Legionella

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Legionella

- What is it
- The Disease
- Sources
- Sampling
- Prevention
New York: The outbreak of Legionnaires’ disease — the worst in the city’s history — has claimed 12 lives and sickened more than 120 people since early July in the South Bronx, where residents have asthma, diabetes and other health issues. In response, city health officials ordered this month that every building with a cooling tower had to disinfect it within two weeks of receiving the notice.
Legionella Outbreak 2015

- Autopsy confirms Legionnaires' disease in KC death

- Age 40, became ill with what he thought was the flu and eventually went to a doctor. By the time he wound up at a hospital, his organs were failing. He had a stroke and a heart attack. The cause of his death was officially listed as pneumonia and multiple organ failure
Legionella Outbreak 2015

- San Quentin: 4 cases
- Illinois: 10 deaths
- NASA Center: 1 case
- Toledo: 19 cases
- England: 9 cases in two cities
- Hong Kong: 40 cases
Discovery of Legionnaires’ Disease & Legionella

- American Legion Pennsylvania State Convention July of 1976
- 221 cases of a strange respiratory illness
- Two-thirds of the patients required hospitalization and 34 died
- Discovery of the causative agent, a bacterium, in subsequently named Legionella pneumophila
- Not a new disease discovered in 1976 -- just an old one, finally recognized and named.
Terms, Definitions, & General Facts

- Gram-negative, rod-shaped, aerobic bacteria very common to warm water, environments
- 40 identified species of Legionella, more than half being linked to human diseases and 60 serogroups
- Legionellosis is any illness caused by exposure to Legionella
- Legionnaires’ Disease is an environmental disease, not a communicable disease
Legionnaires’ Disease is a potentially fatal, multi-system respiratory illness.

- Attacks 2 to 5% of those exposed, representative of those most susceptible,
- Average mortality rate of approximately 15 to 20%
- Incubation within 2 to 10 days of exposure
- Will not abate without medication
Symptoms include:

- High Fever, Chills, Headache, Muscle Pain (Flu-like symptoms),
- Dry Cough and Difficulty in Breathing (eventual symptoms),
- Diarrhea and/or Vomiting are common, and
- Confusion and Deliriousness are common
Epidemiological Triad

Source: Snieszko (1974), Blackwell Publishing Ltd. Copyright 1974
Epidemiology - Legionellosis

- **Agent: *Legionella pneumophila***
  - 80-90% of human infections
  - Atypical gram – negative bacillus
  - Symbiotic organisms
    - Algae
    - Amoeba
    - Ciliated protozoa - invades
    - Bacteria
  - Habitat: Aquatic bodies
Epidemiology - Legionellosis

• **Causes 2 clinical syndromes:**
  – Legionnaires Disease (pneumonia)
  – Pontiac fever (flu like illness)

• **Incidence** of Legionnaire’s Disease depends on:
  – Degree of contamination of aquatic reservoir
  – Immune status of persons exposed
  – Intensity of exposure
Epidemiology - Legionellosis

- **CDC** estimates only 3% of sporadic community acquired Legionnaire’s disease in US are correctly diagnosed

- **Host risk factors:**
  - Cigarette smoking
  - Chronic lung disease
  - Advanced age
  - Discharge from hospital within 10 days
  - Immunosuppressive conditions
Epidemiology - Legionellosis

**Environment:**
- Natural bodies – small number
- Survive for years in refrigerated water
- Proliferate in:
  - Warm temperatures (25° – 42° C)
  - Scale
  - Sediment

**Modes of transmission:**
- Aerosolisation
- Aspiration
Epidemiology - Legionellosis

Reported Cases of Legionellosis, by Month of Onset, West Virginia, 1999-2008, (N=149)

Legionellosis became reportable in West Virginia in 2003.
Epidemiology - Legionellosis

Average Yearly Age Specific Incidence* of Legionellosis, West Virginia, 1999-2008, (N=149)

Rate per 100,000 Population

Age Group

<1 1-4 5-14 15-24 25-34 35-44 45-54 55-64 >=65

0.00 0.00 0.00 0.08 0.22 0.80 1.09 2.03 1.69


Legionellosis became reportable in West Virginia in 2003.
• Inspected exposures potential in:
  – Drinking water
  – Spa
  – Pools
  – Hot water tubs
  – Race track
  – Showers/baths
Environmental Assessment

- **District, State Engineers and Environmental Health professionals**
  - Inspection of water sources
  - Room to Room
  - All aquatic bodies

- **Meteorological considerations**
  - Cooling towers
  - Data on wind direction, velocity and humidity
Growth & Amplification of Legionella

- Stagnant water conditions
- Warm water temperatures between 68 to 122°F (Optimal 95 to 115°F)
- A pH range between 5.0 to 8.5
- Sediment, scale, deposits, biofilms - also supports the very important supporting microbiota for Legionella.
Growth & Amplification of Legionella

- Microbiota including algae and many bacteria that supply essential nutrients for growth of Legionella.
- Certain amoebae and other protozoan that harbor Legionella as endosymbionts -- allowing them to thrive, resist harsh environmental conditions (including biocides) and to significantly amplify.
Amplification of Legionella (source)

• Cooling Towers and Evaporative Condensers,
• Domestic Hot Water Systems (tap faucets, showerheads, sprayers),
• Spas and Whirlpools (on display or otherwise),
• Humidifiers,
• Decorative Fountains,
Amplification of Legionella (source)

- PTAC, hotels,
- Supermarket Reservoir Misters,
- Respiratory Therapy Equipment,
- Dental Hygiene Equipment, and
- Eyewash Stations & Safety Showers
Contact your lab before collecting samples.

- Cultured Samples (up to 10 days)
- Polymerase Chain Reaction (PCR), fast screening, cannot differentiate between live and dead cells.
**Detection of Legionella**

<table>
<thead>
<tr>
<th>Action</th>
<th>Cooling tower/Evaporative Condenser</th>
<th>Potable water</th>
<th>Humidifiers and Misters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1,000</td>
<td>100</td>
<td>10</td>
</tr>
</tbody>
</table>

The levels requiring action vary for the source of exposure, based on the assumption that some routes of exposure result in a greater dose to the lung. For this reason humidifiers and similar devices (such as misters and evaporative condensers) produce aerosol mists and, therefore, need to be controlled to lower levels than cooling towers and domestic water supplies to minimize the risk of inhalation. Levels of LDB equal to or greater than the values in the table constitute a need for action, as described below:

**Action 1**
- Cleaning followed by biocide treatment of the system, if appropriate.

**Action 2**
- Cleaning and or biocide treatment.
- Take immediate steps to prevent employee exposure.

**Remember that these numbers are only suggested guidelines, and the goal is zero detectable LDB in a water source.**

Detection of Legionella

Association of Water Technologies (AWT) Guidelines:

The action plan seen in Table 2. represents a composite compilation of various AWT member Water Treatment Company LDB actions plans for cooling tower operations.

| Table 2. Cooling Tower Legionella Count, colony forming units (CFU) per milliliter |
|----------------------------------|----------------|----------------|----------------|
| >0-10                            | >10-100        | >100-1000       | >1000          |
| a.                               | b.             | c.              | d.             |
| a. Increase biocide addition/s.  | b. Increase biocides; review program; retest till <10. | c. Disinfect and clean within 30 days; review program. | d. Disinfect and clean within 7 days; review program. |
Solving the Mystery

\[ \frac{1}{n} \sin x = ? \]

\[ \frac{1}{n} \sin x = \]

\[ \text{six} = 6 \]
Prevention: Plumbing

- Five common methods of Legionella disinfection for plumbing systems
  - Heat-and-flush (heat shock):
  - Chlorination:
  - Ultraviolet radiation:
  - Ozonation
  - Copper-silver ionization:
Prevention: Cooling Towers

- Cooling towers and evaporative condensers
  - Cooling tower drift
  - Residence time in the water loop
  - Deposits and sediment debris
  - Ineffective cooling water treatment practices
  - Neglect
Prevention: Cooling Towers

- Biocide Treatments
- Total Bacterial Counts (TBC)
- Bio-dispersants
- Cooling Tower Disinfection
- Maintenance
Prevention: Cooling Towers

- Scheduled inspections
- Biocides
  - Oxidizing agents
  - Non-oxidizing agents
- Wisconsin Protocol
- Recordkeeping
Resources

4. Legionella: An Update and Statement by the Association of Water Technologies (AWT)
Thank You