ABX Outcome Study: SSI Reduction Results

Case Study

Study Location
Confidential Community Hospital
Atlanta, Georgia USA

Study start date: May 1, 2013
Study completion date: September 14, 2014

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Methods and Study Design

AEROBIOTIX (ABX) technology previously demonstrated statistically significant reductions in total airborne particulates, viable particulates, and airborne bacteria when deployed in active operating rooms (OR) [1]. The study was performed in a single OR at a 300-bed community medical center in Atlanta, Georgia, USA. The hospital was reporting above-average SSI rates in orthopedic and spinal procedures. Control cases (no ABX) were documented over the five months period in 2013. The experimental cases (with ABX) were assessed one year later during the same 5-months to avoid seasonal differences. Patients in both groups were followed for 3 months and rate of SSI was reported. This study was limited to orthopaedic procedures.

Background

Elevated airborne pathogen levels in healthcare settings are a significant, yet under-appreciated cause of hospital acquired infections (HAI) and surgical site infections (SSI) [2, 3]. In orthopedic surgery, strong correlation exists between the air contamination, the joint sepsis rate and the number of bacteria isolated from wound washout samples [3]. In the United States, no minimal standard exists for the number of airborne bacteria, viruses, or fungi in the healthcare settings, including critical areas of surgery suites, immunocompromised patient areas, or intensive care units. Global increase in antibiotic resistant bacterial strains and rise in MRSE occurrence further exaggerate the morbidity and mortality of HAIs and SSIs. Consequently, improving environmental controls in the OR by reducing airborne pathogen burden should take precedence over the development of new prophylactic antibiotic programs. [4-7]

The ABX in-room germicidal C-UVC filtration/recirculation unit utilizes a hybrid of biological and physical filtration systems to remove bacteria, fungi and viruses from the air. Its key biocidal technology is a solid-state germicidal irradiation system which provides simultaneous physical filtration and irradiation of high-volume air flow. The system utilizes C-band ultraviolet light (UV-C) at a 254 nm wavelength diffused into a solid media which is gas and radiation permeable. While organisms are slowed or trapped in the solid media, they are inactivated by the internal UV-C dosage (**Figure 1**).

The ABX technology has previously demonstrated statistically significant reductions in airborne particles and bacterial colony-forming units when deployed in active ORs.

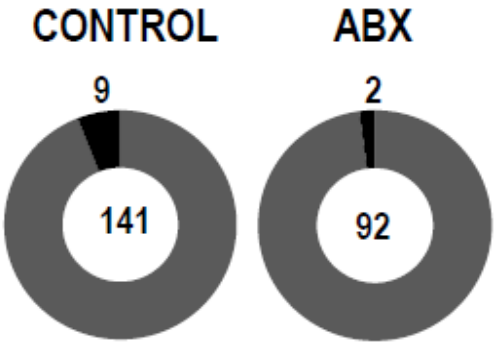
FIGURE 1

In-room ABX C-UVC/HEPA air recirculation system - Illuvia 500 UV. The unit was developed to accommodate the 450 ft^3/min (CFM) airflow for placement in standard operating room (OR) environment. The 24x18 inch (61x46cm) air intake is located at the lower side of the device supplemented with air filtration cartridge (Performance level 1) **(A)** adjacent to the blower/motor unit **(B)**. The C-UVC (254nm) reactor **(C)** is located in the middle of the system along the path of the airflow. The silicate crystals within the reactor form a solid UV-permeable media prolonging C-UVC exposure of airborne pathogens for maximum killing of viable bacteria, viruses and spores. The 24x12 inch (61x30.5 cm) clean air exhaust/HEPA filter assembly is positioned at the top of the device **(D)**.

Results

The implementation of ABX technology in active orthopedic OR performing spinal and joint replacement surgical procedures reduced SSI incidence by 66% (**Figure 2**).

FIGURE 2



Decreased incidence of surgical site infections following the implementation of ABX technology in active orthopaedic ORs. CENTER – total number of cases observed; PERIPHERY – number of surgical site infections. The 66% decrease in SSI rate over the 5-month ABX technology implementation period.

Discussion and Conclusion

This study is the first to document a 66% reduction in SSI rate over 5-month period in orthopedic OR after deployment of ABX technology. The decrease in SSI occurrence is even more impressive for procedures involving the use of implants. It is well established that a 10^2-10^3-fold smaller bacterial inoculum is sufficient to establish infection in the presence of an implant than that required in its absence [8, 9]. Bacterial cells can attach to the implant surface (titanium and titanium alloys, stainless steel, cobalt-chromium and other polymeric biomaterials), evade the immune response and establish chronic, often drug-resistant infections mediated by biofilm formation[10]. Biofilm-related infections are a substantial economic burden to healthcare providers and immense physical, physiological and financial complication for affected patients. The efficacy of ABX HEPA/UV-C air recirculation/filtration biocidal technology has been confirmed in multiple studies [1, 11]. The adoption of this C-UVC germicidal system is recommended as an adjunct to current air quality engineered controls in orthopaedic ORs.

References

1. Kirschman, D. MD, Eachempati, S. R., MD,FACS, FCCM, Aerobiotix, Inc Airborne bacteria in the operating room can be reduced by HEPA/Ultraviolet air recirculation system (HUAIRS). *Surgical Infection Society* (2017).
2. Lidwell, O.M. *et al.* Effect of ultraclean air in operating rooms on deep sepsis in the joint after total hip or knee replacement: a randomised study. *Br Med J (Clin Res Ed)* **285**, 10-14 (1982).
3. Lidwell, O.M. *et al.* Airborne contamination of wounds in joint replacement operations: the relationship to sepsis rates. *The Journal of hospital infection* **4**, 111-131 (1983).
4. Birgand, G. *et al.* Measures to eradicate multidrug-resistant organism outbreaks: how much do they cost? *Clin Microbiol Infect* **22**, 162 e161-169 (2016).
5. Tammelin, A., Domicel, P., Hambraeus, A. & Stahle, E. Dispersal of methicillin-resistant Staphylococcus epidermidis by staff in an operating suite for thoracic and cardiovascular surgery: relation to skin carriage and clothing. *The Journal of hospital infection* **44**, 119-126 (2000).
6. Tammelin, A., Hambraeus, A. & Stahle, E. Routes and sources of Staphylococcus aureus transmitted to the surgical wound during cardiothoracic surgery: possibility of preventing wound contamination by use of special scrub suits. *Infect Control Hosp Epidemiol* **22**, 338-346 (2001).
7. Tammelin, A., Hambraeus, A. & Stahle, E. Source and route of methicillin-resistant Staphylococcus epidermidis transmitted to the surgical wound during cardio-thoracic surgery. Possibility of preventing wound contamination by use of special scrub suits. *The Journal of hospital infection* **47**, 266-276 (2001).
8. Tande, A.J. & Patel, R. Prosthetic joint infection. *Clin Microbiol Rev* **27**, 302-345 (2014).
9. Parvizi, J., Barnes, S., Shohat, N. & Edmiston, C.E., Jr. Environment of care: Is it time to reassess microbial contamination of the operating room air as a risk factor for surgical site infection in total joint arthroplasty? *American journal of infection control* (2017).
10. Gbejuade, H.O., Lovering, A.M. & Webb, J.C. The role of microbial biofilms in prosthetic joint infections. *Acta orthopaedica* **86**, 147-158 (2015).
11. Barnes, S., RN, CIC, FAPIC and Rybalko, Viktoriya, MS, PhD Crystalline UV-C Inactivation of Airborne Microorganisms: Clinical and Laboratory Analysis of a Novel Germicidal Air Recirculation Technology. *The Healthcare Environment Institute* (2017).