The Industrial Hygiene Approach to Preventing Legionnaires’ Disease

What I hope to get across:

• Who works in this space
• Seriousness of Legionella risk
• Exposure and risk paradigm used by OEHS professionals
• Know the difference between risk assessment and risk management as approaches to control
• Understand the basis/content of the AIHA guidelines
• Consider the cost and benefits of IH approach

Major Players in the area of Legionnaires’ Disease Prevention, Investigation, and Control

• Building engineers
• Public water suppliers
• Water treatment operators
• Public health professionals
• Microbiologists
• Industrial hygienist (CDC mentions CIH, ASHRAE...not)
Cases of Legionellosis Reported by CDC (per 100,000 by year)

What types of facilities and equipment being investigated?

- Hotels and resorts
- Long term care facilities
- Hospitals
- Senior living, workplaces, community
- Potable water

CDC Report on Cases Related to Environmental Control Deficiencies

Approximately one-half (48%) due to one or more of the following:

- Two-thirds (65%) associated with process failures (e.g., not having an effective, or adhering to a, Legionella WMP)
- One-half (52%) related to human error (e.g. hot tub maintenance not being followed)
- One-third (35%) associated with equipment failures (e.g. disinfection system)
- One-third (35%) related to changes in source water quality (e.g. water line construction/replacement)
The Industrial Hygiene Approach

How do IHs approach known and potential problems?
- Anticipation, recognition, evaluation and control of workplace and environmental hazards or stressors
- Recognition and evaluation based on the NAS risk paradigm: hazard identification; dose-response relationship, exposure assessment, risk characterization
- How do you characterize risk without an actual or projected exposure?
- Once evaluated and controls implemented – VERIFY!

NAS Risk Assessment Paradigm


Hazard, Risk, and Safety

Safety is relative
- Hazard = the potential for harm
- Risk = the probability the harm will occur
- Safety = acceptable risk (probability below acceptable threshold)

Unknown exposure → Unknown risk → Unknown safety
The Industrial Hygiene Approach to Legionella Investigations and Plans/Programs

Risk Assessment versus Water/Risk Management

- IH approach considers and attempts to quantify sources, amplification sites, and dissemination potential
- 2015 AIHA Guideline: “IH approach differs from the current public health practice...strives to prevent disease...rather than waiting for the disease to occur”
- Focus on assessing potential exposures and verification of risk versus managing potential risk

2015 AIHA Guideline: Recognition, Evaluation, and Control of Legionella in Building Water Systems

Content Highlights:
- Background info on Legionella
- Risk assessment
  - Water system inventory and assessment
  - Sampling-related activities
  - Data interpretation
- Prevention, control, and remediation
- Competent professionals

2015 AIHA Guideline: Recognition, Evaluation, and Control of Legionella in Building Water Systems

Risk Assessments:
- Two types of risk assessments:
  - Routine assessments – proactive, intended to assess presence of amplification
  - Investigative assessments – reactive, outbreak or case-related, intended to identify specific amplification sites and exposure sources
Routine Assessments:
- Assumes no suspected or confirmed cases
- Primary purpose = determine whether current conditions are effective in preventing L. amplification
- Can be used for baseline, periodic maintenance, or post-outbreak control implementation assessment
- May or may not involve a team approach

Investigative Assessments:
- Typically implemented following suspected or confirmed cases
- Primary purpose is to assist in determining whether a facility is the source of cases
- Can also be used for more specific determination of amplification sources not currently associated with cases
- Typically involves multi-disciplinary team approach

Basic five-step approach to assessments:
- Water system inventory
- Characterize water systems for potential hazard (amplification)
- Conduct environmental sampling
- Identify control measures (if necessary)
- Disease surveillance (Investigative assessments only)
2015 AIHA Guideline: Recognition, Evaluation, and Control of Legionella in Building Water Systems

Requires environmental sampling for both assessment types:
- Sampling design and implementation by competent professional (minimum standards provided for professional and technician)
- Recommends viable culture method in lieu of surrogate measures (low correlation between surrogate testing and Legionella concentration):
  - Analysis using ISO Method 11731:1998 (spread plate)
  - Depth of analysis and number of plates variable based on source and interpretation needs

2015 AIHA Guideline: Recognition, Evaluation, and Control of Legionella in Building Water Systems

Provides sampling and analysis guidance with sections covering:
- Sampling strategy and plan development
- Sample collection
- Laboratory selection and analysis methods
- Data evaluation and interpretation
- Major consideration sampling and testing for Legionella directly is cost – but is it really a more expensive approach?

2015 AIHA Guideline: Recognition, Evaluation, and Control of Legionella in Building Water Systems

Source-specific guidelines for data interpretation and recommended actions (monitoring and remediation):
- Relies on previously published information that is collated into a useful tabular format
- Categories for humidifiers/misters; fountains/water features; hot tubs/whirlpools/spas; potable water; industrial fluids; and cooling towers/evaporative condensers
- Utilizes standard CFU/ml-based acceptability criteria with defined actions based on a scale (1, 1A, 2, 2A, 3, and 3A)
Table 3.1 – Date Interpretation Guidelines

<table>
<thead>
<tr>
<th>Sample Source</th>
<th>Non Detectable</th>
<th>Acceptably Low day^1</th>
<th>Action</th>
<th>Possible Amplification</th>
<th>Action</th>
<th>Indicative Amplification</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot Tubs, Whirlpools and Spas</td>
<td>&gt;2 CFU/mL</td>
<td>2 CFU/mL</td>
<td>1</td>
<td>100 CFU/mL</td>
<td>3</td>
<td>&gt;100 CFU/mL</td>
<td>3</td>
</tr>
<tr>
<td>Industrial Water Circuits</td>
<td>&gt;2 CFU/mL</td>
<td>2 CFU/mL</td>
<td>1</td>
<td>100 CFU/mL</td>
<td>3</td>
<td>&gt;100 CFU/mL</td>
<td>3</td>
</tr>
<tr>
<td>Pools</td>
<td>&gt;2 CFU/mL</td>
<td>2 CFU/mL</td>
<td>1</td>
<td>100 CFU/mL</td>
<td>3</td>
<td>&gt;100 CFU/mL</td>
<td>3</td>
</tr>
<tr>
<td>Residential Water</td>
<td>&lt;2 CFU/mL</td>
<td>2 CFU/mL</td>
<td>1</td>
<td>100 CFU/mL</td>
<td>3</td>
<td>&gt;100 CFU/mL</td>
<td>3</td>
</tr>
<tr>
<td>Residential Water</td>
<td>&gt;2 CFU/mL</td>
<td>2 CFU/mL</td>
<td>1</td>
<td>100 CFU/mL</td>
<td>3</td>
<td>&gt;100 CFU/mL</td>
<td>3</td>
</tr>
</tbody>
</table>

Source: AIHA Guideline, Recognition, Evaluation and Control of Legionella in Building Water Systems

Benefits and Application of an Industrial Hygiene Approach

• Preventative approach
• Proactive versus reactive sampling
• Increased confidence in plan/program effectiveness
• Easily integrates with WMP and HACCP methodologies
• Provides a valuable resource to typical engineering-based investigation/survey team

Cases of Legionellosis Reported by CDC
(per 100,000 by year)

Source: US CDC, https://www.cdc.gov/mmwr/volumes/65/wr/mm6522e1.htm#F1_down