Healthcare Facility Management Society of New Jersey

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Presented By:

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AN INTEGRATED SOLUTION TO MITIGATING WATERBORNE HOSPITAL ACQUIRED INFECTIONS (HAIs)
Discussion Topics

• What Is The Impact of HAIs?
• Approaches To Mitigate Waterborne Pathogens?
• What Guidelines / Standards Exist?
• What Would Execution Look Like?
• What Are Remediation Strategies?
• Awareness To A Path Forward?
Ecolab / Nalco Experience & Support Resources
A Network of Experts to Support Your Site Operations With A Dedicated Division Focused On Global Water Safety

21,500 FIELD ASSOCIATES
on the front lines directly serving you

$160 MILLION
in global R&D investment in 2010

5,500 patents

1300 R&D employees
at more than 20 Technology Centers around the world

2012 Revenue: $14 billion
Nalco’s Global Water Safety Capabilities

Environmental Hygiene Services Resume

Nalco’s Environmental Hygiene Services Team has worked with customers on Water Safety planning for 15+ years

30+ Certified HACCP managers

Over 1,000 HACCP plans written and implemented worldwide including over 250 in hospitals

Local service delivered that follows global practice standards

Demonstrated secondary disinfection expertise

Responsible for disinfecting 1 billion+ gallons of potable water annually

Nalco Legionella lab is a charter member of CDC-ELITE proficiency program

Six (6) Industrial Staff Microbiologists
What do Facility Managers and Infection Preventionists have in common?

- Not Enough Hours In The Day!
- They Each Have Their Own Perspective
- They Each Have Their Own Priorities
- They Each Can Impact Reducing Waterborne HAIs

But it takes a team effort!
HAIs have a direct impact on patient health, satisfaction and...
Waterborne pathogens are a clinical relevant cause of Hospital Acquired Infections (HAIs) since water is a vector of infection.
What Most Common Waterborne Pathogens Impact HAIs?
PSEUDOMONAS
a common cause of pneumonia, severe wound and skin infections in hospital patients

‘1,400 deaths occur annually in the US as a result of health care – associated pneumonia caused by waterborne *Pseudomonas aeruginosa* alone (Anaissie et al)’.
LEGIONELLA
the cause of a severe form of bacterial pneumonia

‘In one national survey of 192 hospitals, each hospital had at least one case of nosocomial Legionnaires’ disease, and 16% reported more than 5 cases.’*

‘From the NISS data Cohen et al estimated that 950 cases fatal nosocomially acquired legionellosis occurred in the US annually.’

*Fiore AE, A survey of methods used to detect nosocomial legionellosis among participants in the National Infections Surveillance System, 1999
The human and financial burden due to waterborne pathogens from building water systems is staggering.
CMSE’s Exclusions On HAI Reimbursement?
(Centers for Medicare & Medicaid Services)

1 in every 20 hospitalized patients become ill with an HAI

$30,000 - $50,000
average cost to treat an inpatient HAI

Overall annual direct medical costs of HAI to U.S. hospitals ranges from:
$28.4 to $45 billion

Over 1.7 million HAIs in U.S. hospitals (2002)
Studies published between 1998 & 2005 indicate that between 9.7% and 68.1% of random ICU water samples were positive for Pseudomonas aeruginosa and between 14.2% and 50% of patient infections with this organism were due to genotypes found in ICU water.

Pseudomonas aeruginosa is the fourth most commonly isolated nosocomial pathogen (#1 Waterborne)

~1,400 deaths occur each year as a result of waterborne nosocomial pneumonias attributable to Pseudomonas aeruginosa alone.

Studies have shown up to 50% (85,000) of hospital acquired infections by Pseudomonas may be derived from the water distribution system.

CDC has reported that 10.4% (170,000) of HAI’s are related to Pseudomonas.
CDC estimates that **8,000-18,000** cases of **Legionnaires’ disease** occur each year.

- **23%** of LD cases are acquired in hospitals (1,840-4,140) according to CDC.
- The **$33,000 average cost** to treat an inpatient HAI of legionellosis.
- **$321 million/year** in medical costs to treat Legionnaires’ disease.
- LD fatality is **40%** if acquired in a hospital = 736-1,656 deaths (>4,000 deaths overall annually).
Water is essential...
And yet, water can cause unintended human harm if not properly engineered, managed and monitored.
Temperature, °F / °C

**Disinfection Range**
158 - 176°F (70 - 80°C)

**Slowly Die**
122-158°F (50-70°C)
- 131°F (55°C); die within 5-6 hours
- 140°F (60°C); die within 32 minutes
- 151°F (66°C); die within 2 minutes

**Growth Range**
77 - 122°F (25 - 50°C)
- 95 - 115°F (35 - 46°C) optimum

**Do Not Grow Well**
68-77°F (20-25°C)

**Dormant**
<68°F (<20°C)
waterborne pathogens are lurking in pipes...
Biofilms are the enemy!

Which is where pathogens live.

Stenotrophomonas  Acinetobacter  Mycobacter  Pseudomonas  Legionella
How can this be?
Complex water systems break, pipes leak, and biofilms grow.
**SYSTEM CONDITIONS** Complexity, age, poor temperature controls, lack of residual disinfectant, and water stagnation can provide conditions that allow formation of biofilms.
Legionella Ecology – When good water goes bad

• Disease was **first recognized in 1976** during a Legionnaires’ convention in Philadelphia
  – More than 200 people sickened, 34 died following a stay at the Bellevue-Stratford hotel in Center City Philadelphia

• Key factors required for the bacteria to grow and infect guests and employees
  – Municipal water can be contaminated with the bacterium
  – Bacterium enters buildings water system, finds a niche
    • Scale, biofilm, warm temperatures, plumbing dead legs
    • Organisms can survive, thrive and grow in niche
  – Plumbed water therefore serves as the reservoir
  – Vectors for legionella infection are aerosols, mists, sprays
    • Cooling towers and evaporative condensers, showers, fountains, whirlpools, spas, hot tubs, faucets, water baths
Waterborne Microorganisms

**Primary Clinical Significance**

### Bacteria
- *Pseudomonas aeruginosa*
- *Legionella pneumophila*
- Acinetobacter spp.
- Non-tuberculous or Atypical Mycobacterium

### Fungi
- *Aspergillus fumigatus*
- *Fusarium solani*

### Parasites
- *Cryptosporidium parvum*
- *Giardia lamblia*
- *Acanthamoeba spp.*
Sources of Waterborne Pathogen Exposure

Opportunities for waterborne microbes to enter into the healthcare environment

- Direct contact with water streams
- Aerosols from showers and faucets
- Improperly reprocessed medical devices
- Ice from ice machines
Where are the greatest AT-RISK areas?

At-Risk Patient Populations

- Solid Organ Transplant
- Bone Marrow Transplant
- Burn
- Neonatal Intensive Care
- Pediatric Intensive Care
- Hematology/Oncology
- Medical Intensive Care
- Cardiac Intensive Care
- Respiratory Intensive Care
This pathogen is a major waterborne cause of severe infections including pneumonia, sepsis, and wound and skin infections\(^1\).

Studies have shown up to 50\% of hospital acquired infections by this pathogen may be derived from the water distribution system\(^2,3,4\).

A study found 14\% of ICU health care workers hands were positive for *Pseudomonas* when washed with contaminated tap water and 12\% were positive when last contact was with a *Pseudomonas* positive patient\(^5\).

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**Transmission Pathway**

Droplets of contaminated tap water or contaminated hands of nursing staff can inadvertently come into contact with patient entry portals such as catheters, drains and tracheal tubes.
This waterborne pathogen causes a severe lung infection a form of pneumonia known as Legionnaires’ disease or legionellosis. A person can develop this disease by inhaling contaminated water mists or droplets.

This pathogen is perhaps the best-known for colonizing biofilms that can be found in centralized water storage tanks as well as peripheral water outlets such as showers and faucets.

23% of all cases are reported as HAIs

Ice Machines  Showers  Cooling Towers

Water Features  Jacuzzi/Spas

Legionella pneumophila
Conditions that increase risk of causing harm...

Pathogen Proliferation

- Stagnation
- Protozoa
- Biofilms
- Deposits
- pH
- Temperature
- Biocides

Aerosol Release

- Function/Use
- Defects
- Wind
- Water Flow

Risk of Causing Harm

Susceptible Population

- Smokers
- Gender
- Age
- Immuno-compromised

NOTE:
- Construction projects
- Pressure shocks
- Vacancies
- Dead-legs
- Water main breaks
**Legionella** Life Cycle

**ENVIRONMENTAL EVENTS**
- Survival in Nature
- Amplification
- Dissemination (Aerosolization)
- Transmission
  - Humidity
  - Droplet Size
  - Distance

**CLINICAL EVENTS**
- Diagnosis of Legionnaires’ Disease
- Multiply in Human Phagocytes
- Susceptible Host Exposure
- Susceptible Population Potential

**REDUCING RISK OF LEGIONELLOSIS (PREVENTION)**

**Proliferation Potential**

**Aerosol Exposure Potential**
CDC Recommends:

“The source of Legionella should be identified and decontaminated or removed”.


The Joint Commission, EC.02.05.01

The [organization] manages risks associated with its utility systems.

- Establish and maintain a utility systems management program to promote a safe, controlled and comfortable environment that... reduces the potential for hospital-acquired illness to be transmitted through the utility systems.
- Healthcare Facility identifies and implements processes to minimize pathogenic biological agents in cooling towers, domestic hot/cold water systems and aerosolizing water systems.

Local Guidelines: Allegheny County, PA, Maryland, New York, Texas, Virginia
INDUSTRY AVAILABLE SERVICES IN AN INTEGRATED APPROACH TO HELP YOU

With a focus on waterborne pathogens
INDUSTRY AVAILABLE SERVICES IN AN INTEGRATED APPROACH TO HELP YOU

With a focus on waterborne pathogens

Potential Qualification Criteria

• Water Safety Experience
• Knowledge of Waterborne Pathogen Risk Mitigation
• Technology to Make it Effective
• “Boots on the Ground” to Assist
The AQUA PATH™ Program

- Pathogen Analytical
- Water Safety Plans
- Point-of-Use Water Filters
- Secondary Disinfection
01 Water Safety Plans

Expert Risk Management

» Pathogen Water Safety Plans
» Web-based Data Monitoring & Management
» Consulting & Support
  • Hazard Analysis
  • Process Flow Diagrams
  • Plan Design & Implementation
  • Awareness Training
  • Verification & Validation

Cycle of Safety

ASSESS
ADJUST
ACT
ANALYZE
Execution and setting the cycle...

- Consultation
  - Establishing Policy

- Education
  - Training

- Site Survey
  - Survey Analysis
  - Prioritize Risk

- Hazard Assessment
  - Define Management Plan
  - Define Contingencies
  - Monitoring Controls
  - Legionella Testing

- Verification
  - Validation
  - Review
  - Evaluate
  - Adjust
# Best Practices: Cooling Tower

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Purpose</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Operation</td>
<td>Goal is to operate in a manner that keeps the system treated and limits stagnant conditions. Startup/Shutdown; Intermittent operation; New system startup</td>
<td>ASHRAE 12, 188P CTI</td>
</tr>
<tr>
<td>Inspection &amp; Maintenance</td>
<td>Goal is to maintain mechanical design intent to limit aerosol release, to maintain balanced water flows and to eliminate dead zones.</td>
<td>ASHRAE 12, 188P CTI</td>
</tr>
<tr>
<td>Design &amp; Siting</td>
<td>Be aware of design features (sumps, drift eliminators, location of tower) that can increase risk if not properly managed.</td>
<td>ASHRAE 12, 188P CTI OSHA</td>
</tr>
<tr>
<td>Scale &amp; Corrosion Control</td>
<td>A comprehensive scale and corrosion program is necessary to limit scale and corrosion formation to within specified critical limits.</td>
<td>ASHRAE 12, 188P CTI</td>
</tr>
<tr>
<td>Biocide Control</td>
<td>A comprehensive biocide program applied to within critical limits is necessary to maintain microbial control. Biocides must be applied in a manner that demonstrates control.</td>
<td>ASHRAE 12, 188P CTI OSHA</td>
</tr>
<tr>
<td><strong>Clean &amp; Disinfect (C&amp;D)</strong></td>
<td>Goal is to prevent accumulation of slimes and sludge which can allow microbial proliferation and increase <em>Legionella</em> risk. Twice annual C&amp;D; Off-line and On-line</td>
<td>ASHRAE 12, 188P CTI OSHA</td>
</tr>
<tr>
<td><strong>Legionella Monitoring</strong></td>
<td>Recommended to verify control of the hazard. <em>Typically recommended for investigative or post remedial verification purposes.</em></td>
<td>ASHRAE 12 CTI OSHA*</td>
</tr>
<tr>
<td>Aerobic Bacteria Monitoring</td>
<td>Monitoring is essential to verify biocide program is sufficient to control microbial growth.</td>
<td>CTI</td>
</tr>
</tbody>
</table>
Best Practices: Domestic Water Services

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Purpose</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Construction/ Renovation</td>
<td>Goal is to be aware of design features (cross connections, need for piping insulation, dead-legs, low flow zones, water hammer arrestors, etc.) or stagnant conditions that can increase risk if not properly managed.</td>
<td>ASHRAE 12, 188P</td>
</tr>
<tr>
<td>New Systems, Startup/Shutdown</td>
<td>Goal is to define practice to manage the water system to limit stagnation, implement practices to flush systems after lengthy shutdown or interruption of water service, and requirements for clean and disinfection before commissioning new systems.</td>
<td>ASHRAE 12, 188P</td>
</tr>
<tr>
<td>System Maintenance</td>
<td>Goal is to define practice (Clean and disinfect, flushing, repair, etc.) for system maintenance of hot and cold water tanks, ice machines, water filters, shower heads and hoses, faucets, etc.</td>
<td>ASHRAE 12, 188P</td>
</tr>
<tr>
<td>Water Temperature</td>
<td>Water temperature recommendations for legionellae control are: • Maintain water heater outlet temperatures at or above 140°F (60°C); • Maintain the hot water temperature at coldest point in the water heater, the storage tank, or the distribution system at or above 124°F (51°C); • Maintain the cold water temperature in any part of system at or below 77°F (25°C).</td>
<td>ASHRAE 12, 188P</td>
</tr>
<tr>
<td>Water Disinfection</td>
<td>Where water disinfection or treatment is performed, a defined program must be followed to assure it meets EPA requirements for potable water applications.</td>
<td>ASHRAE 12, 188P</td>
</tr>
<tr>
<td>Emergency Disinfection</td>
<td>Goal is to define practice to be followed if there are suspected legionellosis health problems associated with the use of potable water in a building system.</td>
<td>ASHRAE 12, 188P</td>
</tr>
<tr>
<td>Legionella Monitoring</td>
<td>Recommended to verify control of the hazard. * Typically recommended for investigative or post remedial verification purposes.</td>
<td>ASHRAE 12 OSHA*</td>
</tr>
</tbody>
</table>
02 Secondary Disinfection
A Continuous Treatment Strategy

» Evaluation of alternatives: Pros & Cons
» Hot and cold potable water treatment
» NSF-61 certified equipment
» NSF-60 certified chemistry
» Water treated per EPA regulations
» Nalco 360 24/7 monitoring of disinfectant residuals
» 360 automation of system alarms

Chlorine Dioxide (ClO₂)
# Summary of Disinfection Choices

<table>
<thead>
<tr>
<th></th>
<th>ENVIROX Chlorine Dioxide</th>
<th>Chloramine</th>
<th>Chlorine</th>
<th>Copper-Silver</th>
<th>Ozone</th>
<th>UV-Light</th>
<th>Thermal Disinfect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective against legionella</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Effective against most bacteria</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Effective against biofilm</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>No Legionella resistance</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Protects whole system</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Not affected by pH</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Not affected by water hardness</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Easy to monitor</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Low corrosion rates</td>
<td>YES</td>
<td>YES / NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>No Trihalometanes (THM's)</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Low disinfection by-products (DBP)</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>
03 Point-of-Use Water Filters
A Point Control Strategy

» An absolute barrier for waterborne pathogens
» “Sterilizing Grade Filtered Water”
» For high risk patient areas
  (BMT, ICU, NICU, BURN, ONCOLOGY, ETC.)
» For immediate response to an outbreak or incident
04 Pathogen Analytical

Validation of the Control Strategy

» Legionella Culture Test per ISO 11731
» A Certified CDC-ELITE Proficient Lab
» Interpretation & Consulting
» Testing Plans
Remediation Strategies

» Cleaning & Disinfection Services

• Cooling Water Systems
• Potable Hot & Cold Water Systems
• Decorative Fountains
• Ice Machines
Do I have issues with deposits or scale?
Do I operate systems near people or entry points?
Supplemental Controls

Validation Studies/Endorsements

ENVIROX
“A 17-month evaluation of a chlorine dioxide water treatment system to control Legionella species in John-Hopkins hospital water supply concluded: “Our results indicate that operation of a chlorine dioxide system effectively removed Legionella from the hospital water supply. Our results indicate that chlorine dioxide may hold promise as a solution to the problem of Legionella contamination of hospital water supplies”.

POU Filters
Trautman: “Point-of-use filtration is a simple, successful, and highly cost-effective strategy to lower endemic Pseudomonas aeruginosa infections in a surgical ICU”.

The 2007 WHO publication recommends:
“Legionella and the prevention of Legionellosis point-of-use filters are recommended for high risk areas such as transplant units and ICUs when Legionella free water (0 CFU/1000 mL) is not achievable”.

Nalco EHS Water Hygiene Services Capabilities

RISK MANAGEMENT

- *Legionella* Water Safety Plans
- Waterborne Pathogen Water Safety Plans
- Web-based Data Monitoring & Management
- Consulting and Support:
  - Hazard Analysis
  - Plan Design & Implementation
  - Awareness Training
  - Verification & Validation

PATHOGEN ANALYTICAL

- *Legionella* culture testing per ISO11731
- Certified CDC-ELITE proficient for *Legionella*
- Interpretation & Consulting
- Testing Plans
- *Legionella* Analytical Guide

REMEDIATION

- Cleaning & Disinfection Services:
  - Cooling Water Systems
  - Potable Hot & Cold Water Storage Systems
  - Potable Water Distribution Systems
  - Decorative Fountains
  - Firewater Tanks
  - Emergency Remediation Protocols

SUPPLEMENTAL CONTROL

- Secondary Disinfection:
  - ENVIROX Chlorine Dioxide & E-Chlorine Systems
  - NSF60/61 Approved
  - EPA Regulatory Guidance per SDWA
- Point-of-Use Water Filters:
  - Absolute barrier for waterborne pathogens
  - Validated up to 31-Days or 62-Days per ASTM F838-05 for 0.2 μm sterilizing grade filters
Financial Impact:

Direct Hospital Cost:
- $30,000 – $50,000 Per HAI
  - This will be increasing significantly
  - Lack of CMS reimbursement impact

Regulatory Fines:
- Anticipate this being more prevalent in the future

Litigation:
- 2006 LD Outbreak resulted in a $5.2 MM settlement
- Most LD cases are settled between $1-3MM/fatality

Impact on Moral:
- Recruiting & Retention

Damage To Brand:
- Site/Organization-Specific & Critical

According to the November 2006 report from the Pennsylvania Health Care Cost Containment Council (PH4C), the average charge for patient cases with an HAI was $185,260, compared to $31,389 for cases without a hospital acquired infection. For patient cases with an HAI, the average number of days in the hospital was 20.6 days, compared to 4.5 for cases without an HAI.

Savings for prevention of LD in Medicare beneficiaries alone would be estimated to be over $30MM per year and substantially higher than that for other healthcare-associated conditions.
Risk Reduction Strategies …do this

• Do a Water Safety Plan (WSP)
  • Perform a Risk Hazard Assessment
  • Develop a written Risk Management Plan with defined control goals and contingencies

• Keep it moving

• Keep cooling systems properly treated

• Use “Best Practices” for microbiological control
  • Follow a contingency plan for system upsets or when control goals are not met
  • Keep it clean

• Monitor and inspect the systems routinely

• Document and retain records
An Awareness To The Path Forward:

HAIs Are Reported To The CDC & State Department of Health
(level of detail varies by state reporting requirements)

Better Insight
- Do you know if there can be an improvement at your facility?

Better Action
- Do you believe this is worth further discussion at your facility?

Better Results
- How and who do you suggest should be involved in those discussions?

DELIVERING SAFE WATER