Colorado Legionnaires’ Disease Outbreaks: Lessons Learned
Contact Info

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Agenda

1. Colorado LD Epi
2. Pool Inspections in Colorado
3. Outbreaks
4. Questions
Legionnaires' disease cases by case status and year
Colorado, 2008 - 2018
Legionnaires’ Disease Hospitalization Status Colorado, 2014-2018
n= 412
- Hospitalized: 94.0%
- Not Hospitalized: 4.0%
- Unknown/Missing: 2.0%

Legionnaires’ Disease Outcome Status Colorado, 2014-2018
n= 412
- Died: 8.0%
- Survived: 83.0%
- Unknown/Missing: 9.0%
Recreational Water Inspections in Colorado

5 CCR 1003-5, Swimming Pool and Mineral Bath Regulations

1. Not all public health agencies in Colorado have environmental health programs or perform routine pool inspections.

2. Facilities are characterized as either private (not inspected), semi-public, or public.

3. Semi-public and public facilities are required to adhere to state regulations at all times, even if they are not routinely inspected.
Few critical violations that require immediate closure of a facility

- Elevated bacterial or fecal coliform levels
- Out of range chlorine or pH
- Turbidity issues related to main drain visibility
Outbreak #1
First Investigation

- May 10, 2016- notified of the first case; MN resident.
- November 29, 2016- Notified of the second case; CO resident.
- December 1, 2016- First environmental investigation conducted at the facility. Pool/hot tub closed.
## Environmental Sampling Round 1

<table>
<thead>
<tr>
<th>Sample #</th>
<th>Culture Result</th>
<th>Sample Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>Pool water</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>Pool water line swab</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>Pool filter basket swab</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>Pool pump swab</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>Hot tub water</td>
</tr>
<tr>
<td>6</td>
<td>-</td>
<td>Hot tub water line swab</td>
</tr>
<tr>
<td>7</td>
<td>-</td>
<td>Hot tub jet swab</td>
</tr>
<tr>
<td>8</td>
<td>-</td>
<td>Hot tub pump swab</td>
</tr>
<tr>
<td>9</td>
<td>-</td>
<td>Guest room jacuzzi swab</td>
</tr>
<tr>
<td>10</td>
<td>-</td>
<td>Pool shower swab</td>
</tr>
</tbody>
</table>
Round 1 Pictures
Second Investigation

• April 3, 2017- at 6:00 am the pool and hot tub are routinely inspected and both are closed due to multiple critical violations of state code. At 12:00 pm, CDPHE is notified of a third case associated with this facility; NM resident.

• April 4, 2017- Second environmental investigation conducted.
# Environmental Sampling Round 2

<table>
<thead>
<tr>
<th>Sample #</th>
<th>PCR Result</th>
<th>Culture Result</th>
<th>Sample Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+</td>
<td>+</td>
<td>Hot tub water</td>
</tr>
<tr>
<td>2</td>
<td>+</td>
<td>-</td>
<td>Pool water</td>
</tr>
<tr>
<td>3</td>
<td>+</td>
<td>+</td>
<td>Hot tub jet swab #1</td>
</tr>
<tr>
<td>4</td>
<td>+</td>
<td>+</td>
<td>Hot tub jet swab #2</td>
</tr>
<tr>
<td>5</td>
<td>+</td>
<td>-</td>
<td>Hot tub water line swab #1</td>
</tr>
<tr>
<td>6</td>
<td>+</td>
<td>-</td>
<td>Hot tub water line swab #2</td>
</tr>
<tr>
<td>7</td>
<td>+</td>
<td>-</td>
<td>Pool water line swab #1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample #</th>
<th>PCR Result</th>
<th>Culture Result</th>
<th>Sample Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>+</td>
<td>-</td>
<td>Pool water line swab #2</td>
</tr>
<tr>
<td>9</td>
<td>+</td>
<td>-</td>
<td>Rear air vent swab</td>
</tr>
<tr>
<td>10</td>
<td>+</td>
<td>+</td>
<td>Hot tub filter basket swab</td>
</tr>
<tr>
<td>11</td>
<td>+</td>
<td>-</td>
<td>Pool filter basket swab</td>
</tr>
<tr>
<td>12</td>
<td>+</td>
<td>-</td>
<td>Front air vent swab</td>
</tr>
<tr>
<td>13</td>
<td>+</td>
<td>+</td>
<td>Hot tub pump swab</td>
</tr>
<tr>
<td>14</td>
<td>+</td>
<td>-</td>
<td>Pool pump swab</td>
</tr>
</tbody>
</table>

*All 19 potable water samples were negative through both PCR and culture*
Round 2 Pictures
Consistent closures due to critical violations of the Colorado Swimming Pool and Mineral Bath Regulation

- 4/4 (100%) failed inspections between February 2016 and April 2017
Inspection Violation History

February 2016
- Spa ph too high and visible debris
- No CPO on staff
- Maintenance records not maintained
- Flow meter not functioning
- Pool disinfectant greater than allowable limit

October 2016
- No CPO on staff
- Maintenance records not maintained
- Flow meter not functioning

June 2016
- Flow meter not functioning
- Maintenance records not maintained
- No CPO on staff

April 2017
- Spa ph too low
- Pool had no detectable disinfectant (Cl)
- Alkalinity too low in pool and spa
- No CPO on staff
- Maintenance records not maintained
- Flow meter not functioning
Epidemiologic Investigation

Epi-X Report
1. Report released on April 10, 2017 through the Epidemic Information Exchange (Epi-X) facilitated by the CDC
2. Notified other counties and states about this exposure

Guest Notification
1. Received contact information for 177 guests that had recently stayed at the hotel (March 3-April 3, 2017)
2. 152/177 guests were able to be contacted
3. No additional confirmed cases were found
   • 3 suspect cases identified that developed pneumonia within 14 days of exposure to the pool or hot tub
# Case Information

<table>
<thead>
<tr>
<th>Patients</th>
<th>Sex</th>
<th>Age</th>
<th>Symptom onset</th>
<th>Case definition</th>
<th>Used hot tub</th>
<th>Used shower</th>
<th>Hospitalized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>Male</td>
<td>63</td>
<td>4/27/2016</td>
<td>Confirmed</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Case 2</td>
<td>Female</td>
<td>63</td>
<td>10/23/2016</td>
<td>Confirmed</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Case 3</td>
<td>Female</td>
<td>45</td>
<td>03/12/2017</td>
<td>Confirmed</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Environmental Remediation

• Mitigation
  ▪ Complete disinfection of the system

• Follow-up testing
  ▪ 6 month re-testing schedule
Mitigation Requirements

1. Drain hot tub (voluntarily drained the pool)

2. Scrub all hot tub and pool surfaces, skimming devices, jets, and circulation components with disinfectant

3. Replace sand filter media and service sand filter unit

4. Inspect for and fix broken or poorly functioning components

5. Refill and superhalogenate water in hot tub and pool

6. Disinfect and/or replace both air filters
Post-Mitigation Pictures
Follow-Up Testing

6 month re-testing schedule
• Sampling every 2 weeks for 3 months, and then
• Sampling once a month for 3 months

Conditions for re-opening
• Negative *Legionella* culture test results
• Pass inspection by JCPH

Conditions for closure
• Any positive *Legionella* culture test results
• Fail inspection by JCPH

- Failed initial inspection after mitigation resulting in delayed opening
- Failed another inspection at the end of July
- Positive samples found at the end of September
Challenges

Communication & Protocol

• Informing about why we were conducting an investigation
  ▪ Response to confirmed illness, not complaints
• Reiterating the overall process and requirements
  ▪ Ensuring proper procedures were followed
• Disagreement over investigation methods
  ▪ Difficulty obtaining guest information
  ▪ Messaging to guests

Knowledge

• Education about *Legionella* and the public health impact
  ▪ All 3 cases were hospitalized
• CPO rarely, if ever, on site
  ▪ No one on staff who understood recreational water risks and operational standards
• Inspection history considerations and improvements
Outbreak #2
Initial Notification

Phone call from a VA physician

• Reports treating a pneumonia patient who told her that a few other people who attended the same wedding as him were also sick

Medical record review and interviews

• 5 people who attended the same wedding developed pneumonia within 10 days of the event; 3 were hospitalized. Pathogen unknown but suspected to be *Legionella*. 
Epi Curve

Cluster of Unexplained Pneumonia by Date of Onset
Summer 2017

Exposure period
Incubation period
First notification
Second notification
Environmental Investigation

Number of Cases
Onset of illness

Hospitalized
Not hospitalized

7/28/2017
7/29/2017
7/30/2017
7/31/2017
8/1/2017
8/2/2017
8/3/2017
8/4/2017
8/5/2017
8/6/2017
8/7/2017
8/8/2017
8/9/2017
8/10/2017
8/11/2017
8/12/2017
8/13/2017
8/14/2017
8/15/2017
8/16/2017
8/17/2017
8/18/2017
8/19/2017
8/20/2017
8/21/2017
8/22/2017
8/23/2017
8/24/2017
## Case Findings

<table>
<thead>
<tr>
<th>Characterization</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Had pneumonia</td>
<td>100% (5)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>Hospitalized</td>
<td>60% (3)</td>
<td>40% (2)</td>
</tr>
<tr>
<td>Survived</td>
<td>100% (5)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>Used room shower</td>
<td>100% (5)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>Went into the pool/hot tub</td>
<td>60% (3)</td>
<td>40% (2)</td>
</tr>
<tr>
<td>Spent time in the atrium</td>
<td>100% (5)</td>
<td>0% (0)</td>
</tr>
</tbody>
</table>
Environmental Investigation

Rooftop Chillers/Swamp Coolers
- Rough shape; leaks, cracks, sediment...etc
- Dead bird inside one of the chillers

Pool/Hot Tub
- Pool hadn’t been drained in 5 years
- Chemical levels were way off
- Filter media hadn’t been replaced in quite a while
- No CPO on staff
- No records being kept

Potable Water System
- Problems with water heaters and water temperature
- Brown water came out of one of the showers
## Lab Results

<table>
<thead>
<tr>
<th>Legionella PCR</th>
<th>Legionella Culture</th>
<th>Sample Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>POS</td>
<td>NEG</td>
<td>SW Swamp Cooler Water</td>
</tr>
<tr>
<td>POS</td>
<td>NEG</td>
<td>SE Swamp Cooler Water</td>
</tr>
<tr>
<td>POS</td>
<td>POS</td>
<td>Pool Water*</td>
</tr>
<tr>
<td>POS</td>
<td>NEG</td>
<td>Pool Filter Basket Swab #1</td>
</tr>
<tr>
<td>POS</td>
<td>NEG</td>
<td>Pool Filter Basket Swab #2</td>
</tr>
<tr>
<td>POS</td>
<td>POS</td>
<td>Pool Water Line Swab #1</td>
</tr>
<tr>
<td>POS</td>
<td>POS</td>
<td>Pool Sand Filter Swab</td>
</tr>
<tr>
<td>POS</td>
<td>NEG</td>
<td>Pool Sand Filter Water</td>
</tr>
<tr>
<td>POS</td>
<td>NEG</td>
<td>Room A Shower Water</td>
</tr>
<tr>
<td>POS</td>
<td>NEG</td>
<td>Room B Shower Water</td>
</tr>
</tbody>
</table>
Mitigation & Follow-Up

- Mitigation was completed throughout much of the facility
  - Swamp coolers were professionally serviced and disinfected
  - Pool and hot tub were cleaned and serviced according to CDC guidelines
  - Potable water system was superheated and flushed
- Showed proof of a CPO on staff who seemed knowledgeable about pool operations
- All follow-up testing was negative for *Legionella* through both PCR and culture testing
- The pool and hot tub were re-opened after the 2.5 month investigation
Rooftop Swamp Cooler
This picture was taken during the initial sampling. Leaking water is pooled underneath. Many parts were broken or rusted out. No inspection or maintenance records available.

Pool
This picture was taken during the initial sampling. It’s a little hard to tell, but the water was murky. In the back of this picture in the pool is the main drain, which was not easily visible. The chlorine level was also low: 0.04 ppm.

Hot Tub
This picture was taken during the follow-up sampling. The water was a mint green color, and the pH, alkalinity, and temperature were too low. Debris were found settled at the bottom.
Epidemiologic Investigation

Epi-X Report

1. Report released on August 28, 2017 through the Epidemic Information Exchange (Epi-X) facilitated by the CDC
2. Notified other counties and states about this exposure

Health Alert Network (HAN)

1. Released a Colorado HAN notifying healthcare providers and local public health departments about this outbreak.
2. Provided information about Legionnaires’ disease and questions to ask suspected cases.
October 2018: Phone call from the regional epidemiologist in southeastern Colorado about a confirmed case and two epi-linked suspect cases of Legionnaires’ Disease in folks who were at the in/near the hotel pool and hot tub during their exposure period.

- Conducted an environmental investigation at the hotel, however the hot tub was shocked with disinfectant prior to our arrival and disinfectant tabs were thrown in the pool upon our arrival.

- No *Legionella* found in the pool or hot tub, but the facility did complete an extensive mitigation.
Challenges

- Staff were uncooperative throughout much of the investigation
- Difficulty following proper mitigation protocols and providing proof of completion
- Difficulty obtaining guest information
  - Initially would not provide guest information. Then stated they didn’t know how to access their system.
  - By the time we received guest information, it had been a few weeks
    - The guest information also only included names and some phone numbers and addresses, but much of the data was blank
- Discovered conflicts of interest between local health department and hotel owner, as well as hotel owner and mitigation company
Questions?