Managing Legionnaires’ Disease
Outbreak readiness
Disclaimer:
This presentation is intended to introduce you to general principles based on current guidance and suggested practices from government agencies and industry groups. As with any overview program, these materials and our guidance are general, and you should always consult your own advisors as appropriate for your circumstances.
Agenda

- Characteristics and ecology of *Legionella*
  - Where *Legionella* can live/grow in a building system
- What defines a Legionnaires’ disease outbreak; when to report an outbreak
- How to identify sample sites in an outbreak
- Criteria for choosing a testing laboratory and analytical methods
- Prevention: use of ASHRAE 188/CDC Toolkit to manage *Legionella*
Characteristics and Ecology of Legionella
Legionella Characteristics

- Aerobic
- Normal aquatic bacteria
- Gram-negative (do not stain well)
- Nonspore-forming
- Flagellated
- Pleomorphic
- Facultative intracellular bacteria
- The causative agent of legionellosis including:
  - Legionnaires' Disease
  - Pontiac fever
Where *Legionella* live

**Potable Water**

**Nonpotable Water**
Biofilm harbors bacteria, including *Legionella*
Biofilm is pervasive, not easily removed and regrows
Infectivity – *Legionella* Aerosolization

Shower aerosol

Cooling tower aerosol
Infectivity Risk Factors – Need All 3

- Exposure
- Virulence of Strain
- Susceptibility of Patient
Legionnaires’ disease is on the rise

- Reported cases have increased more than 550% in the last 15 years
- 8,000 to 18,000 people contract legionellosis in the U.S. each year (est.)
- ~10% of known cases are fatal, but 25% if contracted in healthcare setting

Source: National notifiable disease surveillance system
Legionellosis: US case rates

Reported cases by state

2007

Cases/100,000 population
Legionellosis: US case rates

Reported cases by state

2012

Cases/100,000 population

CDC Source: National Notifiable Diseases Surveillance System
Reported cases by state

2017

Cases/100,000 population

CDC Source: National Notifiable Diseases Surveillance System
L. pneumophila is the cause of 97% of Legionnaires' disease cases

Data from clinical cultures of 4,719 patients over seven years in 17 countries

L. Pneumophila - the most dangerous waterborne pathogen

Legionnaires’ disease is preventable

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

Adapted from CDC Vital Signs June 2017
https://www.cdc.gov/vitalsigns/pdf/2017-06-vitalsigns.pdf
Many organizations focus on managing *L. pneumophila*
Defining a legionellosis outbreak
Defining legionellosis case

- Patient culture +
- Urine Antigen test +
- 4X Patient Seroconversion
Legionellosis case reporting

Confirmed cases of legionellosis are to be reported to CDC using:

1. **National Notifiable Diseases Surveillance System** (NNDSS)
2. Supplemental Legionnaires’ Disease Surveillance System (SLDSS) contact Dr Claressa Lucas

**Resources:**

• Reporting a case: [https://www.cdc.gov/legionella/health-depts/surv-reporting/report-cases.html](https://www.cdc.gov/legionella/health-depts/surv-reporting/report-cases.html)


• Report travel-associated cases within 7 days to: [travellegionella@cdc.gov](mailto:travellegionella@cdc.gov)
Defining Legionnaires’ disease outbreak

- 2+ people exposed in same location/time
- Complex water system
- Common source of exposure
Defining a legionellosis outbreak

Cases and outbreaks can include two types of exposure routes:

**Travel-associated**
Hotel, spa, cruise ship
File [EPI-X Request](https://www.cdc.gov/epi-x/request/index.html) to alert other states. Email travellegionella@cdc.gov.

**Community acquired**
Building water system at a hospital, nursing home, office, apartment complex
*Will you need to do a full investigation??*
Legionnaires’ disease outbreak investigation tools

1. Obtain a Detailed Exposure History and Identify Pattern
   • CDC’s Legionnaires’ Disease Hypothesis-generating Questionnaire Template Cdc-word
   • CDC’s Line List Template is a tool to summarize case demographic, clinical, and exposure information specific to a community-associated outbreak

2. Conduct Additional Case Finding for Community-associated Case(s)
   • Notify local clinical laboratories and healthcare providers for additional case finding (e.g., issue a health advisory notification [HAN]) Provide guidance for appropriate diagnostic testing
Legionnaires’ disease outbreak investigation tools

Other Considerations

• **Map** all patient residences and sites for daily activities

• Identify any possible **common exposures** through conducting patient interviews

• **Contact the local water authority** to determine changes that could have contributed to *Legionella* growth (e.g., modifications to potable water disinfection, water main breaks, major construction activity, water service interruptions)

• **Consider cooling towers** as a possible source if cases are tightly clustered in time and neighborhood but patients lack common potable water exposures
Where to sample for *L. pneumophila*
Risk areas are already defined in a WSP

Process Flow Diagrams

ASHRAE 188
CDC Toolkit

Legend:
- Return Flow
- Water Process
- Backflow Preventer
Water Safety Plan (WSP) 7 step program

**Water Safety (Risk) Management Steps**

- Roles & Responsibilities
- Describe the System
- Identify Risk Areas
- Determine Controls
- Monitoring & Corrective Actions
- Verify & Validate the Plan
- Document
Consider sampling these part of the building water system:

- Cooling Towers
- Evaporative condensers
- Whirlpool spas
- Ornamental fountains
- Misters, air washers, atomizers, humidifiers
- Devices that aerosolize and release fine water droplets, including CPAP other respiratory/surgery devices
Choosing a testing laboratory
Have a laboratory response plan now

Public Health Offices should coordinate with their partner Laboratories to create a plan for:

1. **Routine testing** as part of any water safety plan at a building, hospital, nursing home, etc.

1. **Outbreak investigation assistance**, for when a case or outbreak has been identified, requires connecting clinical to environmental samples to identify route cause for intervention. [CDC Laboratory Response Plan](#)
CDC Laboratory Response toolkit helps your prepare for an outbreak investigation

The laboratory response toolkit includes:

- A checklist to assess current *Legionella* testing capacity
- Templates for identifying response team and determining roles and responsibilities
- Templates for a plan to test clinical specimens and environmental samples in your laboratory
- Templates for a plan to refer samples to an outside laboratory
- A sample Legionnaires’ disease Laboratory Response Plan
- An example response scenario with a sample workflow and timeline
- Sample worksheets to document laboratory results
- Example instructions for specimen storage and shipping
Criteria for choosing an outside testing laboratory

The laboratory should demonstrate proficiency in subject method and be either or both:

- **CDC ELITE**, should consider an ELITE laboratory if there is a case or outbreak
- **National/State accredited laboratory** should be used for routine testing such as testing as part of a water safety plan

What is the difference between ELITE certified and National/State accredited laboratories?
## CDC ELITE Certified Vs. National/State accreditation

<table>
<thead>
<tr>
<th><strong>CDC ELITE Requirements</strong></th>
<th><strong>Accreditation Requirements</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Be able to perform some version of spread-plate culture</td>
<td>• Specifically list S.O.P. for each method on Scope</td>
</tr>
<tr>
<td>• Pass 2 test samples per year via presence/absence (P/A)</td>
<td>• Pass at 1-2 accredited Proficiency Tests (PTs) per year</td>
</tr>
<tr>
<td></td>
<td>• Have a Quality Management System</td>
</tr>
<tr>
<td></td>
<td>• Have a QAPP for each client</td>
</tr>
<tr>
<td></td>
<td>• Have sample Chain of Custody, sample receipt and data reporting forms signed by staff/QA officer</td>
</tr>
<tr>
<td></td>
<td>• Have regular 3rd party audits to determine compliance to accreditation processes</td>
</tr>
</tbody>
</table>
Interviewing an outside laboratory

Ask to see these items:

• Accreditation Certificate
• Scope of Accreditation
• S.O.P. for each *Legionella* method on their Scope; will give insight into TAT and if they can ID *L. pneumophila* and serotypes
• Do they have a Quality Management System and write a QAPP for each client
• A blank Chain of Custody and redacted Data Report, learn how they report their test results
**Example Data Report**

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**Lab Number:** AC19872

**Sample Description:** Water, Receiving temperature: 17.0°C

**Sample Comments:**

**Analysis:**

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Method</th>
<th>Unit</th>
<th>Result</th>
<th>PQL</th>
<th>Analysis Start Date/Time</th>
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</thead>
<tbody>
<tr>
<td>L. pneumophila - Culture</td>
<td>CDC</td>
<td></td>
<td>Absent</td>
<td>Variable</td>
<td>10:44</td>
</tr>
<tr>
<td>Legionella spp. - Culture</td>
<td>CDC</td>
<td></td>
<td>Indeterminate</td>
<td>Variable</td>
<td>10:44</td>
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</tbody>
</table>

**Analysis Comments:**

- A 800ml portion of the water sample was tested by membrane filtration followed by culture. *Legionella pneumophila* was not present.
- A 80ml portion of the water sample was tested by membrane filtration followed by culture. No *Legionella* spp. were detected by culture methods. The laboratory also performed a nucleic acid amplification assay on concentrated sample for internal investigative purposes, and *Legionella* spp. DNA was detected. Discrepancies between PCR and culture methods are not uncommon. PCR detects viable and non-viable organisms; culture methods only detect viable organisms. Non-detection by culture may occur due to lower sensitivity, non-culturability of injured organisms, overgrowth of other bacteria, and absence of viable organisms. Recommend submission of additional samples for further testing.

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**Report approved by:**

[Signature]

Danna Ferguson, Ph.D., P. H. M.
Laboratory Director
## Chain of Custody Example

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### Environmental Analysis Request Form

**Environental Analysis Request Form**

**Monterey County Consolidated Chemistry Laboratory**

1270 Natividad Road, Salinas, California 93906

Phone (831) 755-4516

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**Chain of Custody:**

- **Collected by (Print & sign):**
  - **Received by:**
  - **Received for Laboratory:**
  - **Date & Time:**

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**Client Name:**

**Address:**

**Copy to:**

- Monterey Co EH
- State: Other

**City, Mail, Zip:**

**Date & Time:**

---

**ANALYSES REQUESTED**

<table>
<thead>
<tr>
<th>Laboratory Number</th>
<th>Sample ID or System #</th>
<th>Sample Site or Description</th>
<th>Collection Date &amp; Time</th>
<th>Matrix</th>
<th>Method</th>
<th>Sample Code</th>
<th>Note</th>
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</thead>
<tbody>
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</table>

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<table>
<thead>
<tr>
<th>D=Drinking Water</th>
<th>W=Wastewater (Specify as grab or composite)</th>
<th>I=Irrigation</th>
<th>S=Storm</th>
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</thead>
</table>

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<table>
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<tr>
<th>Payment received with delivery</th>
<th>Amount</th>
<th>Sample code (mixture/harbors, sampling, holding information if different than reporting)</th>
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</thead>
<tbody>
<tr>
<td>Check</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receipt #</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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qPCR for *L. pneumophila* and *L. species*

Some laboratories use qPCR, or molecular detection of *Legionella*, to screen samples that should be cultured. In case or outbreak, you will need to retain the live culture for future testing, so PCR is a tool, *but not a substitute* for culture.
Culture Methods for Water Testing

Liquid Culture

Solid media Culture
High Counts
(Non-potable water)

Transfer 1mL

Acid treat pH 2.2
15 min

Moderate Counts
(Potable or Non-potable)

Plate 0.1mL

GCV
PCV
BCYE

Confirm

BCYE

Low Counts
(Potable water)

Centrifuge

Transfer 1mL

Membrane Filter

OR

Place filter in tube

Plate 0.1mL

Vortex to resuspend
Spreadplate methods are not easy to interpret or reproduce

- Subjectivity of colony interpretation
- Interference of non-*Legionella* organisms
- Analyst experience level
Legiolert liquid culture method
Detection of *L. pneumophila* by Legiolert

- Confirmed results without additional tests
- A positive result can be confirmed without additional incubation
- Detects and quantifies all serogroups of *Legionella pneumophila (Sg1 – 15)*
- 99% reproducibility and repeatability
- Smaller sample size of 100 mL
- Quicker TAT, results in 7 days
**Spread-plate culture vs Legiolert**

**Spread-Plate Culture**

- 250 ml or 1000 ml sample
- Detects/quantifies *Legionella* species *(but not all)*
- Can detect *L. pneumophila* with extra steps
- Serogrouping and speciation direct from plate
- 7-12 day TAT
- Higher variability in processing
- Lower repeatability
- Media can vary per vendor
- Interference from background bacteria, yeasts and filamentous molds
- Possibility of co-culture with *Legionella*

**Legiolert Culture**

- 120 ml sample
- Detects and quantifies LP missed by spread-plate cultures
- 7-day TAT
- Serogroup directly from wells
- 99% Repeatability
- 99% Reproducibility
- High specificity for all LP serogroups 1-15
- Reduce the need to re-test because of overgrowth (vs. TNTC plates)
Legionella speciation and latex agglutination

Culture for live organisms is the gold standard, additional steps needed for spread-plate culture can include determining species and serotype of *L pneumophila*:

Agglutination will determine if you have *L pneumophila* serotype 1 or 2-14

Used to determine the species of *Legionella*. Alternative that is more often used is to serotype *L pneumophila*.
Preventing Legionnaires’ Disease
Memo June 2017
Updated July 2018

Sent to:
State Survey Agency Directors

Subject:
Requirement to Reduce *Legionella* Risk in Healthcare Facility Water Systems to Prevent Cases and Outbreaks of Legionnaires’ Disease (LD)
ASHRAE 188:2018 Standard and the CDC Tool Kit: Resources to create WSM plans

ASHRAE 188
• First NA standard
• Only ANSI Accredited Standard
• Consensus view of the best practices for managing Legionnaires’ risk in building water systems
• Recommended Water Safety Plan
• Testing specific section

CDC Toolkit
• Yes/No Worksheet for risky building areas
• Walk through of Legionella mgmt. program
• Example problem scenarios
• Healthcare-specific guidance
CDC Tool Kit WSM Plan: 7 core activities

1. Establish a water management program team
2. Describe the building water systems using text and flow diagrams
3. Identify areas where Legionella could grow and spread
4. Decide where control measures should be applied and how to monitor them
5. Establish ways to intervene when control limits are not met
6. Make sure the program is running as designed and is effective
7. Document and communicate all the activities

Continuous program review (see below)

Source: CDC  Developing a Water Management Program to Reduce Legionella Growth & Spread in Buildings Version 1.1
Additional Water Safety Management resources

- **Association of Water Technologies (AWT)**
  Certified Water Treaters list [WWW.AWT.org](https://www.awt.org)

- **HC Info**: WSM Templates, checklists & technical information [https://hcinfo.com/home/](https://hcinfo.com/home/)

- **ASHRAE**: Guidance on Reducing the Risk of Legionella [www.ASHRAE.org](https://www.ashrae.org)

- **Centers for Disease Control (CDC)**: Information on Legionella and the CDC Tool Kit [www.cdc.gov/legionella](https://www.cdc.gov/legionella)

- **IDEXX**: information on *L. pneumophila* and a directory of testing laboratories [www.idexx.com/legiolert](https://www.idexx.com/legiolert)
Accreditation Standards and Analytical Method Resources

TNI Accreditation Bodies: http://www.nelac-institute.org/content/NELAP/accred-bodies.php

AIHA/EMLAP: https://www.aihaaccreditedlabs.org/LabAccreditationPrograms/EMLAP/Pages/default.aspx


Question and Answer Session
## Action limits – Guidance / Legislation

### Potable water

<table>
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<th>Country</th>
<th>Entity</th>
<th>Type of rule</th>
<th>Potable water limit</th>
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<tbody>
<tr>
<td><strong>United States</strong></td>
<td>CDC</td>
<td>Guidance</td>
<td>Depends on Risk Mgmt Plan</td>
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<td></td>
<td>AIHA</td>
<td>Guidance</td>
<td>≥ 10 cfu/mL</td>
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<tr>
<td></td>
<td>OSHA</td>
<td>Guidance</td>
<td>≥ 10 cfu/mL</td>
</tr>
<tr>
<td></td>
<td>VA Directive 1061</td>
<td>Guidance</td>
<td>Any positive</td>
</tr>
<tr>
<td><strong>France</strong></td>
<td>New York State Dept. of Health</td>
<td>Legislation</td>
<td>≥ 30% “positive” outlets (healthcare facilities only)</td>
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<td></td>
<td>Ministry of Health</td>
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<tr>
<td><strong>Germany</strong></td>
<td>Trinkwasserverordnung TrinkwV 2001</td>
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# Action limits – Guidance / Legislation

## Nonpotable water

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