Chlorine Dioxide Water Disinfection System in Healthcare Facility – Experience Of A Tertiary Care Centre

Presenter

- Capri Jalota,COO
- Dr Pragathi K,ICO
- Lt Col P Ashok K Reddy(Retd)
- K H Nageswara Rao, Head Engg

Background and Problem Statement

- AIG Hospitals has an average daily footfall of over 2500 patients in outpatient services and has over 500 occupied beds.
- Average daily consumption of water is 400KLD per day.
- The hospital is having water storage capacity of 800KL, with water pipelines of 7 kms spread across 1.2Mn sqft area with over 2000 delivery ports.
- During Feb 2021, our ICUs reported few cases of Elizabethkingia Meningoseptica infection.
- A total of 10 cases were documented between March 2021 and May 2021.
- Surveillance swab cultures showed growth in the tap water of some ICUs.
- Elizabethkingia is a genus of bacteria commonly found in the environment worldwide and its widely found in hospital water supplies.

Problem Statement: To eradicate incidence of Elizabethkingia Meningoseptica infection, a water borne bacteria, in the hospital.

Initial Actions Taken

- The Facility Management Team carried out the following activities:
  a) Manual chlorine dosing was being used and the same was replaced to Automatic chlorine dosing system so that any dosage imbalances can be addressed.
  b) Hand wash terminal pipes were weekly disinfected with Sodium hypochlorite.
  c) Policy of RCC water storage tanks cleaning changed from yearly to quarterly.
  d) Weekly Drinking RO Water dispensers being flushed with bleaching powder.

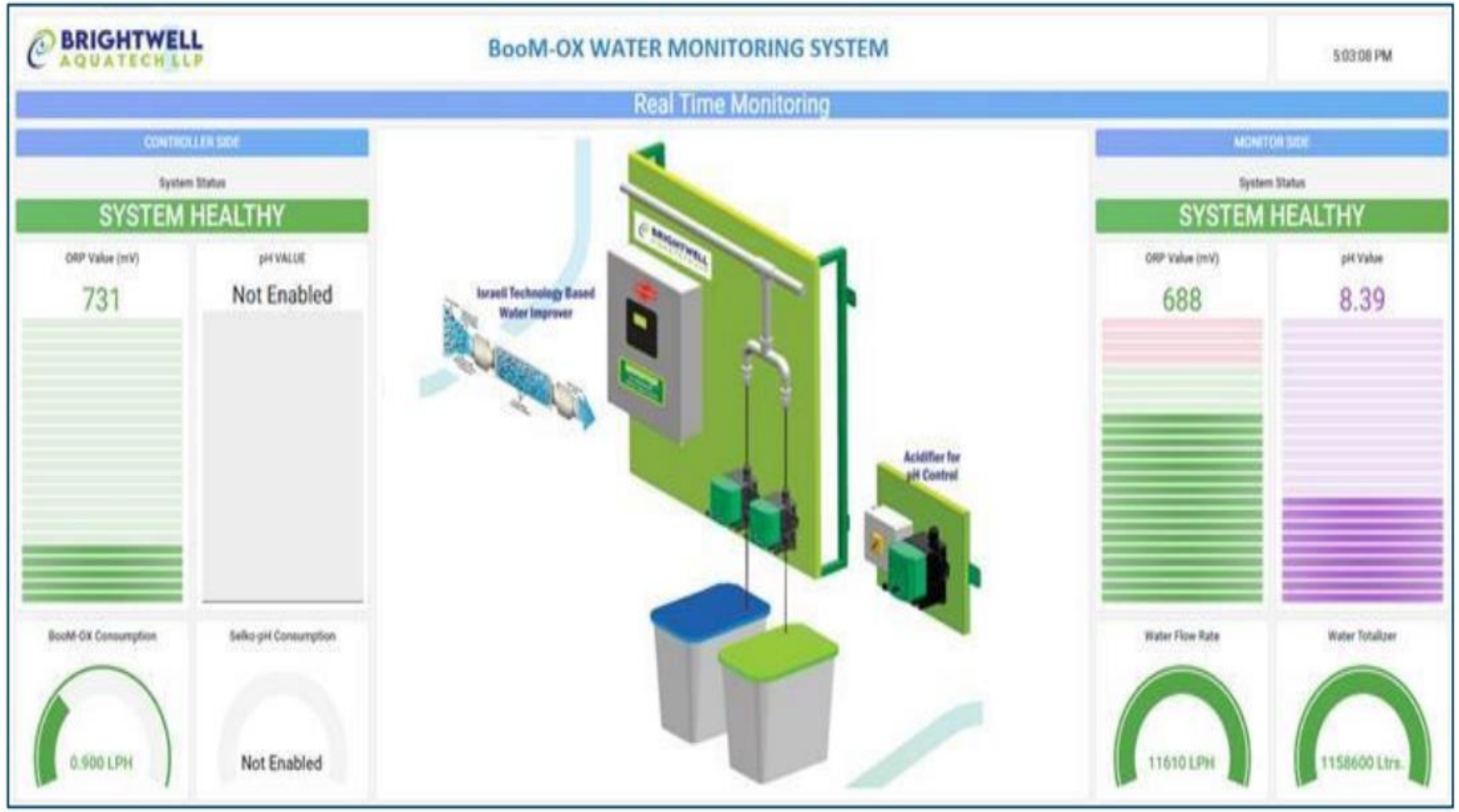
- However, all the above had little impact on the incidence. Upon deeper investigation, it was found that biofilms were still present in the water distribution CPVC pipes and Elizabethkingia being present in them. And until the biofilms are removed, the bacteria would continue to infect patients

- Further, while attempting to solve the issue, the Facility Management and Infection Control team faced the following problems:
  a) Given high footfalls and occupancy, interrupting water supply, even for few minutes, was not possible
  b) The water pipeline length across the hospital is around 7kms with intricate and extensive network. Further, there was only one water supply valve per floor with no branch valves – which limited phase-wise isolation of areas

Alternatives available

Sl#	Alternatives	Pros	Cons	Comments	Selected/Not Selected
1	Flushing with water more than 50 °C	1.Effective disinfection 2. Enhanced cleaning power 3.Legionella control	1. Scaling hazard 2. Material in compatibility	The hospital lacks facility to heat the treated water above 50 °C and flush the same for 1 minute	Not selected
2	Flushing with chemicals	1. Effective contaminant removal 2. Scale and fouling prevention 3. Rapid and through cleaning	1. Health and safety risks 2. Chemical compatibility 3. Residue & rinse requirements	Would lead to corrosion and damage of CPVC lines	Not selected
3	Shock Disinfection	1. Rapid results 2. Affordability 3. Versatility	1. Lack of long term protection 2. Limited efficacy against some pathogens	Possible only if there are isolated lines	Not selected
4	Chlorine dioxide Dosing System	1. Effective disinfection 2. Minimal formation of disinfection by products 3. Residual disinfection	1. Complex generation of ClO2	-	Selected

THE TECHNOLOGY: Boom-OX Stabilized Chlorine Dioxide



- **IoT Enabled System**
- It mixes the chemical as per the set values at the distribution point as it is the water starting point
- From there the chlorine dioxide circulates through all the CPVC distributing pipes till the terminal ends
- Terminal points were repeatedly checked to maintain 0.2ppm chlorine
- The complete system is managed by Oxidation Reduction Potential (ORP) Meter
- Positive ORP in the 600-700mV range is ideal for sanitation and safe consumption
- The entire system had low Capital Expenditure with low Operating costs also

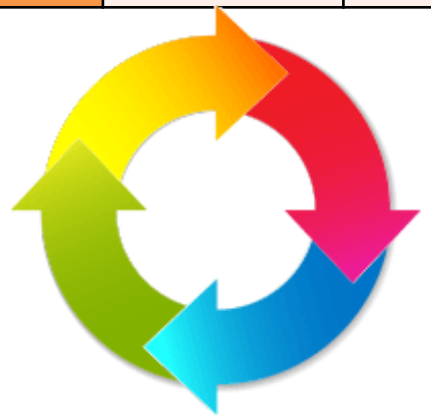
Implementation & IMPACT

The Water analysis reports before and after installation of Chlorine dioxide water disinfection system are as under:

- Installation completed in Jan 2023
- Within 2-days of installation, the water at the terminal ends of pipes (Wash basins) turned to Dark-Brownish color, which was from the residue of biofilms in the pipelines
- To avoid brownish water at terminal end pipes, everyday flushing was done every 2 hourly to drain the dirty water for next 15 days
- Thereafter, the water at the terminal ends has not only been clear without discoloration but more importantly, infection free.

Water borne organisms in clinical samples (Jan 2022 – Dec 2022 'vs' Jan 2023 – Aug 2023)

Type of bacteria	2022 (Cl)	2023(ClO_2)
Elizabethkingia	16	3
Aeromonas	39	3
Pseudomonas	22	4



- There was a significant decrease in water borne organisms in clinical areas where there was biofilm formation. As seen in the table above, we have not observed any growth in the pipelines since the implementation of Chlorine dioxide Dosing System at AIG Hospitals.

Monthly Water Analysis

S.NO	Sources of Water	07 Aug 2022 (Before installation)		31 Jul 2023 (after Cl O2 installation)	
		Aerobic Colony Count cfu/ml	Aerobic Colony Count cfu/ml	Aerobic Colony Count cfu/ml	Aerobic Colony Count cfu/ml
1	Pre flush water – 4th floor, OT scrub	180 CFU/ml	180 CFU/ml	No growth	No growth
	Post flush water – 4th floor, OT scrub	270 CFU/ml	270 CFU/ml	No growth	No growth
2	Pre flush water – B1, OT scrub	>1 Lakh CFU/ml	>1 Lakh CFU/ml	No growth	No growth
	Post flush water – B1, OT scrub	1500 CFU/ml	1500 CFU/ml	No growth	No growth
3	Pre flush water – B3, OT scrub	>1 Lakh CFU/ml	>1 Lakh CFU/ml	No growth	No growth
	Post flush water – B3, OT scrub	No growth	No growth	No growth	No growth