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Letter to the Editor

A ceiling-mounted far-ultraviolet-C light technology reduces methicillin-resistant *Staphylococcus aureus* contamination on surfaces in a simulated operating room

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To the Editor—Cleaning and disinfection of operating room (OR) surfaces is generally recognized as an important practice,[1–4] although the impact on patient outcomes is uncertain.[5] A recent systematic scoping review concluded that the existing literature shows suboptimal compliance and inconsistent effectiveness of OR cleaning and disinfection.[5] Ultraviolet-C (UV-C) light room decontamination devices have been shown to reduce surface contamination when operated as an adjunct to manual cleaning and disinfection.[6] However, use of these devices can require a substantial amount of time and the devices can only be operated when people are not present.[6] Far-UV-C light (200–230 nm) is an alternative technology that may provide similar efficacy while being safe in occupied areas.[7] Here, we evaluated the efficacy of a commercial, ceiling-mounted far-UV-C technology for continuous adjunctive decontamination of surfaces in a simulated OR.

The Visium 1 far-UV-C technology (Lit Thinking, Orlando, Florida) that was tested uses a krypton-chloride excimer lamp (Care222, Ushio America, Cypress, California) that emits a primary wavelength of 222 nm. We tested the Clear Optics version of Visium 1 which emits light over 60-degree angles. With Clear Optics devices placed a minimum of 1.2 m (3.9 ft) apart and operating continuously at a height of ≥2.5 m (8.2 ft), far-UV-C doses are within threshold limit values proposed by the American Conference of Governmental Industrial Hygienists (ie, 161 mJ/cm^2 for eyes and 479 mJ/cm^2 for skin) over an 8-hour workday.[7] Users can also choose an "occupied off" mode in which the device runs continuously but turns off when motion is detected, thereby providing decontamination between cases with no far-UV-C exposure to personnel. Each device is intended to provide far-UV-C coverage for an area up to 18.6 m^2 square meters (200 ft^2); multiple devices can be installed to provide coverage for larger rooms. The supplementary material provides detailed information on the technology and shows results of initial laboratory testing demonstrating efficacy of a single device against methicillin-resistant *Staphylococcus aureus* (MRSA) with 2 and 8 h exposure times.

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Testing was conducted in an 8.1 × 6.8 m (26.6 × 22.3 ft) simulated OR with a 3 m (9.8 ft) ceiling height. Six Visium 1 devices with Clear Optics were installed at a height of 2.8 m (9.2 ft) above the floor. A modification of the American Society for Testing and Materials (ASTM) standard quantitative disk carrier test method (ASTM E 2197-02) was used.[8] The test organism was a clinical MRSA strain; MRSA was chosen for testing given reports that it may be transmitted in the anesthesia workspace.[3,4] A 10 µl inoculum containing 10^4–10^5 colony-forming units (CFU) of MRSA was spread to cover 20 mm steel disks with 5% fetal calf serum as a soil load. The inoculated disks were placed at 10 sites in the room within 3.05 m (10 ft) of the nearest lamp, including horizontal, vertical, and partially shaded sites. The disk locations included the OR patient tabletop (horizontal), patient table side (vertical), patient table bottom (partially shaded), floor beside patient table, adjustable light top, adjustable light bottom (partially shaded), sterile item table top, sterile item table side (vertical), floor beside sterile item table, and workstation in the corner of the room. Far-UV-C irradiance was measured using a radiometer (UIT2400 Handheld Light Meter for 222 nm (Ushio America, Cypress, CA). Testing was completed with exposure times of 4 and 16 hours. The supplementary material provides a picture of the simulated OR with the locations of the far-UV-C devices and the test sites.

Figure 1 shows reductions in MRSA and irradiance readings in the simulated OR with 6 Clear Optics devices. After 4 hours of exposure, MRSA was reduced by ≥2 $\log_{10}$ CFU at 5 of 10 sites. After 16 hours of exposure, MRSA was reduced by ≥3 $\log_{10}$ CFU at 6 of 10 sites and by ≥2 $\log_{10}$ CFU at 8 of 10 sites. The sites with the lowest levels of reduction had low irradiance readings and were partially shaded (ie, bottom of the patient table and bottom of an adjustable light) or in the corner of the room outside the area of maximal light exposure.

In summary, we demonstrated that a ceiling-mounted far-UV-C technology reduced MRSA contamination at multiple sites in a simulated OR. After 4 or 16 hours of exposure, MRSA was reduced by >2 $\log_{10}$ or >3 $\log_{10}$ at 50% or more of the test sites. Although light delivery was reduced in partially shaded areas, average reductions of 1.8 to 2.3 $\log_{10}$ CFU of MRSA were achieved after 16 hours of exposure. Given that multiple studies have demonstrated suboptimal cleaning and disinfection in ORs,[2,3,5] our results suggest that the far-UV-C technology could be useful as an adjunctive measure. The potential advantages of the far-UV-C

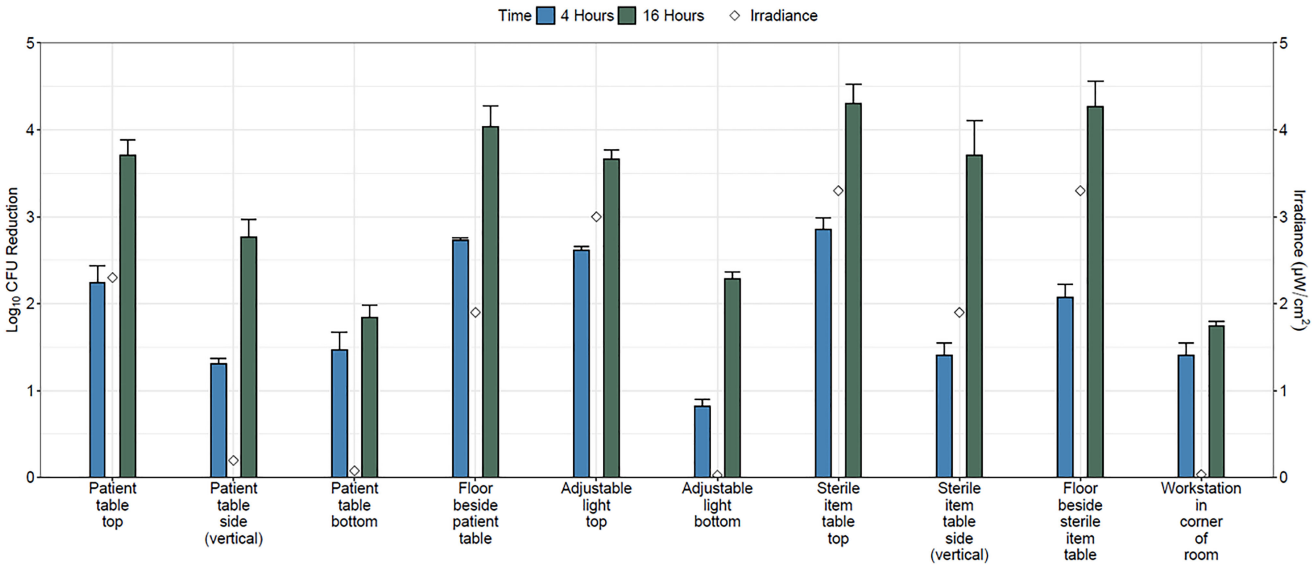

Figure 1. Reduction in methicillin-resistant *Staphylococcus aureus* (MRSA) on steel disk carriers in a simulated operating room after 4 and 16 hours of exposure to far-ultraviolet-C (UV-C) light delivered by 6 ceiling-mounted Clear Optics devices. White diamonds indicate irradiance measured at each test site with a radiometer. Error bars show standard error. Log_{10} reductions were calculated in comparison to untreated controls.

technology over standard UV-C room decontamination devices include minimal personnel time requirement after installation and continuous decontamination during procedures.

Our study has some limitations. Testing was conducted in a simulated OR with inoculated steel disk carriers in a limited number of sites. Additional testing is needed to assess efficacy for real-world surfaces in ORs. However, previous studies have demonstrated that far-UV-C light is effective in reducing contamination on a variety of surfaces including portable equipment.[7,9] We did not assess ozone production. However, we have previously demonstrated that no ozone accumulates in well-ventilated (ie, 8 air changes per hour) hospital rooms with 6 Ushio Care 222 devices operating.[10]

Supplementary material

The supplementary material for this article can be found at https://doi.org/10.1017/ice.2025.10231

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