

*Do you know your H₂O:
Avoiding the un-Grateful Dead Leg*




Laura Riley, PhD, CIH
Michael Mount, CIH, OHST, CHMM
Infection Control Industrial Hygienists
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Learning Objectives

At the end of this presentation you should:

- Understand how legionella affects humans and how it contaminates water systems
- Understand how use the CDC toolkit to develop a WMP for Healthcare
- Know how to describe a water distribution system (both in narrative and schematic form)
- Know the basic components of a WMP including:
 - Required sections
 - Basic testing parameters
 - Basic response actions
- Understand the specific requirements for Healthcare Facilities required in ASHRAE 188 Requirement
- Methods of compliance
- Be familiar with the recent National Academy of Sciences, Engineering and Medicine report (Management of Legionella in Water Systems) recommendations.



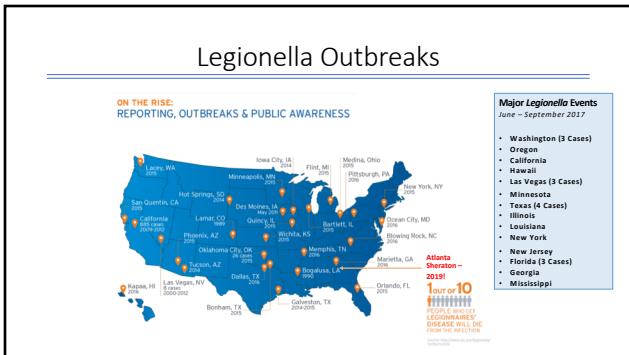
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History of Legionella

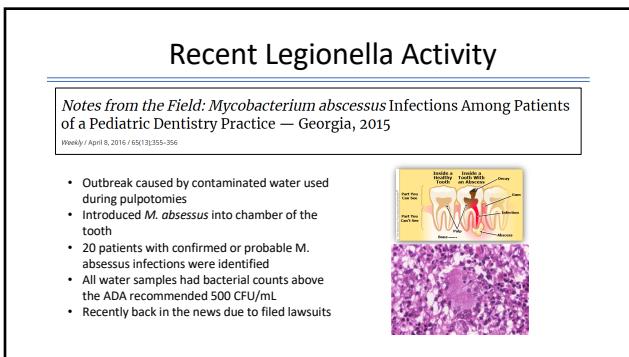
- First documented outbreak in 1976
- Philadelphia American Legion Convention
- 12 members died, 3 dozen hospitalized from "mystery illness"



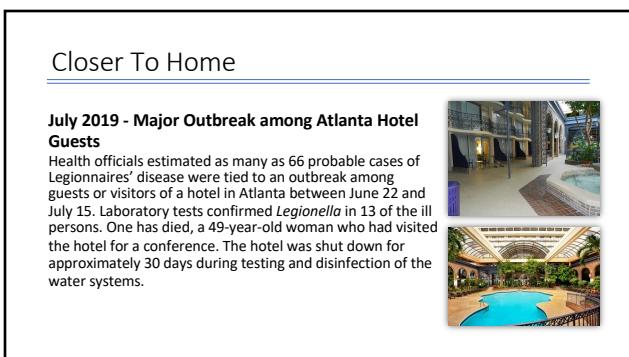

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More Recent

September 2019 - 13 Retirement Community

Residents in Batavia, IL
In late August to early September, 13 residents of a retirement community in Batavia, Illinois (near Chicago) were hospitalized and diagnosed with Legionnaires' disease. The retirement community has worked with Kane County Health Department and state health officials to test and hyperchlorinate the water systems.



Source: Guy & Rodd; Cartoon Stock

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AND Even More Recent

September 2019 - Major Outbreak Associated with the North Carolina State Fair

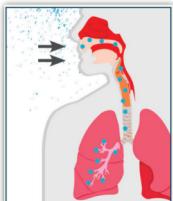
Fair
140 cases of Legionnaires' disease have been diagnosed in connection with the North Carolina State Fair held September 6-15. Four of the victims have died. The North Carolina Department of Health and Human Services investigation indicated a hot tub display as the source of the outbreak.



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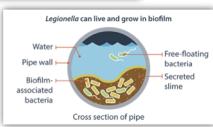
Legionnaires' Disease

- Symptoms (a type of Pneumonia)
 - Cough
 - Shortness of breath
 - Muscle aches
 - Fever/headache
 - Increased risk populations:
 - Current/former smoker
 - Having chronic lung disease
 - Weakened immune system
 - 50 years or older
 - Caused by inhalation of small water droplets



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Microbiology of Legionella



- 60 different species of Legionella
 - Invades and grows within alveolar macrophages
 - *Legionella pneumophila* species
 - Serogroup 1
 - Non-pneumophila species = less than 5% of reported cases
 - Pontiac Fever
 - Same organism; just affects healthier individuals

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Legionella Growth Conditions

- Water temperature range between 77°F and 108°F
 - Stagnation
 - Encourages biofilm growth
 - Reduce levels of disinfectant
 - Water main breaks



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ASHRAE 188-2018

ANSI/ASHRAE Standard 188-2018
Supplements ANSI/ASHRAE Standard 188-2018
Includes ASHRAE addenda listed in Annex D

Legionellosis: Risk Management for Building Water Systems

- Section 4.3: Healthcare Facility Requirements
- Section 6.1: Principles of a Water Management Program
- Water Flow Diagram



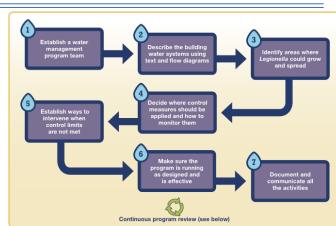
Legionellosis: Risk Management for Building Water Systems



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Water Management Plans

CDC Toolkit



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Where to Start – CDC Toolkit

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.

- 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 (Burns, cancer, solid organ or bone marrow transplant, kidney disease, diabetes, or chronic lung disease) or weakened immune systems (cancer treatments, immune comp., young, old or just stressed)?

Healthcare can pretty much stop right here!

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Another Great Resource

PreventLD Training:

A Training on *Legionella* Water Management Programs

<https://moodle.publichealth.arizona.edu/enrol/index.php?id=66>

- Continuing education credits available from the National Environmental Health Association (NEHA)
- Includes case studies, templates, and other practical resources
- Designed by CDC and partners for a range of professionals
- Takes about 3 hours to complete all modules

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Risk Characterization of Areas: Template

Risk Classification	Rationale for Risk Characterization	Type of Areas #1	Type of Areas #2
High-risk	Immunocompromised Patients are	Showers in – Oncology Patients – 5 th floor BMT Patients – 4 th floor Transplant Patients -3 rd floor	Ice Machines in – Oncology Patients - 5 th fl BMT Patients – 4 th fl Transplant Patients - 3 rd fl
Medium-risk	Patient Care Areas	Showers in – Remaining patient rooms	
Low-risk	Public Areas and registration		

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Potable/Non-potable Systematic Hazard Analysis Table: Template

Water Processing Step	Potential Hazards • Microbial • Chemical • Physical	Risk Characterization (significant Y/N)	Basis for Risk Characterization	Hazard Control Options (at this location)	Is control at this location essential? (Y/N)
1) Receiving	Microbial Chemical	Yes	Standard water provided by municipal water system	Secondary water treatment system (ClO ₂)	Yes
2) Cold Water Distribution	Microbial Chemical	No	Cold water temps stay below optimum growth temp	ClO ₂ Temp	No
3) Heating	Microbial	Yes	Cooling towers are known to harbor legionella and create an inhalable mist	Water treatment using ClO ₂	Yes
4) Hot Water Distribution	Microbial Chemical Physical	Yes	Hot water temps may fall in survival range (110F to 130F)	Increase temps to 130F And keep ClO ₂ concentrations above	Yes
5) Waste Water	Microbial	No	No routine procedures / treatments are done	Personal Protective Eq. N95 facepieces during work	Yes

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Water Management Team Members

- Potential team member titles:
 - Safety Management
 - Engineering Management
 - Engineering Staff
 - Infection Prevention Staff including Epidemiologist, Industrial Hygienist and clinical infectious disease physician
 - Water treatment consultant
 - Plumbing contractor / consultant
 - EVS



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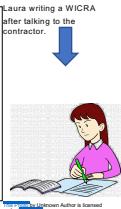
Describe your Water Flow

- A process or water flow written description and diagram should accompany your Water Management Plan. This description will:
 - In written form summarize water flow from the point of entry to the premise through the sewer system
 - In diagram form draw the system highlighting major distribution lines such as cold water, hot water, special system and cooling towers
 - Within this diagram you will note general locations where testing and verification points will be.

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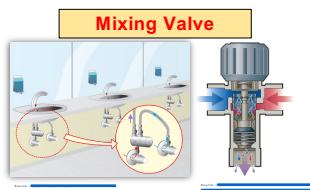
Written Description Example

- Example wording:
 - **RECEIVING.** Water is received from the city of Atlanta, Georgia. Water is immediately drawn off to charge the fire suppression system via a backflow prevention devices on each main, and the water is drawn off to charge the building's internal distribution system via a backflow prevention device. Additional cold water supply lines are detailed in Appendix A.
 - **DISTRIBUTION (COLD).** The building cold water distribution system supplies water to cold and hot potable water services (See Chapter 2), to cooling towers and evaporative cooling systems (See Chapter 3), and to other at-risk water systems (See Chapter 4). Appropriate backflow prevention devices for various water uses are determined by the type of water required by the AHJ. In general, internal plumbing consists of copper piping or other approved materials.
 - **HEATING.** Potable hot water is generated via three hot water systems (HWS) that supply hot water to various potable hot water outlets (showers, tubs and fixtures). Additional HWS details is described in Appendix A.
 - **WASTING.** Each HVAC HWS supplies hot water to a specific building distribution system. These specific areas are further described in Appendix A.
 - **WASTE.** All cold, hot and mixed waste streams are diverted to the waste water piping system and to the sanitary sewer.



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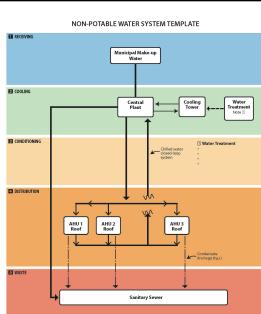
Name! That! Equipment!

**Backflow Preventer****Mixing Valve****Expansion Tanks**

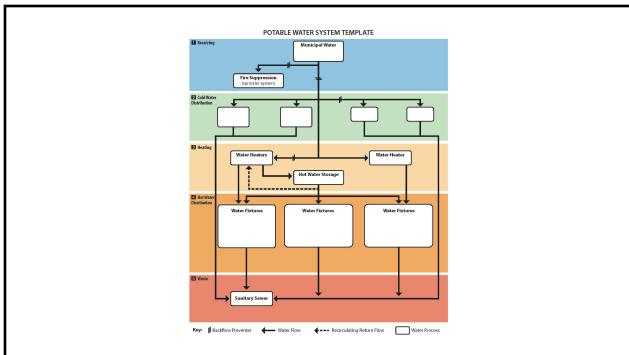
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Flow Diagram Examples

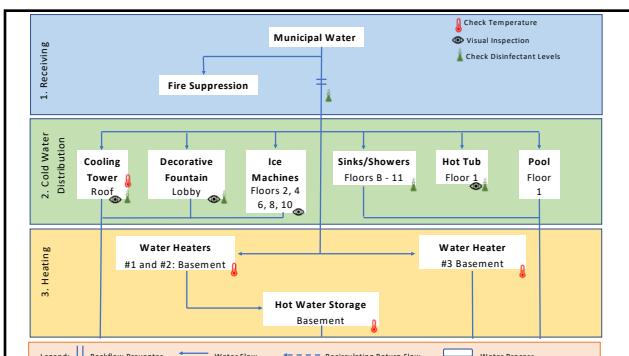
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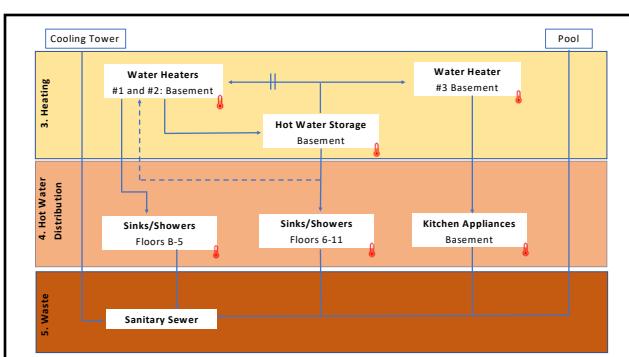
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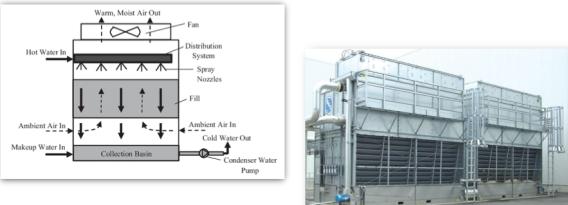


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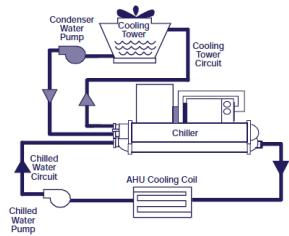
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Cooling Towers



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Chiller and Cooling Tower Relationship



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Control Measures and Monitoring

- Based on guidance from ASHRAE, AIHA and ASTM, the team will have to determine the control measures that will be used for each water component, i.e.
 - Disinfectant levels – disinfectants (i.e. ClO₂) kill bacteria and prevent biofilm
 - Temperature ranges – Temperature can be used to kill or inhibit growth
 - Routine cleaning – of systems such as the cooling tower reduce growth
 - Biological Testing (HPC and Legionella) – can be used to verify that the above prevention measures are working
- If control limits are not being met, the WMP includes procedures to follow for each water component to get them back within range.



Source

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Water Chemistry Testing

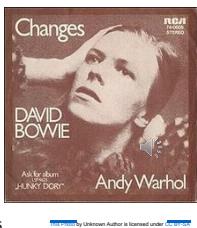
Potable Water Biocide and Temperature Guidelines		
Parameter	Cold Water	Hot Water
Free Chlorine	>0.5 ppm	>0.25 ppm
pH	<7.8	<7.8
Temperature	<70F preferable. If/when above 70F, free chlorine requirement becomes more critical.	Temperature in the range of 120F. After a two minute flush, hot water temperature should be within 2-3F of the hot water system supply temperature

CDC: Guidelines for Environmental Infection Control in Health-Care Facilities

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Anticipate Changes in Building Water System

- Changes in building water system design or management might require increasing the extent and frequency of monitoring.
- Examples
 - System start-up
 - System shut-down
 - Regularly scheduled maintenance
 - Renovations, construction, and installation of new equipment on your property
 - Equipment failure
 - Water main break or other service interruptions



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Sampling for Legionella



- Environmental monitoring for Legionella is essential to prevention and risk management
- Testing provides a means to confirm the control measures implemented are working
- Testing can be useful
 - to help identify potential growth and transmission sources,
 - to confirm the results of remedial procedures, and
 - to investigate potential sources of *Legionella* contamination.

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Selecting a Laboratory

- Is lab accredited under ISO Standard 17025 by AIHA or any other accrediting body?
- Is the lab certified by the CDC Environmental Legionella Isolation Techniques Evaluation (ELITE)
- Does the lab participate in any proficiency testing programs other than the CDC ELITE program?
- Viable culture method can take up to 10 days
- Results reported in colony forming units (CFU) per milliliter



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Corrective Action: Short-Term Remediation

Remedial Procedure	PRO's	CON's
Flush	Simple, inexpensive	Labor intensive, does not address root cause, may require repeated attempts
Super Heat & Flush	Kills bacteria if proper temperature achieved, accepted practice in hot water systems	Labor intensive, outlets cannot be used for period of time, scald awareness needed
Hyperchlorination	Good bacteria kill, addresses biofilm	Labor intensive feed and control, lacks automation, corrosion concerns when used too frequently
Point-of-Use Filtration	14-day filter gains valuable time for decisions, optional 31-day and 62-day filter life options.	Long-term use cost, total suspended solids can shorten life expectancy, requires labor for change-outs

Source: Ecolab

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Corrective Action: Long-Term Remediation

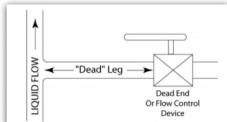
- Eliminating dead-legs in the water system
- Ensuring adequate temperature and free chlorine levels are being met and maintained
- Keep water flowing
- Secondary disinfection



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What is a Dead Leg?

- Dead end or closed-valve pipe branches should not be more than 1.5 times the pipe diameter.
 - Dead legs can be created during a construction project or during non-use
 - They encourage the stagnation of water and bacterial growth



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What is a Dead Leg?

Why do they happen?

- Renovations – Plumbing needs change/ lines are abandoned
 - Areas are vacated -water left in lines without use or with little use
 - Water usage is drastically reduced
 - Buildings are demolished/vacated



Water flow is reduced, chemical treatment is depleted, and microbes start accumulating

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Short Term vs Long Term: Real World Example

- Biofilm growth in decorative fountain
 - Visual slimy growth observed during weekly inspection
 - Short Term Actions
 - WMP procedure – shut off fountain, drain to sanitary sewer, scrub with detergent recommended by manufacturer
 - Follow WMP to turn fountain back on to refill fountain, check residual disinfectant levels to verify they are within limits
 - Document observations and performance of interim cleaning



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Short Term vs Long Term: Real World Example

- **Long Term Actions**

- During annual review of WMP, it was noted that there were 6 interim cleanings of lobby fountain due to biofilm growth during past year
- Logs indicated biofilm growth occurred near the inner wall where incandescent lighting illuminated the water
- Incandescent lights were replaced with LED lights to prevent heating of water
- 3 months of monitoring indicated corrective action worked

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Review and Confirm Program

- **Verification**

- Confirm WMP is being implemented as designed
 - i.e. is hot tub being tested daily for CI
 - Are results being recorded and communicated



- **Validation**

- Confirm WMP is working initially and on ongoing basis
 - Environmental testing? If so specify testing protocol.
 - Difficulty maintaining water system within control limits
 - Prior history of Legionnaires' disease
 - Healthcare facility providing inpatient services for those at increased risk

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Document & Communicate

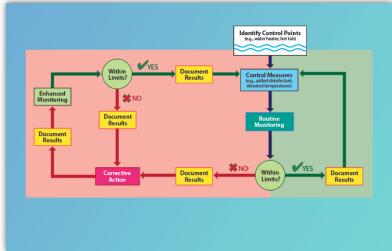
- **Documentation**

- Program team
- Building description
- Water system description
- Control measures
- Confirmatory procedures
- Document collection & transport methods, laboratory performing testing
- Communicate with building occupants on water quality status
 - Signage on components (faucets, ice machines, etc.) stating warning, do not drink, etc.



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Putting it All Together



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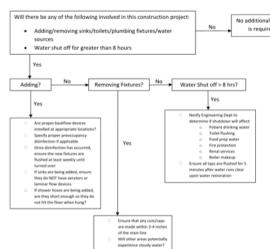
Water ICRA (WICRA)

- Complements your already-established ICRA process
 - Focuses on water/plumbing systems
 - Your plumbing contractor will often not be at the ICRA meeting; only the general contractor (GC)



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Construction Decision Tree



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Considerations During Construction Projects

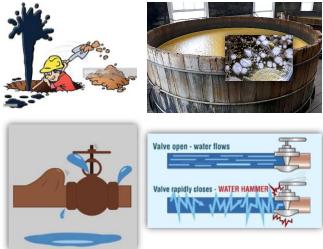
- Waterborne pathogens are a concern during periods of water stagnation in plumbing, and from disruption of established biofilms during construction
- Loss of chlorine - allows growth of pathogens and other microbes.
- Physical impact can disturb biofilms - adding new connections, and shutting off and restarting water service

Source: http://www.cdc.gov/ncidod/diseases/construction/construction_water_stagnation_and_waterborne_infection.htm

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Considerations During Construction Projects

- Excavation
- Time Delays
- Re-pressurization of Water Lines
- Vibration



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Considerations During Construction Project

Dust Control and Fire Hydrants

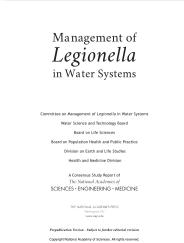
- Large water storage tankers are used to spray water across the construction site to control dust.
- Water in vehicle storage tankers can become stagnant losing residual chlorine levels and creating an environment for developing waterborne pathogens.



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Knowledge Update – New Study by NAS



Recommendations:

- Expand the CMS Memo to REQUIRE monitoring for Legionella in Environmental Water Samples
- Register and Monitor cooling towers.
- Require management plans in building code for ALL public buildings (i.e.: hotels, businesses, schools, apartments)
- Require temps of hot water heaters be increased to 140°F and 131°F at distal points
- Expand training and education on Legionellosis and on the prevention and control of Legionella amplification in water systems

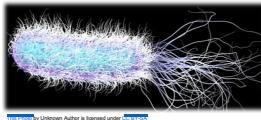
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And Don't Forget!

Legionella is only one of many waterborne pathogens

Some of the others are:

- Pseudomonas aeruginosa
- Nontuberculous mycobacteria (NTM or Environmental Mycobacteria)
- Acinetobacter
- Stenotrophomonas maltophilia
- Various species of fungi



Bacteria that killed 3 NICU babies in Pennsylvania linked to tainted breast milk

BY SOPHIE LEWIS
NOVEMBER 8, 2018 / 4:22 PM / CBS NEWS

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Other Systems

It's not just your sink, toilet and shower plumbing lines!

- Plumbing systems and equipment include:

- ice machines
- shower heads
- faucets
- piped water coolers
- HVAC
 - steam sterilization systems
 - dehumidifiers
 - spot coolers
- Wet Vacs?



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Other Systems

- Bottled water stored for outages
 - Perfusion equipment:
Heater/coolers, dialysis
other medical equipment
dental equipment
 - Piped water purifiers



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Additional Resources

- ASHE – American Society for Health Care Engineers; *Water Management in Health Care Facilities: Complying with ASHRAE Standard 188*
 - AIHA – American Industrial Hygiene; *Association Recognition, Evaluation, and Control of Legionella in Building Water Systems*
 - APIC – The Association for Professionals in Infection Control and Epidemiology; *Water Systems Issues and Prevention of Waterborne Infectious Diseases in Healthcare Facilities*
 - CDC: <https://www.cdc.gov/nceh/eis/elearn/prevent/lid-training.html>
 - Federal – DHHS, Center for Medicare and Medicaid Services; *MEMO - Requirement to Reduce Legionella Risk in Healthcare Facility Water Systems to Prevent Cases and Outbreaks of Legionnaires' Disease (LD)*
 - OSHA <https://www.osha.gov/SLTC/etools/hospital/hazards/leg/leg.html>
 - National Academy of Sciences : <https://www.nap.edu/catalog/25474/management-of-legionella-in-water-systems>

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Thank You!



Questions?

Michael D. Mount, CIH, OHST, CHMM
Michael.mount@choa.org
404.785.7431

Laura Riley, PhD, CIH
Laura.riley@northside.com
404.851.6388

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