Update on Legionnaires’ Disease in Wisconsin

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Wisconsin Department of Health Services

Presentation Topics: Legionella

Background and ecology  Growth and transmission

Burden and surveillance  Public health investigations

Legionella

Fastidious aerobic Gram-negative bacilli

60+ species and 70+ serotypes are recognized.

Legionella pneumophila serogroup 1 is most commonly associated with disease.
Legionnaires’ Disease
American Legion Convention, Philadelphia 1976

Large outbreak of pneumonia among attendees caused by newly identified bacteria

New disease named for the outbreak — Legionnaires’ disease

Bacteria named Legionella pneumophila

Legionellosis

Legionnaires’ disease
Severe type of pneumonia

Pontiac fever
Mild febrile illness

Clinical Features

<table>
<thead>
<tr>
<th></th>
<th>Legionnaires’ disease</th>
<th>Pontiac fever</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signs and symptoms</td>
<td>Pneumonia</td>
<td>No pneumonia</td>
</tr>
<tr>
<td></td>
<td>Cough, fever, muscle aches, shortness of breath, chest pain, headache, confusion, diarrhea</td>
<td>Mild, self-limiting illness with fever and muscle aches</td>
</tr>
<tr>
<td>Incubation period</td>
<td>2–10 days (up to 2 weeks)</td>
<td>24–72 hours</td>
</tr>
<tr>
<td>Attack rate</td>
<td>&lt; 5%</td>
<td>&gt; 90%</td>
</tr>
<tr>
<td>Treatment</td>
<td>Antibiotics</td>
<td>Supportive care</td>
</tr>
<tr>
<td>Hospitalization</td>
<td>Common</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Case-fatality rate</td>
<td>10% (&gt;25% for healthcare-associated infections)</td>
<td>Extremely low</td>
</tr>
</tbody>
</table>

Case-fatality rate
10% (>25% for healthcare-associated infections)
Indications for Diagnostic Testing

Patients with pneumonia who:
• Are hospitalized with atypical pneumonia
• Are immunocompromised
• Fail to respond to antibiotic treatment
• May have healthcare-associated pneumonia
• Have a travel history (14 days before onset of symptoms)

Diagnostic Tests

Confirmatory Tests
• Culture from lower respiratory secretions
  Grown on special media, buffered charcoal yeast extract (BCYE) agar
• Urinary antigen test
  Only detects *Legionella pneumophila* serogroup 1

Non-Confirmatory Tests
• Polymerase chain reaction
• Serology (non-paired)

Legionella Ecology

Found naturally in fresh water but in insufficient quantities to cause disease
Grow in free-living protozoa in water
• Provide nutrients
• Protect from harsh environmental conditions
Can become a public health problem in human-made water systems
Natural water supply
Exposure to Legionella in freshwater environments is not associated with disease.

Complex plumbing system
Legionella grows best in warm water in building water systems that are not adequately maintained.

Amplification
- Warm water
**Conditions for Transmission**

- Rapid decline by 100% 158°F
- 90% decline in 2 minutes 140°F
- 90% decline in 2 hours 122°F
- 90% decline in 2 hours 108°F
- 90% decline in 2 hours 42°C
- 90% decline in 2 hours 77°F
- 90% decline in 2 hours 25°C

Dormant but viable

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**Amplification**

- Warm water (temperatures 77-108°F)
- Stagnation (dead legs in pipes)
- Sediment, scale, organic matter
- Absence of residual disinfectants in water supply
- Biofilm

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**Legionella** can live and grow in **biofilm**.

Source: https://www.cdc.gov/legionella/wmp/overview/growth-and-spread.html
Wisconsin Department of Health Services

Conditions for Transmission

Aerosolization
Devices that can aerosolize water droplets include:
• Showers and faucets.
• Jetted hot tubs.
• Decorative fountains.
• Evaporative cooling towers (used in large buildings).

Transmission
• Inhalation of aerosolized droplets, mists containing *Legionella*
• Aspiration (less common)
• Not transmitted from person to person

Host Risk Factors
People at increased risk for Legionnaires’ disease:
• Are aged 50 years and older.
• Are current or former smokers.
• Have chronic lung disease.
• Have a weakened immune system.
Common sources of infection during outbreaks involve complex water systems found in buildings such as:

- Hospitals.
- Long-term care facilities.
- Hotels.
- Cruise ships.

Sources of Infection

- Potable water
- Cooling towers
- Hot tubs
- Decorative fountains

National Incidence Trend

*National Notifiable Diseases Surveillance System
Wisconsin Incidence Trend
Laboratory-confirmed cases, Wisconsin Electronic Disease Surveillance System

Possible Reasons for Rising Trends
Increased susceptibility
Legionella in environment
Improved diagnostics
Improved surveillance

Disease Burden, Wisconsin
Laboratory-confirmed cases
Wisconsin Department of Health Services
Case Demographics, Wisconsin
Laboratory-confirmed cases by age group (years) and gender, 2012-2016 average

- 85% of cases are aged ≥50 years
- 75% of cases are aged ≥50 years

Seasonality, Wisconsin
Laboratory-confirmed cases by month of illness onset, 2012-2016 average

Epidemic Curve, Wisconsin
Laboratory-confirmed cases by month of illness onset, 2016-2018
Increased Reports during June 2018

STATE OF WISCONSIN
Department of Health Services
Division of Public Health

Date: July 5, 2018

To: Wisconsin Healthcare Providers, Infection Preventionists, Local and Tribal Health Departments, and Laboratories

From: Jim Vergezino, M.D.
Assistant Chief Medical Officer and State Epidemiologist for Communicable Diseases

Increased reports of laboratory-confirmed cases of legionellosis (Legionnaires' disease)

PLEAS DISTRIBUTE WIDELY

www.dhs.wisconsin.gov

Enhanced Statewide Surveillance

• Improve diagnosis and reporting.
  – Approval of fee-exempt testing at the Wisconsin State Laboratory of Hygiene
  – Culture of lower-respiratory secretions
• Use expanded questionnaire during public health follow-up.
  – Detailed exposure history during 14 days prior to symptom onset

Importance of Clinical Isolates

• Characterization of clinical isolates at WSLH and the CDC
  – Pulsed-field gel electrophoresis (PFGE)
  – Whole genome multilocus sequence typing (wgMLST)
• Essential to linking clinical cases and environmental sources
**Legionella Environmental Investigations**

If cases appear to be linked to a common source:

**Conduct environmental assessment.**

Completion of [CDC assessment form](https://www.cdc.gov/legionella/epidemiology/environmental/index.html) helps identify potential problem spots in water system with conditions that contribute to Legionella growth, and where samples should be collected.

**Collect and test water samples.**

In collaboration with DPH and other state or local agencies

**Determine course of action based on results.**

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**Legionella Environmental Investigations**

<table>
<thead>
<tr>
<th>Legionella detected in system</th>
<th>Legionella NOT detected in system</th>
</tr>
</thead>
</table>

**Remediation**

- Removal of Legionella from plumbing system is needed.
- Involvement of a team of specialists is needed.
- Development or amendment of a water management plan is required.

**Water management plan**

- Development or amendment of a water management plan is recommended.
- Provides long-term solutions for the control of Legionella.

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**Two Examples of Legionella Public Health Investigations and Response, Wisconsin**

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Example 1: Assisted Living Facility A, 2017

Case-patient A reported to public health on 7/17

- 62-year-old male
- Onset of illness: 7/14
  - Fever
  - Chills
  - Night sweats
  - No appetite
- Hospitalized 7/16 and diagnosed with pneumonia
- *Legionella* urinary antigen positive on 7/16

Example 1: Assisted Living Facility A, 2017

Case-patient A exposures:

- Admitted to facility A on 6/30
- Other exposures during incubation period:
  - Swimming in a pool
  - Showering at a fitness center
  - Grocery shopping
  - Attending church
  - Visiting a salon

Example 1: Assisted Living Facility A, 2017

Case-patient B reported to public health on 8/28

- 89-year-old female
- Onset of illness: 8/25
  - Fever
  - Cough
  - Weakness and fatigue
  - Decreased appetite
- Hospitalized 8/27 and diagnosed with pneumonia
- *Legionella* urinary antigen positive on 8/27
- Sputum collected 8/27 positive by culture on 9/7
Example 1: Assisted Living Facility A, 2017

Case-patient B exposures:

- Admitted to facility A on 8/9
- Other exposures during incubation period:
  - Possibly shopping
  (Unable to interview patient right away to determine additional exposures)

Environmental Investigation

- Municipal water not disinfected
- Hot water heater temperature settings
- No cooling tower/evaporative condenser
- No pool or whirlpool spa (single-use tub only)

Enhanced surveillance for Legionnaires' disease
Example 1: Assisted Living Facility A, 2017

Environmental Sampling
- Measurement of water quality parameters
  - Free or total chlorine levels
  - Temperature
  - pH
- Collection of environmental samples
  - Bulk water
  - Biofilm swab

Environmental Sampling
- Third floor (patient A room)
  - Water heater tank
  - Bathroom faucet
  - Shower
  - Kitchen faucet
- Second floor (patient B room)
  - Water heater tank
  - Bathroom faucet
  - Shower
  - Kitchen faucet
- Main floor
  - Water heater tank
  - Bathroom faucet
  - Kitchen faucet

Environmental Investigation
Enhanced surveillance for Legionnaires' disease
### Example 1: Assisted Living Facility A, 2017

#### Environmental Testing Results

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Date Collected</th>
<th>Specimen Type</th>
<th>Sample Description</th>
<th>Temp (°F)</th>
<th>Free Cl2 (ppm)</th>
<th>pH</th>
<th>Result</th>
<th>Count</th>
<th>Concentration, bulk water (CFU/ml)</th>
<th>Concentration, swab (CFU/sample)</th>
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</thead>
<tbody>
<tr>
<td>001</td>
<td>9/12/2017</td>
<td>Swab</td>
<td>Room B (patient B), shower</td>
<td>0.0</td>
<td>0</td>
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<td>Legionella pneumophila</td>
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<td>Room B, bathroom faucet</td>
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<td>Room B, bathroom faucet</td>
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<td>0.0</td>
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<td>Room A, water heater tank</td>
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<td>0.0</td>
<td>Legionella pneumophila</td>
<td>563</td>
<td>37</td>
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<td>Bulk water</td>
<td>Main floor, shared water heater</td>
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<td>016</td>
<td>9/12/2017</td>
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<td>Main floor, shared kitchen faucet</td>
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<td>0.0</td>
<td>Legionella pneumophila</td>
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<td>017</td>
<td>9/12/2017</td>
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<td>0.0</td>
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<td>53</td>
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<tr>
<td>018</td>
<td>9/12/2017</td>
<td>Swab</td>
<td>Main floor, shared bathroom faucet</td>
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<td>0</td>
<td>0.0</td>
<td>Legionella pneumophila</td>
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<td>53,000</td>
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<tr>
<td>019</td>
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<td>Main floor, shared bathroom faucet</td>
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<td>0</td>
<td>0.0</td>
<td>Legionella pneumophila</td>
<td>67</td>
<td>3.4</td>
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</tr>
</tbody>
</table>

#### Interpretation of Environmental Testing Results

- **Locations of positive samples**
  - Systemwide versus localized to distal points
  - In conjunction with environmental assessment
- **Presence versus absence of Legionella within water system**
  - *Legionella pneumophila*
  - Other *Legionella* species
  - Molecular subtyping and comparison with clinical samples
Example 1: Assisted Living Facility A, 2017

Linking Clinical and Environmental Isolates
PFGE at WSLH

Example 1: Assisted Living Facility A, 2017

Linking Clinical and Environmental Isolates
wgMLST at CDC

Example 1: Assisted Living Facility A, 2017

Response
• Remediation with assistance from specialized consultants
• Development of a water management plan

Immediate action steps during remediation process:
• Notification of residents, staff, and families
• Water restriction measures (for example, showering)
• Installation of point-of-use filters on faucets
• Continued enhanced surveillance for legionellosis
• Restriction of new admissions
Case-patient A reported to public health on 1/15

- 91-year-old male
- Onset of illness: 1/9
  - Weakness
  - Confusion
  - Shortness of breath
  - No appetite
- Hospitalized 1/13 and diagnosed with pneumonia
- *Legionella* urinary antigen positive on 1/13
- Patient died 1/18, primary cause of death: cancer

Case-patient A exposures:

- Admitted to facility B (assisted living) on 11/27/2017
- Other exposures during incubation period:
  - Grocery shopping
  - Outpatient hospital and clinic visits
Example 2: Facility B, 2018

Case-patient B reported to public health on 3/14

- 82-year-old female
- Onset of illness: 3/8
  - Weakness
  - Runny nose
  - No appetite
  - No fever or chills
- Hospitalized 3/12 and diagnosed with pneumonia
- *Legionella* urinary antigen positive on 3/12
- Patient died 3/19, cause of death: bronchopneumonia

Example 2: Facility B, 2018

Case-patient B exposures:

- Admitted to facility B (nursing home) on 9/1/2017
- Other exposures during incubation period:
  - Used a portable humidifier in her room

Example 2: Facility B, 2018

Environmental Investigation

- Municipal water supply (disinfected with chlorine)
- Connected water system (nursing home, assisted living)
- No recent construction or plumbing projects
- No cooling tower/evaporative condenser
- Outdoor fountains (during summer months only)
- No pool or whirlpool spa (single-use tubs only)
Example 2: Facility B, 2018

Environmental Investigation

Enhanced surveillance for Legionnaires' disease

|------|------|------|------|------|-----|-----|-----|

Environmental Sampling

- Boiler room
- Hot water storage tanks
- Nursing home
- Patient B shared bath
  - Tub faucet
  - Tub sprayer
  - Shower
- Nursing home
  - Patient B room
  - Personal humidifier
  - Room sink faucet
- Assisted living
  - Patient A room
    - Bathroom faucet
    - Shower
- Patient B room
  - Bathroom faucet
  - Shower

Example 2: Facility B, 2018

Environmental Investigation
### Example 2: Facility B, 2018

#### Environmental Testing Results

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Date Collected</th>
<th>Specimen Type</th>
<th>Sample Description</th>
<th>Temp (°F)</th>
<th>Free Cl2 (ppm)</th>
<th>pH</th>
<th>WSLH Result</th>
<th>Count, Concentration, bulk water (CFU/ml)</th>
<th>Count, Concentration, swab (CFU/sample)</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>3/27/2018</td>
<td>Bulk water</td>
<td>Water heater tank 1, left*</td>
<td>100.0</td>
<td>0.01</td>
<td>5.0</td>
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<td>&lt;0.053</td>
<td>-</td>
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<td>Bulk water</td>
<td>Water heater tank 2, right*</td>
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<td>004</td>
<td>3/27/2018</td>
<td>Swab</td>
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<td>Legionella pneumophila</td>
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<td>-</td>
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<td>Swab</td>
<td>Room A (patient A), sink</td>
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<td>Legionella pneumophila</td>
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<td>Bulk water</td>
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<td>34</td>
</tr>
<tr>
<td>016</td>
<td>3/27/2018</td>
<td>Swab</td>
<td>Personal humidifier (patient B)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Legionella pneumophila</td>
<td>533</td>
<td>13,000</td>
</tr>
</tbody>
</table>

*Water recirculates between all three water heater tanks

### Response

- Remediation with assistance from specialized consultants
- Revision of existing water management plan

**Immediate action steps during remediation process:**

- Notification of residents, staff, and families
- Water restriction measures (for example, showering)
- Installation of point-of-use filters on faucets, showers, sprayers
- Continued enhanced surveillance for legionellosis
- Restriction of new admissions
Preventing Legionella Growth and Colonization

Centers for Medicare and Medicaid Services Requirement

Preventing Legionella Growth and Colonization

Developing a Water Management Program: CDC Toolkit

- Basic elements of a water management program
- Common scenarios, responses, and special considerations

Water Management Program Resources

- CMS, Legionella and Other Waterborne Pathogens Webinar: [surveyortraining.cms.hhs.gov/pubs/VideoInformation.aspx?id=134&cid=0CMSLEG_WEB_Archived](http://surveyortraining.cms.hhs.gov/pubs/VideoInformation.aspx?id=134&cid=0CMSLEG_WEB_Archived)
Additional Information and Resources

- Wisconsin Department of Health Services (DHS), Legionellosis webpage:
  www.dhs.wisconsin.gov/disease/legionellosis.htm
- Wisconsin DHS, Division of Quality Assurance, Hot Water Temperatures in Adult Family Homes, 2017:
  www.dhs.wisconsin.gov/publications/p01942.pdf
- Wisconsin DHS, Investigating Legionellosis in Wisconsin, Epi Express, Spring 2018:
- CDC Legionella information: www.cdc.gov/legionella/index.html
- CDC Vital Signs, Healthcare-associated Legionnaires’ Disease, 2017:
  www.cdc.gov/vitalsigns/pdf/2017-06-vitalsigns.pdf
- CDC Environmental Investigation Resources: www.cdc.gov/legionella/health-depts/environmental-inv-resources.html
- U.S. Environmental Protection Agency, Technologies for Legionella Control in Premise Plumbing Systems, 2016:
  www.epa.gov/ground-water-and-drinking-water/technologies-legionella-control-premise-plumbing-systems
- World Health Organization, Water Safety in Buildings, 2011:
  apps.who.int/iris/bitstream/handle/10665/76145/9789241548106_eng.pdf

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- Wisconsin State Laboratory of Hygiene
- Wisconsin Occupational Health Laboratory
- Wisconsin DHS, Division of Quality Assurance
- Wisconsin Department of Agriculture, Trade, and Consumer Protection
- Wisconsin Department of Safety and Professional Services
- CDC Team Legionellosis
- CDC Epidemiology and Laboratory Capacity (ELC) Cooperative Agreement

Questions?

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LEGIONELLOSIS
(Legionnaires’ Disease, Pontiac Fever)

10/30/2018
Legionnaires’ Disease
A problem for health care facilities

Legionnaires’ disease (LD) is a serious, and often deadly, lung infection (pneumonia). People usually get it by breathing in water droplets containing *Legionella* germs. People can also get it if contaminated water accidentally goes into the lungs while drinking. Many people being treated at health care facilities, including long-term care facilities and hospitals, have conditions that put them at greater risk of getting sick and dying from LD. *Legionella* grows best in buildings with large water systems that are not managed effectively. CDC outbreak investigations show that effective water management programs—actions that reduce the risk of *Legionella* growing and spreading in building water systems—can help prevent problems that lead to LD. Health care facility leaders* should be aware that LD is a risk in their facility and that they can take action to prevent infections.

Health care facility leaders can:

- Build a team focused on keeping their facility’s water safe.
- Create and use a water management program to limit *Legionella* and other waterborne germs from growing and spreading. [www.cdc.gov/legionella/WMPtoolkit](http://www.cdc.gov/legionella/WMPtoolkit)
- Work with healthcare providers to identify LD cases early and determine if the cases may be associated with a health care facility.
- Report LD cases to local public health authorities quickly and work with them to investigate and prevent additional cases.

Want to learn more? [www.cdc.gov/vitalsigns/legionella](http://www.cdc.gov/vitalsigns/legionella)

*Leaders may include infection control practitioners, facility managers, hospital administrators, quality assurance staff, or others.*
Health care facilities may put people at risk for LD when they do not have an effective water management program. These limit germ growth by:

- Keeping hot water temperatures high enough.
- Making sure disinfectant amounts are right.
- Keeping water flowing (preventing stagnation).
- Operating and maintaining equipment to prevent slime (biofilm), organic debris, and corrosion.
- Monitoring factors external to buildings, such as construction, water main breaks, and changes in municipal water quality.

Contaminated water droplets can be spread by:

- Showerheads and sink faucets.
- Hydrotherapy equipment, such as jetted therapy baths.
- Medical equipment, such as respiratory machines, bronchoscopes, and heater-cooler units.
- Ice machines.
- Cooling towers (parts of large air-conditioning systems).
- Decorative fountains and water features.

Health care facility leaders and providers should be aware that some people are at increased risk for LD:

- Adults 50 years or older.
- Current or former smokers.
- People with a weakened immune system or chronic disease.

16 of 21 jurisdictions reported definite cases of health care-associated LD in 2015

Reported definite cases of health care-associated LD
Did not report a definite case of health care-associated LD
Not included in the analysis: Jurisdictions reporting less than 90% of Legionella infections to SLDSS, which contains information such as health care facility exposures

*Alaska had no cases to report

SOURCE: Supplemental Legionnaires’ Disease Surveillance System (SLDSS), CDC, 2015.

A 62-year-old man has been in the hospital for 12 days and just started showing symptoms of pneumonia.

His doctor orders tests to check for different types of pneumonia. They come back positive for LD. He gets treated with antibiotics.

Infection prevention staff promptly contact the local health department to report the case.

Hospital staff review the patient’s stay at the hospital to see all the places he’s been exposed to water.

Hospital leaders and public health experts put measures in place to help protect others while figuring out how the patient got sick.

The water management team looks for changes in water quality and collects water samples from around the hospital to test for *Legionella*.

*Legionella* is found in the building’s water supply. Hospital leaders work with public health and other experts to make the water safe.

Hospital leaders remind providers to test for LD with respiratory culture and urinary antigen in patients with health care-associated pneumonia.

Hospital leaders review their water management program to see if they need to make changes to help prevent LD infections.

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**Health care facility leaders can protect patients from LD with prevention and early recognition.**

*The same steps apply when two or more cases of possible health care-associated LD (patients with LD who spent part of the 10 days before symptoms began at the same facility) are identified within 12 months of each other.*

What Can Be Done?

The Federal government is

- Promoting LD prevention practices and providing tools on how to develop water management programs for health care facilities and other at-risk buildings.
- Tracking LD and providing guidance in responding to outbreaks to find the source and help prevent more infections.

Health care facility leaders can

- Build a team focused on keeping their facility’s water safe.
- Create and use a water management program to limit *Legionella* and other waterborne germs from growing and spreading. [www.cdc.gov/legionella/WMPtoolkit](http://www.cdc.gov/legionella/WMPtoolkit)
- Work with healthcare providers to identify LD cases early and determine if the cases may be associated with a health care facility.
- Report LD cases to local public health authorities quickly and work with them to investigate and prevent additional infections.

Healthcare providers can

- Test for LD in people with health care-associated pneumonia, especially those with severe pneumonia or in facilities where other LD cases have been identified or *Legionella* has been found in the water.
- Test for LD in people with pneumonia who have a weakened immune system or chronic disease, fail outpatient treatment, require intensive care, or report recent travel.
- Order a culture specific for *Legionella* from a lower respiratory specimen (e.g., sputum), preferably before giving antibiotics. Also order a urinary antigen test.
- Talk to their laboratories to make sure they do *Legionella* tests on site or have another way to quickly get results.

State and local officials can

- Improve monitoring for LD in health care facilities (including reviewing previous cases to look for patterns), and respond promptly to reports of cases.
- Understand capacity of laboratories to process *Legionella* specimens, and encourage laboratories to save patient isolates for public health investigations.
- Report details for all LD outbreaks to CDC’s National Outbreak Reporting System. [www.cdc.gov/nors](http://www.cdc.gov/nors)
- Provide tools and information to help health care facility leaders create and use *Legionella* water management programs.

1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348
[www.cdc.gov](http://www.cdc.gov)
Centers for Disease Control and Prevention
1600 Clifton Road NE, Atlanta, GA 30329
Publication date: 06/06/2017

Practical guide for developing a *Legionella* water management program

[www.cdc.gov/legionella/WMPtoolkit](http://www.cdc.gov/legionella/WMPtoolkit)