SYNOPSIS

KEY POINT SUMMARY

OBJECTIVES

This descriptive study tested the effectiveness of VBL405 lights in reducing microbial contamination of five different bacteria at varied distances within a controlled environment.

Efficacy of violet–blue light to inactive microbial growth

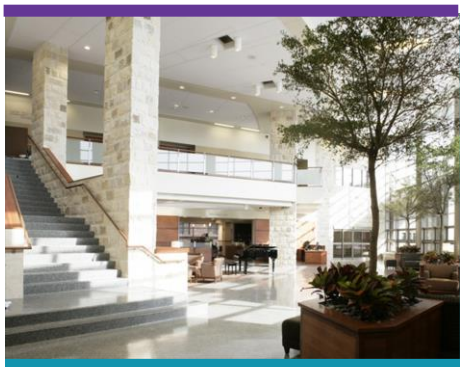
Amodeo, D., Lucarelli, V., De Palma, I., Puccio, A., Nante, N., Cevenini, G., Messina, G., 2022 | Scientific Reports, Volume 12, Issue 1, Page(s) 20179

Key Concepts/Context

Research demonstrates that certain lights have antimicrobial properties. Violet-blue light at 405 nm (VBL405) has a broad-spectrum effect on organisms that frequently cause hospital-acquired infections including Clostridium difficile, Escherichia coli, Staphylococcus epidermidis, Pseudomonas aeruginosa, Klebsiella pneumoniae, Streptococcus pyogenes, and various Mycobacterium. Because the ultraviolet radiation commonly used for disinfection can be harmful, the potential for VBL405 as a less harmful option should be explored.

Methods

Researchers positioned two ceiling lamps that had 12 light-emitting diodes (LEDs) and 69 VBL405 LEDs at differing distances from carefully prepared bacterial samples of Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli, Salmonella typhimurium, and Klebsiella pneumoniae. Samples were placed 2m directly under one light (position 1); between and 3m beneath the two light sources (position 2); and 3m directly under the second light (position 3). For each round of data collection baseline samples were collected one hour after the VBL405 lamps were turned on and the room doors were closed. All of the samples were exposed to their respective lighting positions for 12 hours, incubated at 36°C for 48 hours and then colony-forming units (CFUs)/mL, CFUs/m^3 were counted using a manual colony counter. The experiment was repeated in triplicate for each of the five bacterial strains. Controls were prepared for each of the sample placements and were kept at the same temperature and humidity conditions, but away from light sources. Throughout the experiment, doors and windows to the room were closed and the ventilation systems were turned off. Data collected included date, sample identification, CFUs/mL, CFUs/m^3; species, and inoculum concentrations. Descriptive statistics primarily focused on CFU reduction across conditions and across types of bacteria. A photometric simulation was also performed to establish



The Center for Health Design: Moving Healthcare Forward

The Center for Health Design advances best practices and empowers healthcare leaders with quality research that demonstrates the value of design to improve health outcomes, patient experience of care, and provider/staff satisfaction and performance.

Learn more at www.healthdesign.org

distribution of light exposure over the surface of the planes represented within each of the experimental conditions.

Findings

One-way AONVA and pairwise comparisons demonstrated no statistically significant differences between S. aureus and P. aeruginosa and between S. Typhimurium and K. pneumoniae at all three lighting positions. Higher average reduction values were noted for S. aureus and P. aeruginosa at positions 1 and 3, with a smaller reduction at position 2. Reductions between Escherichia coli and S. Typhimurium were evident for position 1, and to a lesser degree at positions 2 and 3. Differences in bacteria reduction were statistically significant with the exception that S. Typhimurium was not significantly different from that of S. aureus and P. aeruginosa (ANOVA, $p > 0.05$) at position 1. Escherichia coli showed average reductions similar to S. aureus and P. aeruginosa at position 1, and intermediate reductions at positions 2 and 3, which were statistically different from S. aureus, P. aeruginosa and S. Typhimurium at position 3 and from K. pneumoniae at position 1. There were no statistically significant differences in all comparisons with the other bacteria at position 2 for E. coli. The two lowest reductions are for K. pneumoniae in position 2 and S. Typhimurium in position 3. Air test measurements demonstrated a constant reduction (70%) of airborne microorganisms after 12 hours of exposure to the lights such that consecutive exposure to the VBL405 lights resulted in a general reduction of environmental contamination overall. Because VBL405 has demonstrated microbial reduction in a controlled setting, it may be an innovative method of reducing microbial presence in healthcare settings in general.focused on dampening non-therapeutic noise sources while incorporating pleasant sounds into the healing potential of the patient space.

Limitations

The experiments herein were conducted systematically within a controlled environment and may not represent what would happen in the care environment. CFU growth in a variety of bacterial strains should be examined under more realistic conditions including: a) diverse VBL405 lighting; b) variations in VBL405 lighting intensity; c) different numbers of VBL405 light sources; d) varied positions and distance from VBL405 light sources; and e) in the presence of potential obstacles to VBL405 light exposure.

Design Implications

While VBL405 has demonstrated microbial reduction in a controlled setting, it should be used as part of a holistic program of cleaning and disinfection, providing an additive effect that does not replace traditional regimes. The use of VBL405 can improve disinfection levels and is safe to use with humans and delicate sanitary equipment.