New Technologies in Disinfection and Sterilization

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Disclosure: Research support from Pfizer, Merck, Clorox, GOJO, Avery Dennison, PDI
Outline

- Expanding applications of UV-C
  - Automation, proximity, UV-C by light-emitting diode (LED), low-intensity devices used while people are in the room
- Spray products
- Continuous disinfection
  - High-intensity visible light, UV-A
- New monitoring tools
Decrease in irradiance with distance

- Inverse square law: Irradiance \( \sim \frac{1}{\text{distance}^2} \)
Effect of distance and shading

Test conditions: steel carriers, inoculum spread to cover 1 cm²
4 feet from device with direct exposure, 41 minutes

(~1 log less reduction in areas with indirect UV exposure)
Effect of distance on the efficacy of a pulsed xenon UV device

Test conditions: glass slides, inoculum spread to cover 1 cm² direct exposure, 10 minutes exposure, shaded = under bedside table

Disinfection of mobile hand held devices

- Enclosed box
- Conveyer belt (.4 in/sec)
- UV-C in close proximity to mobile handheld devices
- Time for disinfection: cell phone, 15 sec; iPAD 50 sec

Log reductions with UV box used for disinfection of hand held devices

Keyboard decontamination

Keyboard with automated UV-C decontamination

Log reduction MRSA

Automated touchscreen decontamination with UV-C

Alhimidi H. Evaluation of an automated ultraviolet-C light disinfection device and patient hand hygiene for reduction of pathogen transfer from interactive touchscreen computer kiosks. AJIC 2018;146:464-467
Shared pens and styluses

- Pens and styluses are often shared in healthcare settings.
- Inoculation of a shared pen in a waiting room resulted in dissemination of a benign virus throughout the clinic\(^1\).
- An LED (light-emitting diode) UV-C device was effective in reducing pen contamination\(^2\).

UV-C emitted by light emitting diodes (LEDs) for stethoscope decontamination

Low-intensity UV-C for keyboard decontamination

Spray products
Hydrogen peroxide mist

- Sporicidal
- Requires protective equipment
- Operator dependent
Limitation of spray products:
Inadequate application reduces efficacy

Effectiveness of a spray product versus distance from direct point of spray

Deshpande A, et al. ID Week 2013
Continuous disinfection
High-intensity visible light

- Blue-violet light (~405-415 nm) generated through light emitting diodes
- Safe to use in occupied rooms
- Replace standard lighting
- Limited effectiveness (0.5 to 1 log reduction in MRSA and E. coli in 24 hours)

Ultraviolet-A light (315-400 nm) for continuous room disinfection

UV-A

- Proposed as a safe method to provide continuous disinfection in occupied rooms up to 8 h per day
- At the intensity proposed for use in patient rooms (3 \( \text{w/m}^2 \)), MRSA, *E. coli*, and bacteriophage MS2 reduced by >1.2 logs after 24 hours

Livingston S. SHEA 2018.
Monitoring cleaning
Fluorescent markers

Phil Carling

Fluorescent marker on a toilet seat after housekeeping cleaning

Low-cost fluorescent marker:
Tide free & gentle laundry detergent
Fluorescent marker spray

- Liquid spray
- Fluorescent marker
- Detected by black light
- 200 sprays per tube
A novel reflective marker visualized by flash photography

No flash        With flash

Tomas ME. Utility of a Novel Reflective Marker Visualized by Flash Photography for Assessment of Personnel Contamination During Removal of Personal Protective Equipment. ICHE 2016;37:711-3
Chemical additive to colorize chlorine-based disinfectants to improve visualization

Mustapha A. Evaluation of novel chemical additive that colorizes chlorine-based disinfectants to improve visualization of surface coverage. AJIC 2018;46:119-121.
Summary

- Application of UV-C expanding beyond hospital rooms
  - Automation, proximity, LEDs, low-intensity devices used while people are present
- Spray products
- Continuous disinfection
  - High-intensity visible light, UV-A
- New monitoring tools