Sustained Microbial Burden Reduction and Impact on COVID19 Cases in a Long-Term Care Facility through Advanced Photocatalysis (AP)

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INTRODUCTION

COVID19 remains deadly to Americans over 75 years old[1] despite vaccination and additional infection control practices in long term care (LTC). The evolution of more transmissible COVID19 variants and continued viral aerosols result in persistent COVID19 outbreaks in LTC during high community levels of COVID19[2]. Despite the end of pandemic Federal support and the continued vulnerability of elderly to the virus[3], LTC facilities remain dedicated to protecting this vulnerable population. This study hypothesized that utilization of continuous, facility-wide, advanced photocatalysis (AP) disinfection technology will reduce microbial burden on surfaces, floors, and in the air, demonstrating a decrease in infectious aerosols and subsequent COVID19 cases among residents and staff.

SUMMARY

The effect of the AP technology on environmental surface and floor aerobic bacteria, fungi, and Methicillin-resistant Staphylococcus aureus (MRSA) and airborne aerobic bacteria and fungi was designed as a prospective controlled experimental study, using pre-activation environmental samples as the baseline to compare to post-activation samples in the intervention center.

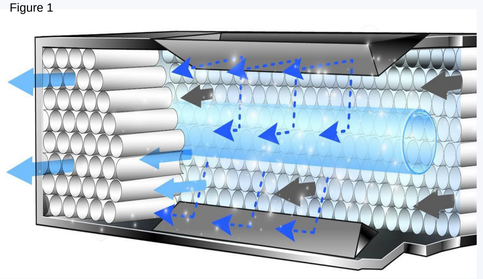
Statistically significant reductions of greater than 92% were reported for all surface and floor samples after AP technology activation (Figures 2-5). Air testing showed reductions of aerobic bacteria and fungi by 87% and 36%, respectively, but were not statistically significant, likely due to small sample size (n=10).

The intervention center performed 68% better than the control centers with a 79% reduction in staff COVID19 cases compared to the same matched time period one year prior (Figure 6). The incidence of resident COVID19 cases was reduced 94% in the intervention center while the control centers experienced a 46% increase compared to the matched time period one year prior (Figure 7).

MATERIALS & METHODS

A prospective facility controlled experimental study was performed in skilled nursing facilities in Pennsylvania and New Jersey from January 2023 to April 2023 to surveil environmental surface and floor aerobic bacteria, fungi, and MRSA colony forming units (CFUs) and airborne aerobic bacteria and fungi CFUs prior to and post AP technology activation. Sampling occurred at baseline prior to activation and again after activation every 4 weeks for 3 consecutive months in the intervention centers. Two control centers in regional proximity to the intervention facility were also prospectively studied. Impacts on resident and staff COVID19 cases were recorded and compared to the same extended observation period (February-July) one year prior (2022).

Figure 1



The AP technology recreates the process of photolysis to mechanically deliver continuous diffusion of trace oxidative molecules for persistent disinfection of surfaces and air. The AP device consists of a patented cell design, containing a 253.8nm UV-C bulb surrounded on both sides by a proprietary, honeycomb shaped photocatalyst that triggers a photochemical reaction with the water (H_2O) molecules in the air to yield oxidative molecules that neutralize pathogenic compounds (Figure 1).

A one-way repeated measures analysis of variance (ANOVA) with post-hoc simple contrast was used to analyze mean CFUs from baseline to final post-activation. Significance of p <.05 was used throughout.

RESULTS

Mean aerobic bacterial CFUs:
93% surface reduction (p<.001)
92% floor reduction (p=.008)

Mean fungal CFUs:
99% surface reduction (p<.001)
96% floor reduction (p=.012)

Mean MRSA CFUs:
99% surface reduction (p=.007)
99% floor reduction (p=.006

Figure 2

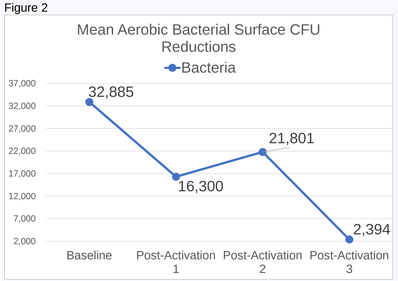


Figure 4

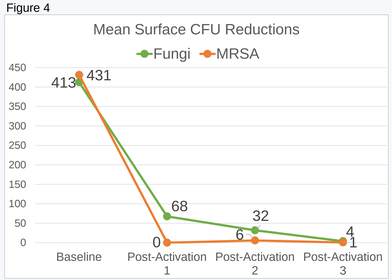


Figure 3

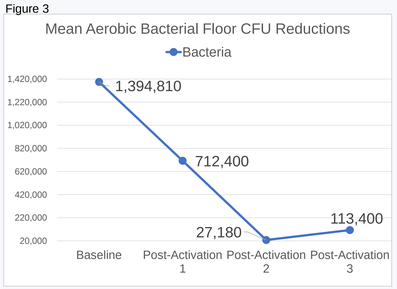


Figure 5

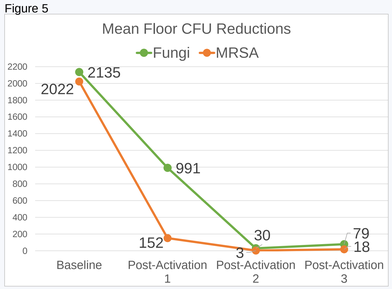


Figure 6

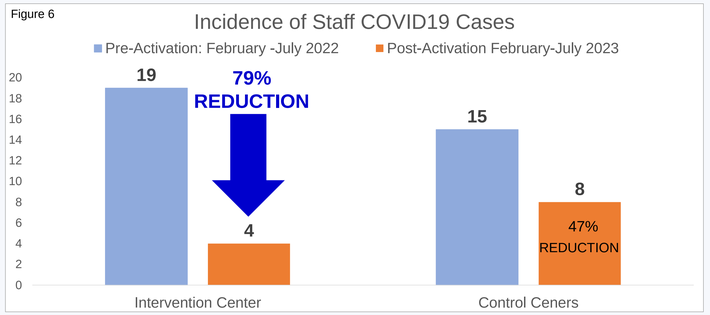
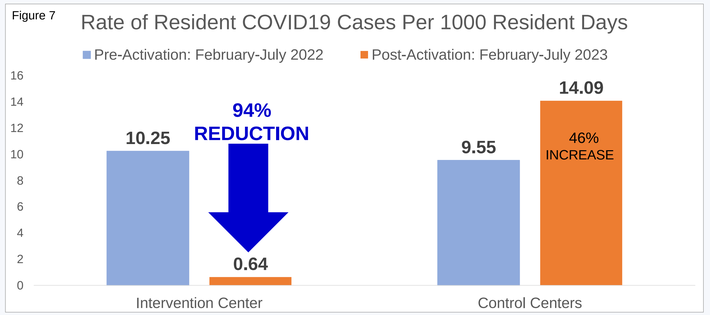


Figure 7



CONCLUSIONS

Despite intensive efforts through current cleaning and disinfection practices, serious microbes remain on surfaces, floors, and in the air. This study is on the pioneering edge of demonstrating that continuous and persistent disinfection technology reduces contaminant reservoirs on surfaces, floors, and in the air all without the need for additional skilled labor, increases in cleaning and disinfection practices, or supplemental training. The reduction in environmental contamination clearly decreases infectious aerosols and improves resident outcomes by dramatically reducing the rate of COVID19 transmission in LTC facilities. The continuous nature of the AP decontamination, the ability to use it in occupied rooms, and its independence of human resources, provides a novel safe intervention for complex healthcare environments.

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DISCLOSURES

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