Legionella Prevention and Management

Bureau of Environmental Health and Radiation Protection

Bureau of Infectious Diseases
Legionella

- Legionnaires’ disease is becoming an increasing concern in the United States and worldwide.
- Legionnaires’ disease is caused by the *Legionella* bacterium.
- *Legionella* is a naturally occurring bacterium that occurs in freshwater lakes and streams, however the quantities in natural water bodies are generally insufficient to cause disease.
Legionella Growth

- Growth or amplification of *Legionella* can occur under different environments in water systems.
- Conditions that promote amplification:
  - Water stagnation
  - Warm temperatures (25 - 51° C [77° - 124° F])
  - Presence of scale and sediment
  - Presence of organic matter (biofilms)
  - Protozoa
  - Lack of residual disinfectant
Legionella Transmission

- *Legionella* is dispersed through aerosolization.
- Sources include:
  - Showers and faucets
  - Cooling towers
  - Hot tubs
  - Decorative fountains
  - Large, complex water systems
**Legionella**

**Source:** Water

**Incubation:** 2-10 days

**Transmission:** Airborne, inhalation of aerosolized water; aspiration may be possible

**Secondary Cases:** No

**Symptoms:** Legionnaires’ Disease—pneumonia, cough, shortness of breath, fever, muscle aches, and headaches. **Pontiac Fever**—mild flu-like symptoms, no pneumonia

**Mortality:** Approximately 10%
Sensitive Populations

• People 50 years or older
• Current or former smokers
• People with a chronic lung disease (chronic obstructive pulmonary disease or emphysema)
• People with weak immune systems or who take drugs that weaken the immune system (transplant or chemotherapy recipients)
• People with cancer
• People with underlying illnesses such as diabetes, kidney failure, or liver failure
Legionnaires’ Disease in the US, 2000-2015

*Legionnaires' Disease Is On The Rise
   2000–2015*

*National Notifiable Diseases Surveillance System*
Cases of Legionellosis in Ohio

- Number of Cases
- Year
- Cases of Legionellosis in Ohio

Graph showing the number of cases of Legionellosis in Ohio from 2006 to 2015.
Possible reasons for increased number of cases

- Increased use of diagnostic tests
- Increased surveillance
- Increased awareness and testing
- Increased susceptibility of the population – illness, medication, aging
- Increased *Legionella* in the environment due to climate change, aging infrastructure, and water-saving fixtures
CDC Investigation of Building –Associated Outbreaks

- The CDC recently identified that common settings for outbreaks include:
  - Hotels
  - Long-term care facilities
  - Hospitals

CDC Vital Signs

- Healthcare facilities often have large and complex water distribution systems
- Serve sensitive populations

[Image of CDC Vital Signs poster]

https://www.cdc.gov/vitalsigns/pdf/2017-06-vitalsigns.pdf
CDC Investigations

Exposure to a health care facility in the 10 days prior to symptom onset

• Definite: exposure to a hospital or long-term care facility for the entire 10 days before symptom onset

• Possible: exposure to a health care facility for a portion of the 10 days before symptom onset
CDC Investigations

Definite Health Care Associated Cases

- 16 of 21 Jurisdictions reported definite cases of health care associated Legionnaires’ disease in 2015
- Definite cases were associated with long-term care facilities (80%), hospitals (18%), or both (2%)
- The case fatality rate was 25%

Possible Health Care Associated Cases

- Possible cases were associated with long-term care facilities (13%), hospitals (49%), clinics (26%) and other (3%).
- The case fatality rate was 10%.
Centers for Medicare and Medicaid services

- June 2017 memo
- Identifies *Legionella* control as responsibility of the facility

Legionella Prevention Actions

- Clinical
  - Proactive monitoring of cases
  - Reporting of Legionnaires’ disease to local health districts
- Environmental
  - Includes facility assessments, water management plans, environmental controls and monitoring
Proactive monitoring for facilities

1. Keep a high index of suspicion for legionellosis.
2. Test patients with pneumonia for *Legionella* spp. (culture from lower respiratory specimen AND urine antigen test, preferably).
3. Track and report cases to public health.
4. Work with public health to ensure appropriate prevention and control measures are in place.
Proactive Monitoring for Local Health Departments

1. Educate clinicians and facilities to keep a high index of suspicion for *Legionella*

2. Encourage clinicians and facilities to test patients with pneumonia for *Legionella* spp. (culture from lower respiratory specimen **AND** urine antigen test, preferably)

3. Work with facilities to ensure appropriate prevention and control measures are in place to prevent spread.

4. Investigate all reported cases of legionellosis.
Environmental Sources

- Common sources in buildings
  - Showers, faucets, ice machines
  - Cooling towers
  - HVAC (Heating, Ventilation, and Air-Conditioning) Systems
  - Hot tubs
  - Decorative fountains
  - Large, complicated cold and hot water systems
At-risk facilities

- Facilities housing sensitive populations such as hospitals and long-term care facilities
- Buildings with more than 10 stories
- Buildings with cooling towers
- Building with large, complex hot water distribution systems
Development of Water Management Plans

- Also called Water Safety Plans

- Purpose
  - Prevention of *Legionella* growth
  - Remediation in case of outbreaks

- Means
  - Monitoring of system parameters
  - Remediation measures
Water Management Plans

- Components

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
Water Management Plans

Resources


Facility assessments

_Necessary Team Member Skills:_
- Knowledge of the water systems
- Infection prevention
- Monitoring and documentation
- Communication

_Potential Team Members:_
- Building manager or administrator
- Maintenance or engineering employees
- Contractors and consultants
- Infectious disease specialist
- Risk and quality management staff
Importance of Facility Assessments

• Provides a complete understanding of a facility water system and helps identify areas of risk
• Can be used with epidemiological information to determine environmental sampling locations

Key components of an environmental assessment

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility Characteristics</td>
<td>Map and blueprints of facility</td>
</tr>
<tr>
<td></td>
<td>Occupancy rates, stories or levels, number of buildings</td>
</tr>
<tr>
<td></td>
<td>Renovations and recent major construction</td>
</tr>
<tr>
<td>Water Supply Source</td>
<td>Disinfectant method</td>
</tr>
<tr>
<td></td>
<td>Water disruptions</td>
</tr>
<tr>
<td>Premise Plumbing</td>
<td>Where and how water flows through building (hot water heaters, storage tanks, secondary disinfectant)</td>
</tr>
<tr>
<td>Water System Parameters</td>
<td>Maintenance logs, routine testing results, WMP review</td>
</tr>
<tr>
<td></td>
<td>Temperature, pH, and residual disinfectant</td>
</tr>
<tr>
<td>Sources of Exposure</td>
<td>Potable water (showers, sinks)</td>
</tr>
<tr>
<td></td>
<td>Whirlpool spa</td>
</tr>
<tr>
<td></td>
<td>Cooling tower</td>
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<tr>
<td></td>
<td>Decorative fountains and other water features</td>
</tr>
</tbody>
</table>
Facility assessments

Describe the Building Water Systems

- Develop a process flow diagram showing where the building connects to the water supply and how hot and cold water is distributed to the building
- Identification of dead-end plumbing legs or areas of water stagnation – presence of water saving fixtures
- Updates or construction should be based on the initial system assessment and procedures should be in place for updating documentation and schematics
Facility assessments

- Location of open or closed-loop cooling towers or evaporative condensers.
  - Evaluation of maintenance procedures
  - Proximity to indoor air intakes
- Hot water heaters and boilers
  - Distribution pattern through the building
  - Assessment of maintenance
  - Identify presence or absence of whirlpools, hot tubs or spas, ornamental fountains, misters, atomizers, air washes, humidifiers, or other aerosol generating devices
Facility assessments

Identify Areas Where *Legionella* Could Grow and Spread

- Identify potentially hazardous conditions within the process flow diagram
- Areas where medical procedures may expose patients to water droplets
- Areas with occupants that are undergoing treatment for burns, chemotherapy, solid organ or bone marrow transplantation, are immunocompromised, are taking drugs that weaken the immune system, have renal disease, diabetes, chronic lung disease, or are over 65 years old
Proactive environmental monitoring

- Measurable standards for ensuring that system is not conducive to *Legionella* growth
- Ex. Chlorine residual, temperature, flow rate...
- Decide on action levels with a corresponding plan of action when unacceptable
- Use CDC ELITE certified laboratory for any sample analysis
Prevention - Long-term control

- At the discretion of facility managers, based on system characteristics, usage rates, and water quality parameters
- Meant to maintain an environment that is not conducive to *Legionella* growth
- Not sufficient to guarantee the elimination of the risk of *Legionella* exposure
- May require plan approval and licensure as a public water system from Ohio EPA.
Long-term control

Temperature
- Cold water should be maintained below 25° C (77° F)
- Hot water above 50° C (122° F)
- Temperature logs and time to reach highest temperature

Chlorine
- Most common chemical method
- Maintain residual levels of 0.5-1 mg/L
- Chlorine residual logs
Long-term control

Monochloramine
- Used in hot water systems
- Normal residual rates between 1.0 – 3.0 mg/L

Chlorine dioxide
- Normal residual between 0.1 and 0.5 mg/L
- Remains a gas in solution, harder to maintain residual in hot water
Long-term control

Copper-Silver Ionization

- Water flows through electrically charged flow cells with copper and silver anodes releasing copper and silver ions into the water
- Most commonly used on recirculating hot water systems
- Recommended residual of 0.3 – 0.8 ppm for copper and 0.01 – 0.08 ppm for silver
Long-term control

Ultraviolet (UV)
- Best when used along with another measure

Filtration
- Point-of-use and point-of-entry
- Reverse osmosis, nanofilters, ultrafilters, and certain microfilters

Ozone
- Almost never used
Response to Outbreaks

- Clinical and epidemiological investigations
- Environmental components
**Legionella Outbreak Response**

- Consider implementing water use restrictions to prevent additional exposures and cases
  - Showering
  - Ice machines
  - Drinking water
  - Hand – washing and wound care
  - Commercial and industrial uses
- Install temporary water filtration
- *Legionella* testing for all pneumonia cases and enhanced surveillance
Epidemiological Investigations

Case investigations may uncover:

- Two or more cases with a common exposure (long-term care facility, work-site, gym, church, etc.)
- A person whose job involves contact with aerosols (e.g. manufacturing, etc.)
- A person who has been living in a long-term care facility for the 10 days prior to developing symptoms

These all merit further investigation.
Epidemiological Investigations

Further investigation may include:

- Case finding (retro and prospective)
- Use of CDC risk assessment tools
- Water testing
Tools for Case Interviews

- Legionellosis Case Report Form
- CDC Hypothesis Generating Questionnaire (as necessary)

Facility outbreak response

Coordinate with local health departments and ODH
Active case monitoring
Short term remediation options
Long term remediation
What to do if you have a case of Legionnaires’ Disease

- Individual cases (and outbreaks) are required to be reported to your city or county health department.
- Identify the patient’s onset date.
- Where was this person for the 10 days prior to onset (e.g. trips outside your facility)?
- Have there been other cases of pneumonia among residents or staff?
- Have there been other cases of flu-like illness (Pontiac Fever)?
- Follow the CDC Case Definition
- If other cases of pneumonia occur, test promptly for *Legionella*. 
Environmental Outbreak Response Actions

• If not done already - conduct a facility assessment
• The CDC assessment tool is a good start – https://www.cdc.gov/legionella/downloads/legionella-environmental-assessment.pdf
Environmental Outbreak Response Actions

- Evaluate and consider points of exposure
- Compare to data collected from the facility assessment
- Evaluate need to conduct environmental monitoring at key locations where exposure may have occurred
Environmental Outbreak Response

- Install temporary filtration until short term remediation actions are conducted to prevent exposure
  - Legionella bacteria is approximately 2µm in length and 0.3-0.9µm in width,
  - Point of use filtration devices must be capable of removing particles less than 0.3 micron in size at 99.999% efficiency
Environmental Outbreak Response Actions

- Implement short term remediation options
- Conduct environmental monitoring at points of potential exposure prior to and after short term remediation
- Use CDC ELITE certified laboratory for sample analysis
LIST OF POTENTIAL SAMPLING SITES

<table>
<thead>
<tr>
<th>Site</th>
<th>Approximate number of samples</th>
<th>Type of samples</th>
<th>Sample processing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potable water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incoming water main (where water enters the facility/campus/building)</td>
<td>1</td>
<td>1L bulk water</td>
<td>Concentrate</td>
</tr>
<tr>
<td>Every well and water tower that supplies water to the facility/campus/building</td>
<td>1 per well or water tower</td>
<td>1L bulk water</td>
<td>Concentrate</td>
</tr>
<tr>
<td>Every holding tank or cistern</td>
<td>1 per holding tank/cistern</td>
<td>1L bulk water</td>
<td>Concentrate</td>
</tr>
<tr>
<td>Centralized water heater</td>
<td>1</td>
<td>1L bulk water (or biofilm swab if drained)</td>
<td>Direct</td>
</tr>
<tr>
<td>Expansion tank for hot water (absorbs excess water pressure caused by thermal expansion within the hot water heater)</td>
<td>1</td>
<td>1L bulk water</td>
<td>Concentrate</td>
</tr>
<tr>
<td>Hot and cold water returns</td>
<td>1 each for hot and cold</td>
<td>1L bulk water</td>
<td>Concentrate</td>
</tr>
<tr>
<td>For buildings with water softeners, special filters, and disinfection systems, sample water before and/or after these processes</td>
<td>1</td>
<td>1L bulk water</td>
<td>Concentrate</td>
</tr>
<tr>
<td>Shower</td>
<td>2 per shower</td>
<td>1 biofilm swab and 1L bulk water</td>
<td>Concentrate</td>
</tr>
<tr>
<td>Faucet</td>
<td>2 or 3 per faucet</td>
<td>1 biofilm swab inside the faucet, 1L bulk water</td>
<td>Concentrate</td>
</tr>
<tr>
<td>Whirlpool baths (i.e., Jacuzzi)</td>
<td>1</td>
<td>1 biofilm swab inside the jets</td>
<td>Concentrate</td>
</tr>
</tbody>
</table>

**Cooling towers**

| Make-up water (water added to replace water loss because of evaporation, drift, or leakage) | 1                             | 1L bulk water | Direct |
| Collection basin (an area below the tower where cooled water is collected and directed to the sump) | 2                             | 1L bulk water and a biofilm swab at the water line | Direct |
| Sump (a depressed chamber contiguous to the basin, where water flows to facilitate pump suction; may also be used as collection point for all and drainage) | 2                             | 1L bulk water and a biofilm swab at the water line | Direct |
| Storage tank or reservoir in the system                              | 1                             | 1L bulk water | Direct |
| Cell eliminators or other surfaces that remain moist                 | 1                             | 1L bulk water | Direct |
| Heat sources (e.g., chillers)                                        | 1                             | 1L bulk water | Direct |
Facility outbreak response

Superheat and Flush
- Raise temperature to 71 - 77 °C (160° - 170° F) allowing for temperatures above 65 °C (149° F) at the outlets
- Duration may vary depending on system, approximately 30 minutes
- Not appropriate for cold water systems
- Restrict water usage during treatment
Facility outbreak response

Hyperchlorination
- Raise chlorine levels to a range between 20 – 50 mg/L
- Maintained for 2-24 hours
- Flushed at 20 mg/L through each distal site or fixture
- Restrict water usage during treatment
Cooling Towers

- Evaluation of cooling tower maintenance
- As necessary conduct physical cleaning
  - Areas that hold water
  - Areas where water circulates
  - Remove any biofilms
- Re disinfection of cooling tower and addition of fresh biocidal agents
Post Outbreak Actions

- After outbreak –
  - Develop or update, and implement water management plan
  - Implement and monitor control measures as needed
  - If necessary, install long term treatment
  - Continue disease surveillance
Resources and training


- ODH http://www.odh.ohio.gov/features/archived/Legionella.aspx

- Local Health Departments - http://www.odh.ohio.gov/localhealthdistricts/lhdmain.aspx

- Ohio EPA – Division of Drinking and Ground Waters http://www.epa.state.oh.us/ddagw/DrinkingandGroundWaters.aspx
CDC training

• Additional training on the CDC water management toolkit and facility assessment tool
• Scheduled for August 9, 2017 from 10:00 am to 12:00 pm.
• Connection information will be mailed and emailed.
Follow up survey

• To help ODH identify future training needs – please take the quick five question survey at: https://www.surveymonkey.com/r/7MQRNBP

• Thank you!
Contact Information

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