
***Legionella* and Legionellosis: Introduction to Epidemiology and Risk Management**

Participants will be in listen only mode.
9 a.m. (PST)

Presented by:

Michael Berg, Ph.D.

Download the PDF:

[http:// www.emlab.com/m/media/legionella-webinar.pdf](http://www.emlab.com/m/media/legionella-webinar.pdf)

Continuing Education Units (CEUs)



To receive a **certificate of attendance**, you must complete the survey after the webinar:

Click on the survey link in the “Thank you” email. (sent 1 hour after this webinar)

- Complete survey within 24 hours.
- You will receive an email in 2-3 weeks when your certificate is ready.

Outline

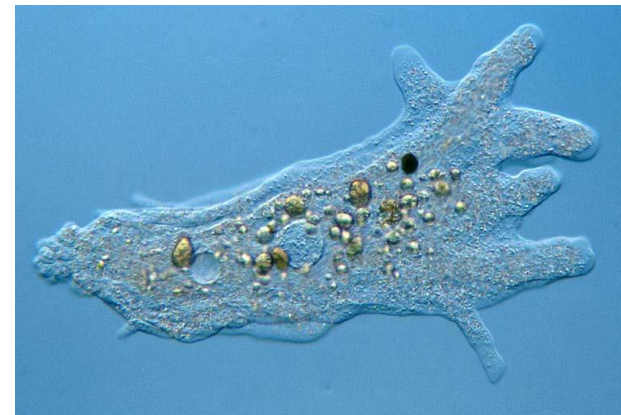
- Overview of *Legionella*
- Legionellosis
- ANSI/ASHRAE 188-2015
- Guidelines, Reviews & Regulations
- Monitoring
 - Sampling
 - Analysis
- Remediation



Transmission electron micrograph of *Legionella pneumophila* multiplying inside a cultured human lung fibroblast. CDC Public Health Image Library/Dr Edwin P. Ewing, Jr.

Basic Biology

- Gram negative rod-shaped bacterium
- More than 60 species and >70 serogroups have been described
- Widely distributed natural inhabitant of water
- Survives and multiplies as intracellular parasite in protozoans (e.g. *Acantamoeba polyphaga*)

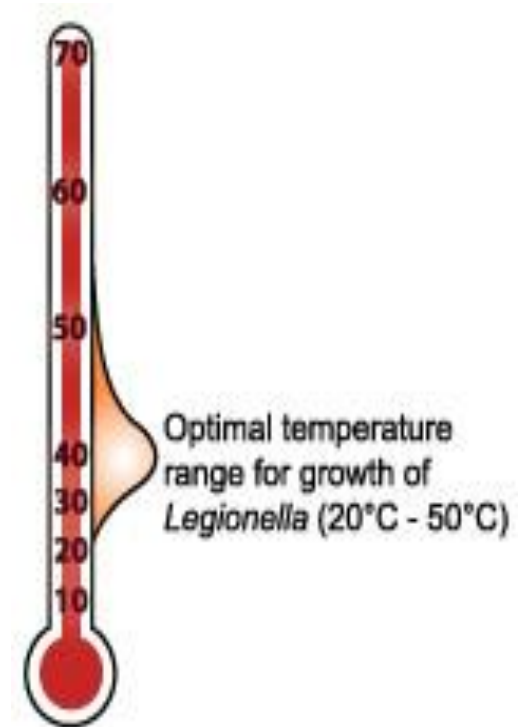


Acantamoeba

Source: <https://sixkingdomsmaraleve.weebly.com/protista.html>

Temperature Requirements

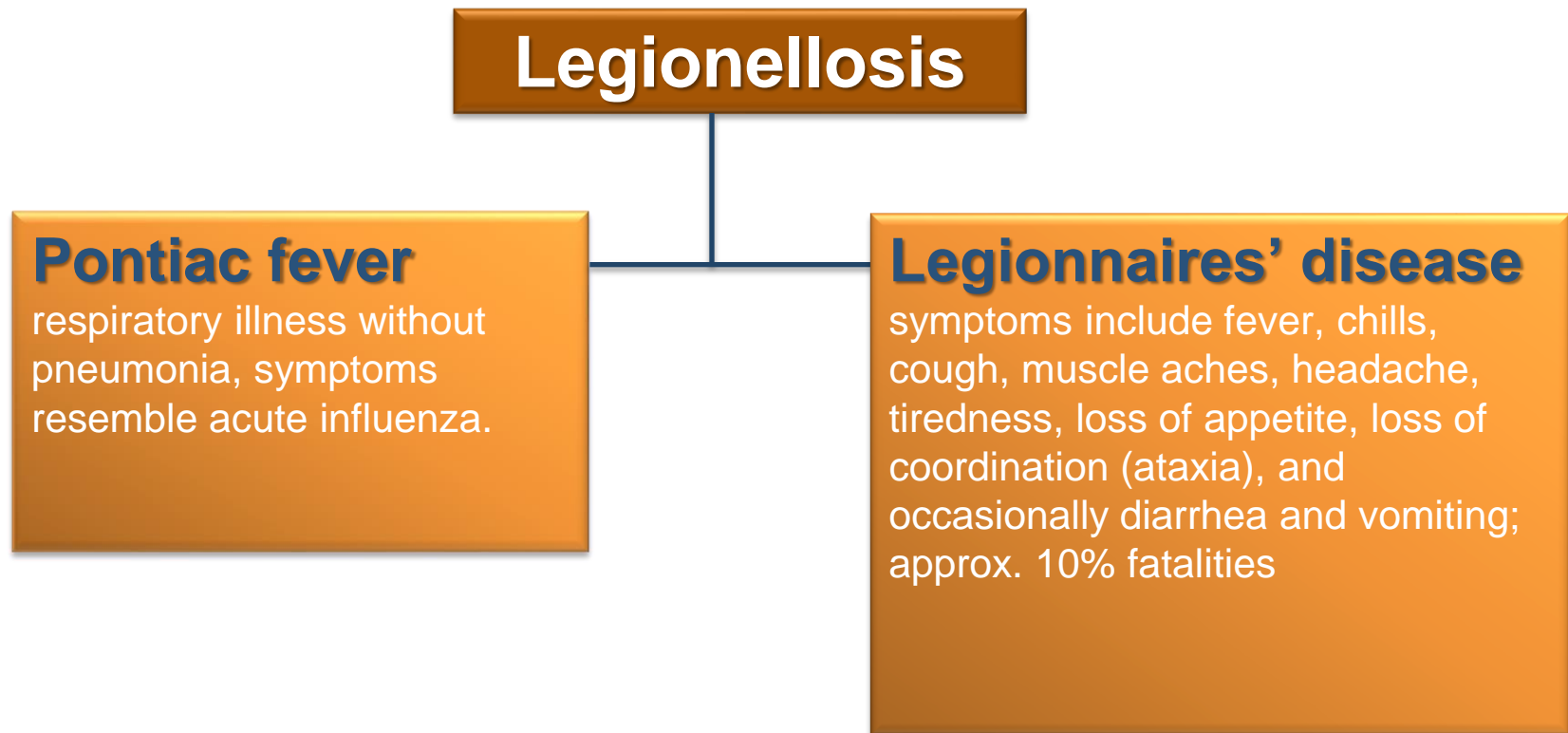
- 35 - 46°C (95 - 115°F): Optimum temperature range for growth
- Below 20°C (< 68°F): Predominantly dormant but viable
- Above 50°C (>122°F): 90% kill rate in 2 hrs
- Above 60°C (>140°F): 90% kill rate in 2 min
- Above 70°C (>158°F): 100% rapid kill



Basic Pathology

Legionella is the causative agent of Legionellosis.

Legionellosis takes two distinct forms...



History

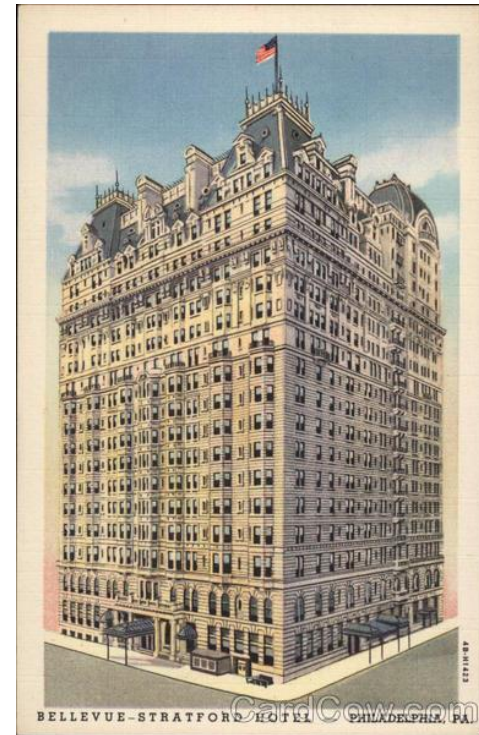
Legionnaires' disease

The first recognized outbreak of the disease occurred 1976 in Philadelphia.

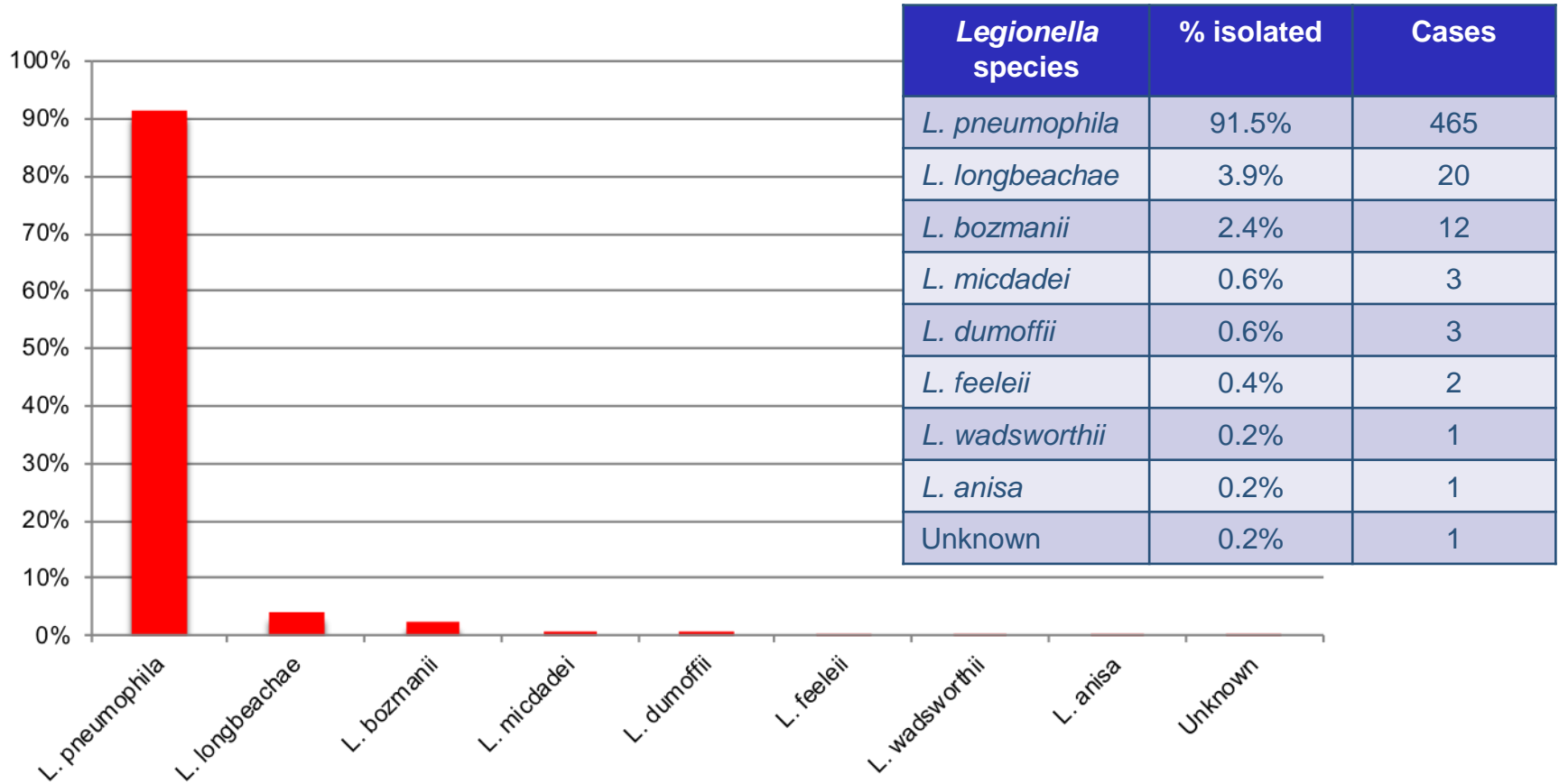
As many as 221 people were treated and 34 deaths occurred.

The source was identified as the *Legionella* bacterium and found in the cooling tower of the hotel's air conditioning system.

Over 90% of Legionellosis are caused by *Legionella pneumophila*.



Legionella species Isolated from Patients



Legionella species isolated from consecutive patients with community-acquired pneumonia (84.2% of the *L. pneumophila* were SG1). Data source: Yu et al., JID 2002;186

Risk Factors

- Age
 - Highest risk in elderly >65
 - Not common in people <50
 - Very rare in people <20
- Smoking
- Pre-existing chronic obstructive pulmonary disease (COPD)
- Diabetes
- Compromised immune system

Infection and Transmission

- **Not transmitted from person to person**
- **Inhalation** of aerosols (or soil)
- **Aspiration** when choking or spontaneously during drinking

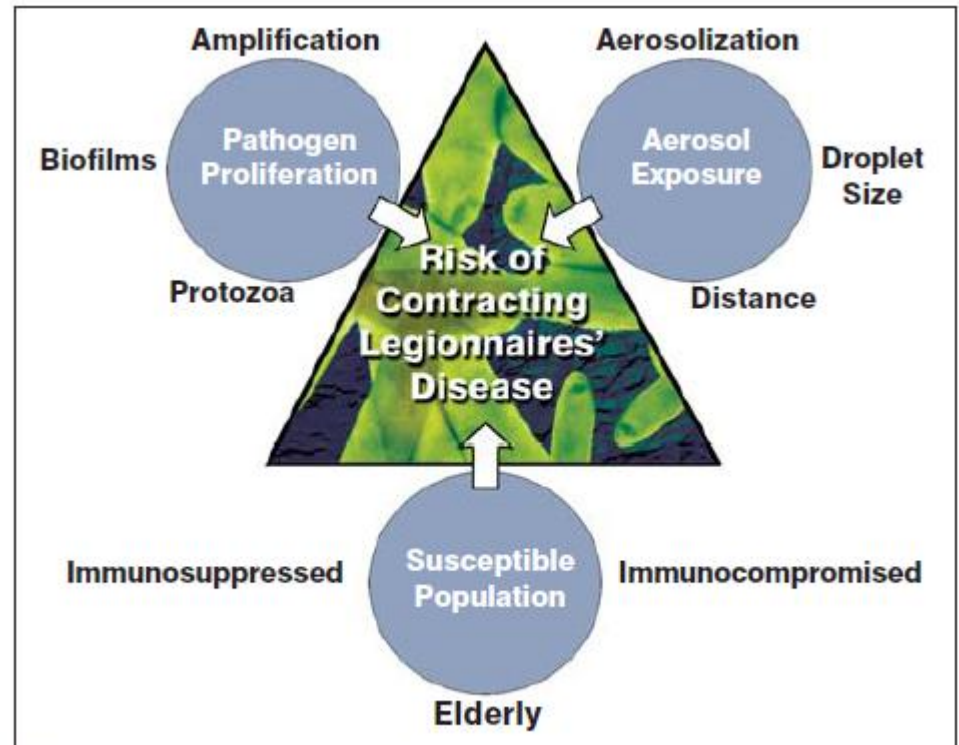
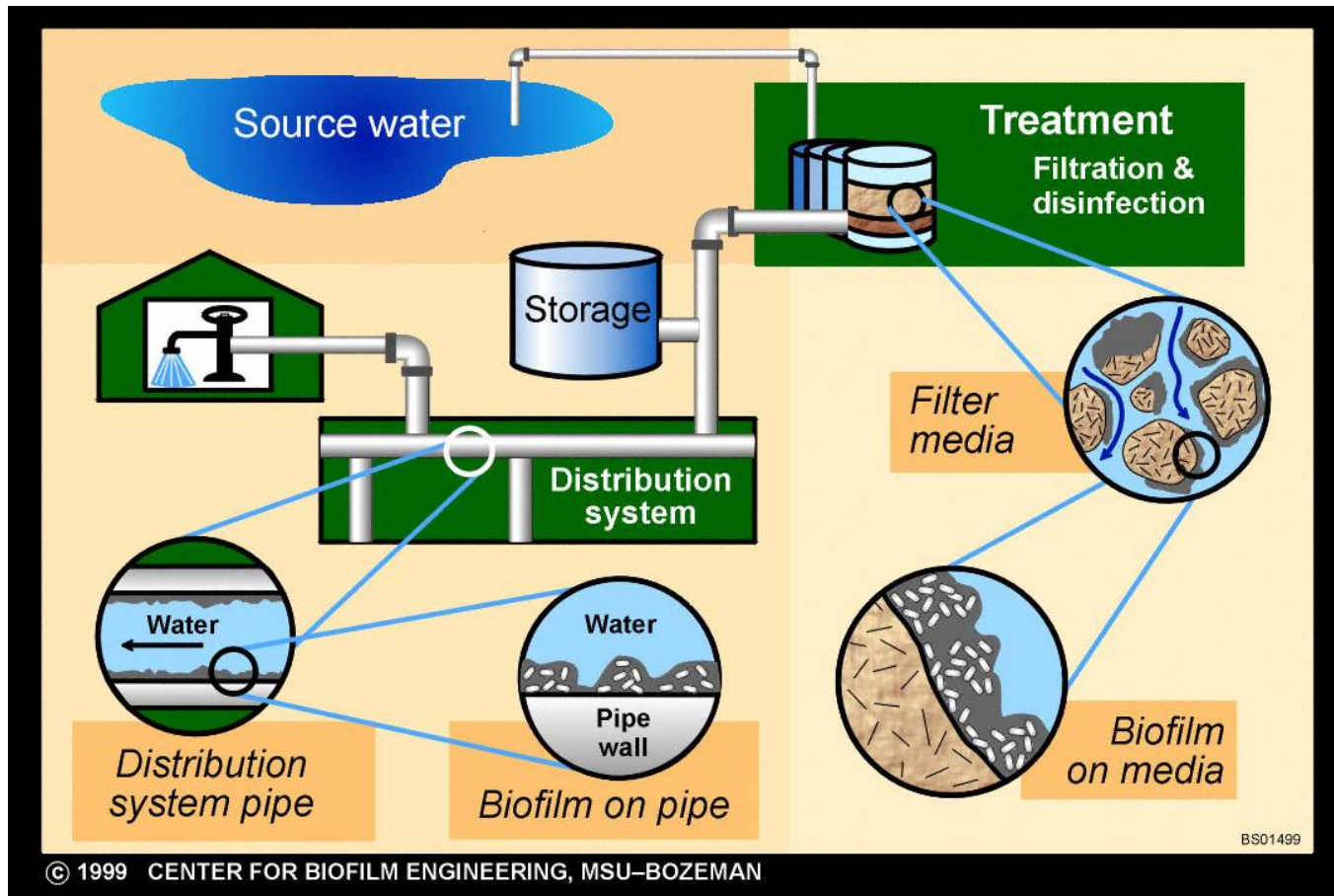


Figure 1: Factors that affect legionellosis risk.

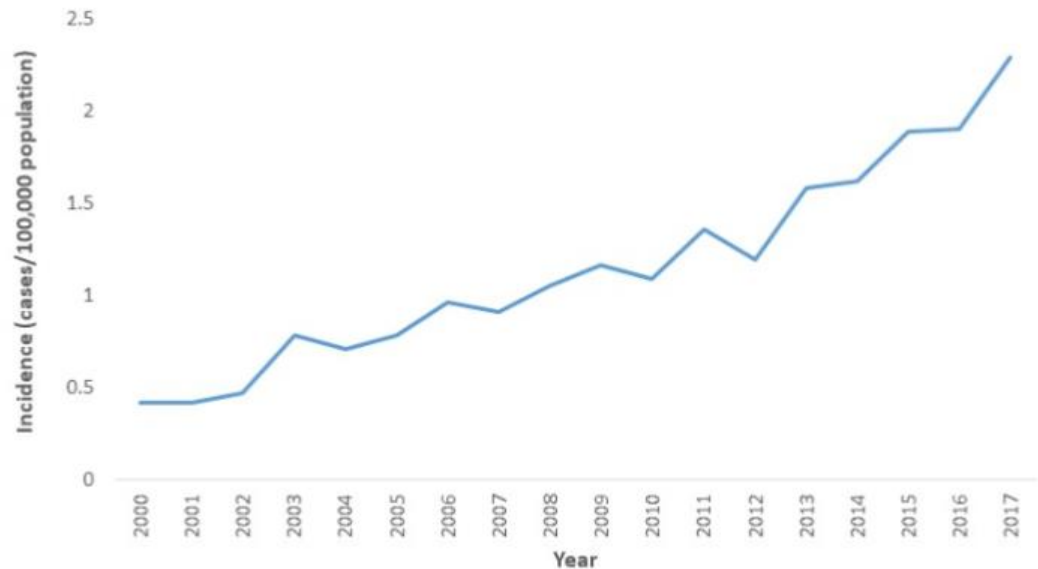
Source: ASHRAE Journal, April 2004

Plumbing Systems and Biofilms



CDC – Reported Cases of LD

Legionnaires' disease is on the rise in the United States



Rate of reported cases increased 5.5 times (2000–2017)

Source: National Notifiable Diseases Surveillance System

Centers for Disease Control and Prevention (CDC)

<https://www.cdc.gov/legionella/images/national-incidence.jpg>

Legionella – CDC Review (June 2016)

JUNE 2016
Vital^{CDC}**signs™**

Legionnaires' Disease

Use water management programs in buildings to help prevent outbreaks

CDC investigated the first outbreak of Legionnaires' disease, a serious lung infection (pneumonia), in 1976. An increasing number of people in the US are getting this disease, which is caused by breathing in small water droplets contaminated with Legionella germs. About 5,000 people are diagnosed with Legionnaires' disease and there are at least 20 outbreaks reported each year. Most identified outbreaks are in buildings with large water systems, such as hotels, long-term care facilities, and hospitals. Legionella grows best in building water systems that are not well maintained. Building owners and managers should adopt newly published standards that promote Legionella water management programs, which are ways to reduce the risk of this germ in building water systems.

Building owners and managers can:

- Learn about and follow newly published standards for Legionella water management programs. <http://bit.ly/1P1QwQP>
- Determine if the water systems in their buildings are at increased risk of growing and spreading Legionella.
- Develop and use a Legionella water management program as needed. www.cdc.gov/legionella/WMPtoolkit
- Monitor and respond to changes in water quality.

Want to learn more? www.cdc.gov/vitalsigns/legionnaires

National Center for Immunization and Respiratory Diseases
National Center for Environmental Health

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

4x
The number of people with Legionnaires' disease grew by nearly 4 times from 2000–2014.

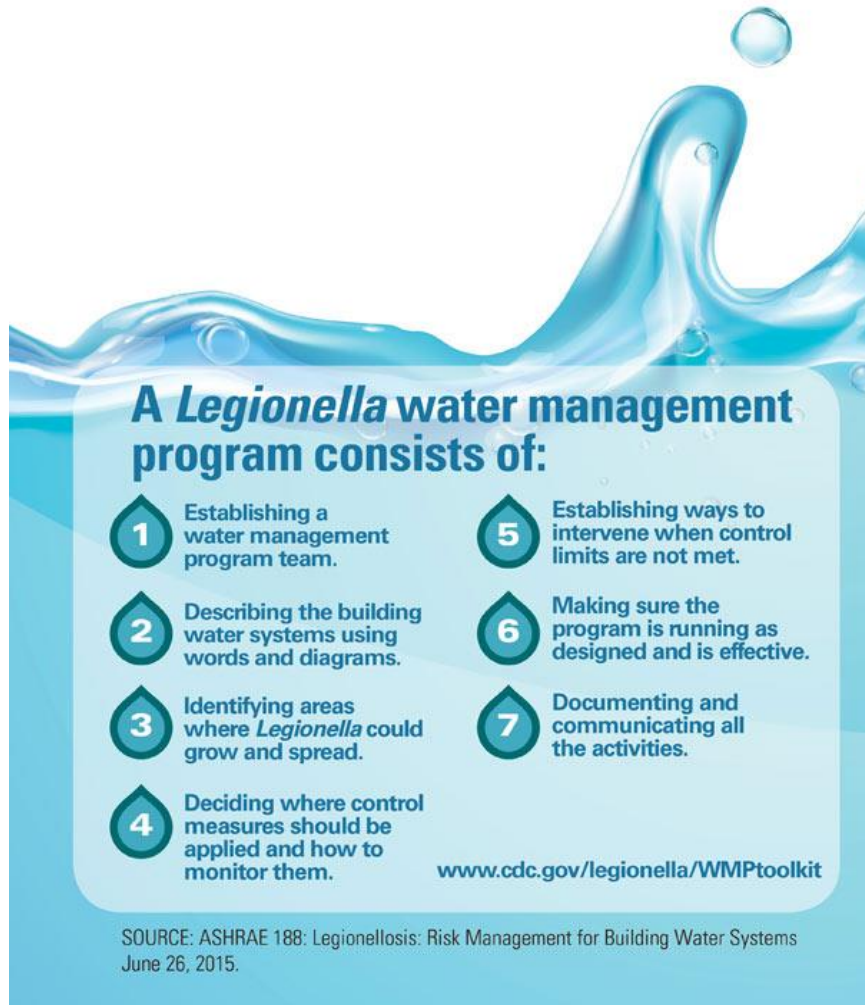
1 in 10
Legionnaires' disease is deadly for about 10% of people who get it.

9 in 10
CDC investigations show almost all outbreaks were caused by problems preventable with more effective water management.

CDC report:

- ✓ 4x increase of legionellosis between 2000 and 2014
- ✓ 10% fatality rate
- ✓ 9 in 10 cases were caused by problems preventable with more effective water management

Legionella – CDC review



A *Legionella* water management program consists of:

- 1 Establishing a water management program team.
- 2 Describing the building water systems using words and diagrams.
- 3 Identifying areas where *Legionella* could grow and spread.
- 4 Deciding where control measures should be applied and how to monitor them.
- 5 Establishing ways to intervene when control limits are not met.
- 6 Making sure the program is running as designed and is effective.
- 7 Documenting and communicating all the activities.

www.cdc.gov/legionella/WMPtoolkit

SOURCE: ASHRAE 188: Legionellosis: Risk Management for Building Water Systems
June 26, 2015.

Water management program

- 1) Establish management team
- 2) Describe building water system
- 3) Identify areas where *Legionella* could grow and spread
- 4) Decide where control measures are applied and how to monitor them
- 5) Establish ways to intervene when control limits are not met
- 6) Make sure the program is effective
- 7) Document and communicate all activities

ANSI/ASHRAE Standard 188

Purpose

... to establish minimum Legionellosis risk management requirements for building water systems.

Scope

... applies to human-occupied commercial, institutional, multiunit residential, and industrial buildings - excluding single-family homes

Intended use

... building owners and managers as well as individuals involved in design, installation, commissioning etc. of centralized building water systems and components

ANSI/ASHRAE 188 – Compliance

Are building owners required to comply with ASHRAE 188?

- ASHRAE Standard 188 is a set of standards, not legislation!
- It provides a robust and effective *Legionella* risk management system.
- It provides protection against allegations of wrongdoing or negligence, should a *Legionella* outbreak occur.

ASHRAE 188 – Water Management Program

PROGRAM TEAM—Identify persons responsible for Program development and implementation.

DESCRIBE WATER SYSTEMS/FLOW DIAGRAMS—Describe the potable and nonpotable water systems within the building and on the building site and develop water-system schematics.

ANALYSIS OF BUILDING WATER SYSTEMS—Evaluate where hazardous conditions may occur in the water systems and determine where control measures can be applied.

CONTROL MEASURES—Determine locations where control measures must be applied and maintained in order to stay within established control limits.

MONITORING/CORRECTIVE ACTIONS—Establish procedures for monitoring whether control measures are operating within established limits and, if not, take corrective actions.

CONFIRMATION—Establish procedures to confirm that

- the Program is being implemented as designed (verification), and
- the Program effectively controls the hazardous conditions throughout the building water systems (validation).

DOCUMENTATION—Establish documentation and communication procedures for all activities of the Program.

**Elements of a water management program
(Fig.1: ANSI/ASHRAE 188)**

ASHRAE 188 – Water Management Program (cont'd)

Program Team – Identify persons responsible for program development and implementation

Health Care

Hospitals etc.

Facility Director
Administrator
Health & Safety
Infection control
Environm. Services
Medical Director
Chief Engineer

Institutional

Hotels, Casinos etc.

Facility Director
Maintenance
Housekeeping
Health & Safety

Industrial

*Pharma, Food
etc.*

Plant Manager
Maintenance
Engineering
Health&Safety

ASHRAE 188 – Water Management Program

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**Elements of a water management program
(Fig.1: ANSI/ASHRAE 188)**

ASHRAE 188 – Water Management Program (cont'd)

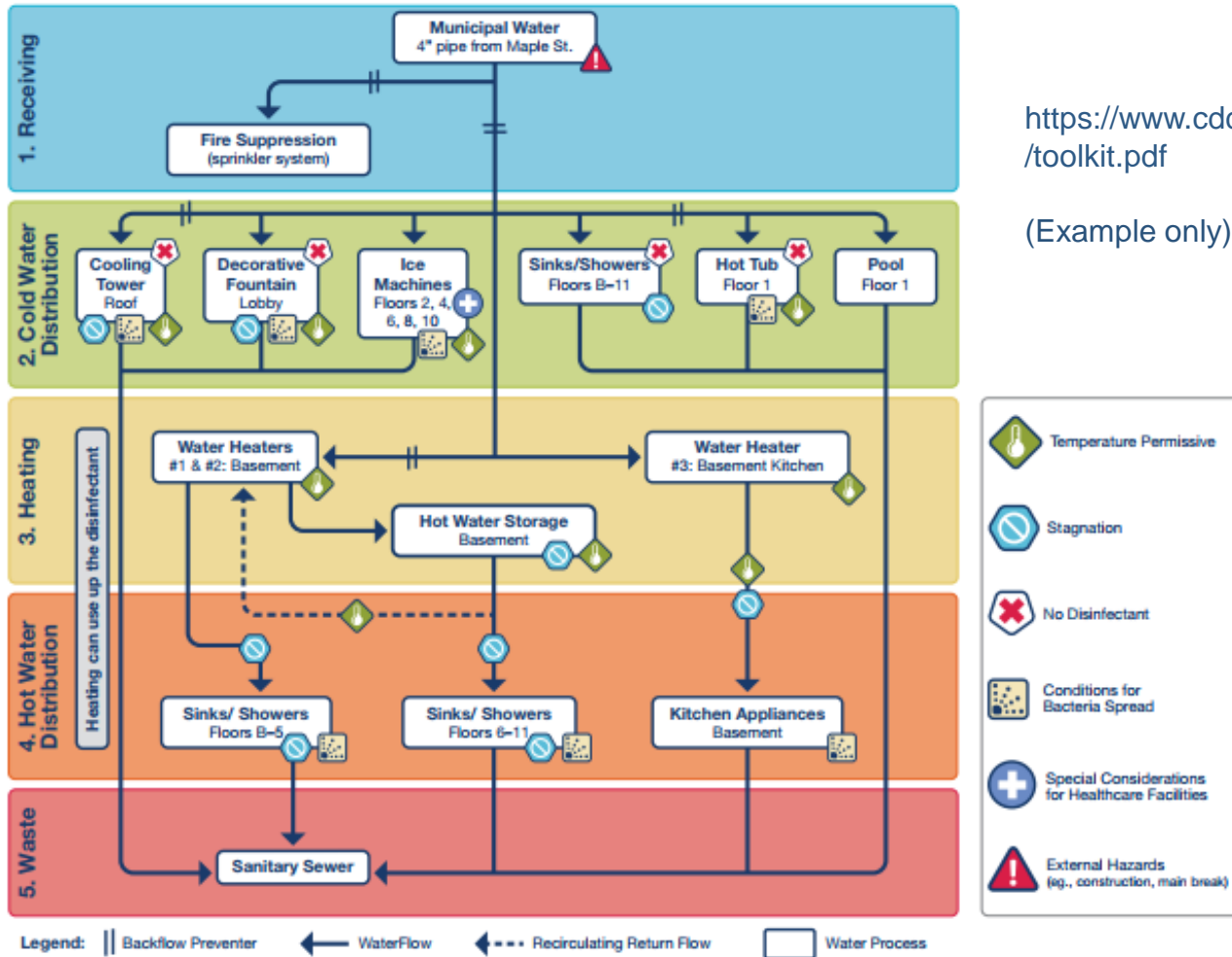
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ASHRAE 188 – Water Management Program (cont'd)

Water Systems – Description and analysis



<https://www.cdc.gov/legionella/downloads/toolkit.pdf>

(Example only)

CDC Toolkit

June 5, 2017

Version 1.1



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>

ASHRAE 188 – Water Management Program (cont'd)

MONITORING/CORRECTIVE ACTIONS—Establish procedures for monitoring whether control measures are operating within established limits and, if not, take corrective actions.

Access Point /Process Unit	Action Item	Control Limit	Method	Frequency
Cooling tower (CCP1)	Legionella	<100 cfu/ml	Culture test	Quarterly
	HPC	<10,000 cfu/ml	Culture test	Weekly
	Disinfection	See microbial action limits	Ozone treatment	As needed (see microbial thresholds)
	Off-line cleaning	Visual appearance	Visual inspection	Annually (late fall)
	On-line cleaning	Visual appearance	Visual inspection	Annually (early spring)
...				

Control Measures

Legionella control measures

- Temperature control
- Supplemental disinfection/treatment
- Flushing
- Recirculation
- Filtration
- Cleaning and maintenance

ASHRAE 188 – Water Management Program (cont'd)

CONFIRMATION—Establish procedures to confirm that

- the Program is being implemented as designed (verification), and
- the Program effectively controls the hazardous conditions throughout the building water systems (validation).

DOCUMENTATION—Establish documentation and communication procedures for all activities of the Program.

ASHRAE 188 – Water Management Program (cont'd)

Documentation

May include

- Work orders
- Vendor reports
- Critical Control Points Map
- Data logs
- Contact list w/ responsibilities

Verification

Designate responsible party to ensure...

- *Control measures*
 - *Monitoring*
 - *Corrective action*
- ...are carried out.*

Validation

Review program to make sure...

- *The plan is being followed*
- *The plan is effective*
- *New scientific data and regulations are considered.*

ASHRAE Guideline 12-2000R

Proposed Revision of Guideline 12-2000, Managing the Risk of Legionellosis Associated with Building Water Systems (3rd public review Nov 2018)

Purpose: ...to provide information and guidance for *control* of legionellosis associated with *building water systems*.

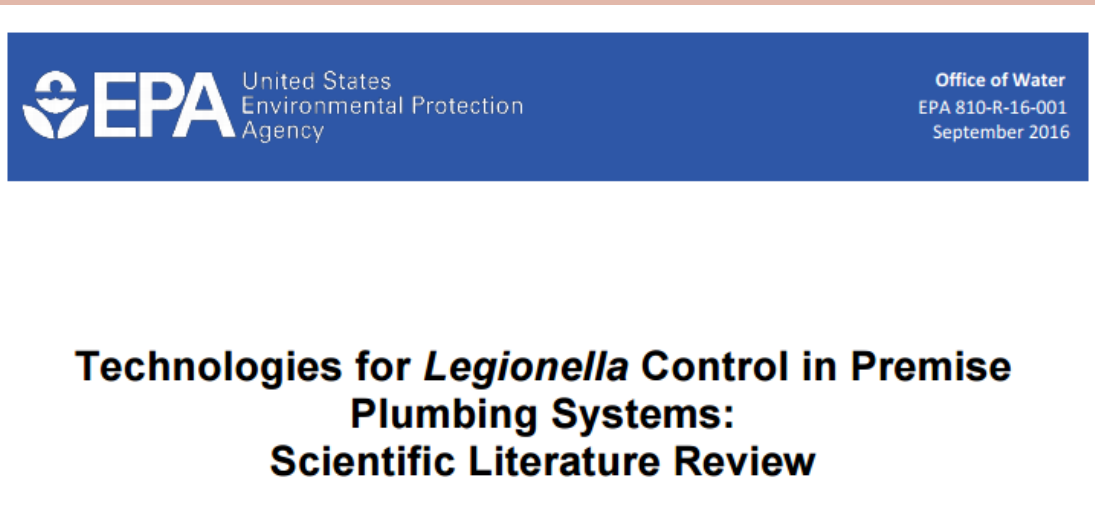
Scope: ...applies to human-occupied commercial, institutional, multiunit residential, and industrial buildings - excluding single-family homes. *It is also intended for use in the implementation of ANSI/ASHRAE Standard 188.*

Planned publication of revision in 2019 (Q4)

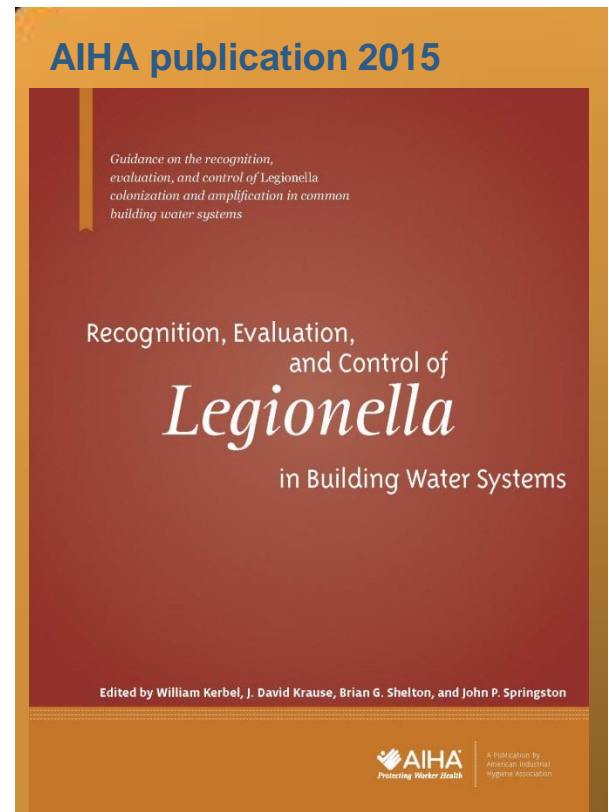
Legionella Reviews and Guidelines

US Organizations weighing in on *Legionella*

EPA, 2016



<https://www.epa.gov/sites/production/files/2016-09/documents/placeholder.pdf>



AWT Position Statement (2019)

Legionella Control Measures (Appendix A) – Potable Water

Regulatory Authority	Test Frequency	Legionella Concentration (cfu/ml)	Remediation
NYC	No data		No data
NYS	Every 90 days first year, annually thereafter	<30% positive results	Maintain WMP
		≥30% positive results of sites tested	Immediate short-term control levels. Retest. Persistent ≥30% results - institute long-term control levels.
AIHA	2x/year	1-9	Continue monitoring and review MWP.
		10 - 100	ID infection source and online disinfection.
		>100	ID infection source and offline disinfection.
OSHA	Not stated	1 - 99	Online disinfection.
		≥100	Offline disinfection.
PW and GSC Canada	2x/year	1 - 100 Lp sg 2-15	Online disinfection within 48 hours.
		1 - 10 Lp sg 1	Online disinfection within 48 hours.
		> 100 Lp sg 2-15	Offline disinfection within 48 hours.
		> 10 Lp sg 1	Offline disinfection within 48 hours.
...			

Associated Water Technologies: (<https://www.awt.org/pub/035C2942-03BE-3BFF-08C3-4C686FB7395C>)

AWT Position Statement (2019)

Legionella Control Measures (Appendix A) – Cooling Towers

Regulatory Authority	Test Frequency	Legionella Concentration (cfu/ml)	Remediation
NYC	At system startup and every 90 days thereafter.	<10	Maintain water chemistry and biocide levels.
		≥10 - <100	Online disinfection within 24 hours. Retest.
		≥100 - <1000	Online disinfection within 24 hours. Retest. Review WMP.
		≥1000	Online disinfection within 24 hours. Offline disinfection within 48 hours. Retest. Notify DOH within 24 hours of results.
NYS	At system startup and every 90 days thereafter.	<20	Maintain water chemistry and biocide levels.
		≥20 - <1000	Online disinfection immediately. Retest. Review WMP. Online disinfection immediately. Retest. Review WMP. Any retest >1000 offline disinfection immediately.
AIHA	Monthly.	10-99	Review WMP and retest until <10 CFU/ml.
		100-1000	Review WMP and conduct an online disinfection until consistently <10 CFU/ml.
		>1000	Review WMP and conduct an offline disinfection until consistently <10 CFU/ml.
OSHA	Not stated.	100-999	Online disinfection.
		>1000	Offline disinfection.
...			

Associated Water Technologies: (<https://www.awt.org/pub/035C2942-03BE-3BFF-08C3-4C686FB7395C>)

CMS Memorandum – updated July 2018

DEPARTMENT OF HEALTH & HUMAN SERVICES
Centers for Medicare & Medicaid Services
7500 Security Boulevard, Mail Stop C2-21-16
Baltimore, Maryland 21244-1850



Center for Clinical Standards and Quality/Quality, Safety and Oversight Group

Ref: **QSO-17-30- Hospitals/CAHs/NHs**
REVISED 07.06.2018

DATE: June 02, 2017

TO: State Survey Agency Directors

FROM: Director
Quality, Safety and Oversight Group (*formerly Survey & Certification Group*)

SUBJECT: Requirement to Reduce *Legionella* Risk in Healthcare Facility Water Systems to Prevent Cases and Outbreaks of Legionnaires' Disease (LD)

****Revised to Clarify Expectations for Providers, Accrediting Organizations, and Surveyors****

Memorandum Summary

- **Legionella Infections:** The bacterium *Legionella* can cause a serious type of pneumonia called LD in persons at risk. Those at risk include persons who are at least 50 years old, smokers, or those with underlying medical conditions such as chronic lung disease or immunosuppression. Outbreaks have been linked to poorly maintained water systems in buildings with large or complex water systems including hospitals and long-term care facilities. Transmission can occur via aerosols from devices such as showerheads, cooling towers, hot tubs, and decorative fountains.

CMS memorandum (cont'd)

Expectations for Healthcare Facilities and Surveyors

CMS expects Medicare certified healthcare facilities **to have water management policies and procedures to reduce the risk of growth and spread of *Legionella*** and other opportunistic pathogens in building water systems. An industry standard¹ calling for the development and implementation of water management programs in large or complex building water systems to reduce the risk of legionellosis was published in 2015 by American Society of Heating, Refrigerating, and Air Conditioning Engineers (**ASHRAE**). In 2016, the CDC and its partners developed a toolkit to facilitate implementation of this ASHRAE Standard (**<https://www.cdc.gov/legionella/maintenance/wmp-toolkit.html>**). Environmental, clinical, and epidemiologic considerations for healthcare facilities are described in this toolkit.

Note: CMS does not require water cultures for *Legionella* or other opportunistic water borne pathogens. Testing protocols are at the discretion of the provider.

NY Outbreak 2015

Cases

Infected: 128

Death toll: 12

The outbreak was said to be linked to a cooling tower in the Opera House Hotel in the Bronx.



The Opera House Hotel (Bronx, NY).
Source: <http://www.trumanreview.com/opera-house-hotel-aims-class-bronx-historical-site-2-2073/>

NY Outbreak 2015 (cont'd)

- City, state and federal officials canvassed more than 700 sites in the south Bronx.
- 14 of 39 buildings with the type of cooling towers that lend themselves to *Legionella* growth were found to be contaminated.
- New York City passed new legislation to regulate testing of cooling towers. This makes NYC the first major city in the U.S. to regulate cooling towers.
- New York State follow with State regulations for *Legionella* testing (cooling towers and health care facilities).

NY Regulations

Secure | <https://regs.health.ny.gov/content/part-4-protection-against-legionella>

New York Codes, Rules and Regulations

[Home](#)

[Title 10](#)

[Title 18](#)

[Laws & Regulations](#)

[Home](#) / [VOLUME A \(Title 10\)](#) / [Title: Part 4 - Protection Against Legionella](#)

Title: Part 4 - Protection Against Legionella

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[Outli](#)

Effective Date

07/06/2016

Part 4 - Protection Against Legionella

- [Subpart 4-1 - Cooling Towers](#)
- [Subpart 4-2 - Health Care Facilities](#)
- [Appendix 4-A - Interpretation of Legionella Culture Results from Cooling Towers](#)
- [Appendix 4-B - Interpretation of Routine Legionella Culture Results from Covered Facilities](#)

Legionella - Sampling

Sample types

- Water samples
- Swab samples
- Air samples (?)

Sampling instructions:

https://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_7.html

Sampling for *Legionella* (cont'd)

Personal protective equipment



SAFETY PRECAUTIONS

The facility should be notified in advance to turn off (but do not drain or disinfect) any aerosol-generating devices to minimize the risk to the sampling team. Persons at an increased risk of developing Legionnaires' disease if exposed to *Legionella* (e.g., immunocompromised individuals) should not accompany the sampling team.

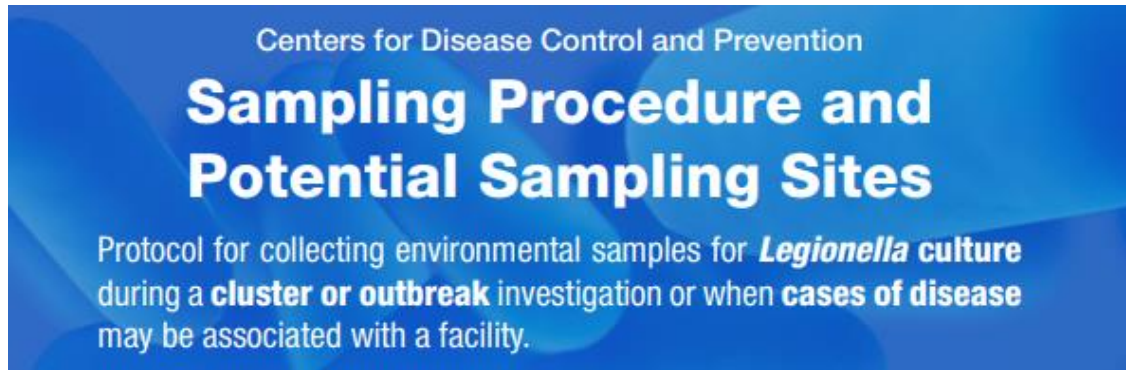
Optional personal protective equipment (PPE):

- Gloves are useful for sampling whirlpool spa filters or other sites that may be heavily contaminated with organic material.
- Wearing a half-face air-purifying respirator equipped with an N95 filter may be appropriate in the following situations: a.) when sampling cooling towers if the fans cannot be turned off, or b.) in enclosed spaces with an aerosol-generating device that cannot be turned off. Respirators must be used in accordance with a comprehensive respiratory protection program, which includes fit testing, training, and medical clearance ahead of their use (see OSHA standard [29 CFR 1910.134](#)). For more information about N95 respirators, visit the National Institute for Occupational Safety and Health (NIOSH) [website](#).

<https://www.cdc.gov/legionella/downloads/cdc-sampling-procedure.pdf>

CDC Sampling Instructions

<https://www.cdc.gov/legionella/health-depts/environmental-inv-resources.html>



Keep in mind: Focus of CDC procedure and sampling is for case investigations!

Considerations for case investigations and water management:

- *Sample volume and sample number*
- *Test sensitivity*
- *Species and serotype identifications*
- *Isolate storage*
- *Test method*

Sampling – Water Samples

- 250 ml or 1 L polypropylene bottles
- Collect 250 ml - 1 L water
- Add sodium thiosulfate
- Warm water systems
- Collect pre- and post-flush sample
- Cold water systems may also contain *Legionella* bacteria



Sampling – Surface Swabs

- Swabs can be used to collect surface samples
- Especially useful for investigating biofilms



Sampling – Air Samples

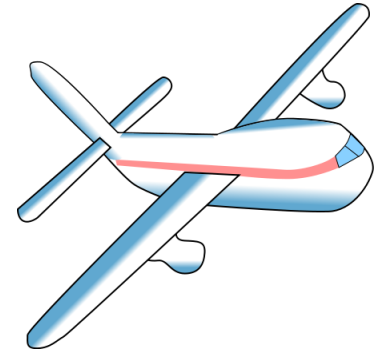
- Air sampling is typically not recommended.
- Impaction samplers often collect fast growing fungi and bacteria which overwhelm slow growing *Legionella*.
- Concentration of *Legionella* in water is generally higher than in air and easier to detect.



Source: CDC 2005: Procedures for the Recovery of *Legionella* from the Environment.

Shipping Samples

- Overnight
- Temperature stable coolers
- Recommended shipping temp: 6 - 18°C
- Check for local regulations



Holding Time

NY ELAP (*Legionella*)

Sample Type	Holding Time	Reference	Temperature
Potable Water	24 hours*	ISO19458:2006(E)	5 ± 3°C*
Cooling Tower	24 hours*	ISO19458:2006(E)	5 ± 3°C*

* 24 hrs recommended, 48 hrs acceptable; ambient temp. acceptable

For non-NY ELAP holding times are recommendation (check local requirements and guidelines)

Detection Methods

Culture testing

- **Traditional spread plate (ISO11731, CDC)**
- IDEXX Legiolert

PCR

- ISO12869
- BioRad iQ-Check
- Veriflow

Field tests

- Spartan cube (qPCR test)
- Lovibond and other antibody based field tests
- Dipslide tests (culture test)

Detection Methods - Considerations

1) Sensitivity / specificity



2) Time

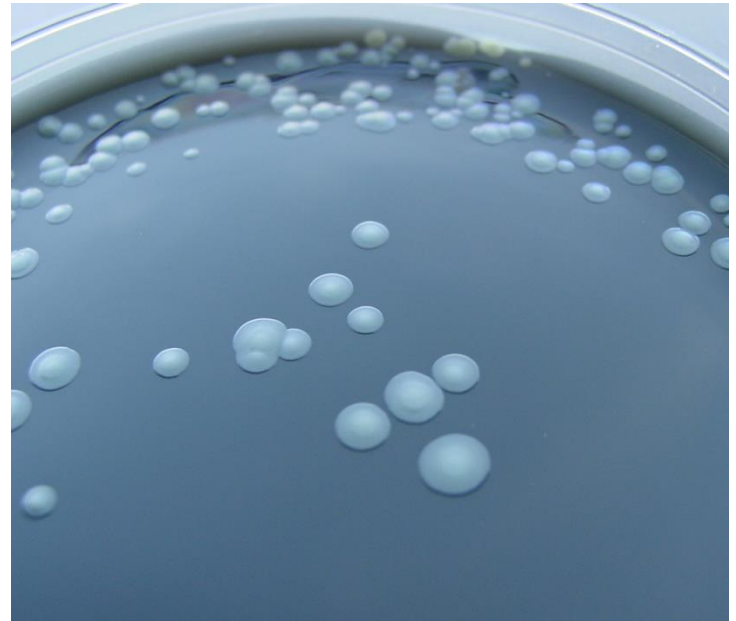


3) Legal defensibility (accreditations)



Spread Plate Culture Testing

- CDC protocol
- ISO 11731
- Heat and/or acid treatment
- Selective media
- Confirmation of *Legionella*
- Detects only viable colony forming units
- **Reference method – application of threshold values refers to culture test only**



Viable But Non-Culturable Bacteria (VBNC)

Not every cell forms a colony (culture test) because:

- a) The cell is already dead**
 - b) The cell is alive but culture conditions prevent the formation of a colony**
-
- **Enumeration of Legionella via different test methods may not always correlate well.**
 - **Use caution with the terms “false positive” or “false negative”.**

Action Levels

- There are no mandated action limits or threshold levels in the US beyond which remediation should take place except in New York.
- Action limits should be based on the threat of infection from exposure.
- The AWT position statement provides a good summary of national and international recommendations and requirements for threshold levels.
- Threshold levels refer to spread plate culture test results and sum of all *Legionella* species in the US.

Action Levels – Guidelines (OSHA)

Occupational Safety and Health Administration (OSHA)

- Action 1: Prompt cleaning and/or treatment of the system.
- Action 2: Immediate cleaning and take prompt steps to prevent employee exposure.

Action	Cooling Tower	Domestic Water	Humidifier
1	100 CFU/ml	10 CFU/ml	1 CFU/ml
2	1,000 CFU/ml	100 CFU/ml	10 CFU/ml

https://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_7.html

Action Levels (NY State) – Cooling Towers

- Appendix 4-A (NY Regulations) – Interpretation of *Legionella* Culture Results from Cooling Towers

Results (cfu per ml)	Approach
<20 (or no detection)	Maintain treatment program and <i>Legionella</i> monitoring
≥20	Review treatment program
<100 (but >20)	Institute immediate online disinfection Retest water in 3 -7 days Continue retest and treatments until 2 consecutive acceptable tests are obtained
<1000 (but >100)	Further investigate treatment program in addition
≥1000	Review treatment program Institute immediate online decontamination Continue retest and treatments until 2 consecutive acceptable tests are obtained

<https://regs.health.ny.gov/volume-title-10/1339572150/appendix-4-interpretation-legionella-culture-results-cooling-towers>

Action Levels (NY State) – Health Care Facilities

- Appendix 4-B (NY Regulations) – Interpretation of Routine *Legionella* Culture Results from Covered Facilities

% positive <i>Legionella</i> test sites	Approach
< 30%	Maintain environmental assessment and <i>Legionella</i> monitoring in accordance with the sampling and management plan.
≥ 30%	Immediately institute short term control measures Re-sample no sooner than 7 days and no later than 4 weeks Implement long term control measures to ensure ≤30% positive sites If ≥30% positive sites, repeat short term control measures

<https://regs.health.ny.gov/volume-title-10/11428922/appendix-4-b-interpretation-routine-legionella-culture-results-covered>

Remediation - Heat

- 158°-176°F (70°-80°C): Disinfection range
- At 151°F (66°C): Legionellae die within 2 minutes
- At 140°F (60°C): Legionellae die within 32 minutes
- At 131°F (55°C): Legionellae die within 5 to 6 hours
- ASHRAE Guideline 12-2000 recommends storing hot water at 140°F or periodically raising the temperature to 150°F.



Remediation - Chlorination

- **Chlorination (free Chlorine - Cl_2)**

- continuous chlorination at 1-2 ppm (free chlorine) is minimally effective
- shock chlorination at 20 to 50 ppm provided temporary results but causes corrosion and has odor and “bad taste” effect

- **Chlorine Dioxide (ClO_2)**

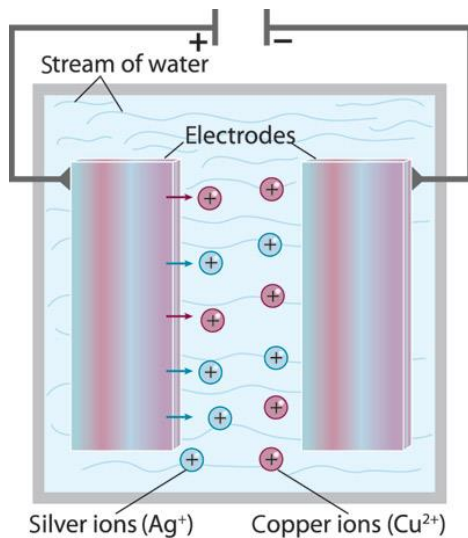
- (effective against *Legionella* at levels as low as 0.2 mg/l)

- **Monochloramine (NH_2Cl)**

- More effective than free chlorine against bacteria

Remediation – Cu / Ag Ionization

- Copper and silver ions are introduced into the water system
- Ions kill off the bacteria by interfering with cell walls



Source: Tidsskr Nor Legeforen 2011; 131: 1554-7



Source: Liquitech

Remediation - Biocides

- Work using a variety of mechanisms
- May produce byproducts
- Read labels!



Remediation – Ultraviolet Light

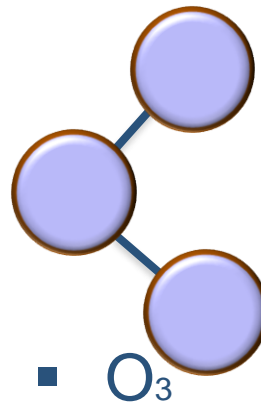
- UV light can be used at the point of delivery
- High energy short wavelength UV light disrupts bacterial DNA, preventing cellular reproduction and killing the cells.



Source: <http://www.water-technology.net/projects/-catskill-delaware-ultraviolet-water-treatment-facility/>

Remediation – Ozone

- First used for treating drinking water in 1893 (Netherlands)
- Strong oxidizer
- Portable injection devices can be used for remedial applications



■ Source: <http://www.ozotech.com/>

Point of Use Filters (POU)

- ✓ Sheffer et al. reported >99% reduction of waterborne bacteria (including *Legionella*) with point of use water filters.
- ✓ Can be a good solution for example for sensitive individuals in residential settings.
- ✓ In addition point of entry filters (POE) may be considered to minimize particles and bacteria that enter the water system.
- ✓ Some filter materials may reduce disinfectants (e.g. carbon filters) and are not recommended for POE.
- ✓ Filters must be well maintained to remain effective.



Scheffer *et al.* Efficacy of new point-of-use water filter for preventing exposure to *Legionella* and waterborne bacteria. *Am J Infect Control.* 2005 Jun;33(5 Suppl 1):S20-5.

Summary

- ✓ *Legionella* bacteria are common in aquatic freshwater systems.
- ✓ Legionellosis is a rapidly evolving topic in the US with increasing attention.
- ✓ New guidelines and regulations: CDC toolkit, ANSI/ASHRAE 188, NY Regulations establish best practice and legislate requirements.
- ✓ Culture testing remains the “gold standard” but other methods may provide additional useful tools.
- ✓ Water management plans and effective control measures will (hopefully) help reduce number of infections and outbreaks of LD.

Continuing Education Units (CEUs)



To receive a certificate of attendance, you must complete the survey after the webinar:

- Click on the **survey link** in the “Thank you” email (sent 1 hour after this webinar).
- Complete survey within **24 hours**.
- You will receive an email in 2-3 weeks when your certificate is ready.

Thank you for joining us!

Questions About Legionella:

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