Electro-Chemical Active System (ECAS)or mixed oxidant supplementary water disinfection trial in H Block Frankston Hospital 2017 Executive Summary

2018

Background

In 2013 following a large legionella outbreak in Queensland where an audit found over 100 hospitals with Legionella growth a working party was established of Facilities Management and Infection Prevention and Control staff by the Executive Director of Planning, Infrastructure and Information Technology to undertake investigations to identify and analyse risks of such an incident at Peninsula Health(PH).

Legionella is a reportable organism requiring treatment of water systems. There have been many outbreaks in healthcare facilities resulting in patient mortality and morbidity as well as expensive treatment regimens and loss of reputation. (6)

However there are a number of other harmful organisms including antimicrobial resistant ones able to live and be transmitted in a facility's water system. PH Frankston has one ward where colonisation of a system has occurred with an unusual carbapenem resistant Pseudomonas aeruginosa GES 1. Sinks and toilets have been replaced but there has been recolonisation with the organism, so currently the organism is being suppressed by a weekly steam clean and super chlorination of fixtures by environmental services staff. This is reliant on staff availability and does not always occur. All costly and not providing a long term solution for the protection of our patients and service.

Working Party

From a table top investigation it was established that indeed PH could be in the same position as the hospital in Queensland. The working party was tasked with further investigations and identification of risk areas for all sites and to develop a risk mitigation strategy.

Due to an existing program of phasing out the use of cooling towers and replacement with chiller systems, the greatest risk of legionella transmission was identified as our potable water supply. This is amplified by the age and complexity of a number of our buildings and the difficulty in clearly identifying older plumbing networks, after multiple building updates and refurbishments leading to many dead legs throughout the service. This picture creates the ideal environment for biofilm growth which protects bacteria from the action of disinfection. While our hot water circulates at around 60^0C the use of temperature mixing valves(TMVs) for scolding prevention allows water to remain stagnant prior to use within the temperature danger zone for legionella and other harmful bacteria growth.

Activities undertaken 2010-2017

Aquaklar Analytical were contracted to carry out a cold-water halogen decay profile across the Frankston hospital campus. 32 samples were taken from 8 sample points over a four week period. The samples were analysed on site for chlorine (the oxidising biocide supplied by South East Water), pH and conductivity. Water from South East Water into PH was consistently delivered at 0.4ppm. This environment will inhibit the growth of most water borne bacteria. As the water traverses, our system this residual reduces in relation to the distance from the inlet. The lowest readings were found during this period of testing consistently in Building A Stage 2 and 3 and G Level 5 where many vulnerable and high risk inpatients are accommodated. (1)

- Copper/silver ionisation dosing of water trialled was discontinued and deemed unsatisfactory due to constant blocking of device and gross flow between hot and cold water
- Development of a working party

- Table top risk assessments all sites
- A risk management plan was policy was written. [2]
- Low use fixtures were identified for a frequent flushing regime. While this was instituted it is of limited success. Due to the large size of facilities, it requires local areas to flush these fixtures weekly and it is a low priority task in relation to the workload demands of the clinical areas.
- Shower roses were also identified as high risk and should be replaced if not used for extended periods. This requires local area to raise a replacement so is rarely done.
- Maintenance and remedial activities were identified and instigated
- Supplementary dosing was identified as necessary to mitigate remaining risk by eliminating harmful bacteria and reducing biofilms.
- Mapping of known supply system carried out
- Research into most appropriate method of supplementary dosing for PH was undertaken, finally identifying Chlorine dioxide or Electro-Chemical Active System (ECAS) as two best solutions to achieve a safe system at PH.
- C-Tech Services were approached to present to working party the risk/benefit of the two systems for our service.
- The two systems would have a similar set up cost but ongoing costs for ECAS would be much lower and there would be no hazardous chemical to store or transport as the solution is manufactured from water and salt. [3]
- Using Electro-Chemical Active System (ECAS) or mixed oxidant was selected as the preferred option. By electrolysing a weak brine solution this system produces variety of oxidants, including hypochlorous acid, free chlorine and free radicals, known to possess antimicrobial properties with superior effect on removing biofilms without evidence of mutagenicity / carcinogenicity.
- Identification of site able to be isolated from main system and without high risk activities as a possible trial site
- Design of trial and funding for trial established.
- Trial of ECAS water was implemented by C-Tech with independent environmental scientific testing and reporting by PT Environmental.

Trial

H Block (Mental Health) was identified as the best and safest area of least risk area in Frankston hospital to conduct the trial. The H block system is able to be isolated from rest of supply is soon after mains entry point with most access to Southeast Water preliminary dosing. The patient population in this block are not as a rule immune compromised.

PH working party wanted to be able to prevent any adverse events during the trial, to not inconvenience staff or patients and to closely monitor the introduction of supplementary dosing. It did not want to alarm patients or staff or have notable water quality changes requiring remedial treatments, as the area housed our two mental health wards. In order to achieve this there was a hypothesis formed that a dosing regimen starting and remaining at a much lower level of disinfection than had previously been undertaken the South Australian trial or those in the literature, until inhibitory levels of free chlorine were available in system would achieve the groups aims. This was to be monitored and analysed by both C-Tech and an independent environmental scientist PT Environmental.

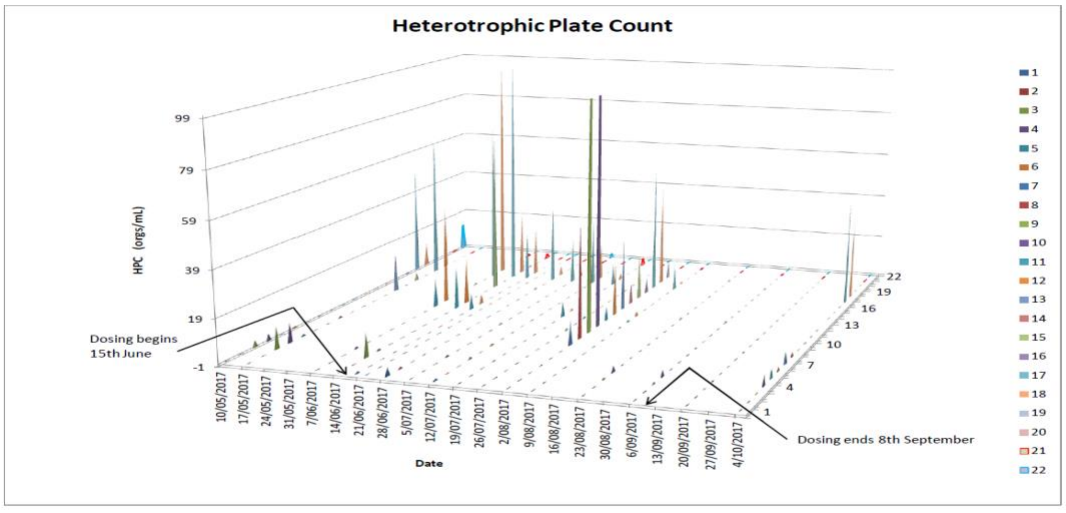
Trial timeline

- Pre-trial design and baseline testing May 10th until June 14th
- Equipment installation and plumbing adjustments
- Trial dosing commenced June 15th and ceased 8th September (16 weeks) monitoring of dose and water testing of 22 sites maintained during trial. Monitoring and analysis was routinely carried out on both physical and chemical parameters of pH, redox and chlorine (free and total) and turbidity and colour of water. Heterotrophic plate count (HPC) was used to ensure no significant increase in bacterial load occurred with breakdown of biofilm during the trial which could put patients and staff at risk. Incremental interval testing (7 events) of some higher risk sites was also carried out for E coli, coliforms and legionella prior to dosing and during dosing was also carried out again there was little significant change due to presence of disinfection from SE Water or supplementary dosing. [4,5]
- Corrosiveness of process was also tested during the trial to judge effect on system as ECAS is purported to be less corrosive than some other disinfection regimes [4]

Dosing was commenced at .65ppm and gradually increased to 1.6ppm with monitoring to achieve consistent levels of free chlorine with minimal changes to turbidity and colour across all areas over two floors in H Block. Drinking water guidelines for chlorine is 5ppm (mg/L). HPC levels were also run each testing in addition chemical and physical results to ensure the levels remained within safe limits. At times HPC testing highlighted some areas of poorer bacteriological water quality where available disinfectant levels were lower but generally did not change significantly throughout the trial ensuring safety of patients and staff in the area.

Free Chlorine levels increased as the dose increased consistently over the trial more quickly on the lower floor and also more slowly in the hot and mixed temperature taps than cold water taps. The trial was able to successfully demonstrate that a lower dose of disinfectant introduced into the potable water system to supplement SE water treatment would over time achieve biofilm removal and increase available free chlorine for pathogenic organism suppression. [4, 5]

The trial also demonstrated that although there had been some increase in the presence of organic matter as biofilm was removed there was overall no major change in the background HPC due to the increased activity of disinfection post supplementary dosing.[4, 5] The last five testing events did however show a reduction in background HPC when compared to pre-trial baseline testing.



There was no increased corrosion demonstrated during the trial period.

During the trial a number of incidental plumbing defects in the system were identified and rectified as well as an electrical malfunction in monitoring equipment which was engineered out. Dosing ceased on September 8th 2017.

Recommendations

Due to the successful outcome of the trial Facilities Management and Infection Prevention and Control Unit recommend the adoption of ECAS system for supplementary water disinfection for PH in-patient sites in order to risk mitigate both the legionella and carbapenem resistant Pseudomonas aeruginosa GES 1 infectious risks A benchmarking exercise was undertaken of several sites to establish the current state of actions of other organisations (Appendix 1).

Supporting Documents

1. Peninsula Health, Frankston Hospital Cold Water Halogen decay Profile across the Hospital Campus report prepared by AquaKlar Analytical. September 2015
2. Legionella Risk Management PH policy PROMPT document number 31029767
3. Legionella Risk Management Strategy Executive Briefing Paper November 2016
4. Frankston Hospital ECAS Disinfection Trial report prepared by PT Environmental October 2017
5. Water Trial Statistical Summary of data undertaken by Professor Srikanth Velandai PH Academic Unit, Department of Medicine
6. Guidelines for Legionella Control in the operation and maintenance of water distribution systems in health and aged care facilities. Australian Government, 2015

Appendix 1 External Benchmarking with Healthcare Services Undertaking Risk Mitigation

1. Bendigo Hospital: attempted to use cooper-silver water treatment which failed. They have now adopted Chlorine dioxide secondary disinfection using twinoxide (chlorine dioxide) product.

2. RMH: Currently have a problem with pseudomonas aeruginosa, adopted Sodium Hypochlorite secondary disinfection of warm water system. As with Frankston, they have feed forward control on water meter, with a redox override in case chlorine gets too high.

3. Austin Hospital: Have problem with Legionella; presently carry out monthly thermal disinfection on some wards. Looking to permanent solution. At this stage, they are favouring twinoxide (chlorine dioxide).

4. Alfred Hospital: Have problems with Legionella, attempted to use cooper-silver water treatment, failed, presently carry out monthly thermal disinfection on some wards. Looking to permanent solution. Thermal disinfection is working for them but at a cost.

   General consensus: DHHS does not have any guidelines on secondary disinfection and risk mitigation. Everybody who has had to do a mass thermal disinfection has done so at significant expense out of their existing budget with services affected. DHHS are also happy with “Oxidising biocide” disinfection. Some concern expressed with thermal & oxidising disinfection where plastic piping (PEX, rehau, AquaTherm) was being used.