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Copper and Silver Water Treatment

Case Study

Good Hope Hospital

Controlling *Legionella pneumophila and Pseudomonas aeruginosa* risk in a UK hospital using copper and silver ionisation.

Background

Good Hope Hospital, the heart of England NHS Foundation Trust, serves North Birmingham, Sutton Coldfield, and Southeast Staffordshire for a total of 450,000 catchment population (Heart of England NHS).

Healthcare associated infections (HCAI) control is the priority for the patients' health in the Trust's agenda. The full risk assessment of contaminated water to patients' health has been carried out, which reviewed the importance of using copper and silver ionisation system as a solution to control waterborne bacteria in hospital water system (Infection Prevention and Control Annual Report 2012-13).

L. pneumophila and P. aeruginosa can cause minor to complicated life-threatening infections involving multiple parts of the body (Marston et al., 1994). Patients with compromised immune system are especially at risk of contracting the bacteria and becoming ill.

The Water Management Group of the hospital had monitored the water outlets since 2012 as a response to national guidance for controlling _L. pneumophila and P. aeruginosa_ contamination in water systems (Infection Prevention and Control Annual Report 2012-13). In the Infection Prevention and Control Annual Report 2012-13, copper and silver ionisation treatment of water systems showed excellent performance for the control of L. pneumophila and P. aeruginosa. This case study reports a long-term performance of ProEconomy's copper and silver ionisation Orca system for the control _L. pneumophila and P. aeruginosa_ with a data collection of 2100 samples in total from 2011 to 2018.

Installation of the Orca copper and silver system

Before installation, 50 pre-commissioning samples were collected and analysed in 2008. A total of 22% of these had _L. pneumophila_ positives.

After installation in 2011, around 25 samples were collected every month in hospital outlets to test for _L. pneumophila_. The sample collection for _P. aeruginosa_ started in 2013, around 30-80 samples were collected every six months for _P. aeruginosa_ analysis, if previous test had found no infection. If the outlet had positive _P. aeruginosa_ samples, it would be monitored every couple of days until no infection was detected.

Results

L. pneumophila monthly measurements results are shown in Figure 1. The highest percentage of positive _L. pneumophila_ was in the pre-commissioning samples which reached 22% positives. From 2012 to 2013, the number of _L. pneumophila_ positives had been reduced to 10%. Since July 2013, _L. pneumophila_ has been reduced to below 5%.
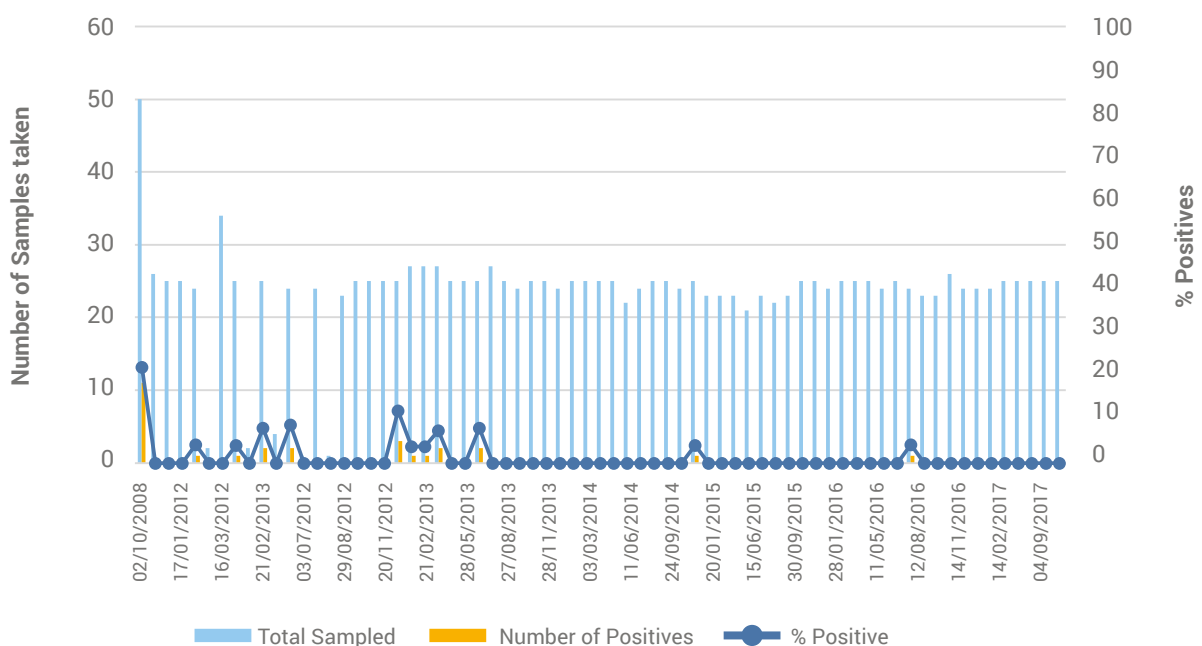

Figure 1. _L. pneumophila_ monthly results - total samples analysed, number of _L. pneumophila_ positives and percentage positives in Good Hope Hospital, 2008-2017.

Monthly data from 2011 to 2018 and pre-commissioning data from 2008 were summarised to annual data which is shown in Table 1. Around 50-300 samples were collected every year. After installation of the copper and silver ionisation system, L. pneumophila positives were significantly reduced to below 3% as of 2013. The range L. pneumophila was also reduced from 100-4000 CFU/Volume in 11 positive samples in 2008 to 100 CFU/Volume in only 1 positive sample by 2016, which is shown in Table 1.

Table 1. Annual results - total samples, number of positives, % positives, and ranges of *L. pneumophila* in Good Hope Hospital water system.

Year	Total samples	No. of Positives	% Positives	Range of L. pneumophila CFU/Volume
2008	50	11	22	100-4000
2011	51	0	0	0
2012	289	6	2.1	100-500
2013	307	9	2.9	100-1200
2014	269	1	0.4	400
2015	208	0	0	0
2016	268	1	0.4	100
2017	148	0	0	0
2018	25	0	0	0

The *P. aeruginosa* measurement results are shown in Table 2. The overall control of *P. aeruginosa* was very effective. Only 2 positive samples had been found in February, August 2016, and September 2017 monthly measurement. The range of positive *P. aeruginosa* was also very low, which was below 100 CFU/Volume (Table 2).

Table 2. Total samples, number of positives, percentage positives, and ranges of *P. aeruginosa* in Good Hope Hospital water system.

Month	Total samples	No. of Positives	% Positives	Range of P. aeruginosa CFU/Volume
Jun-13	124	1	0.8	0-9
Feb-15	42	0	0	0
Feb-16	112	2	1.8	1-2
Aug-16	106	2	1.9	7-27
Sep-17	105	4	3.8	3-100
Oct-17	2	0	0	0

The temperature measurement taken during *L. pneumophila* sampling is shown in Figure 2. The water temperature in 52% of outlets was below 20 °C and in 12% of outlets, the water temperature was above 50°C. For the number of positive *L. pneumophila*, 19 positives were found in cold water, 8 positives in water temperature between 20°C and 50 °C, and only 1 positive was found in hot water >50°C. It appears that copper and silver together with hot water temperature had the best effect on killing *legionella* at Good Hope, with only 0.52% positive being observed; whereas cold water and water between 20 and 50 °C had slightly more bacterial growth, with 2.3% and 1.4%, respectively. Temperature can improve control of bacterial growth, but it cannot be an efficient control factor by itself. The application of the copper and silver ionisation system is the main control to significantly reduced bacterial growth.
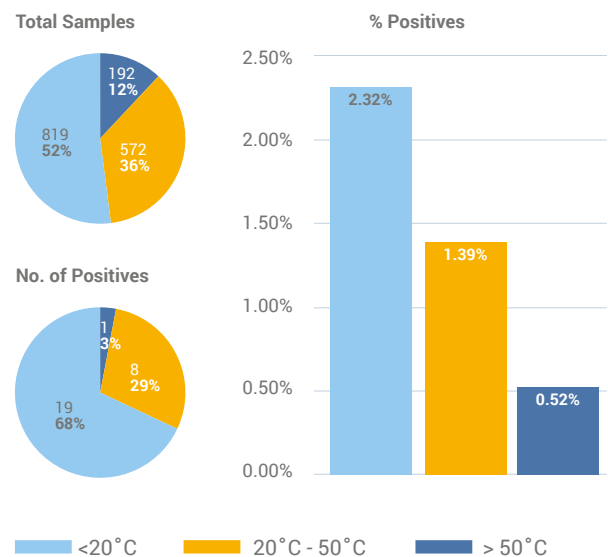

Figure 2. *L. pneumophila* percentage at three temperature ranges, Good Hope Hospital water system.

Conclusion

The copper and silver ionisation Orca system has had an obvious effect on both *L. pneumophila* and *P. aeruginosa* over time from 2011 to the present in the Good Hope Hospital water system. No *L. pneumophila* has been detected since 2017 and very low *P. aeruginosa* positives were detected throughout the time.

It has been proved that frequent flush of the tap is also important for the circulation of the copper and silver ions in the water system. Most bacteria are found in the area with low water usage (Infection Prevention and Control Annual Report 2012-13).

With careful monitoring of the level of copper, silver, temperature, and regular management, it is possible to ultimately eliminate bacterial infection in water.

Study carried out and written by Xinyuan Liu, Intern MSc Student, King's College London
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References

Heart of England NHS, available at:
http://www.heartofengland.nhs.uk/good-hope-hospital/

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