Assessment of an Innovative Antimicrobial with Surface Disinfectant in the Operating Room Environment Using ATP-Bioluminescence Assay

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Introduction

The role of terminal cleaning is to reduce the risk of microbial contamination within the operating room environment.[1] However, previous studies have suggested that ineffective cleaning processes can results in significant microbial contamination of critical touch surfaces throughout the healthcare environment. The present study assesses the impact of an antimicrobial isopropyl alcohol/organofunctional silane solution (IOS) to reduce microbial contamination over a 6 weeks study period. Residual bioburden was determines using ATP-bioluminescence assay.

Materials and Methods

Operating Room Environment:

Four separate operating rooms were chosen for study including (**A & B**) two general surgical operating rooms; (**C**) a hybrid OR where open and endovascular procedures are performed; and (**D**) an OR used for kidney and liver transplant. In each OR 5 sites were chosen for testing.

- **A.** Anesthesiology monitor positioned at the end of the operating room table, anesthesiology keyboard, a flat screen room monitor, assist handle of OR light positioned over the table and computer keyboard used by OR team.
- **B.** X-ray monitor, anesthesiology keyboard, stainless steel light grips positioned over table, room telephones, surface of back table (outside of sterile field).
- **C.** Large multi-view flat screen monitor positioned at foot of table, handles on OR access door, computer keyboard, stainless-steel light grips positioned over table and hybrid control room keyboard.
- **D.** Anesthesiology monitor, anesthesiology keyboard, large flat screen monitor, room telephones and inner surface of room door exiting to sub-sterile core.

Treatment and Testing of Designated Study Surfaces:

Prior to treatment of the study surfaces, baseline ATP-bioluminescence (Getinge Assure SafeStep, Getinge USA, Inc., Rochester, NY) analysis (N=120) was conducted on three separate days following terminal cleaning of each room to determine residual bioburden on test surfaces. A 2-cm^2 area was sampled by rubbing and rolling the test surface for 15-seconds. A value of ≤45 relative light units (RLU) reflected a surface containing little or no bioburden, while a value of ≥46 reflected bioburden contamination as per manufacturer recommendations (Getinge USA). All samples were analyzed within 60-seconds of collection. Following baseline, test surfaces were treated with the IOS (MicrobeCare XLP™, Allendale, Michigan). The antimicrobial solution was applied using a cloth (microfiber) covered sponge. The solution was liberally applied to the test surfaces and allowed to dry. The test sites were divided into treated (T) and non-treated (NT) segments. While test sites were agreed upon prior to sampling, the individual performing the sampling was blinded to the T and NT sites.Test surfaces in each OR were tested twice-weekly for 6-weeks (N=480 total tests) following terminal cleaning. Comparative RODAC plates (BD BBL™, Sparks, MD) cultures were obtained from selective test site surfaces on alternating weeks to assess microbial recovery. All plates were incubated for 24-48-hrs at 35°C followed by colony counting under magnification. Surfaces yielding 0-5 colonies were assessed as excellent, 6-20 colonies were assessed as moderate, while ≥20 was viewed as significant contamination.

Results

I. Mean baseline RLU and range values were highly variable in all OR tested (N=40 RLU/)OR:

Room A *(photo A)* 137.5 (15.0-176.2) Room B *(photo B)* 298.4 (4.0-543.6)
Room C *(photo C)* 994.2 (18.2-2112.3) Room D *(photo D)* 167.8 (9.3-269.7)

II. Table 1-4

Document the RLU values for Treated (T) and Non-Treated (NT) surfaces

Table 1. *Operating Room A*

Mean RLU (N=120) and Mean RODAC Colony Counts RCC (N=40)

Surfaces	Non-Treated RLU / RCC (RLU Range 29.4-301.7)	Treated RLU / RCC (RLU Range 0-117.4)
Anesthesiology Monitor	226.7/39.1	98.4/0
Anesthesiology Keyboard	137.4/17.1	87.2/1.8
Flat Screen Monitor	61.4/8.6	44.3/2.3
Assist Handle OR Light	37.8/2.3	29.6/0.4
Computer Keyboard	87.8/10.6	42.6/0

Table 2. *Operating Room B*

Mean RLU (N=120) and Mean RODAC Colony Counts RCC (N=40)

Surfaces	Non-Treated RLU / RCC (RLU Range 16.1-785.5)	Treated RLU / RCC (RLU Range 0146.6)
X-ray Monitor	266.6/13.3	94.6/1
Stainless-Steel Light Grips	67.1/4.1	41.7/0
Anesthesiology Keyboard	117.8/8.8	4.2/1.0
Room Telephones	709.9/10.9	87.8/0
Back Table	29.6/1.8	41.7/0

Table 3. *Operating Room C*

Mean RLU (N=120) and Mean RODAC Colony Counts RCC (N=40)

Surfaces	Non-Treated RLU / RCC (RLU Range 27.4-2951.6)	Treated RLU / RCC (RLU Range 0-310.6)
Large Multi-View Monitor	2056.4/47.3	298.7/2.9
Handle OR Access Door	188.2/8.8	67.4/0
Team Computer Keyboard	80.1/6.6	37.8/2.1
Stainless Steel Light Grips	21.8/2.1	39.9/0
Hybrid Control Room Keyboard	267.1/19.4	110/0.9

Table 4. *Operating Room D*

Mean RLU (N=120) and Mean RODAC Colony Counts RCC (N=40)

Surfaces	Non-Treated RLU / RCC (RLU Range 17.7-256.8)	Treated RLU / RCC (RLU Range 0-133.4)
Anesthesiology Monitor	238.1/15.9	99.6/1.0
Anesthesiology Keyboard	198.5/41.6	92.7/1.7
Large Flat Screen Monitor	87.4/11.6	49.1/0
Room Telephones	192.3/9.4	84.4/2.2
Inner Surface of Exit Door	37.6/6.6	49.4/0

Operating Room A

Operating Room B

Operating Room C

Operating Room D

III. Study Findings

- Overall baseline analysis documented that 29.9%, 43.7%, 57.8% and 45.7% of selected OR surfaces were designated as dirty following terminal cleaning.
- The mean RLU for non-treated control sites was 279.9 (range 16.1-2951.6).
- The mean RLU for IOS treated sites was 75.9 (range 0-310.6).
- 82.5% of all IOS treated surfaces were culture negative — The mean microbial recovery on culture positive IOS treated surfaces was 0.8 colonies.
- 80% of all non-treated OR surfaces were culture positive — The mean microbial recovery on culture positive non-treated OR surfaces was 14.3 colonies.
- The predominant microbial isolate recovered from non-treated and IOS treated culture positive sites was coagulase-negative staphylococci.
- No degradation of antimicrobial activity based on RODAC plate cultures was observed in the IOS treated sites over the 6-week study period.

Conclusions

- A significant ($p<0.001$) reduction in residual microbial contamination was documented (RODAC) in 4 selective operating rooms in IOS treated compared to non-treated surfaces following terminal cleaning.
- Use of ATP-bioluminescence assay is an effective strategy for monitoring viable and nonviable bioburden contamination following terminal cleaning in the operating room setting by providing direct feedback to the environmental services staff.[2-5]
- An innovative antimicrobial isopropyl alcohol/organofunctional silane solution was effective in minimizing microbial contamination on selective surfaces in the operating room environment over a 6-weeks test period.
- While non-treated and treated surfaces in the OR are not immune to contamination by blood, body fluid or tissue protein – The presence of IOS on vulnerable surfaces in the operating room would appears to minimize the opportunity for microbial surface contamination following terminal cleaning.

Study Limitations

- The results of this study were limited to 4 operating rooms in a tertiary medical center which were sampled three times a week over a 6-week period.
- A recent prospective report has suggested that selective antimicrobial organosilane compounds may not prevent microbial surface contamination over a prolonged period of time as indicated in this study.[6] Unfortunately, these agents were not available to the authors for comparative analysis.

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