Legionellosis: Epidemiology and Surveillance

Ellen Laine, JD, MPH
Infectious Disease Epidemiology, Prevention and Control Division
Minnesota Department of Health

Legionella bacteria by scanning electron micrograph (CDC image)
Outline

• Overview of *Legionella* and legionellosis

• Surveillance in Minnesota
History of Legionellosis

• First described after July 1976 outbreak at American Legion convention at a Philadelphia hotel

  – 221 cases, 34 deaths
In Philadelphia 30 Years Ago, an Eruption of Illness and Fear

A snapshot from an American Legion convention in Philadelphia in July 1976. Within a month, an infectious disease killed two of these men.

By LAWRENCE K. ALTMAN
Published: August 1, 2006
Stephen Thacker, right, of the U.S. Center for Disease Control, interviews Thomas Payne in Chambersburg Hospital in Pennsylvania on Aug. 4, 1976. Payne was one of the Legionnaires who became ill after attending a state convention in Philadelphia. (Associated Press Photo)
Scientists Link the Legion Disease To a Hitherto Unknown Bacterium

By HAROLD M. SCHMECK JR.
Special to The New York Times

WASHINGTON, Jan. 18—Federal scientists believe that they have discovered the cause of the mysterious legionnaires' disease that killed 29 persons who were in Philadelphia during an American Legion convention there last July.

The apparent cause was a hitherto unknown bacterium discovered by scientists at the Center for Disease Control in Atlanta. The center is the Federal agency that has been searching for the cause of the mysterious deaths since midsummer.

Announcing the discovery today, Dr. David Sencer, director of the center, said that the bacteria have been "quite definitely associated with the disease." The newly discovered type of bacterium also appears to have been the cause of an earlier mysterious outbreak of fatal pneumonia among patients at St. Elizabeths Hospital here in 1965.

"The present findings provide very strong evidence that the two epidemics were caused by the bacterium," said a report on the discovery released today by the center.

The report said that there had not been time to identify the organism, thus leaving open the question of whether it was something entirely new to medical science or some obscure germ that had previously been seen but not identified with pneumonia in humans.

The source of the bacteria and the manner in which they were transmitted to humans in Philadelphia and in the earlier outbreak at St. Elizabeths Hospital are

Continued on Page D17, Col. 4
Legionella Bacteria

• Atypical gram-negative bacteria; 52 species (22 associated with human illness), 70 serogroups (most common: *L. pneumophila* serogroup 1 [Lp1], ~90% of cases)

• Difficult to culture (CBYE media)

• Intracellular parasite of free-living protozoa primarily found in freshwater environs, but natural environments (lakes, rivers) unlikely to have sufficient quantity for human infection

• “Ubiquitous”
Legionella Bacteria (cont.)

- Loves temps in 20 – 45 degree C (68 – 113 degree F) range, stagnant environments, scale, sediment, biofilm, free-living aquatic amoebae, low/undetected biocide levels

- Does not spread person-to-person; transmission is via aerosolized water; bacteria-containing droplets inhaled and infect respiratory tract

- Outbreaks have been attributed to sources including cooling towers, showers, hot tubs, decorative fountains, grocery store misters

- “Heat, stasis, and aerosolization”
Legionellosis: Legionnaires’ Disease vs. Pontiac Fever

- **LD**: Pneumonia, commonly resulting in hospitalization including ICU and mechanical ventilation; antibiotic treatment; case fatality rate 5-40%; attack rate <5%; high risk groups those >50 years, smokers, immunosuppression, diabetes, COPD; incubation period 2-10 days

- **PF**: Milder, flu-like illness rarely requiring treatment; attack rate 85%; not restricted to high risk groups; incubation period 1-3 days; may be an inflammatory response to *Legionella* endotoxin)
Clinical Features

- Incubation period 2 to 10 days
- Loss of appetite, malaise, fatigue, headaches, myalgia progressing to fever, nonproductive cough, nausea, diarrhea
- Clinical diagnosis of pneumonia by chest x-ray or CT scan
- Treatment includes antibiotics and supportive measures; may require ICU care and mechanical ventilation
- Can progress to respiratory failure, septic shock; can be fatal in approximately 5-30% cases
Diagnostic Testing

- **Culture** is “gold standard” (e.g., of sputum or bronchoalveolar lavage); can be technically difficult and time consuming; availability of clinical isolates to compare to environmental isolates is valuable for outbreak investigations.

- **Urine antigen test** is currently the most common by far diagnostic test—quick and accurate, though only detects most common strain (Lp1); can be positive for weeks after infection.

- **Serology** used to be more commonly used, but requires paired sera four-fold rise (acute and convalescent); acute sera result only has no diagnostic value; **DFA** also rarely used now.

- **PCR** detection of *Legionella* DNA—currently a positive means a “suspected” not “confirmed” case.
CDC Data on National Disease Burden

• Major cause of severe atypical, community-acquired pneumonia

• Estimated 8,000 – 18,000 hospitalizations per year; 5 – 30% case fatality rate

• Increased incidence but may be in part a surveillance artifact (urine antigen test?)—0.39 per 100 K in 2000 to 1.36 in 2011 (249% increase) (from 1110 to 4202 cases)
CDC Data on National Disease Burden (cont.)

• Number one cause of “drinking water” outbreaks (recent MMWR- 21 of 32 such outbreaks caused by Legionella, 2011-2012)

• Estimated 80-90% of cases are SPORADIC (not outbreak-linked)

• Estimated 20% of cases are travel-associated (definition: case spent at least one night away from home in 10 days prior to onset)
MDH Surveillance

- Reportable disease by state law; nationally notifiable
- Active surveillance/audits
- Try to interview all cases/proxies
- Clusters (cases close together in time/space) investigated; database of locations maintained
- Travel out of state reported to CDC
- Outbreaks reported to CDC
Confirmed Legionellosis Cases
Minnesota, 2004-2014

Number of Cases

Year of Diagnosis

17 34 26 30 25 27 36 28 51 50 58
Reported Cases, MN, 2014

58 confirmed cases (additional 5 suspected cases by PCR only); rate 1.1 per 100,000 population

- Pneumonia: 98%
- Hospitalized: 95% (median 5d, range 1-35d)
- ICU admit: 43%
- Mechanical ventilation: 28%
- Died: 2%
- Male: 67%
- Age ≥50 years: 67% (median 50y, range 25-91y)
- Onset June – September: 47%
- Metro area resident: 57%
- Sporadic: 97%
# Minnesota Outbreaks

<table>
<thead>
<tr>
<th>Year</th>
<th>Outbreak Type</th>
<th>Illness Type</th>
<th>Source</th>
<th>Setting</th>
<th>No. Cases</th>
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<tr>
<td>1988</td>
<td>Recreational Water</td>
<td>PF</td>
<td>Spa Pool</td>
<td>Hotel</td>
<td>28</td>
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<td>2000</td>
<td>Other</td>
<td>PF</td>
<td>Plant lagoon/power washer</td>
<td>Sugar beet plant</td>
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<td>2000</td>
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<td>Spa Pool</td>
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<td>2013-14</td>
<td>Other</td>
<td>LD</td>
<td>Decorative water wall</td>
<td>Casino</td>
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</tbody>
</table>

*PF = Pontiac Fever; LD = Legionnaires’ Disease*
Health Care Settings

• Infection preventionists at health care facility are our point of contact for following up on a case potentially exposed at facility
• Follow CDC HICPAC guidance
  Available at: http://www.cdc.gov/hicpac/pubs.html
• Stem cell/solid organ transplant units vs. Other settings
• Primary prevention vs. Secondary prevention
Health Care Settings (cont.)

• CDC does not strongly recommend routine environmental testing for *Legionella*; but says facilities could do so as part of a comprehensive water management plan
  - Unclear how to use routine testing information as a risk measure
  - But once facilities test, should be prepared to eliminate *Legionella* from their water system

• CDC has helpful information about environmental assessment, sampling, and remediation on their *Legionella* website:
  http://www.cdc.gov/legionella/index.html
Bronx Outbreak, 2015

- July: outbreak detected in South Bronx; ultimately at least 128 cases and 12 deaths
- Multiple cooling towers in area tested positive
- Regulatory response:
  - NYC health commissioner emergency order
  - NYC city council passed legislation signed by mayor
  - State of NY released emergency health regulations
Bronx Outbreak, 2015 (cont.)

- August 20: source announced as a hotel cooling towers; matched “DNA fingerprint” of cases; “inadequate maintenance and inadequate levels of biocide may have contributed”
- *L. pneumophila* serogroup 1 (Lp1)
  - Three labs, three lab methods: pulsed-field gel electrophoresis (PFGE); sequenced based typing; whole genome sequencing (WGS); rapid PCR was used for detection in cooling towers water, then samples cultured & subtyped
Finding the Source
Linking Cooling Towers and Patients by DNA

Affected Area

Outbreak Pattern Found
- Opera House Hotel Cooling Tower
- Patients (with Legionella DNA results)*

Outbreak Pattern Not Found
- Cooling Towers¹
- Patients (without Legionella DNA results)

*As of last update, all patient results match the outbreak pattern.
¹Includes cooling towers in which the outbreak pattern could not be determined and those with pending results.

Map updated on August 20, 2015.

NYCDOH,
GE_Results_for_Cases.pdf
City Urges Precautions To Bar Legion Disease

By The Associated Press

Operators of water cooling towers used for air-conditioning or refrigeration should clean them twice a year to prevent possible development of legionnaires’ disease, the city’s Health Department said yesterday.

Commissioner Reinaldo A. Ferrer said: “Since investigations appear to show a possible link between contaminated water cooled units and legionnaires’ disease, the department is recommending that operators of these units provide proper operations and maintenance procedures.”

The New York Times
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