Exploring the Relationship Between the Reduction of Floor Microbial Burden and its' Impact on Healthcare-Associated Infections with the Implementation of an Advanced Photocatalytic Oxidation Technology

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Introduction

Healthcare floors have become an emerging vehicle and/or source for potential pathogens that cause healthcare associated infections.[1] Previous research has shown that hospital floors are often heavily contaminated with pathogens such as *Clostridioides difficile* and Methicillin-Resistant *Staphylococcus aureus*, however definitive research linking reductions in floor burden to reductions in HAIs has not yet been established.[2] The facility was interested in evaluating emerging technology for continuous disinfection and its' potential impact on HAIs. This study was designed to explore the potential relationship between the reduction of microbial burden of floors and healthcare associated infections.

Methods

A prospective study was conducted in a 22-bed medical-surgical Intensive Care Unit in a 180-bed suburban hospital near New Orleans, Louisiana from November 2021 to June 2022. Using sterile, pre-moistened sponges, samples were collected from the floors of 10 areas throughout the unit including two nurses' stations, the physician charting area, and five areas in seven of the patient rooms. The advanced photocatalytic oxidation (aPCO) equipment was then installed in the HVAC ductwork throughout the ICU and activated. Environmental sampling of the same 10 floor areas were then repeated every four weeks for the first five months of the study. Tracking of healthcare-associated infections continued for an additional three months. The facility's normal cleaning protocol for floors, which utilized a neutralizing floor cleaner, was unchanged and followed during the entire study period. Healthcare-associated infections, specifically hospital-onset MRSA (HO-MRSA) bacteremias, hospital-onset *Clostridioides difficile* infections (HO-CDI), and central-line associated bloodstream infections (CLABSI) were also tracked during the study period. Changes in floor microbial burden were calculated using a repeated methods ANOVA with post hoc analyses as appropriate. Rates of healthcare-associated infections per 1,000 patient days were compared using chi-square analyses. The data was communicated to the unit staff and hospital leadership monthly.

Results

There was an overall 99.6% statistically significant decrease in floor environmental microbial burden from the baseline to final post-activation test (F= 69.359, p <.001). The average colony forming unit count (CFU) went from 318,850 CFU/100cm^2 to 2,998 CFU/100cm^2 during the same period (Figure 1). Post hoc analyses with Bonferroni adjustment showed that the overall microbial burden was statistically significantly decreased from baseline to every subsequent environmental test(Z= -2.191, p =0.028; Z= -2.803, p =0.005; Z= -2.803, p =*0.005*; Z= -2.803, p =0.005). Additionally, there were statistically significant decreases seen between post-activation tests, including between post activation tests one and two (Z= -2.666, p =0.008), post activation tests one and three (Z= -2.803, p = 0.005), post activation tests one and four (Z= -2.803, p= 0.005), and post activation tests two and three (Z= -2.395, p= 0.017). The unit also saw a statistically significant decrease in publicly reported healthcare associated infections (HO-MRSA, CLABSI, HO-CDI) during the study period when compared to the same time frame a year prior and in the immediate 6 months prior to the study start (Figure 2).

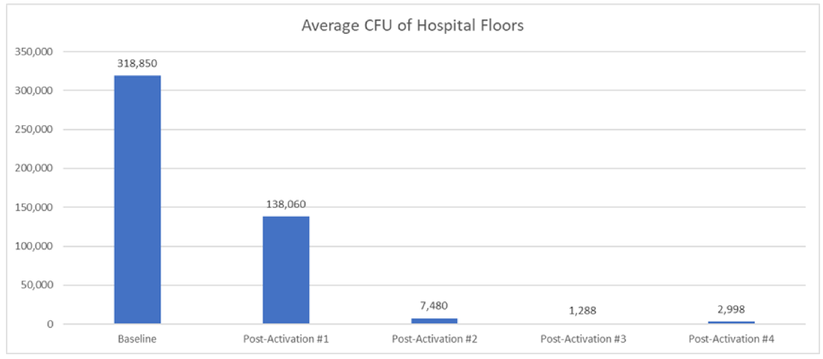

Figure 1

	Baseline Periods			Study Period							
	11/2019 - 02/2020	11/2020 - 02/2021	05/2021 - 10/2021	21-Dec	Jan - 22	22-Feb	22-Mar	22-Apr	22-May	22-Jun	Total Trial Period
Patient Days	1,368	1,676	2,891	459	567	464	382	406	392	353	3,023
MRSA Infections	1	8	8	0	0	0	0	0	0	0	0
MRSA Infection Rate	0.08	0.67	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C *diff* Infections	1	5	4	0	0	0	0	0	0	0	0
C. *diff* Infection Rates	0.09	0.46	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CLABSI Infections	0	0	2	0	0	0	0	0	0	0	0
CLABSI Infection Rate	0.00	0.00	0.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Figure 2

Conclusions

The advanced photocatalytic oxidation technology resulted in a reduction of microbial burden on the floors of a high-traffic intensive care unit. Statistically significant decreases in hospital-onset *C. difficile* infections, hospital-onset MRSA bacteremias, and CLABSIs were also seen. This study highlights a novel aPCO technology and its efficacy at reducing microbial burden and healthcare associated infections despite no change in practice. Further research is needed to elucidate the relationship between the reduction in floor microbial burden and healthcare associated infections.

References

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