

Evaluation of the Sterilray™ Far-Ultraviolet Irradiation Wand for Environmental Decontamination of *Clostridium difficile* and Other Healthcare-associated Pathogens



Michelle M. Nerandzic, BS, Jennifer L. Cadnum, BS, Michael J. Pultz, and Curtis J. Donskey, MD
Research Service, Cleveland Veterans Affairs Medical Center, Cleveland, Ohio



Abstract

Background: Environmental surfaces play an important role in transmission of healthcare-associated pathogens. There is a need for new disinfection methods that are effective against *Clostridium difficile* spores, but also safe and rapid. The Sterilray™ Disinfection Wand device is a hand-held room decontamination technology that utilizes far-ultraviolet irradiation (185-230nm) to kill pathogens.

Objective: To examine the efficacy of environmental disinfection using the Sterilray™ device in the laboratory and in rooms of hospitalized patients.

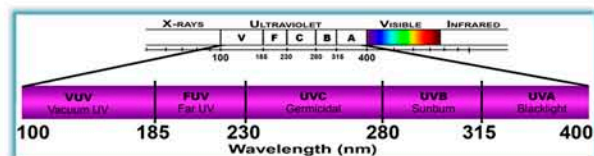
Methods: Cultures for *C. difficile*, methicillin-resistant *Staphylococcus aureus* (MRSA), and vancomycin-resistant *Enterococcus* (VRE) were collected before and after use of the Sterilray™ device from inoculated surfaces in the laboratory and from commonly-touched surfaces in rooms of hospitalized patients.

Results: On inoculated surfaces in the laboratory, application of the Sterilray™ device at a radiant dose of 100 mJ/cm² for ~ 5 seconds consistently reduced recovery of *C. difficile* spores by >3-4 logs, MRSA by >4-5 logs and of VRE by >6-7 logs. A >3 log reduction of MRSA and VRE was achieved in ~2 seconds at a lower radiant dose, but killing of *C. difficile* spores was significantly reduced. However, the presence of organic material significantly reduced the lethal effect of the far-ultraviolet radiation. In hospital rooms that were not pre-cleaned, disinfection with the Sterilray™ device reduced the frequency of positive *C. difficile* cultures by 61%, MRSA cultures by 41% and VRE cultures by 58%. On gloved hands contaminated with *C. difficile* spores, disinfection with a radiant dose of 100 mJ/cm² for ~ 5 seconds reduced transfer of spores by 3 logs.

Conclusions: The Sterilray™ Disinfection Wand is a novel environmental disinfection technology that rapidly kills *C. difficile* spores and other healthcare-associated pathogens on surfaces and on gloved hands. However, the presence of organic matter decreases the efficacy of the far-ultraviolet radiation, possibly explaining the more modest results observed on surfaces in hospital rooms that were not pre-cleaned.

Background

- Environmental surfaces play an important role in transmission of healthcare-associated pathogens.
- There is a need for new disinfection methods that are effective against *Clostridium difficile* spores, but also safe and rapid.
- The Sterilray™ Disinfection Wand device is a hand-held room decontamination technology that utilizes far-ultraviolet irradiation (185-230nm) to kill pathogens.



Results

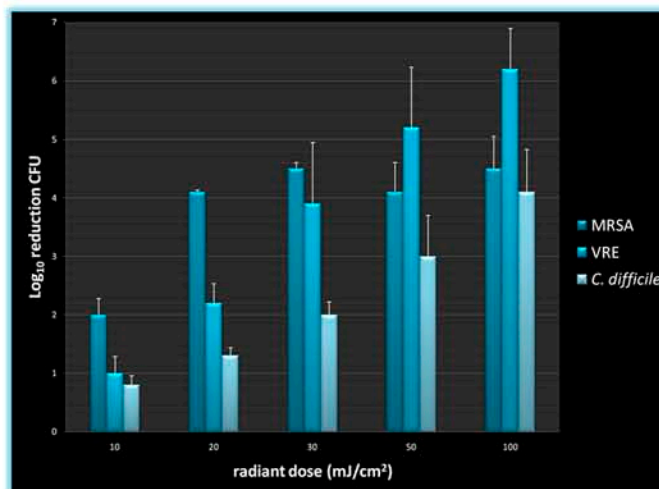


Figure 1. On inoculated surfaces in the laboratory, application of the Sterilray™ device at a radiant dose of 100 mJ/cm² for ~ 5 seconds consistently reduced recovery of *C. difficile* spores by >3-4 logs, MRSA by >4-5 logs and of VRE by >6-7 logs.

A >3 log reduction of MRSA and VRE was achieved in ~2 seconds at a lower radiant dose (30 mJ/cm²), but killing of *C. difficile* spores was significantly reduced.

Methods

- Cultures for *C. difficile*, methicillin-resistant *Staphylococcus aureus* (MRSA), and vancomycin-resistant *Enterococcus* (VRE) were collected before and after use of the Sterilray™ device from inoculated surfaces in the laboratory and from commonly-touched surfaces in rooms of hospitalized patients.

Laboratory Experimental Design

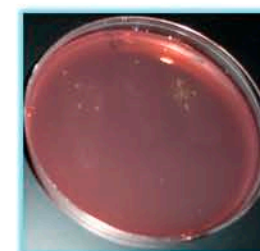
- Nine droplets (20 µl's each) of each organism (10⁶ to 10⁸ CFU) were inoculated onto the cover of a sterile, plastic Petri dish.
- The droplets were subjected to high power irradiation at doses of 10, 20, 30, 50 or 100 mJ/cm² with the Sterilray™ device or left untreated (i.e., positive controls).
- After the organisms were treated the droplets were collected (dish tipped and drops transferred to a tube) and enumerated by serial diluting and plating suspensions.

organism		before Sterilray™	after Sterilray™	% reduction
<i>C. difficile</i>	Sites positive (N=245)	28 (10.6%)	11 (4.2%)	61
	# colonies	60	17	72
	# colonies per site mean (range)	2.14 (1-29)	1.55 (1-2)	
VRE	Sites positive (N=247)	12 (4.5%)	5 (1.9%)	58
	# colonies	125	75	40
	# colonies per site mean (range)	10.4 (1-43)	15 (1-56)	
MRSA	Sites positive (N=106)	49 (46%)	29 (27%)	41
	# colonies	2992	831	72
	# colonies per site mean (range)	28.2 (1-1000)	7.84 (1-200)	

Figure 2. In hospital rooms that were not pre-cleaned, disinfection with the Sterilray™ device reduced the frequency of positive *C. difficile* cultures by 61%, MRSA cultures by 41% and VRE cultures by 58%.



Before treatment with Sterilray™
Gloved hand touched to surface inoculated with *C. difficile* spores and then touched to plate



After treatment with Sterilray™
Gloved hand touched to surface inoculated with *C. difficile* spores, treated with Sterilray™ and then touched to plate

Figure 3. On gloved hands contaminated with *C. difficile* spores, disinfection with a radiant dose of 100 mJ/cm² for ~ 5 seconds reduced transfer of spores by 3 logs.

Conclusion

- The Sterilray™ Disinfection Wand is a novel environmental disinfection technology that rapidly kills *C. difficile* spores and other healthcare-associated pathogens on surfaces and on gloved hands.
- However, the presence of organic matter decreases the efficacy of the far-ultraviolet radiation, possibly explaining the more modest results observed on surfaces in hospital rooms that were not pre-cleaned.

Contact Information
Michelle Nerandzic B.S.
michellenerandzi@aim.com