State of the Art Water Distribution System and Subsequent Water Quality Research

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Conclusions:
• Dec 2003 nosocomial case of Legionella resulted in one death
• Subsequently Legionella was found at all Calgary hospitals
• Media and Opposition Parties focused intently

Actions
• Joint IPC / FM&E / Prov Lab team
• Literature review, expert consultation
• Legionella testing
• High temperature water disinfection
• Search for dead legs

High Temp Disinfection
• Source water temp to 80 C
• Flow 75 C water at every faucet for 10 min
• Prevent scalding accidents
• Prove success or lack thereof

Hot Water Disinfection
• Conclusions:
  – High temp disinfection is risky and difficult
  – Legionella returns within weeks
  – High temp disinfection does not work in a conventional distribution system

Search for Dead Legs
• Located and removed numerous no flow pipe sections
• Conclusions:
  – Did not improve high temp disinfection results
  – Eradicating existing dead legs not possible
  – Dead legs contain ideal temp spectrums to culture legionella
Proposed Solutions

- Survey for additional cases before intervention (Recommended)
- Install copper silver ionization (Chosen)
- Install chlorine dioxide injection system

Copper Silver Ionization Works

- Percent of sample locations that tested positive for Legionella:
  - Prior to installation - 29%
  - 1 year after installation - 2%
  - 4 years after installation - 0%

Scalding

- In January 2004 a long term care resident in the Alberta was scalded and died as a result
- All healthcare facilities in Alberta were scrambling to review and modify PM and operational procedures to prevent scalding

Research Project

- 17% to 20% of our patients are susceptible to Legionella infection if it becomes aerosolized into the environment:
  - The proportion of at risk patients is growing
  - Innovative ACH design resulted in $400K research grant

Research Project

- Research team – U of C professor, IPC Doc, Provincial Lab PHD, myself
- Final year of a 5 year research project
- ACH remains Legionella free, 6 years after opening
- Looking forward to future research on SHC water re-use system

Alberta Children’s Hospital Domestic Hot Water Distribution

- Design overview
Alberta Children’s Hospital
- 70,000m² Building – Opened Sept 2006
- 131 In-Patient Beds
- 34 Ambulatory Clinics
- 8 Operating Rooms

Primary Design Concerns
- Scalding Risk
- Legionella Propagation

Design Standard
- CSA-Z317.2-99 – Plumbing in Healthcare Facilities
  - Distribute water at 60°C
  - Maximum outlet temperature = 43°C
  - Minimize lower temperature piping

Effect of Hot Water
<table>
<thead>
<tr>
<th>Water Temperature</th>
<th>Time to Incur Burn</th>
<th>First Degree</th>
<th>Second Degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>44°C</td>
<td>4 ½ Hours</td>
<td>5 Hours</td>
<td></td>
</tr>
<tr>
<td>60°C</td>
<td>3 Seconds</td>
<td>5 Seconds</td>
<td></td>
</tr>
</tbody>
</table>

Typical Design – point of use mixing

Desired Configuration – no high temperature water
Competing Factors

- Low Temperature Distribution
  - (+) No Scalding Risk
  - (-) Legionella Risk
- High Temperature Distribution
  - (+) Lower Legionella Risk
  - (-) Higher Scalding Risk

Design Solution

- Distribute at lower temperature
  - 38 °C to tempered water outlets
  - 43 °C to hot water outlets
- Mitigate Legionella risk

Legionella Risk Mitigation

- Reduce / Eliminate Legionella in water
- No storage tanks
- No piping dead legs
- Continuous flow in piping system

Reduce Legionella in water

- Ultra-violet light sterilizers

No storage tanks

- Gas-fired instantaneous water heaters

Eliminate dead legs

- Strict specification requirements
- Educated contractor’s installers
- Rigorous monitoring during construction
Continuous flow – effective recirculation

- Manageable-sized building zones
- Measured flow through each zone
- Self-balancing distribution within each zone

Manageable Building Zones

- Divided building into 12 zones per floor
- Each zone supplied by separate circulated loop
- Average size of zone = 1250m²

Distribution Zones

Measured Flow in each zone

Recirculation to each outlet

Self-Balancing Loops
Safeguard measures

- Designed to permit practical heat sterilization
- Made provision to add copper-silver ionization

• These measures have NOT been needed to date

Goal
- Legionella-free water supply
- No risk of scalding

Means
- Distribute at low temperature
- U/V treatment of water source to building
- Effective recirculation

Results
- Complete success to date
- No safeguards needed to date
Presenters

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