Sustained Reduction of Microbial Burden and Healthcare-Associated Infections (HAIs) Impact in Skilled Nursing Facility through Advanced Photohydrolysis (AP) Technology

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INTRODUCTION

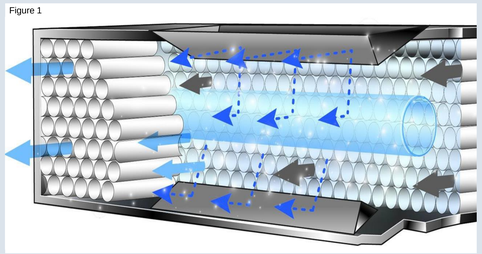
Despite evolution in disinfection practices and treatments, there is an increasing spread of multi-drug resistant organisms (MDROs) and healthcare-associated infections (HAIs). Without new treatments or countermeasures, antimicrobial resistance (AMR) and untreatable infections will continue to rise[1]. The study hypothesized that utilization of facility-wide, continuous disinfection technology will reduce microbial burden in the environment of care, resulting in a decrease in HAIs and improved patient outcomes.

MATERIALS & METHODS

A controlled experimental study was performed in long-term care (LTC) facilities in Pennsylvania and New Jersey from January 2023 to April 2023 to surveil environmental surface and floor aerobic bacteria, fungi, and methicillin resistant *Staphylococcus aureus (*MRSA) colony forming units (CFUs) and airborne aerobic bacteria and fungi CFUs before and after AP technology activation. Sampling occurred at baseline and again every 4 weeks for 3 consecutive months. Two control centers in regional proximity were also prospectively studied. Aggregate HAI counts (catheter associated urinary tract infections [CAUTIs], central line associated bloodstream infections [CLABSIs], Clostridioides difficile [C. diff], Non-ventilator associated healthcare acquired pneumonia [NV-HAP], MRSA) were recorded and compared to the same extended observation period (February-July) one year prior (2022).

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 device consists of 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).

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.

RESULTS

Mean Surface CFU Reductions:

Aerobic Bacteria: **93%** (p<.001)

Fungi: **99%** (p<.001) MRSA: **99%** (p=.007)

Figure 2

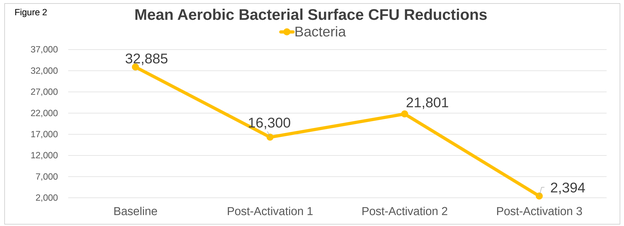
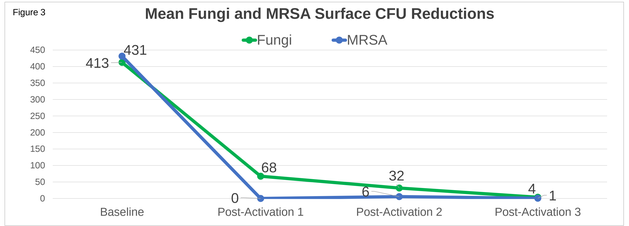


Figure 3



Mean Floor CFU Reductions:

Aerobic Bacteria: **92%** (p=.008)

Fungi: **96%** (p=.012) MRSA: **99%** (p=.006)

Figure 4

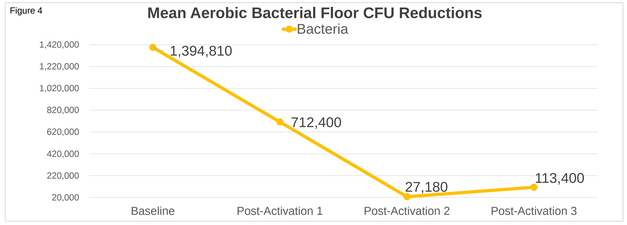


Figure 5

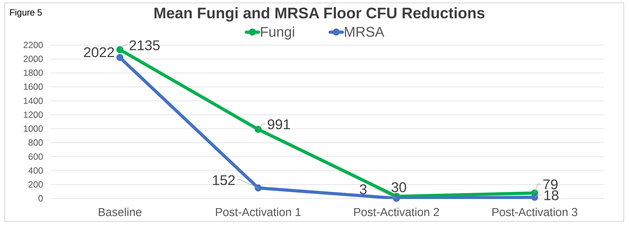


Figure 6

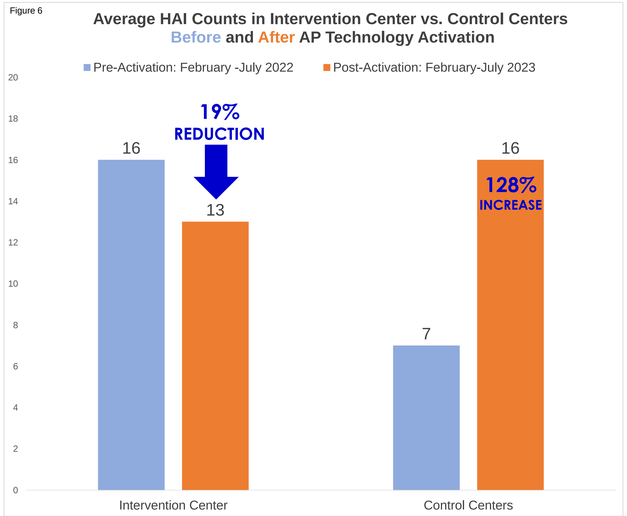
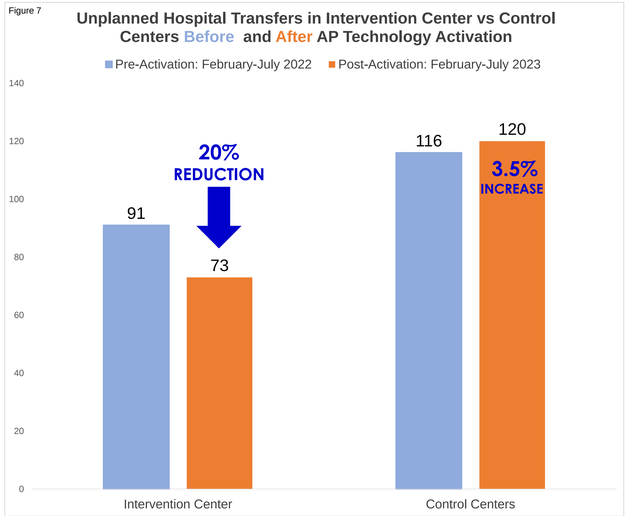


Figure 7



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 reservoirs and improves patient outcomes by reducing the incidence of HAIs in LTC facilities as well as hospital transfers, which are a critical indicator for quality of care. The continuous nature of the AP decontamination technology, the ability to use it in occupied rooms, and its independence of human resources, provides an innovative and safe intervention for complex healthcare environments.

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 controlled experimental study, with statistically significant reductions of greater than 92% 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 insufficient sample size (n=10).

A cumulative count of HAIs that occurred during the extended observation period was compared to the matched period one year prior and showed a 19% reduction in the intervention center while the control centers increased 56% (Figure 6).

Additionally, the intervention center experienced a 20% reduction in unplanned patient transfers to a hospital while the control centers experienced a 3.5% increase during the same matched time period (Figure 7).

REFERENCES

1. Centers for Disease Control and Prevention (CDC). Antibiotic resistance threats in the United States, 2019. Antibiotic Resistance Threats in The United States [Internet]. 2019 Nov; Available from: https://www.cdc.gov/drugresistance/pdf/threats-report/2019-ar-threats-report-508.pdf

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