Epidemiology of Legionnaires’ Disease in Skilled Nursing Facilities

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What is Legionella?

• Gram-negative bacteria
• Can live and grow on water, soil, and biofilm
• More than 60 different Legionella species.
  – *L. pneumophila*: ~90% of Legionnaires’ disease cases in U.S.
• Generally does not affect healthy people.
What is Legionnaires’ Disease (LD)?

• A serious type of pneumonia (lung infection).
• Up to 14% of people exposed can get LD.
• Illness onset begins 2-10 days after exposure.
• Healthcare-associated LD is deadly for 1 in 4 people who gets it.

Overview of LD’s Transmission Pathway:

1. ENTER BUILDING WATER SYSTEM

2. AMPLIFY IN IDEAL GROWTH CONDITIONS

3. SPREAD VIA AEROSOLS

4. INFECT SUSCEPTIBLE PATIENTS
How can *Legionella* enter your building water system?

- Biofilm disruptions in the water system can dislodge *Legionella*.
- **Examples:**
  - Constructions
  - Water main breaks
  - Changes in water pressure

Source: Centers for Disease Control and Prevention (CDC)
What are the conditions that help *Legionella* grow faster?

**Ideal growth conditions:**

- Danger Zone: 77-108°F
- Biofilm
- Sediments
- Inadequate disinfectant
- pH outside ideal disinfectant range (~6.5-8.5)

Source: Centers for Disease Control and Prevention (CDC) and U.S. Occupational Safety and Health Administration (OSHA)
How are people exposed to *Legionella*?

- Patients can acquire LD by **breathing in aerosolized water** containing *Legionella*.
  - Less commonly, aspiration of contaminated water.

**Common Types of Exposures:**
- Showerheads, faucets
- Cooling towers
- Hot tubs
- Decorative fountains

Who is At Risk?

Susceptible patients:

- Age >50
- Smoking
- Chronic lung disease
- Weak immune system
- Chemotherapy
- Underlying illness

Source: Centers for Disease Control and Prevention (CDC)
Legionellosis cases --- LA County, 2002-2016

- Annual number of Legionellosis cases **increased ten-fold** within the last decade.

![Bar chart showing the increase in Legionellosis cases from 2002 to 2016. The highest number of cases in 2016 was 245, with a peak of 2.55 cases per 100,000 population, compared to 0.27 cases per 100,000 in 2002.](image-url)

Why is the number of reported cases increasing?

- Increased susceptibility of the population
  - Aging U.S. population
  - More people on immunosuppressing medications
- More *Legionella* in the environment
  - Warmer temperatures
  - Aging infrastructure
- Improved diagnostic capability
  - Urine antigen test availability
- Increased awareness and reporting
Legionella Surveillance in LA County

• Legionellosis is a mandatory reportable disease in LA County.

• Lab reports with positive *Legionella* test results are directly sent to LA County Department of Public Health.

• All suspected & confirmed cases must be reported to local public health department.

• Department of Public Health investigates reported cases and outbreaks in healthcare facilities.
Definition of healthcare-associated LD

- **Definite** case if patient was hospitalized or resided at one or more skilled nursing facilities (SNFs) during the **entire 2-10 day** incubation period prior to symptom onset.

- **Possible** case if patient was hospitalized or resided at one or more SNFs for a **portion of the 2-10 day** incubation period prior to symptom onset.
When does public health investigate healthcare-associated LD?

- > 1 case of **definite** healthcare-associated LD is identified.

- > 2 cases of **possible** healthcare-associated LD is identified within 12 months of each other at same facility.
Who should be tested for *Legionella* in SNFs?

- Majority of SNF residents are likely to have *L. pneumophila* risk factors.
  - E.g. Age >50, diabetic, lung disease
  - Routine testing likely to be more effective than risk factor-based screening.
- Consider routine *Legionella* testing in any patient with suspected pneumonia.
  - Including patients with acute respiratory symptoms who will be started on empiric antibiotic.
Why test patients for *Legionella*?

- Obtain etiologic diagnosis.
  - Inform antibiotic therapy
    - Minimize emergence of antimicrobial resistance
    - Reduce costs and adverse effects associated with additional diagnostic evaluation for an etiologic agent
- Identifying LD cases can inform facility to investigate sources of exposure to protect other patients.
  - Can help prevent additional cases
How to test for *Legionella*?

- **Preferred Diagnostic Approach:**
  - Lower respiratory tract secretion culture
  - Urine antigen test (UAT)
  - Both samples should be obtained concurrently.

- **Other Diagnostic Approaches:**
  - Paired serology
  - Direct Fluorescent Antibody Stain
  - Polymerase Chain Reaction
  - Not preferred because they have lower sensitivity, technically difficult, and are not widely available.
Respiratory culture for *Legionella*

- Lower respiratory secretions (e.g. induced sputum)
- Must culture specimens on Buffered Charcoal Yeast Extract agar (or other appropriate media for *Legionella* diagnosis).

**Advantages:**
- Detects all species & serogroups
- Able to compare clinical & environmental isolates

**Disadvantages:**
- Slow (>5 days to grow)
- Affected by antibiotic treatment
- Requires BCYE agar

**Sensitivity:** 20-80%, **Specificity:** 100%

Source: Centers for Disease Control and Prevention (CDC)
UAT

• Detects *L. pneumophila* serogroup 1 (Lp 1) but other undetected species/serogroups are still pathogenic.
  – Patients may still have *Legionella* even with a (-) UAT result.

• Antigen can be present for months.
  – Should not be ordered in asymptomatic persons.

• **Advantages:**
  – Rapid test
  – Same day results

• **Disadvantages:**
  – Only for Lp1
  – Unable to compare molecular and environmental isolates

• **Sensitivity:** 70-100%, **Specificity:** 95-100%

Source: Centers for Disease Control and Prevention (CDC)
Why are we focusing on LD in SNFs?

• SNFs have complex water systems that are at risk for *Legionella* introduction and amplification.
• Most SNF residents have risk factors for LD.
• Many SNF residents stay multiple days—greater duration of exposure compared to general population.
• Morality is high for healthcare-associated LD (~25% of cases die).

Source: Centers for Disease Control and Prevention (CDC) and World Health Organization
Legionnaires’ Disease is Preventable

• LD is preventable with good Water Management Program (WMP)
• WMP identify hazardous conditions and take steps to minimize the growth and transmission of Legionella and other waterborne pathogens in building water systems.
• Centers for Medicare & Medicaid Services issued WMP requirement in 2017 (updated in 2018):
  “Develop and adhere to policies and procedures...that reduce the risk of growth and spread of *Legionella* and other opportunistic pathogens in water.”

Source: Centers for Disease Control and Prevention (CDC) and County of Los Angeles Department of Public Health
Summary

• **1 in 4 patients** with healthcare-associated Legionnaires’ disease die.

• **Diagnostic testing** is essential to identify *Legionella*.

• Legionnaires’ disease is preventable with an ASHRAE-compliant **WMP**.
Questions?

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DEVELOPING A WATER MANAGEMENT PROGRAM (WMP) TO PREVENT LEGIONELLA GROWTH

Jeremy Macleod
Industrial Hygienist
Skilled Nursing Facility Outreach Program
What is a Water Management Program?

• It is a logical documented system to manage water safety
• It requires an understanding water systems
• It requires assessment of how and where bacteria grow
• It will implement controls to destroy or limit the growth of the bacteria
• The WMP monitors and documents all actions
• It is unique to your building
Why a WMP in a Skilled Nursing Facility?

- Your clients
- Extended stays
- Complex water systems
- It is a ‘Centers for Medicare & Medicaid Services’ requirement
How are water systems contaminated?

- *Legionella* is in the environment
- Breaks in the main supply pipework
- In-house or external construction work
- Wind-blown debris
- Animals
Conditions for growth in water

- Temperature - between 77° & 108 °F
- Harborage – biofilms, protozoans, scale, sediment, dead legs
- Stagnation – dead legs; ‘off-peak’; water efficiency features
- Inadequate disinfection
- Disinfection deactivation when pH is low or high
*Legionella* growth within a biofilm

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**Attachment 1**

**Growth 2**

**Detachment 3**

© 2003, Center for Biofilm Engineering at MSU–Bozeman

P. Dirickx
A cross section of pipework

Legionella can live and grow in biofilm

Water
Pipe wall
Biofilm-associated bacteria
Free-floating bacteria
Secreted slime

Cross section of pipe
Legionella sites of growth

- Potable and non-potable water systems
- Hot and cold water
- Storage tanks
- Cooling towers
- Filters, pipes, valves and fittings
- Ice machines
- Aerators
- Showers, fountains and eye wash stations
- Medical devices using water

... and many more!
Example: A Short Dead Leg
HOW COOLING TOWERS WORK

- **Warm, moist air out**
- **Fan**
- **Distribution system**
- **Spray nozzles**
- **Fill material**

- **Hot water in**
- **Collection basin**
- **Dry air in**
- **Cold water out**
Regulation and guidance

- CMS ‘Requirement to reduce Legionella risk in healthcare facility water systems to prevent cases and outbreaks of Legionella Disease’. QSO -17 -30 Hospitals/CAHs/NHs Revised 07.06.2018

  
  188 Originally published June 2015
A Water Management Program - 7 steps

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)
Step 1. Establish a WMP Team

Essential
• Business / building owner or administrator
• Water services / building facilities engineer
• Infection control specialist

Additional
• Water treatment specialist
• OSHPD / EH / PH
Step 2. Describe the building water systems in text & in flow diagrams
Step 3. Identify areas where *Legionella* can grow and spread
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Example: Decorative Fountain
Step 4. Decide where control measures should be applied and decide how to monitor
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Example: Decorative Fountain
Example – Hot Water System

Part 1. The Boiler(s)
What control measures should we monitor

• Temperature >140 F
  Check daily

• Stagnation (ensure no stratification)
  Insulate or circulating pump

• Cleanliness
  Remove sediment
Hot Water Boiler
Example – Hot Water System

Part 2. Distribution
What control measures should we monitor

• Temperature @ 125 - 140 F
  Taken near outlets; distal points

• Return line temperature
  Just prior to boiler re-entry

• Stagnation
  Empty / irregular use of rooms

• Cleanliness
  Outlets
### Step 5  Example: Logbook

**Sandringham Health Care**

**Daily Log - Weekly**

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Temp</th>
<th>Cl</th>
<th>pH</th>
<th>Quality</th>
<th>Notes</th>
<th>Signed</th>
</tr>
</thead>
</table>

**Temp:** If below 140F reset thermostat and check temp in 2 hours. If still below 140F at recheck inform maintenance and line manager. Log results in notes.

**pH:** If below 6.5 or above 8.5 chemically dose as applicable and recheck. If still incorrect inform line manager. Log results in notes.

**Chlorine:** If Cl level is below 2.0 mg/l consult chart for correct top up dosing procedure. Recheck. If still incorrect inform line manager. Log results in notes.

**Quality:** If water looks cloudy or slimy follow cleaning and disinfection instructions. Log results in notes.

**FOLLOW SPECIFIC WORK INSTRUCTIONS**
**ENTER ACTUAL VALUES**
Step 6. Make sure the Water Management Program is running as designed and is effective by:

Verification

• Is the program being implemented?

• Scheduled checks?

• Who is this reported to?

• Remedial action?
Step 6. cont.

Validation

• Is the program effective?

• Confirms hazard control

• Environmental testing for *Legionella*

• Implement a testing protocol
Environmental testing

• Examples of action limits

Potable:

CDC & ASHRAE  Guidance - dependent on WMP

AIHA & OSHA  Guidance - $\geq 10$ cfu/ml

VA Directive 1061  Guidance - any positive

NY State DoH  Legislation - $\geq 30\%$ +ve outlets (health care fac’s)

Gov France & Germany  Legislation - $\geq 1$ cfu/ml
Non-potable:

CDC & ASHRAE Guidance – dependent on WMP
AIHA & OSHA Guidance – dependent on WMP
Gov France Legislation - ≥ 1 cfu/ml
Gov Germany Guidance - ≥ 1 cfu/ml
Canada Legislation - ≥ 10 cfu/ml

Control measures for adverse results.

- Number of CFU’s and Number of Outlets
- Disinfection by heat or chemicals. Flushing.
Step 7. Document and communicate

- Responsibility
- Accountability
- Consultation
- Inform
Suggested timeline

Week

1: Assemble your team

2/3: Describe the water systems in text and diagrams

4: ID where Legionella could grow and spread

5: Decide control measures and monitoring

6: Establish intervention when limits exceeded

7/8: Verify and Validate

9: Document

10: Make an appointment for a review
Guidance and training resources

LA County Dept Public Health; ACDC; Legionella

http://publichealth.lacounty.gov/acd/Diseases/Legion.htm

ASHRAE 188 -2018, Legionellosis: Risk Management for Building Water Services
ASHRAE 12-2000, Minimizing the Risk of Legionellosis Associated with Building Water Systems. Both at:


VA Dir 1061, Prevention of Healthcare-Associated Legionella Disease and Scald Injury from Potable water Systems


CDC Prevent LD, Preventing Legionnaires’ Disease: A Training on Legionella Water Management Programs

https://www.cdc.gov/CDC legionella/nceh/ehs/elearn/prevent-LD-training.html

Developing a Water Management Program to Reduce Legionella Growth & Spread in Buildings

https://www.cdc.gov/legionella/WMPtoolkit
Consultants

Association of Water Technologies. www.AWT.org

HC Info. https://hcinfo.com/home (WMP templates)

TNI Accreditation Bodies

https://www.nelac-institute.org/content/NELAP/accred-bodies.php

AIHA/EMLAP

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

ISO 11731:2017 – Accreditation Standard

Staff

OSHA Technical Manual, Section III: Chapter 7 Legionnaires’ disease

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

“Think water, think Legionella”

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