



**Department
of Health**

A Legionellosis Intervention

Timeline, treatments and efficacy of treatments

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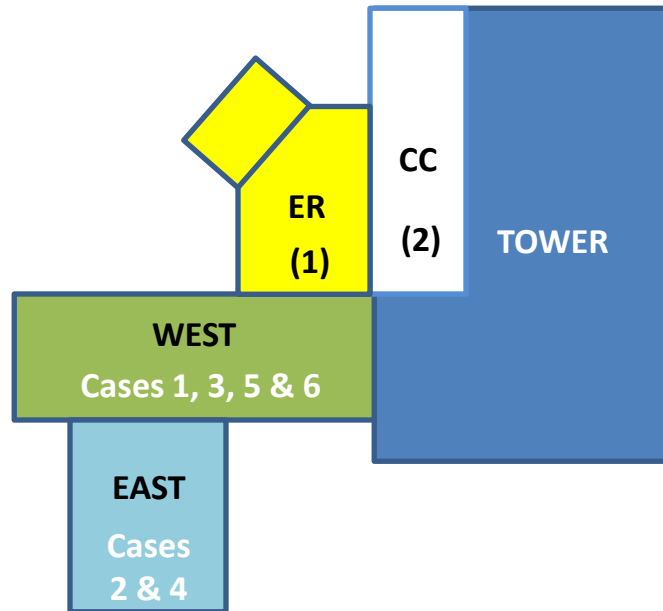
John Gaetano at Faxton-St. Luke Healthcare and the staff at both the Hospital and St. Luke's Home for freely sharing data and information obtained during the course of this intervention.

Background Information

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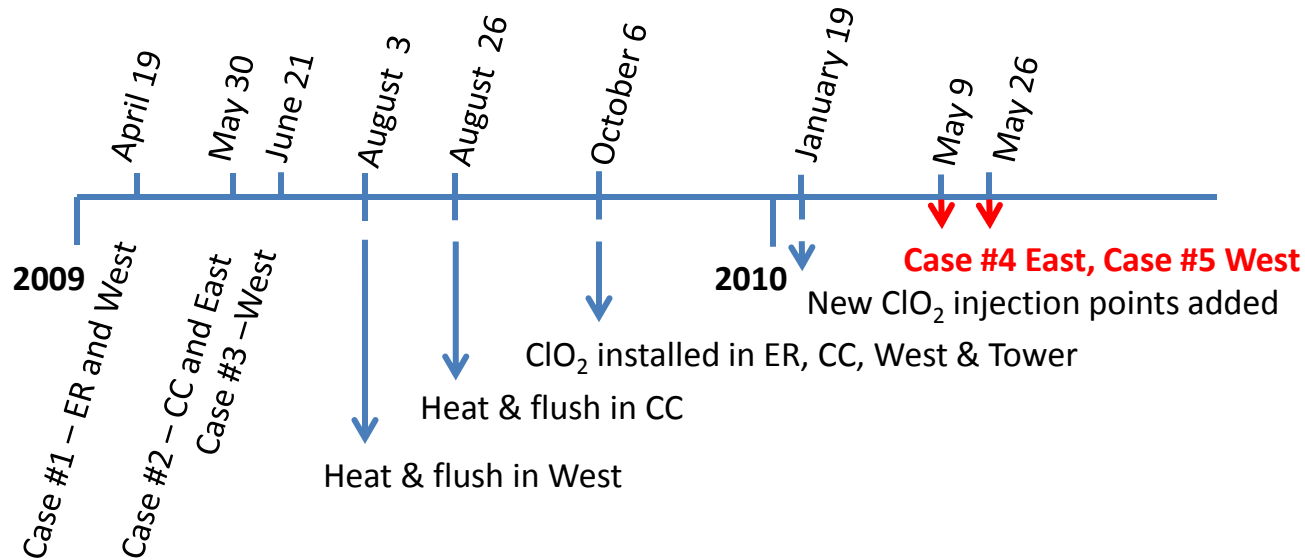
- Originally this intervention, by CDC EHS-Net staff, involved one critical care facility (hospital).
 - It was extended to include a nursing home, in the same neighborhood, owned by the same healthcare group and using the same public water.
- Cases of legionellosis initially occurred in the hospital - -
Very complex assemblage of hot water systems.
- Phased approach to treatment beginning with Heat and Flush – easiest and quickest treatment to implement.

Facility Layout & Disease Occurrence



Numbers in parentheses indicate other incidental locations of the case patient

Initial Timeline – Dates, Cases and Locations.



ER = Emergency room; CC = Critical Care; Tower = Main Building



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Water Chemistry

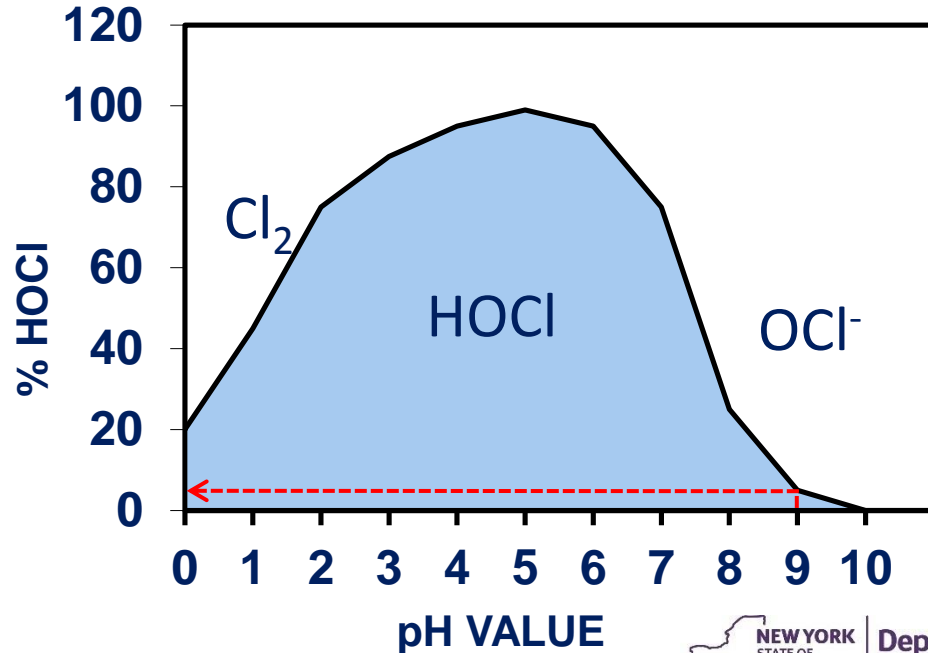
- The city is served by a single surface reservoir source.
- Typical data leaving the water treatment plant from a July monitoring report:
 - pH = 8.6 – 9.4
 - Turbidity = 0.11 – 0.23 NTU
 - Chlorine = 1.4 – 1.7 mg/L
 - Total Organic Carbon = 1.29 – 1.79 mg/L
- A key concern regarding treatment is the alkaline pH levels. Sample data indicate pH up to 9.9.

Treatment Concerns - Chlorine

Chlorine & Hyperchlorination

- High pH range favors hypochlorite ion over hypochlorous acid.
- Hypochlorous acid is the effective disinfectant.
- In the pH range of 9.0 to 9.5 less than 10% of the chlorine exists as the disinfecting acid.

Chlorine Species & pH



Treatment Concerns – Copper-Silver Ionization

- A 2002 Study by Lin, et al found that high pH impacted the effectiveness of copper-silver ionization.
 - Work done in a hospital with a pH range of 8.5 to 9.0;
 - Impact of water hardness (Ca^{2+} and Mg^{2+}), alkalinity (HCO_3^-) & dissolved organic carbon (DOC) was also studied;
 - Changes in the amounts of these parameters around neutral pH had no negative effect on treatment efficacy;
 - The effectiveness of copper ions was severely reduced at pH >9.0;
 - Precipitation of copper was suspected at pH >6.0;
 - Silver ions were not impacted with increased pH.

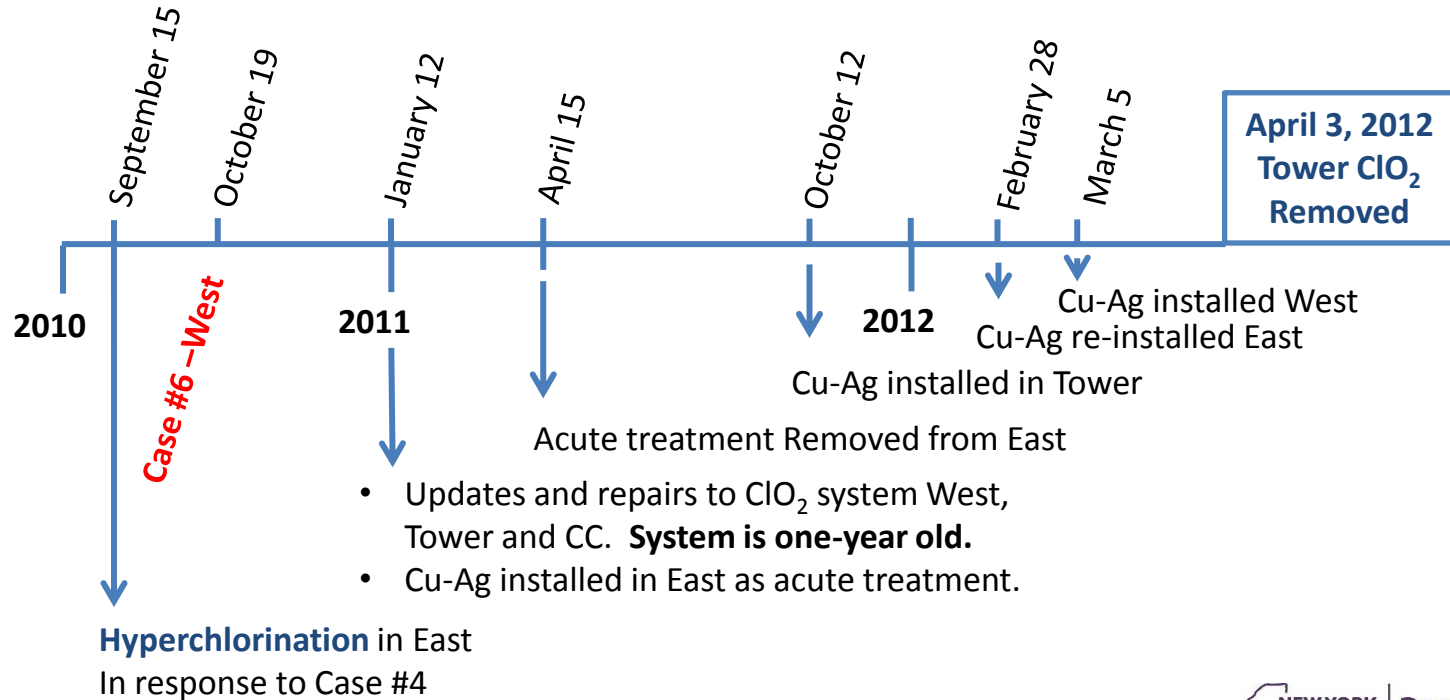
Chlorine Dioxide

- Highly soluble in water / 10 times more 'soluble' than chlorine
- Does not hydrolyze to a great extent and remains as a 'dissolved gas'.
- Much less of a pH effect than chlorine: Good biocidal activity between pH 6.0 and 8.5 (USEPA).
- Reported to be effective between pH 5.0 and 10.0 (Lenntech).
- Lower temperature negatively impacts disinfection activity.
- USEPA targeted maximum of 0.8 ppm.



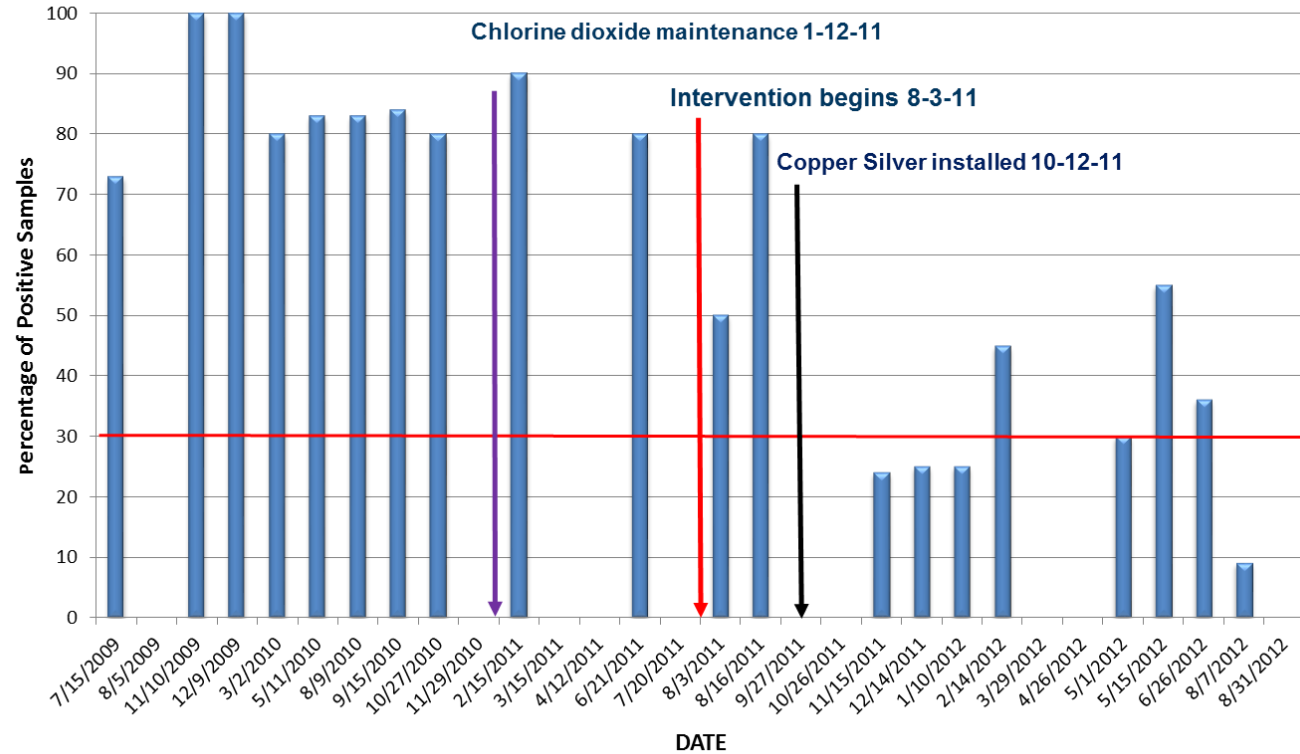
The Interventions

Later Timeline – Key Dates, New Case and Locations.

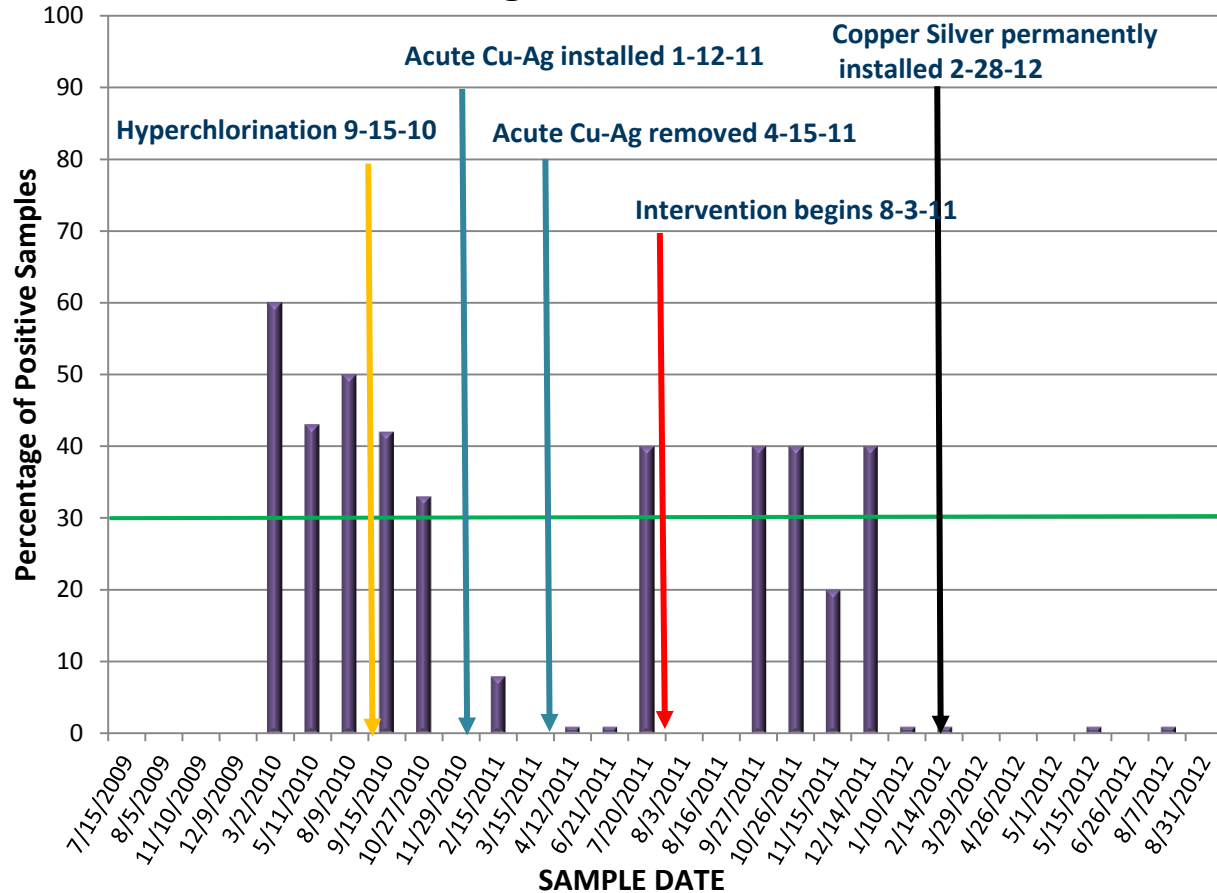


ER = Emergency room; CC = Critical Care; Tower = Main Building

Tower- Percentage of Culture Positive Sites

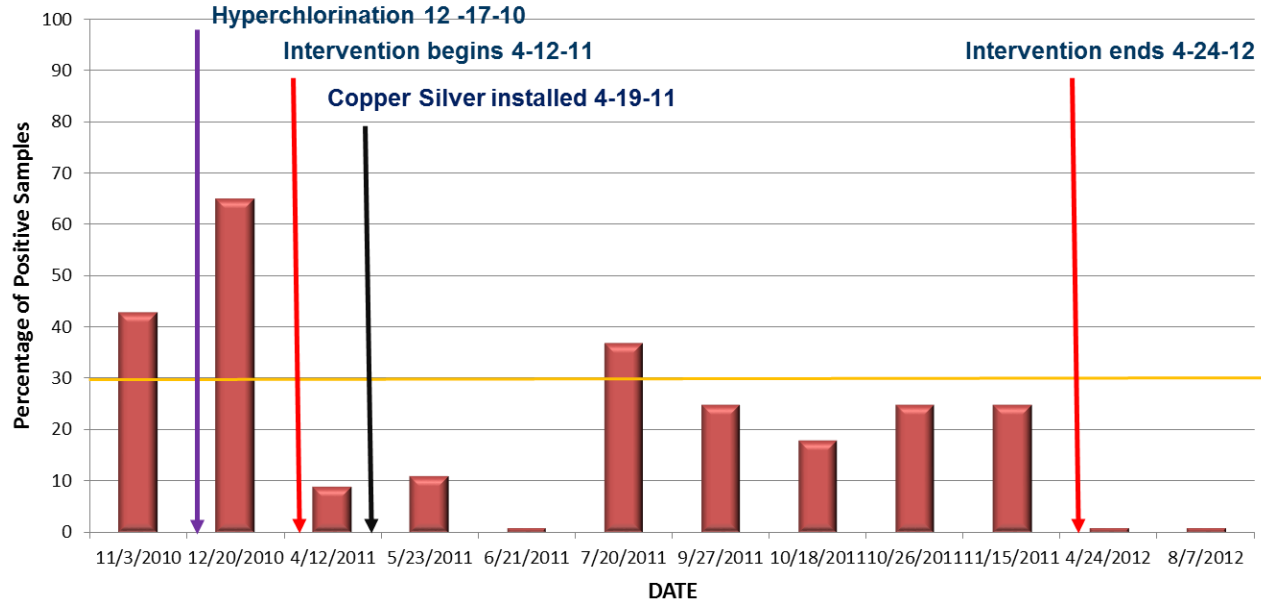


East - Percentage of Culture Positive Sites



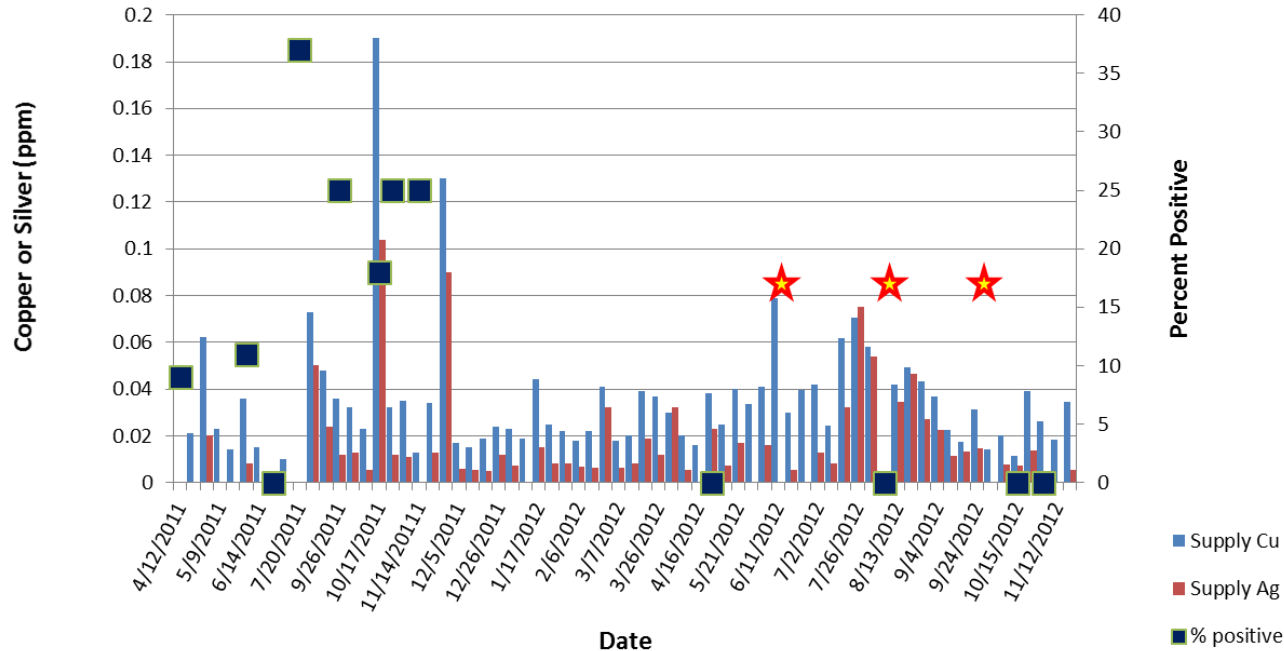
Second Intervention Site

Nursing Home – Percentage of Culture Positive Sites



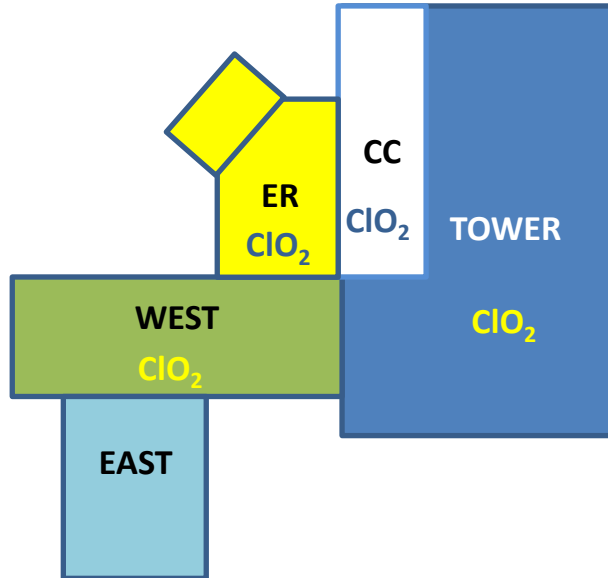
Example of Long-Term Results at St. Luke's Home

Copper-Silver Concentrations and Percent Positive Legionellae Detected in St. Luke's Home Hot Water Supply

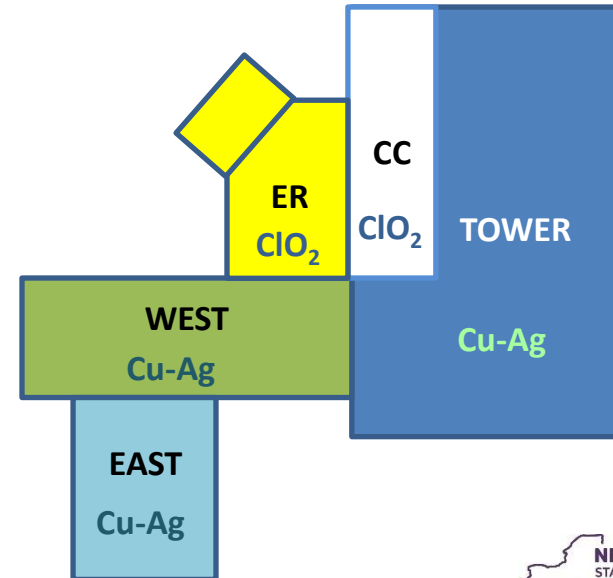


Hospital Long-Term Treatment Summary

Initial Treatment



Final Treatment



Conclusions

Conclusions

1. Remediating facility water systems as a result of legionellosis may be a complex process & it can require long-term assessments in order to result in adequate control.
2. Chlorine dioxide had limited success in a complex hospital environment; this involved multiple buildings with multiple premise distribution systems.
3. Implementation of Cu-Ag ionization in certain buildings of the hospital and an entire nursing home helped control both *L. pneumophila 1 and 6* and *L. anisa*.
4. The intervention showed that Cu-Ag could be effective in an alkaline pH environment in the range of 9.0 to 9.5.

On-Going Work

On-going Work

- Due to the precipitation of Cu in alkaline environments, the risk of Cu corrosion should be examined.
 - As a result of this, and other, work industry has considered testing a silver electrode with minimal copper; status unknown.
 - Using CDC EHS-Net funds NYSDOH had done a preliminary assessment of metal deposition (i.e., Ag and Cu) and corrosion.



On-going Work

- We are completing an extensive review of the biocidal action & resistance mechanisms of Cu and Ag (and other metals) as it relates to:
 - Growth state (active growth vs. starving state)
 - Cellular energy needs

Recommendations

Recommendations

- The literature reports that both Cu and Ag resistance may develop over a three-to-four year period. Each facility should:
 - Be aware of the need for increased Ag (or Cu) to control legionellae;
 - Consider intermittent hyperchlorination to cause turnover of the entire microbial community.
- Reevaluate water quality data to determine the role of pH, free chlorine, temperature, dissolved oxygen etc. in reducing legionellae.

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Selected References

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