New Theories on Plumbing in Healthcare

Bob Gulick, PE, LEED AP
Brian Hageman, LEED AP
Outline

• Priorities – What the Healthcare Industry Needs from Plumbing
• Current Domestic Water System Design in Healthcare
• Infection Control as it Relates to Domestic Water
• Future Domestic Hot Water Design in Healthcare
• Opportunities for Investigation and Research
Healthcare Overview

- Average of 504 gallons of water per bed per day (ASHE 2002)
- Patient and Staff Safety is top priority
- Cost of Ownership, including maintenance and operation
- Sustainability, particularly in Energy and Water Conservation
Water Usage in Healthcare Facilities

- Cooling Tower: 22%
- Toilets: 16%
- Kitchen Misc: 16%
- Garbage Disposal: 1%
- Sterilization CT: 5%
- Kitchen Food Prep: 3%
- Dishwasher: 2%
- Lab: 1%
- Boiler: 5%
- Irrigation: 12%
- Film Processors: 1%
- Sterilization Vacuum: 1%
- Leaks: 1%
- RO (Dialysis): 3%
- Faucets: 5%
- Showers: 3%
- Janitorial (bathrooms/floors): 4%
# Uses of Domestic Hot Water in Healthcare

<table>
<thead>
<tr>
<th>Patient/Staff</th>
<th>Process/Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Hand Washing</td>
<td>• Janitorial</td>
</tr>
<tr>
<td>• Showers</td>
<td>• Kitchen</td>
</tr>
<tr>
<td>• Med Prep</td>
<td>• Food Services</td>
</tr>
<tr>
<td>• Food Prep</td>
<td>• Sterilization</td>
</tr>
<tr>
<td>• Emergency Eye/Face wash</td>
<td>• Laundry</td>
</tr>
<tr>
<td></td>
<td>• Laboratory</td>
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<tr>
<td></td>
<td>• Pharmacy</td>
</tr>
<tr>
<td></td>
<td>• Emergency Shower</td>
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</table>
A Look at Patient and Staff Uses

Where Hot Water is Really Needed in a Patient Care Unit

- Hand washing is a critical part of infectious control within the Patient Care Unit
- Showers are a seldom utilized feature, but often required by governing codes
- Prep areas for meals, medications, and linens
Domestic Hot Water Delivery
# Domestic Hot Water Systems in Healthcare Facilities

<table>
<thead>
<tr>
<th>Components</th>
<th>Design Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Central Heat Source</td>
<td>• Redundancy</td>
</tr>
<tr>
<td>• Heat Exchangers</td>
<td>• Temperature Maintenance in Distribution Piping, 10F loss</td>
</tr>
<tr>
<td>• Pumps</td>
<td>• Deadleg Piping</td>
</tr>
<tr>
<td>• Storage Tanks</td>
<td>• Zoning for Maintenance</td>
</tr>
<tr>
<td>• Expansion Tanks</td>
<td>• Balancing</td>
</tr>
<tr>
<td>• Mixing Valves</td>
<td>• Sizing Equipment to Handle Peak Loads</td>
</tr>
<tr>
<td>• Distribution Piping</td>
<td>• Lack of actual data on hot water usage</td>
</tr>
<tr>
<td>• Circulation Pumps</td>
<td></td>
</tr>
<tr>
<td>• Balancing Valves</td>
<td></td>
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</tbody>
</table>
The Bugs in Our Water

• Legionella – found in water supply piping

• Pseudomonas Aeruginosa – spread by patient/staff to faucet

• Giardia and Cryptosporidia – transferred to sink via fecal matter

• Researchers, including the CDC, reported that Legionella, Cryptosporidia, and Giardia cost US $539M each year (Reuters 2008)
Mitigating Legionella

• Legionella requires bio-film to grow, all pipes have bio-film

• Use heat to disinfect the pipes

• Conduct regular cleaning and flushing of entire piping systems

• Use technology, such as electronic copper-silver ionization, to reduce bio-film

<table>
<thead>
<tr>
<th>Legionella Growth by Temperature</th>
<th>Degree F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ideal Growth Range</td>
<td>90 - 108</td>
</tr>
<tr>
<td>Overall Growth Range</td>
<td>77 - 113</td>
</tr>
<tr>
<td>Start to Die Above*</td>
<td>122</td>
</tr>
<tr>
<td>Disinfect Above</td>
<td>160</td>
</tr>
<tr>
<td>Remain Dormant Below</td>
<td>68</td>
</tr>
</tbody>
</table>

Temperatures above are as published by the W.H.O.
Improving Hand Wash Sink Design

- Infection Control and Hospital Epidemiology Study, 2009
- Eliminate aerators
- Use smooth, solid surfaces, preferably with antimicrobial features
- Design faucet and sink basin to prevent splashing
- Do not have water stream aimed directly at drain
- Control domestic water pressure, lower pressure prevents spraying
- Programmable flush
Hand Wash Sinks

• Primary method of limiting the spread of infections

• Water temperature has been shown to not be a factor in the effectiveness of hand washing (Food Science Tech, 2002)

• Existing systems can regularly take more than 20 seconds to deliver hot water, and in some cases minutes

• Staff already wash hands in room temperature water

• Used by Staff several times a day, often 15+ for Nurses
Hot Water Design Considerations

Maintain a healthier environment, save money, and be more efficient

- Wash hands with 65-75F water
- Supply hand wash sinks with single water pipe
- Supply showers with 65-75F water and provide point of use heater
- Supply support/prep areas with 65-75F water and provide point of use heater as required
- Supply water closets with 65-75F water
- Supply emergency fixtures with 65-75F water, which meets ANSI standards for tepid water

Benefits

- Reduce growth of Legionella
- Single pipe distribution system
- Greatly reduce central heating requirement
- Heat water to 65F using other waste heat, not boiler heat
- Eliminate recirculation of water
- Eliminate dead legs
- Improve zoning
- Overall smaller system to maintain
Design Comparison

### Previous Design

- Assume incoming water at 50F
- Previous design had 110 gpm, or 3,850 MBH of required boiler heat at peak load to create 120F water

### New Design

- New design eliminates 63 gpm, or 57% of the peak load.
- New design requires 1,645 MBH of boiler heat
- Due to addition of heating cold water for water closets, new design also requires 180 gpm of 65F, or 1,350 MBH of waste heat

### Benefits

- The new design reduces total required heat at peak load by 855 MBH, or 22%
- Boiler heat required reduced by 2205 MBH, or 57%
- Large energy savings from the storage and distribution of 68F water
- Large cost savings from single pipe system
- Utilize waste heat from cooling towers or building effluent
Opportunities

• Baseline domestic hot water usage data
• Sink and faucet design
• Accurate temperature range for organisms
• Psychological affects of not providing hot water
• Alternatives for point of heating
Questions?