Whole-Genome Sequencing

- *L. pneumophila* serogroup 1 isolates recovered from the South Bronx Hotel (building A) cooling tower were identical to the *L. pneumophila* serogroup 1 isolates from 26 patients linked to this outbreak.

How to Test?

- Method of sample collection and processing can dramatically affect the results
  - Cooling towers
  - Potable water – building water distribution systems
    - Hot water primary reservoir

SAMPLE COLLECTION

First Draw Hot Water

- Do not Flush
  - Collect hot water immediately after opening faucet or shower valve
  - Flushing reduces recovery
  - Immediate draw 97.7% positive reduced to 69.1% after 2 min. flush
BIOFILM AT THE PERIPHERY

PRE FLUSH (Positive)

FLUSH TO WASTE

POST FLUSH (Negative)

SAMPLE COLLECTION: FROM COOLING TOWER BASIN
Test Because You Can’t Tell by Looking

Automated dosing of chemical biocides and clean

>3000 CFU/mL
*Legionella pneumophila* serogroup 1

Laboratory Detection Methods
**Legionella Testing According to CDC**

- CDC recommends using a testing method capable of detecting all members of the *Legionella* genus (not just *Legionella pneumophila*) and provides material for typing.
- At the moment, this means culture.
  - ISO 11731 Second edition 2017-05
- Particularly true during an investigation and in the immediate aftermath

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**Legionella Testing**

- Culture is more reliable (sensitive & specific) than other “rapid tests”
- Preliminary results available in 4 days, final in 7 days.
- Alternative methods/approaches
  - Molecular (qPCR and microarray)
  - Most Probable Number (L. pneumophila only)
  - Immunochromatographic (ICT) test
ICT-Type Test: Quick But Inaccurate?

Culture Method

- Industry standard/best practice
  - Standards based
    - ISO 11731 (1&2)
    - ASTM D 5952
    - CDC
    - International – HSE L8 ACP 2013

- Laboratory Proficiency Programs
  - NY ELAP
  - ELITE is not a traditional proficiency program
Greater Focus On Legionella Prevention

CDC Vital 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

4x

The number of people with Legionnaires’ disease grew by nearly 4 times from 2000–2014.
CDC Focuses on Effective Water Management For Legionnaires’ Disease Prevention (AKA ASHRAE 188)

ASHRAE Standard 188

- First *Legionella* standard in the United States
- Approved June 26, 2015
- Revised 2018
- Establish minimum Legionellosis risk management requirements for building water systems.
2018 Code-intended Language

FOREWORD

ASHRAE Standard 188 establishes minimum legionella risk management requirements for building water systems. The 2018 edition benefits from changes to improve usability and from comprehensive updates that replace permissive language with enforceable, code-intended language to facilitate adoption of the standard for code and regulatory purposes. For a full list of changes to the 2015 edition of Standard 188, see Informative Annex D.

The purpose of ASHRAE Standard 188 is to establish minimum legionella risk management requirements for building water systems.
**Code Change and Regulations**

- ASHRAE Standard 188 is a *voluntary* standard

- Legionella prevention, detection and control requirements should be incorporated into building and plumbing code

**New Responsibilities**

**BUILDING OWNERS & FACILITY MANAGERS**

- Responsible for implementing ASHRAE 188 requirements and safeguards to protect against *Legionella*

**WATER MANAGEMENT TEAM**

- Assist building owners with Program development and review, monitoring water systems and results interpretation

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**Building Survey**

- Cooling Tower
- Spa/Pool
- Decorative Water Feature
- Other Aerosol Devices
- Multiple Housing Units
- >10 Stories
- Healthcare
- Long term Care
- CMS Compliance

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**Compliance**

The building shall be surveyed to determine whether it has one or more of the listed water systems and/or the factors described that relate to risk for Legionellosis.
WATER SAFETY AND MANAGEMENT PLAN

Elements of a Water Management Program

<table>
<thead>
<tr>
<th><strong>Program Team</strong></th>
<th>Persons responsible for Program development and implementation.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water Systems/Flow Diagrams</strong></td>
<td>Describe potable and non-potable water systems and develop water system-schematics.</td>
</tr>
<tr>
<td><strong>Water System Analysis/Control Measures</strong></td>
<td>Evaluate where hazardous conditions may occur and decide where control measures should be applied.</td>
</tr>
<tr>
<td><strong>Monitoring/Corrective Actions</strong></td>
<td>Establish procedure for monitoring whether control measures are within operating limits and, if not, take corrective actions.</td>
</tr>
<tr>
<td><strong>Confirmation</strong></td>
<td>Establish procedure to confirm Program is being implemented as designed (verification) and the Program effectively controls the hazardous conditions (validation).</td>
</tr>
<tr>
<td><strong>Documentation</strong></td>
<td>Establish documentation and communication procedures for all activities of the Program.</td>
</tr>
</tbody>
</table>
Standard 188-2018
Normative Annex A
Healthcare Facilities
Elements of a Water Management Program

- Infection control
- Facility managers
- Engineering
- Administration
- Water treatment providers
- *Legionella* experts

Executing Your Plans

1. Establish Program Team
2. Determine level of *Legionella* Knowledge and time of team to develop plans
3. Perform site assessment
4. Complete risk assessment report
5. Address assessment recommendations
6. Develop water safety and management plan
7. Implement monitoring
8. Implement validation program
9. Verification by Program Team
Knowledge

The program team shall have **knowledge** of the building water system design and water management as it relates to Legionellosis.

Test Your Knowledge: True or False?

- Legionella is ubiquitous (everywhere).
- If chlorine levels at or above 0.5 mg/L in the supply water, Legionella is controlled.
- Only old buildings have Legionella problems.
- If total bacteria (TBC or ATP) are controlled, Legionella is controlled.
- Water and energy conservation approaches minimize Legionella risk.
- Legionella is not a concern during construction.

**FALSE**
Water Safety and Management Plan

CONTENTS

1. Legionella
2. ASHRAE 188 Compliance Requirements
3. Program Team
4. Building List
5. Potable Water Systems
6. Cooling Towers
7. Whirlpool Spas
8. Decorative Water Features
9. Aerosol-Generating Equipment
10. Confirmation
11. Contingency Response Plan
12. Designing New Building Water Systems
13. Documentation
14. Resources
Section 8. Requirements For Designing Building Water Systems

Addresses A Known Risk: Delayed Occupancy
Legionella Outbreak UAB University Hospital

Hematology/oncology Unit

2 patients die at UAB after testing positive for legionellosis

Kecia May 27, 2014 10:01 PM CDT
Updated: May 26, 2014 1:56 PM CDT

By WBRC Staff

BIRMINGHAM, AL (WBRC) - Two out of eight patients who tested positive for the legionella bacteria have died at UAB, hospital officials confirm.

Legionella is a bacteria that can cause a form of pneumonia called legionellosis, or Legionaire's disease, according to Dr. Leonig Kibele, UAB's Chief Patient Safety and Clinical Effectiveness Officer.

Ruc says most people are exposed to legionella regularly and usually don't get legionellosis, but people with weak immune systems are typically most susceptible to legionellosis.

Most people get infected by inhaling the bacteria. It can't be transferred by person to person contact.

After eight patients in the hematology/oncology unit tested positive for legionellosis, UAB hospital implemented water restrictions in a section of the hospital on Saturday.

The bacteria was discovered in one unit that shares plumbing with two floors. So far, they have not found any new infections outside of that one unit.

The hospital installed filters on shower and faucet heads, flushed the water system and shocked it with extreme temperatures in an effort to make sure the water was safe to use. They also mailed notifications to water meters when
New Unit

- May 2014, 10 cases following completion of new hematology-oncology unit
- *L. pneumophila*, serogroup 1 isolated from 50% (17/34) distal sites (faucets/showers)
- Cases stopped following shock disinfection and installation of Point-of-Use (POU) filters
- Long-term, hot water monochloramine

Retirement Community

Second case of Legionnaire’s disease reported at Ellicott City retirement community

Retirement Community Outbreak After Opening in 2016

- Newly constructed buildings officially opened in April
- 2 residents diagnosed with Legionnaire’s disease in May and June
- Water restrictions, health dept., news
- Disinfection measures
  - Short-term (hyperchlorination)
  - Long-term supplemental (monochloramine on the hot water system)

Changes In Water Quality
Flint, Michigan

Flint water crisis likely the cause of deadly Legionnaires outbreak

By Sara Ganim, CNN    Mar 30, 2017

Water Quality in Flint Michigan
Cross section of 4 inch pipe from hospital hot water system

Weather and Legionnaires’ Disease

Weather-Dependent Risk for Legionnaires’ Disease, United States
Jacob E. Simmering, Linnea A. Polgreen, Douglas B. Hornick, Daniel K. Sewell, Philip M. Polgreen

Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 23, No. 11, November 2017

Wet Weather and Legionnaires’ Disease?

Rain, flooding likely led to spike in Legionnaires' disease
Reports of Legionnaires' disease follow heavy rains.

By Tim Darragh, Of The Morning Call
11:42 P.M. EDT, OCTOBER 17, 2011

All that rainfall in September may have left more than wet basements here and flood-wrecked communities in northeast Pennsylvania.

It also appears it was at least partly responsible for a record spike in Legionnaires' disease, a water-borne bacterial pneumonia that can be fatal to some people.
I Have Legionella in My Building…
Now What?

DISINFECTION APPROACHES

DISINFECTION OPTIONS
**Secondary Disinfection Methods**

- Thermal shock treatment (heat & flush)
- Shock chlorination (>10 mg/L residual), may require water tanks to be 20-50 mg/L
- Continuous chlorination (2-4 mg/L)
- Copper-silver ionization (continuous and short-course)
- Chlorine Dioxide (ClO2)
- Monochloramine
- Point-of-use filtration

**Evidence-based Approach to Evaluating Efficacy**

- Do some research – don’t assume the salesperson will tell you everything you need to know
  - Consult with experts
  - Get information from other users of the technology
  - Don’t “google” it!

**Efficacy of Disinfection Methods**

- Testing should be performed to demonstrate efficacy:
  - Baseline testing prior to installation and start-up
  - Test within 2-4 weeks of start-up
  - Test quarterly for one year
  - Adjust monitoring schedule based upon performance and patient risk
Field Evaluation: Monochloramine

Evaluation of A New Monochloramine Generation System for Controlling Legionella In Building Hot Water Systems

Scott Duda, MS; Sheena Kandiah, MD, PhD; Janet E. Stout, PhD; Julianne L. Baron, BS; Mohamed Yassin, MD, PhD; Marie Fabrizio, BSN, CIC; Juliet Ferrelli, MS, MT (ASCP) CIC; Rahman Hariri, PhD; Marilyn M. Wagener, MS; John Goepfert; James Bond; Joseph Hannigan, CWT; Denzil Rogers
High (>30%) *Legionella* Distal Site Positivity And Cases Prior to Treatment

- **Cases**
- No Cases after Treatment (NH2Cl)

[Graph showing distal site positivity with a decline after treatment (NH2Cl)]
Maintaining *Legionella* control in building water systems

*Legionella* and other waterborne pathogens can present a risk to consumers of potable water. In particular, building hot water systems have been established as the primary reservoir for bacteria linked to cases of Legionnaires' disease (LD). These systems provide ideal conditions for *Legionella* proliferation because of their elevated temperature and lack of disinfection residual. Control of *Legionella* in potable water systems has become a focus for health care facilities because they serve a population that is particularly susceptible to LD from underlying health conditions such as suppressed immune systems.

Journal Am Water Works Assoc 2014; 106(10): 24-32
Summary

- Potable Water systems, especially in hospitals (and other buildings) with complex hot water systems, are the most important source of *Legionella* transmission.

Any organization that disputes this and tells people not to test their water systems as part of an effective prevention strategy is at best foolish and at worst endangering lives.

- Each building owner must assess the risk and validate their water management plans to demonstrate control of the hazard (*Legionella*).

- Determining the risk or validating a water management plan **cannot** be done without testing for *Legionella*.
Resources

www.legionella.org
Ending Legionnaires' Disease

Plumbing systems should have a regime of regular water tests and air movement to control the disease.

Legionnaires' disease is caused by the microorganism Legionella pneumophila, which is commonly found in warm water systems, such as those found in buildings, hospitals, and hotels. The disease is transmitted through the air, and people can become infected by inhaling aerosols containing the bacteria. The disease can be prevented by controlling the growth of Legionella in water systems.

To control the growth of Legionella, it is important to maintain water temperatures above 60°C and below 50°C. This can be achieved by heating the water supply or by using chemical biocides. Regular water testing is also important to ensure that the water is safe to use.

Air movement is also important in controlling the spread of Legionella. This can be achieved by using ventilation systems to circulate fresh air and by using Fans to help disperse airborne particles.

In conclusion, plumbing systems should have a regime of regular water tests and air movement to control the disease. This will help to ensure that the water is safe to use and that the risk of infection is minimized.

References:


Legionella: Could This Potentially Deadly Bacteria Be Lurking in Your Facility's Water Distribution System?

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THE PENNSYLVANIA PATIENT SAFETY ADVISORY
HTTP://PATIENTSAFETY.PA.GOV
This concludes The American Institute of Architects Continuing Education Systems Course

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THANK YOU

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