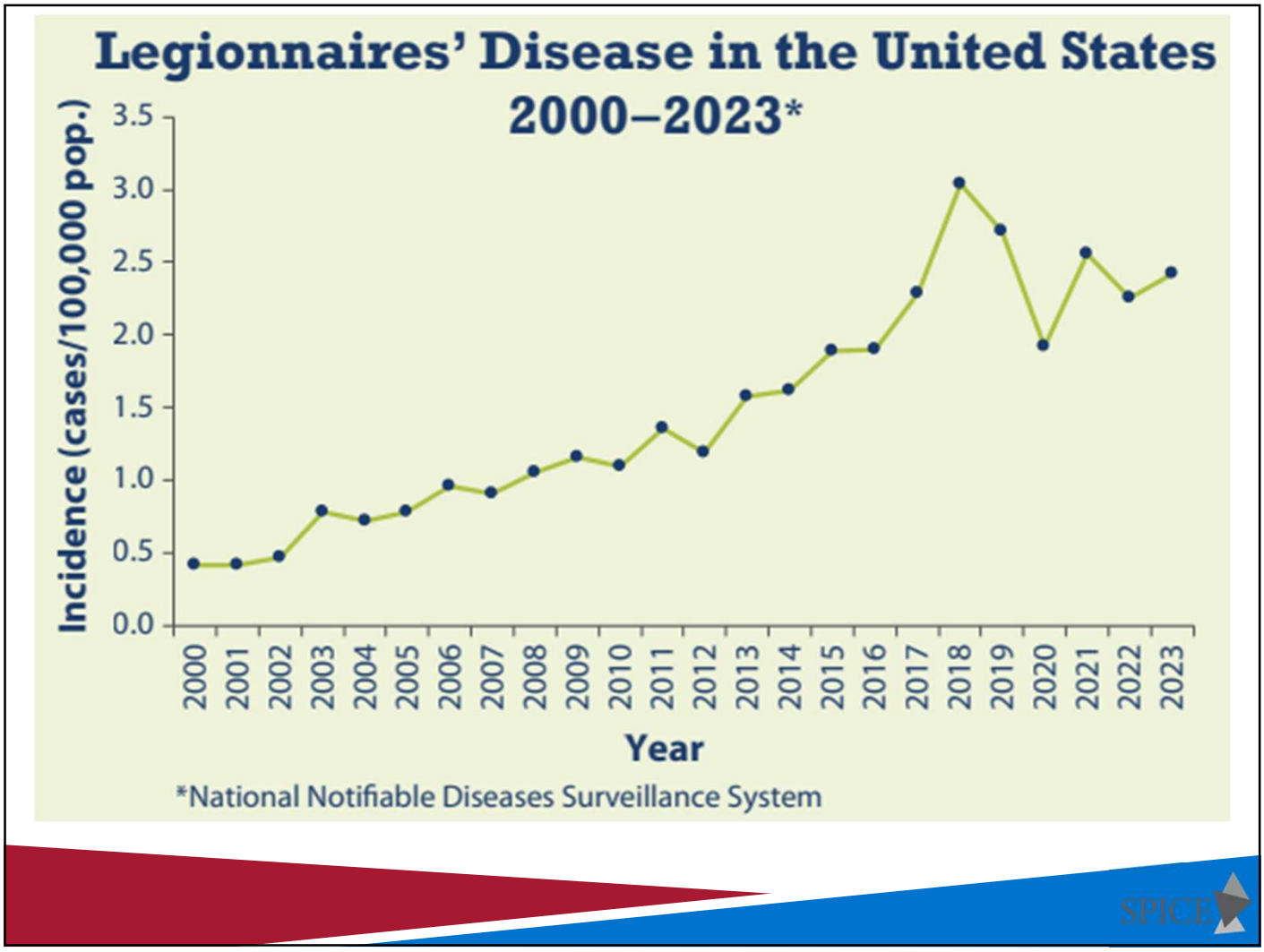
LEGIONELLA ECOLOGY

- Legionella is found naturally in freshwater environments, like lakes and streams.
- People can get sick when they inhale water containing Legionella from building water systems or devices not adequately maintained.
- Legionnaires' disease is a serious type of pneumonia (mostly caused Legionella bacteria).



SPICE

5


Legionnaires' Disease in the United States
2000–2023*
Incidence (cases/100,000 pop.)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year
*National Notifiable Diseases Surveillance System
SPICE

6

LEGIONELLOSIS

Pulmonary infection most commonly: *Legionella pneumophila serogroup 1*

Not transmitted from person to person Two clinical syndromes:

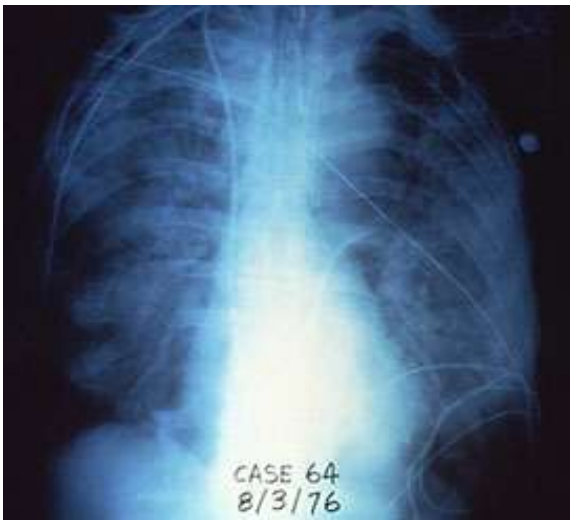
- Pontiac fever— Self-limiting flu-like illness --under reported and diagnosed
- Legionnaires Disease aka *Legionella* Pneumonia--About 10% mortality rate
  - Onset about 2-14 days after exposure
  - Severe cough, high fever, chest pain, N/V/D and confusion and x-exam.

Risk factors for Legionnaires disease include:

  - Age > 50, current/former smoker, chronic Lung Disease (emphysema or COPD), immune system disorders
- Diagnosis based on clinical examination and laboratory tests
  - Urinary Antigen Test – sensitive and specific to serotype 1
  - Microbiological isolation of *Legionella species* and *serotype* in sputum
- Treatment by antibiotics

LEGIONNAIRES DISEASE IS REPORTABLE

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



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

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

8

WHERE CAN LEGIONELLA GROW/SPREAD?

- Legionella can grow in many parts of building water systems that are wet, and certain devices can then spread water droplets containing Legionella.

- Examples include:

• Hot and cold water storage tanks • Water heaters • Water-hammer arrestors • Expansion tanks • Water filters • Electronic and manual faucets* • Aerators • Faucet flow restrictors • Showerheads* and hoses • Pipes, valves, and fittings • Centrally-installed misters*, atomizers*, air washers*, and humidifiers* • Nonsteam aerosol-generating humidifiers* • Infrequently used equipment, including eyewash stations* • Ice machines* • Hot tubs* • Decorative fountains* • Cooling towers* • Medical devices* (such as CPAP machines, hydrotherapy equipment, bronchoscopes)

https://www.cdc.gov/control-legionella/media/pdfs/toolkit.pdf

SPICE

9

EXTERNAL FACTORS THAT CAN LEAD TO LEGIONELLA GROWTH

- **Construction:** Vibrations and changes in water pressure can dislodge biofilm and free Legionella into the water entering your building.
- **Water main breaks:** Changes in water pressure can dislodge biofilm and free Legionella into the water, while dirt and other materials can be introduced into the water and use up disinfectant.
- **Changes in municipal water quality:** Changes in water quality can increase sediment, lower disinfectant levels, increase turbidity, or cause pH to be outside recommended ranges.

Picture source: https://bossegi.com/what-we-do/water-lines/

INTERNAL FACTORS THAT CAN LEAD TO LEGIONELLA GROWTH

- **Biofilm:** Protects Legionella from heat and disinfectant; provides food and shelter to germs; grows on surfaces and can last for decades
- **Scale and sediment:** Uses up disinfectant and creates a protected home for Legionella and other germs
- **Water temperature fluctuations:** Provide conditions where Legionella grows best (77°F–113°F); Legionella can still grow outside this range
- **Water pressure changes:** Can cause biofilm to dislodge, colonizing downstream devices
- **pH:** Disinfectants are most effective within a range (~6.5 to 8.5). Many things cause hot water temperature drop into Legionella growth range
- **Inadequate disinfectant:** Does not kill or inactivate Legionella.
- **Water stagnation:** Encourages biofilm growth and reduces temperature and levels of disinfectant.

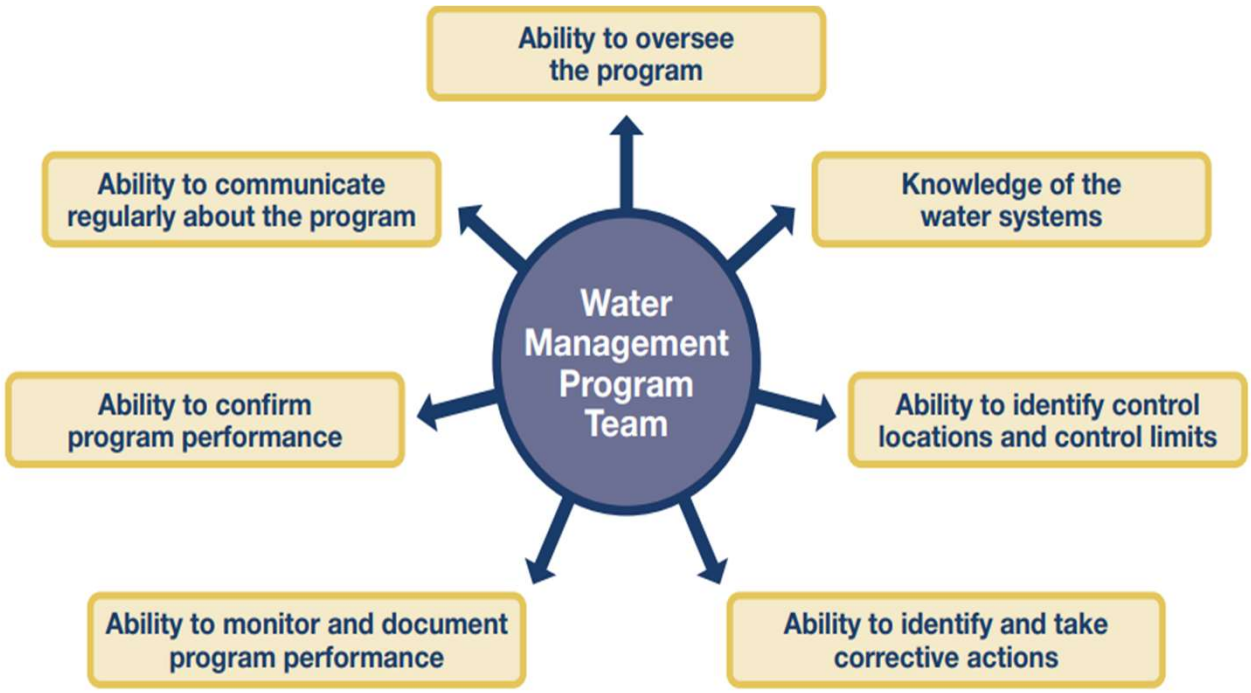
IMPLEMENTING A WATER MANAGEMENT PROGRAM KEY ELEMENTS

- 1. Establish a Water Management Program Team
- 2. Describe Your Building Water Systems (e.g., diagram)
- 3. Identify Areas Where Legionella Could Grow/Spread
- 4. Decide Where Control Measures Should Be Applied
- 5. Establish Ways to Intervene (if Control limits Not Met)
- 6. Make Sure the Program Is Running & Effective
- 7. Document & Communicate Activities

https://www.cdc.gov/control-legionella/media/pdfs/toolkit.pdf

12

FIRST, THE TEAM



https://www.cdc.gov/control-legionella/media/pdfs/toolkit.pdf

13

WATER MANAGEMENT TEAM

Interdisciplinary across organization and external partners.

Team members should be "competent Persons" – knowledge, skills, and abilities to recognize hazards and authorized to take corrective actions.

Integrate into existing programs policies and procedures

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

Ad Hoc
- Finance
- Human resources
- Legal
- Public affairs
- Contractors & consultants
- Local water Utility
- Regulators

THEN, THE GOALS

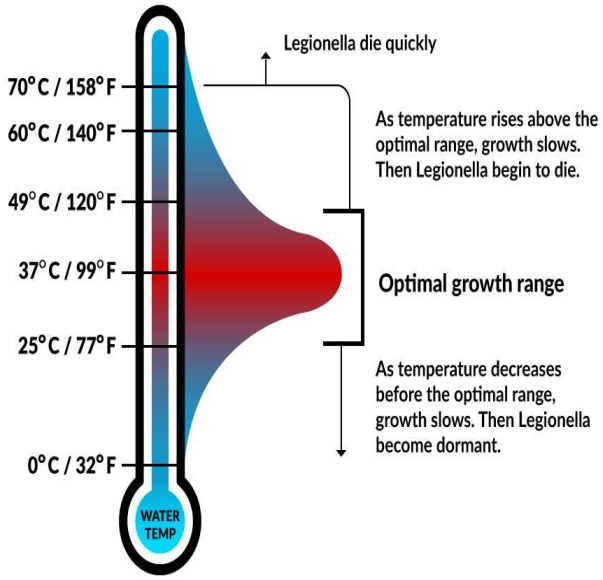
Align with the facility infection control program

- Prevent *Legionella* and other waterborne pathogens from amplifying and colonizing building water systems and limit
- Dispersal of contaminated water aerosols in a way that people might be exposed.

Prevent water systems from becoming the source of illness in your facility

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

Goals need to be realistic, feasible, achievable, defensible



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

THE WATER MANAGEMENT PLAN

Policies, procedures, and practices that

- Limit the potential for *Legionella* 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

Water Management Plans (WMP) are site specific and driven by

- Hazard analysis
- Risk characterization
- Control points

What to do when there if something happens

- Positive Legionella case or other water borne disease in your facility?
- Planned, or emergency construction, maintenance or repair that impacts the water system that may cause temporary loss of water pressure and how the water systems are brought back into service?
- Flushing program?

16

THE WATER MANAGEMENT PLAN

Your written program plan should include at least the following:

- **Program team:** Names, titles, contact info, and team roles
- **Building description**: Location, age, uses, and occupant types
- **Water system description**: General summary, uses of water, Ice machines/water fountains; aerosol-generating devices (e.g., hot tubs, cooling towers, med devices), and process flow diagrams
- **Control measures**: Points in the system where critical limits can be monitored and where control can be applied
- **Confirmatory procedures**: Verification steps showing the program is being followed as written/and validation to show it's effective.
- **Communicate** Activities: (e.g., quality, QUPI, etc.)
- **Documentation:** Activities and results. Collection and transport methods and which lab will perform the testing (if environmental testing is conducted)

DECIDE WHERE CONTROL MEASURES SHOULD BE APPLIED

- **Water quality** should be measured (if tested) throughout the system to ensure that changes that may lead to Legionella growth (such as a drop in chlorine levels) are not occurring.
- **Water heaters** should be maintained at appropriate temperatures.
- **Decorative fountains** should not be operated in healthcare facilities.
- **Disinfectants** and other chemical levels in cooling towers and hot tubs/whirlpools/hydrotherapy should be continuously maintained and regularly monitored. Surfaces with any visible biofilm (i.e., slime) should be cleaned properly disinfected.

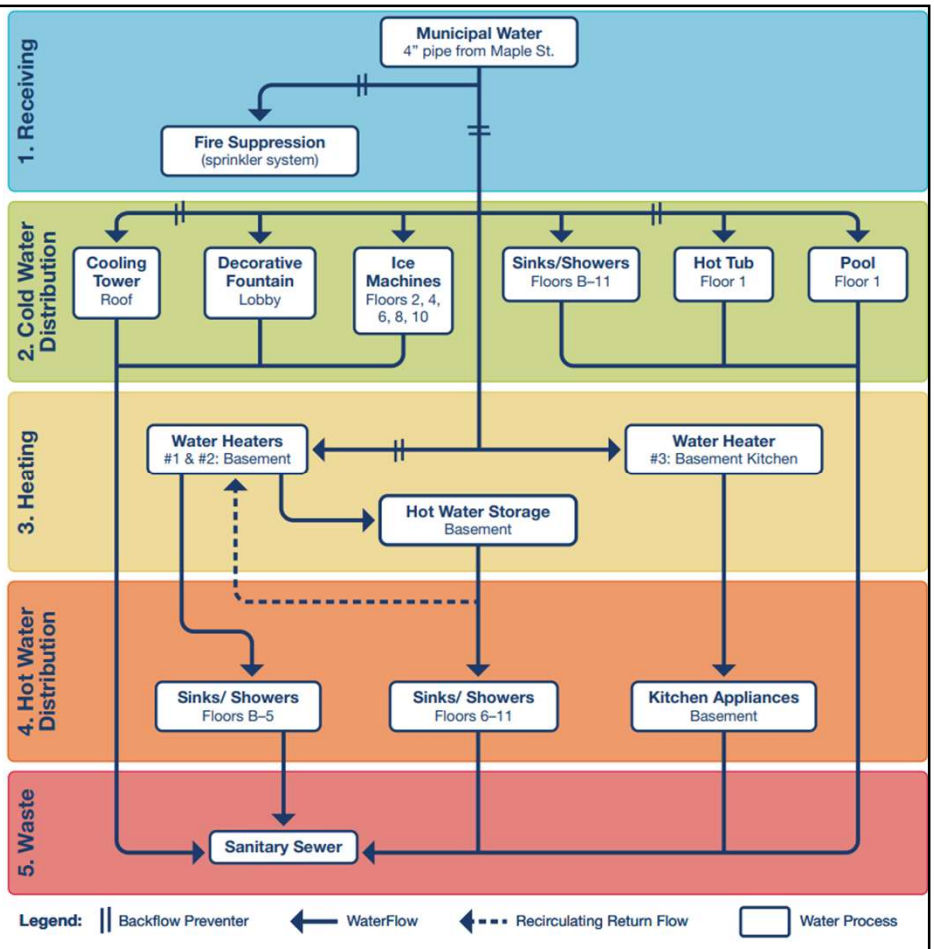
MAKE SURE THE PROGRAM IS RUNNING AS DESIGNED AND EFFECTIVE

Your program team should establish procedures to confirm effectiveness. Examples:

- Plan states a therapy tub is to be tested daily for chlorine. Was this done and results recorded? If you found a problem, did you take the action included in your program?
- Plan includes infection control staff to use their facility's routine surveillance for healthcare associated Legionnaires' disease.
- Is this reviewed & reported?

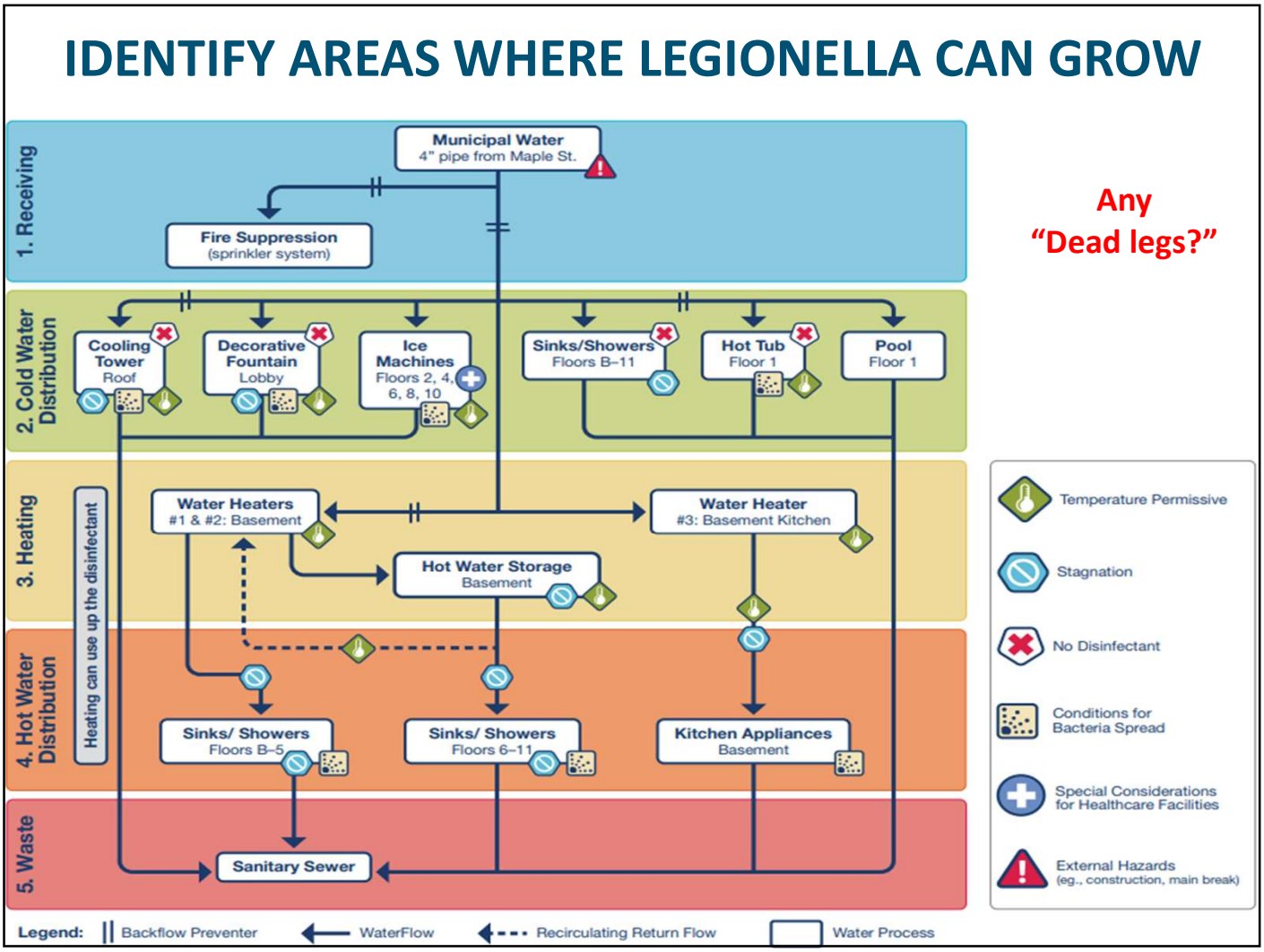
19

FLOW SHEET: DESCRIBING BUILDING WATER SYSTEMS



20

IDENTIFY AREAS WHERE LEGIONELLA CAN GROW



Any "Dead legs?"

21

ICE MACHINE AS A SOURCE OF LEGIONELLA

Water supply line passes near compressor & accumulator

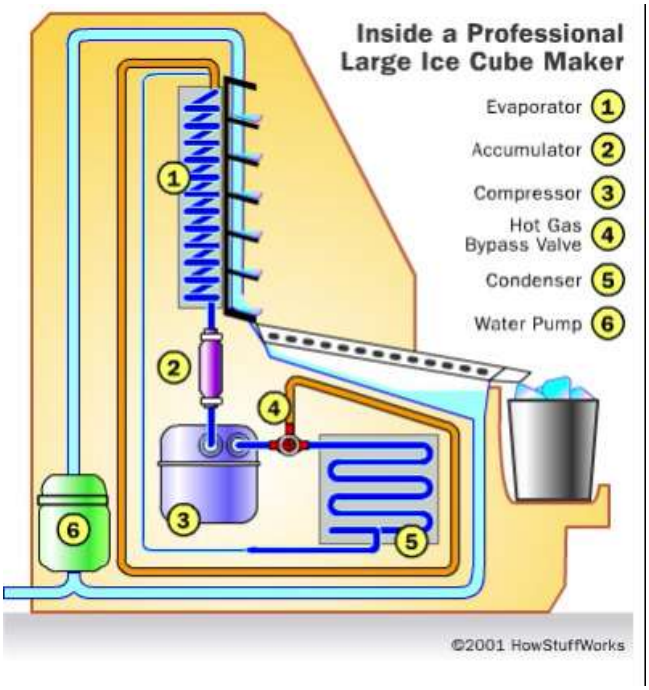
Heat from condenser & accumulator and compressor is dissipated (points 3, 4, and 5)

At the cooling unit refrigerant evaporates and heat is transferred from the water to form ice

Filters can be reservoirs

Legionella in ice is dormant but not dead

Incidental aspiration of ice



HOT TUBS & SPAS

- Permitted -- must meet Rules Governing Public Swimming Pools 15A NCAC 18A .2500 plus additional requirements, inspected by local health departments
- Certified (licensee) pool operators
- Circulation and turnover rate
- Continuous disinfection (2–4 ppm chlorine or 4-6ppm bromine)
- Maintain pH between 7.2–7.8.
- Needs routine cleaning, maintenance, monitoring disinfectant levels, filter changes, etc.

HOT TUBS AT TEMPORARY EVENTS

Final report – Legionnaires Disease at Mountain State Fair September 2019

136 cases associated with hot tubs on display (~200 cases of Legionnaires' disease reported yearly in NC from 2014–2018).

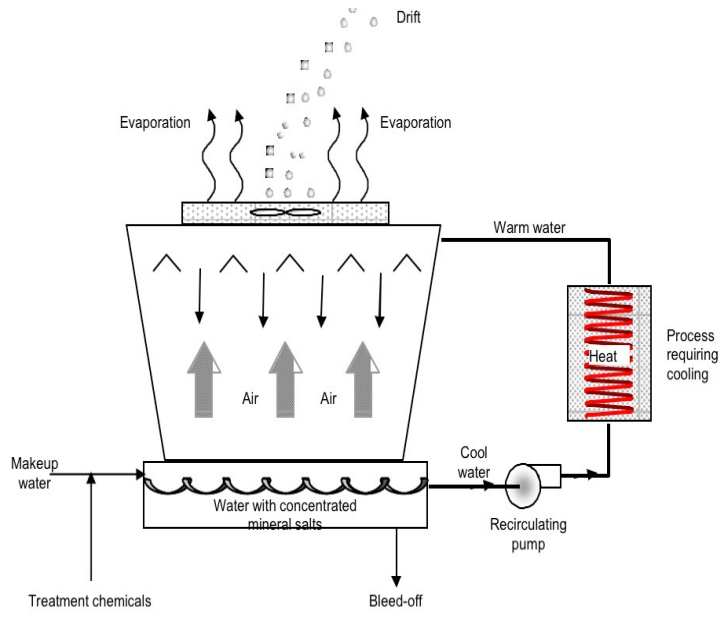
Increase awareness of event planners and hot tub vendors of hazards and risks of hot tubs at displays

- 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

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

https://www.cdc.gov/control-legionella/php/toolkit/hot-tub-module.html

LEGIONNAIRES DISEASE
OFTEN ASSOCIATED WITH COOLING TOWERS



Original 1976 outbreak traced to mist from a cooling tower cooling tower pulled into an adjacent building's HVAC system **200 people ill and 34 fatalities**

August 2015 Bronx New York **128 cases with 12 fatalities** 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

If There is a case of Legionellosis in your facility

✓ **Notify Local Health Department.**

Case definition and investigation steps can be found here:

- https://epi.dph.ncdhhs.gov/cd/lhds/manuals/cd/invest/LEGIONELLOSIS_LHD_STEPS_0419.pdf
- Call CD Branch (919) 733-3410 for additional information

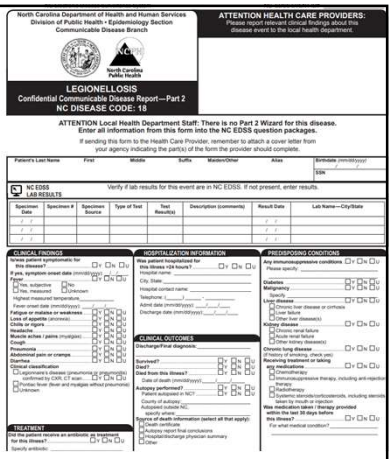
Was the Patient in your facility during the 14 days prior to symptom onset?

Create a timeline

- When was the patient admitted?
- When did symptoms start?
- Did the patient go anywhere else in the 14-day period prior to symptom onset (family member's home, trips, outings, other healthcare facilities)
- https://epi.dph.ncdhhs.gov/cd/lhds/manuals/cd/legionella/Legionellosis-algorithm.pdf

NC ELECTRONIC DISEASE SURVEILLANCE SYSTEM (NC-EDS) LEGIONELLOSIS COMMUNICABLE DISEASE REPORT

https://epi.dph.ncdhhs.gov/cd/lhds/manuals/cd/reportforms/legionellosis.pdf


North Carolina Department of Health and Human Services
Division of Public Health • Epidemiology Section
Communicable Disease Branch

ATTENTION HEALTH CARE PROVIDERS:
Please report relevant clinical findings about this disease event to the local health department.

LEGIONELLOSIS
Confidential Communicable Disease Report—Part 2
NC DISEASE CODE: 18

ATTENTION Local Health Department Staff: There is no Part 2 Wizard for this disease.
Enter all information from this form into the NC EDSS question packages.

If sending this form to the Health Care Provider, remember to attach a cover letter from your agency indicating the part(s) of the form the provider should complete.

Patient's Last Name | First | Middle | Suffix | Maiden/Other | Alias | Birthdate (mm/dd/yyyy) | SSN

NC EDSS LAB RESULTS — Verify if lab results for this event are in NC EDSS. If not present, enter results.

Specimen Date | Specimen # | Specimen Source | Type of Test | Test Result(s) | Description (comments) | Result Date | Lab Name—City/State

CLINICAL FINDINGS | HOSPITALIZATION INFORMATION | PREDISPOSING CONDITIONS

CLINICAL OUTCOMES

TREATMENT

Communicable disease nurses obtain information from health care providers, laboratories, and patients

- Clinical Findings
- Hospitalization
- Predisposing conditions
- Treatment (antibiotics)
- Clinical outcomes
- Travel
- Water exposure
- Patient interview
- HCP interview
- Medical Records
- Other exposures
- Geographical site

- About 90 % of cases are “sporadic” -- no link in time and space with other cases.
- Two or more cases linked in time and space in permitted facilities like lodging places or pools are an outbreak and trigger an environmental investigation.
- A single case in a Long-term Care or other Health Care facility may be considered as a “possible” health care associated case or a “sentinel” case.

27

POSSIBLE HEALTHCARE ASSOCIATED CASE

(PATIENT WAS IN FACILITY FOR PART OF 14 DAYS BEFORE SYMPTOM ONSET)

Have there been any other cases of LD among residents, staff, or visitors in the last six months?

NO

Enhanced surveillance for 2 months, patients with signs & symptoms of pneumonia should have Urinary Antigen Test

NO

Monitor for 12 months for any additional cases

NO

Resume routine surveillance and water safety measures

YES

Two or more healthcare associated cases are an outbreak

- Consult with CDB (919)733-3410
- Follow 10 steps for an outbreak investigation
- Retain a legionella consultant

YES

- Conduct environmental assessment
- Institute Control Measures
- Environmental Sampling and testing
- Declare outbreak over in Consultation with CDB

NC Communicable Disease Manual Legionella Outbreak Response Materials

PRESUMPTIVE HEALTHCARE ASSOCIATED CASE

(PATIENT DID NOT LEAVE THE FACILITY DURING 14-DAY PERIOD BEFORE SYMPTOM ONSET)

Have there been any other cases of LD among residents, staff, or visitors in the last six months?

NO

Sentinel Case investigation
- Consult with CDB
- Conduct a Site Visit using Environmental Assessment of Water Systems
- Conduct six-month retrospective surveillance
- Were other cases of legionellosis identified?

YES

Enhanced surveillance for 2 months, patients with signs & symptoms of pneumonia should have Urinary Antigen Test

Monitor for 12 months for any additional cases

Resume routine surveillance and water safety measures

YES

Two or more healthcare associated cases are an outbreak
- Consult with CDB (919)733-3410
- Follow 10 steps for an outbreak investigation
- Retain a legionella consultant CDC Working With Legionella Consultants
- Institute Control Measures
- Environmental Sampling and testing
- Declare Outbreak over in Consultation with CDB

NC Communicable Disease Manual Legionella Outbreak Response Materials

CONSULTANTS AND CONTRACTORS

Think of consultants and contractors as partners in the process

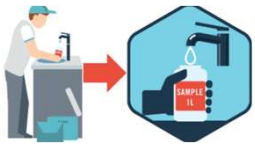
- Make sure that facility and contractor/consultants have clearly defined roles and responsibilities specific to the facility

When selecting contractors and consultants consider

- Experience in developing and implementing WMP
- Expertise in design and operation of plumbing systems
- Knowledge of codes, standards, regulations and best practices –
- May need licenses or certifications like Professional Engineer (PE), Certified Industrial Hygienist (CIH) or Certified Water Technologist (CWT)
- Conflicts of Interest

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

ENVIRONMENTAL SAMPLING



- Point of entry
- Holding tanks
- Centralized hot water heaters supply & returns
- 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
- Fixtures used infrequently

Measure temperature, pH, and residual disinfectants wherever samples are collected. In lieu of culture-based methods, for environmental sampling, molecular tests (PCR) and antibody assays can be used for verification of effective WMP in the absence of outbreaks or sentinel cases in people

In outbreaks and sentinel case investigations –

CDC investigating Healthcare Associated Cases and Outbreaks

1-liter water samples and biofilm samples with culture-based analysis by CDC ELITE laboratory is the 'gold standard"

INTERPRETING RESULTS

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

Reference benchmarks to interpret sampling results during *routine testing:*

https://www.cdc.gov/control-legionella/php/toolkit/routine-testing-module.html

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

WHY HEALTHCARE FACILITIES NEED WATER MANAGEMENT PLANS

CMS is an Authority Having Jurisdiction (AHJ) --r*equires* 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

Joint Commission is an AHJ for Certification -- Water R3
Report: New Standard of Water Management Program - Hospitals, Critical Access Hospitals, and Nursing Care Centers

Industry Standard: Legionellosis: Risk management for building water systems CDC Toolkits for developing a Water Management Program is an AHJ for best practices
https://www.cdc.gov/control-legionella/php/toolkit/index.html

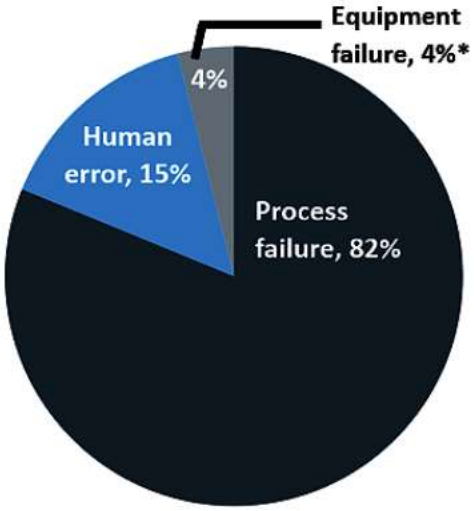
In possible, presumptive cases, and outbreaks in permitted, or regulated facilities the local health department in consultation with the Communicable Disease Branch is the AHJ.

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.



https://www.cdc.gov/control-legionella/php/data-research/outbreaks-water-management-gaps/index.html

34

FINAL REMARKS

- A verified and validated water management plan enables informed decisions to reduce hazards, risks, optimize costs, and improve safety.
- Time, energy, resources, and management commitment are needed for success.
- Facilities depend on their Public Water Supply to deliver high quality water with adequate residual disinfectants.
- Main control methods are water temperature, maintenance, cleaning, and preventing stagnation (time, flow, and dead legs).
- In every water system, there will be places within the optimum temperature range for Legionella to grow and amplify.
- CMS expects that healthcare facilities establish a WMP Team and gone through the steps to develop and implement a plan. CMS does not require sampling.

ADDITIONAL RESOURCES-REFERENCES

Considerations When Working with Legionella Consultants
https://www.cdc.gov/control-legionella/php/wmp/consultants-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 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

Healthcare Facility Water Management Program Checklist
https://www.cdc.gov/healthcare-associated-infections/media/pdfs/PHS-ReduceWaterRisk-ChecklistTool-508.pdf

LEGIONELLA CONSULTANTS

This list was compiled by the North Carolina Division of Public Health; however, this 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 (IWC), 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

37

QUESTIONS?

38