



## KEY POINT SUMMARY

### OBJECTIVES

To evaluate the efficacy of a hybrid lighting technology that provides both visible white light and UV-A optical radiation for decontamination purposes.

## An assessment of a hybrid lighting system that employs ultraviolet-A for mitigating healthcare-associated infections in a newborn intensive care unit

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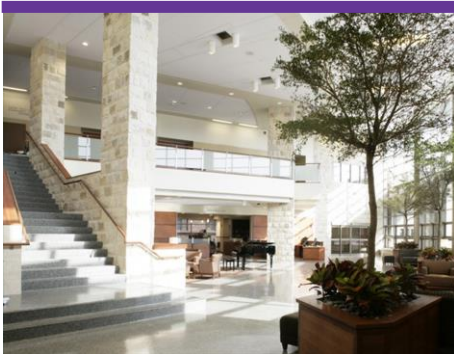
### Key Concepts/Context

Healthcare-associated infections (HAIs) affect approximately one in 25 patients in the US. One study found that an average of fewer than 50% of patient room surfaces are properly cleaned, making infection spread more easily. This study explores the use of a no-touch decontamination method that employs hybrid lighting technology with both white light and UV-A optical radiation. The results may help designers develop and utilize a new generation of no-touch sterilization and lighting technology.

### Methods

This study took place in the 39-bed neonatal intensive care unit (NICU) of a children's hospital. This NICU was designed and built in 2017 and features private patient rooms for infants born prematurely. Each patient room has separate sinks and counter spaces for families and medical staff. Due to their status as high-touch surfaces, these countertop areas were the main focus for gauging the ability of UV-A radiation to eliminate human-borne pathogens.

Six NICU patient rooms were involved in the study. Each room featured some natural daylighting, but most ambient lighting came from ceiling and wall-mounted luminaires. Nurses worked in 12-hour shifts and cleaned the sink and counter areas at the beginning of each shift using PDI Super Sani-Cloth germicidal disposable wipes. Additionally, each room was sanitized by another cleaning crew using Diversey Oxivir 1 Wipes; however, this crew was not responsible for cleaning countertop areas.



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During the experiment, the hybrid lights ('Lumination' LBU Disinfection Series D-Light, manufactured by GE Current, a Daintree company) were surface mounted above the countertop and sink areas after the existing luminaires were removed. Curtains were installed around the countertop areas to help further mitigate any potential UV-A overexposure in the patients and staff.

A one-week treatment protocol was repeated three times. Adenosine triphosphate (ATP) samples were collected Monday through Saturday of each study week. To test for the photodegrading effects of the new lights, two ISO Blue Wool Standard fade test cards (TALAS, Brooklyn, NY, USA) were installed next to wall clocks in each patient room. Lastly, staff questionnaires concerning opinions on the hybrid lighting system were issued anonymously; this questionnaire consisted of three questions answered on a 5-point Likert scale.

### Findings

Although the amount of organic material in the ATP samples was low (typically below the hospital's threshold for 'clean' at 300 relative light units [RLUs]), there was a wide variation among the samples, making it difficult to draw conclusions about the efficacy of any single intervention. However, evidence for the efficacy of the hybrid lighting technology for killing bacteria was found in the daily change in ATP counts; when the UV-A radiation was not present, there was no statistically relevant change in ATP counts, and when the UV-A radiation was present, there were significant changes.

Inoculated culture plate results showed that the prevalence of important pathogens identified by The Centers for Disease Control and Prevention as sources of HAIs was diminished by the UV-A lighting installations.

Measured changes in the Blue Wool tests indicated that materials that are not sensitive to UV-A radiation would be ideal for environments employing the hybrid luminaire technology.

Thirty-four staff questionnaires were answered before the installation of the hybrid luminaires, and 19 were answered after installation. Results indicated a general approval for the ability to see more easily with the new lights; however 'overall' ratings for the hybrid lighting system saw reduced appreciation, especially with regard to the overall appearance of the patient rooms. In particular, complaints were made about the curtains that were hung around the new light installations.

### Limitations

The authors note that insufficient numbers of accessible ATP testing materials led to reduced testing during their first week, which may have interfered with the accuracy or relevance of ATP sampling data. This study took place in a relatively new healthcare facility that employed many evidence-based routines for



cleanliness. The authors noted that the well-maintained environment may have made it more difficult to assess the actual efficacy of the lighting fixtures.

### Design Implications

Designers looking for a no-contact solution to safely decontaminating high-touch surfaces might consider installations similar to the hybrid white and UV-A lighting fixtures examined in this study. If these lights are used, consider outfitting the room with surfaces that are insensitive to UV-A radiation.

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