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Copper and Silver Water Treatment

An Evidence-Based Review of Disinfection of Legionella

It is well known that hospital-acquired Legionnaires' disease is often directly linked to Legionella presence in hospital drinking water. It is also known that disinfecting the drinking water system is an effective preventive measure. In fact, in the UK it is a requirement that public buildings have a measure in place to prevent water contamination with pathogens like Legionella pneumophila and Pseudomonas aeruginosa that cause Legionnaires' disease and for their control if they enter the water system.

Lin et al. (2011) reviewed various Legionella control methods and stated that the efficacy of any disinfection measure should be validated in a stepwise fashion from laboratory assessment to a controlled multiple-hospital evaluation over a prolonged period. In their review, they provide a detailed evaluation of: systemic disinfection methods (copper-silver ionization, chlorine dioxide, monochloramine, ultraviolet light, and hyperchlorination), a focal disinfection method (point-of-use filtration) and short-term disinfection methods in outbreak situations (superheat-and-flush with or without hyperchlorination) for control of Legionella and other pathogens in water systems. See below the summaries for the main disinfection methods evaluated.

Copper-Silver Ionization

Summary:

- This systemic disinfection method is the only disinfection technology that has been validated by the 4-step standardized evaluation criteria we recommend (Table 1).
- Copper-silver ionization appears to be the best available technology today for controlling Legionella colonization in hospital water systems. Numerous vendors now offer ionization systems.
- Recommendations and assessments from other hospitals using ionization should be routinely sought before making a purchase.
- Rigorous maintenance plans with regular monitoring of both ion concentrations and the percentage of sites with Legionella positivity is necessary to ensure long-term success.

Table 1:Standardized Evaluation Criteria for Disinfection Methods: A 4-Step Approach (Adapted from Stout and Yu, 2003)

Step 1	Demonstrated efficacy in vitro against Legionella.
Step 2	Reports of anecdotal experience of efficacy in controlling Legionella contamination in individual hospitals.
Step 3	Peer-reviewed and published reports of controlled studies of prolonged duration (years) of efficacy in controlling Legionella growth and preventing cases of hospital-acquired Legionnaires' disease in individual hospitals.
Step 4	Confirmatory reports from multiple hospitals with prolonged duration of follow-up (validation step).

Chlorine dioxide

Summary:

- Chlorine dioxide is a promising disinfection modality; however, it has not yet fulfilled the 4 criteria required for validation of efficacy shown in Table 1 (Zhang et al. 2007).
- The review was optimistic that the challenges for chlorine dioxide disinfection would be overcome. However, they pointed out that for now, they would recommend it in circumstances that favour efficacy, including smaller secondary distribution system, a low cold-water temperature, non-galvanized piping, and low total organic carbon content in the hospital water.
- In future published studies, chlorine dioxide concentrations in concert with Legionella positivity rate should be reported.
- Given the many vendors offering varying types of chlorine dioxide generators and the marginal success experienced by so many hospitals, recommendations and assessments from other hospitals with experience with chlorine dioxide would seem mandatory.

Hyperchlorination

Summary:

- Of the 17 hospitals applying hyperchlorination as the sole modality or in combination with another modality, virtually all have since converted to other methods of disinfection (Muraca et al. 1990; Lin et al. 1998).
- Hyperchlorination was found to be the most unreliable and the most expensive disinfection modality.
- It has met with increasing disfavor because of inadequate penetration of the agent into biofilms in piping, persistence of Legionella organisms in hyperchlorinated systems (Garcia et al. 2008), corrosion of the water distribution system leading to pinhole leaks over time, and the introduction of carcinogens into the drinking water (Morris et al. 1992).

UV Light

Summary:

- The efficacy of UV disinfection is optimized if the system is installed on the incoming water main of a newly built hospital in which no biofilm has been established.
- It may play a role if the area for disinfection is limited (e.g. a transplant unit) and if a systemic disinfection system is used at the same time.

Selecting a method

Given the proliferation of companies that offer disinfection systems, failures have become commonplace, with patients contracting Legionnaires' disease despite installation of an expensive disinfection system. Therefore, the review strongly advocates that the infection control practitioner, not healthcare facilities personnel, should lead the task force in selecting the disinfection method and in selecting the vendor and that evidence-based data be used in making the selection. Other members of the task force should include hospital engineers and members of the administration.

In addition to installation costs, the experience and service commitment by the commercial vendors must be reviewed in detail by the infection control practitioner. Specifics regarding the service and monitoring of the system after installation must be put in writing before purchase.

The review emphasizes the need for maintenance and monitoring after installation, which is often underestimated. It is pointed out that the Legionella positivity rate for water outlet sites and the disinfectant concentrations need to be routinely monitored for the life of the system.

Low costs for initial installation are easily offset by the need for maintenance and repairs later on, often requiring the system to be shut down because of flawed design, improper installation, or poor service.

Final remark

ProEconomy Ltd's copper and silver Orca system strongly adheres to the recommendation in this review, i.e. we have robust maintenance plans with regular monitoring of both ion concentrations and Legionella, Pseudomonas, as well as TVCs assessment. With over 200 Orcas installed in sites in the UK and Europe, including hospitals (Great Ormond Children, John Radcliffe, the Royal Free, Birmingham Heartlands), the European Space Agency, Baxter's Soup and Windsor Castle, the company has a large amount of data to provide as evidence of Legionella control. The percentage of sites with Legionella positivity is at very low levels, hence proven long-term success of the Orca system.

References

Garcia MT, Baladron B, Gil V, et al. (2008). Persistence of chlorinesensitive Legionella pneumophila in hyperchlorinated installations. J Appl Microbiol 105:837–47.

Morris RD, Audet AM, Angelillo IF, Chalmers TC, Mosteller F. (1992). Chlorination, chlorination by-products, and cancer: a metaanalysis. Am J Public Health 82:955–963.

Muraca PW, Yu VL, Goetz A. (1990). Disinfection of water distribution systems for Legionella: a review of application procedures and methodologies. Infect Control Hosp Epidemiol 11:79–88