Effectiveness of onsite monochloramine disinfection for waterborne pathogen control in a Canadian acute care academic hospital

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1. Timeline background and objectives

At least 2 cases of ST379 in 2 years confirmed to be acquired at an acute care hospital:

- Nosocomial Lp infection (ST379) and pan-drug resistant P. aeruginosa (ATCC 6604341)

1 nosocomial Lp case on care- Clinical isolation

ST379

Clinical isolation

ST379

• Interruption of NHCl in a hospital hot water system on the:  
  1. Absence of Lp at the water heater outlet
  2. Concentrations of general microbial indicators (E. coli, coliforms (E. coli) and enterococci) were below detection limits.
  3. Relative abundance of all bacterial (16S) and eukaryotic (18S) genera
  4. Concentrations of other physical-chemical parameters and common plumbing metals

Measurable impact of in situ disinfection with NHCl in a hospital hot water system on the:

- Lp culturability suppression and rapid reductions (3 weeks) in gc/L
- Mspp gene copies in targeted risk units

2. Materials and methods

540-bed Canadian academic hospital water system (1954):

- > 55 °C in all hot water return loops
- > 60 °C at the water heater outlet

- Legionella pneumophila
- Nontuberculous mycobacteria (NTM)
- Pseudomonas aeruginosa (Pa)

3. Results and discussion

3.1. Legionella pneumophila ➔ Immediate (24h) cultivability suppression and rapid reductions (3 weeks) in gc/L

BEFORE monochloramine:

- 61% (40/66) of distal points positive (10⁻¹⁰ MPPM/L) to culturable Lp
- 13% (4/30) of system points positive (10⁻³ MPPM/L) to culturable Lp

AFTER monochloramine:

- One distal point remaining positive (10⁻⁵ MPPM/L) despite receiving 1.1–1.7 mg/L of NHCl throughout the study
- Discontinuation of NHCl dosage resulted in important increases in cultivability (> 3-log) and gene copies (> 4-log) at one distal point

3.2. Legionella spp ➔ Rapid reductions (4 weeks) in gc/L

BEFORE monochloramine:

- 100% (66/66) of distal points positive (10⁻¹⁰ gc/L) to Lpp
- 100% (30/30) of system points positive (10⁻⁷ gc/L) to Lpp

AFTER monochloramine:

- Gradual (4 weeks) reductions in Lp gene copies, then mean concentrations stabilized between LoD and LoQ
- Discontinuation of NHCl dosage resulted in important increases in Lpp (> 2-log) and Mpp (> 3-log) at all distal points and system points
- Stagnant distal points (showheads, faucets) generally result in increased (> 1-log) Lpp and Mpp gene copies

3.3. Mycobacterium spp ➔ Rapid reductions (2 weeks) in gc/L

BEFORE monochloramine:

- 100% (66/66) of distal points positive (10⁻¹⁰ gc/L) to Mpp
- 100% (30/30) of system points positive (10⁻⁷ gc/L) to Mpp

AFTER monochloramine:

- Gradual (2 weeks) reductions in Mpp gene copies, but important (up to 4-log) differences gene copies concentrations in distal points

3.4. Take-home messages

1. Recurring costs and inconveniences related to points of use filters highlight the need to seek effective long-term mitigation solution
2. NHCl is a highly efficient treatment to mitigate Lp despite the optimization of other control parameters (e.g., hot water temperatures)
3. Persistence of lower levels of Lpp and NTM after NHCl demonstrates the need for proper risk assessment
4. Interruption of NHCl confirms persistence of Lpp/NTM in the biofilm (rebounds observed) ➔ in situ disinfection must be maintained
5. Preventative flushing of low use distal sites should be implemented to ensure efficient treatment across all hospital water system

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