Reduction of Surface Microbial Burden in an Operative Setting with the Implementation of Advanced Photocatalytic Oxidation Technology

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Problem/Purpose

Surgical site infections are some of the most common healthcare associated infections (HAIs) reported in the United States, accounting for approximately 20.2% of all HAIs.[1] The facility was interested in investigating and trialing new innovations to reduce air and surface microbial burden in the perioperative area which could help prevent surgical site infections..

Literature Review

Prior research has shown that exogenous contamination can occur intraoperatively from the air and surfaces in the operating room.[2] However, previous air or surface intraoperative mitigation methods such as laminar airflow have not been shown to conclusively reduce surgical site infections.[3] The facility was interested in new innovations to reduce air and surface microbial burden in the perioperative area and decided to trial an advanced photocatalytic oxidation technology.

Hydrogen peroxide is well known as an effective surface disinfection agent.[4] However, using low levels of hydrogen peroxide in the air to minimize pathogens in the air and on surfaces has not been well researched. The proposed technology is an FDA cleared class II medical device that was placed into the operating area. The device is composed of a honeycomb matrix coated with titanium dioxide and other rare earth metals and a UV bulb that activates the matrix. The device uses the ambient air and humidity in the room, which is run through the matrix, and is broken down into hydrogen peroxide, water, and other oxidative molecules, which is then dispersed throughout the area and works to deactivate and cause degradation of environmental contaminations as well as pathogens in the air and on surfaces.[5]

Research Question

Does the implementation of an advanced photocatalytic oxidation technology result in reduced surface and air microbial burden?

Methodology

A prospective quasi-experimental study was conducted in perioperative services from March 2022 to August 2022. Using sterile, pre-moistened sponges, 10 environmental surface samples throughout the ORs were collected for bacterial enumeration. Samples were collected from surfaces throughout the operative room including the anesthesia workstation, circulator work area, phone, supply cart, and computer keyboard.

Air samples were also taken in each OR. The advanced photocatalytic oxidation (aPCO) machine was then placed into the selected operating rooms and activated. Sampling of the same 10 surfaces and air sampling was then repeated every four weeks during the study period. The facility's normal cleaning and disinfection protocols were unchanged during the study period.

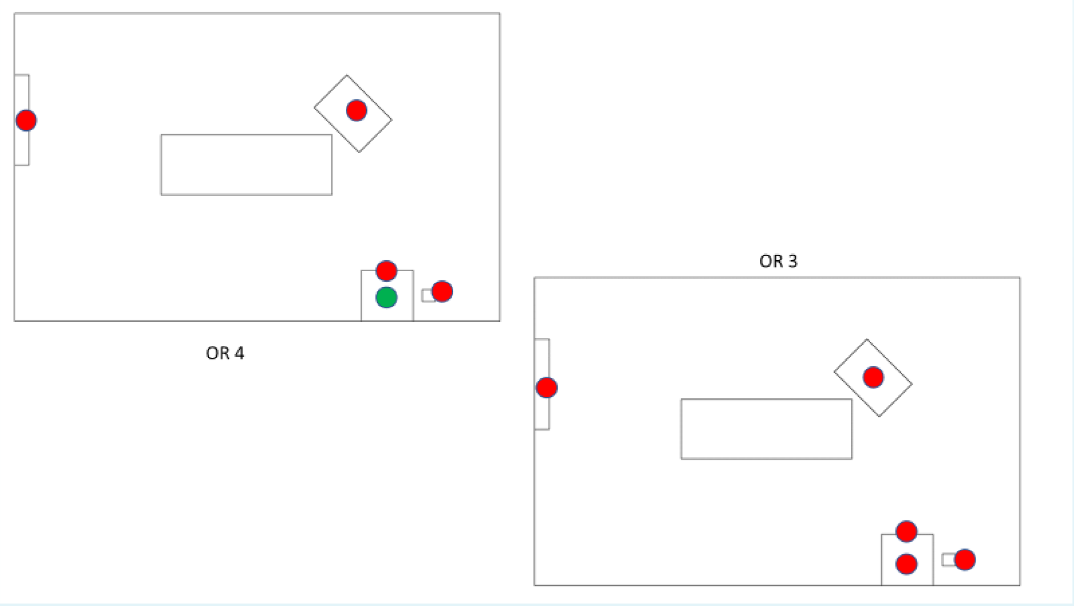
Results

Basic descriptive statistics were run using SPSS (Version 28). Changes in bacterial surface burden were calculated using a repeated methods ANOVA with post hoc analyses as appropriate.

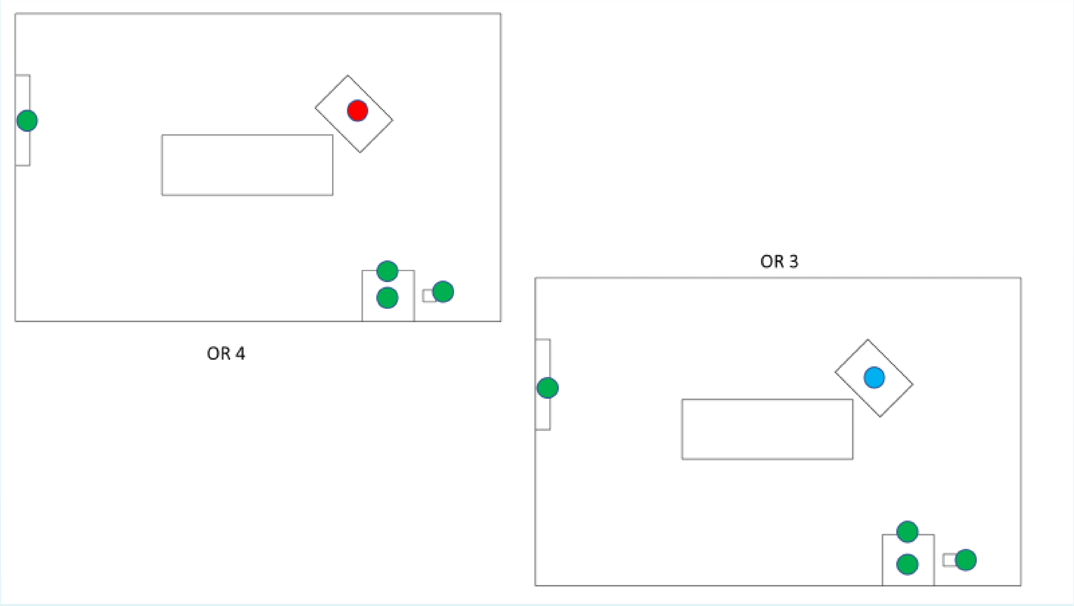
Data Analysis

Overall, there was a 98.4% statistically significant decrease in microbial surface burden from the baseline to final post-activation test (Figure 1). The average colony forming unit count (CFU) went from 9,231 to 149 CFU/100cm^2 during the same time. Surfaces that had greater than 500 CFU/100cm^2 decreased 89% during the study time period. Air quality also increased, with a 100% decrease in bacterial air counts.

Baseline Surface Microbial Burden

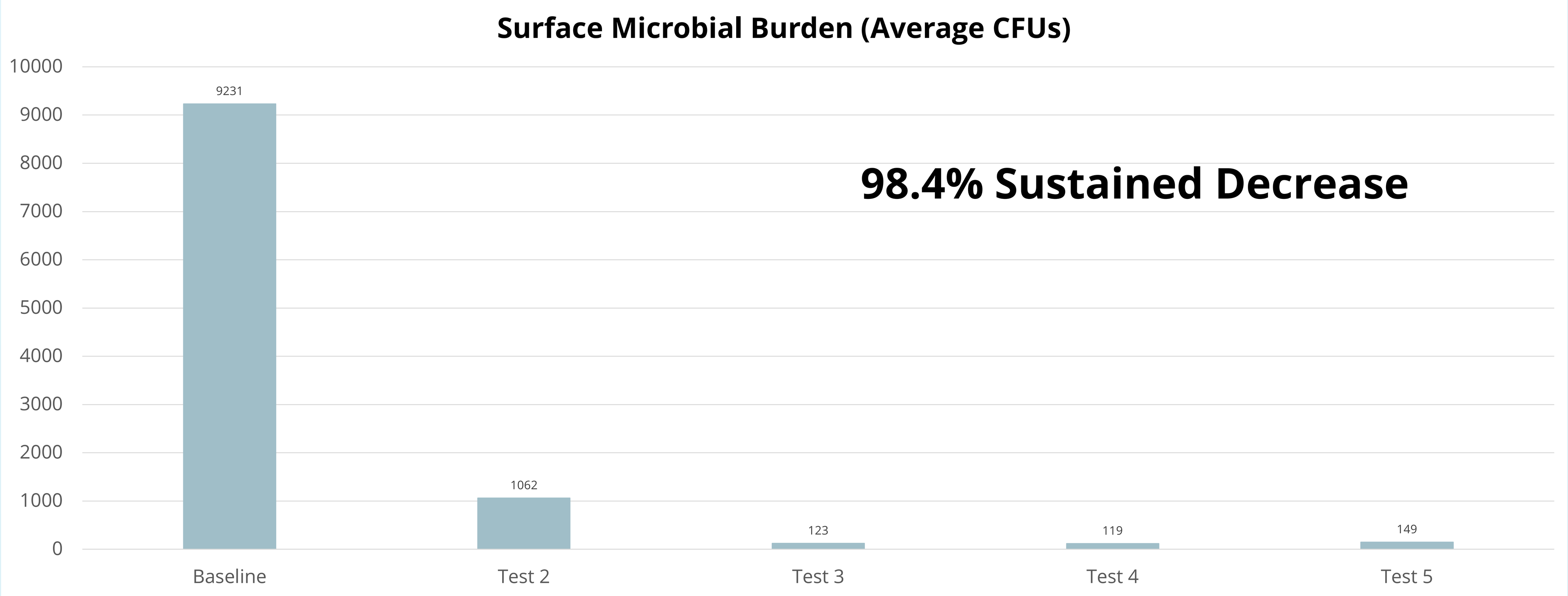


Final Surface Microbial Burden



Legend:
Red- > 500 CFU/100cm^2
Green- <500 CFU/100cm^2
Blue- Not detected

Figure 1



Discussion and Implications for Perioperative Nursing

As most SSIs are seeded intra-operatively, it's important to ensure that the surgical environment has a low microbial burden. By reducing the microbial burden on commonly touched surfaces in the operative setting, theoretically the risk of intra-operative surgical contamination from extrinsic sources will be reduced, thus reducing the risk of the patient developing a surgical site infection. Further research is needed to correlate the reduction in surface and air microbial burden to reduction in surgical site infections..

References

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