ADS-55

Quick and Effective Disinfection of Hospital Rooms after Discharge of Patients

David W. Stroman, Brandi S. Whiteley, Stella M. Robertson, Michael L. Stoltz, Rodney E. Rohde

Background

It is imperative to quickly clean and disinfect a hospital room after discharge of patients to reduce transmission of antibiotic resistant pathogens found with healthcare associated infections (HAIs).

Objectives

- **Evaluate the effectiveness of an 85 micron positive hypochlorous acid (HOCl) electrostatic spray combined with routine cleaning and disinfection after patient discharge in a hospital setting.**
- **Quantitative assessment of microbial load before and after sanitization, and after HOCl spray disinfection.**
- **Characterize isolates to the species level; determine the susceptibility profile to 15 selected antibiotics.**

Methods

Disinfection procedures:

- **Hospital staff - Clean and sanitize surfaces with a quaternary ammonium chloride using routine spray and wipe technique.**
- **Sprayer personnel – Disinfect with electrostatic positively charged spray of HOCl produced from sodium troclosene. The "85µ" size droplets were sprayed at a 3 ft. distance; allowing up to a 15 min dwell time.**

Specimen Collection:

- **Collect specimens from five "high touch" areas (dry swab 2"x 4" area): Bedrail; Call light; Over the bed table; Handrail near toilet; Exterior door handle.**
- **Collect specimens at the indicated times: a) after patient discharge (before any cleaning); b) after standard cleaning and disinfection; and c) after electrostatic spray of HOCl.**

Specimen Processing :

- **All specimens (swabs) in tubed transport media sent overnight to IHMA, Schaumburg, IL.**
- **Specimen swabs processed to quantitatively recover aerobic and anaerobic bacteria. Unique colony types were counted separately.**
- **Species-level identification determined with MALDI-TOF or sequencing of 500 bp of 16S rRNA gene.**
- **Susceptibility profiles (end-point MICs to 15 selected antibiotics) were determined.**

Results

Electrostatic Hypochlorous Acid Disinfection Provides Additional Killing After Routine Cleaning and Disinfection

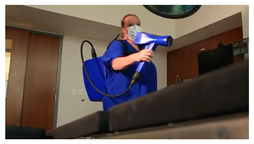
Table 1. Quantitative recovery of bacterial isolates

Hospital Room Unit Type	Initial Collection			Second Collection After Routine Cleaning/Disinfection			Third Collection After HOCl Electrostatic Spray		
	# of Species	# of Isolates	Total CFUs	# of Species	# of Isolates	Total CFUs	# of Species	# of Isolates	Total CFUs
Room 1 Empty	5	7	260	na	na	na	na	na	na
Room 2 Regular	7	8	$2.2x10^6$	7	9	$1.9x10^3$	1	1	100
% Surviving						0.085			0.004
Log Reduction						3.07			4.36
% Kill						99.92			99.996
Room 3 Regular	12	13	$4.3x10^6$	4	4	$7.2x10^3$	1	1	20
% Surviving						0.168			0.00046
Log Reduction						2.77			5.33
% Kill						99.83			99.9995
Room 4 Trauma Unit	10	18	$6.02x10^{10}$	4	4	$8.5x10^7$	0	0	0
% Surviving						0.141			0
Log Reduction						2.85			10.8
% Kill						99.86			100

Total bacterial load, the number of bacterial species, and the number of isolates were reduced by electrostatic spray of HOCl after routine cleaning and disinfection with a quat (spray and wipe).

Electrostatic Spray Method

- **The Electrostatic Spray places a positive (+) charge on the droplets as they leave the spray nozzle.**
- **The dispersed droplets (85µ) spread out evenly and seek out a negative (-) or neutrally charged surface.**
- **The electrical charge difference *between* the target surfaces and the spray droplets creates an electrical attraction between the target surfaces and the droplet.**
- **This phenomenon creates a wrapping effect of the droplets creating comprehensive coverage.**



Electrostatic Spray Pink Dye on Can

Before After

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Results

Table 2. Diversity of bacterial species

Gram-Positive Bacteria		Gram-Negative Bacteria
Bacillus circulans		*Escherichia coli*
Bacillus niabensis		
Bacillus simplex		
Corynebacterium singular		*Klebsiella pneumoniae*
Corynebacterium tuberculostearicum		
Enterococcus feacium		*Pantoea agglomerans*
Micrococcus luteus		*Acientobacter johnsonii*
Paenibacillus amylolyticus		*Moraxella oslonensis*
Paenibacillus provencensis		
Propionibacterium acnes		*Pseudomonas fluorescens*
Staphylococcus		*Stenotrophomonas maltophilia*
S. capitis	*S. hominis*	
S. caprae	*S. pasteurii*	
S. cohnii	*S. petrasil* subsp.*progensis*	
S. epidermidis	*S. saprophyticus*	
S. gallinarium	*S. warnerii*	
S. haemolyticus	*S. hominis*	
S. capitis	*S. pasteurii*	
Streptococcus oralis		

Table 3. Susceptibility Testing

- **Six of 28 strains were methicillin-resistant (MR)**
  - ***S. epidermidis*, *S. hominis*, and *S. haemolyticus***
  - **At least one methicillin-resistant strain was recovered from every room.**
- **MR *S. hominis* strain (Room 2) was highly resistant to oxacillin, penicillin, amoxicillin, cefazolin, erythromycin-clindamycin, tobramycin, gentamicin, amikacin, ciprofloxacin, tetracycline, trimethoprim, and sulfamethoxazole. This strain was recovered from all 5 "high-touch" sites.**
- **MR *S. epidermidis* strain (Room 4) was highly resistant to oxacillin, erythromycin-clindamycin, tobramycin, gentamicin, amikacin, ciprofloxacin, moxifloxacin, tetracycline, trimethoprim, and sulfamethoxazole.**
- ***E. faecium* strain (Room 3) was highly resistant to oxacillin, penicillin, amoxicillin, cefazolin, erythromycin-clindamycin, tobramycin, amikacin, ciprofloxacin, moxifloxacin, tetracycline, polymyxin B, and sulfamethoxazole. *This is one of the most troublesome species from the perspective of spread of nosocomial infections resistant to antibiotic therapy.***
- ***K. pneumoniae* strain (Room 3 and 4) was highly resistant to oxacillin, penicillin, amoxicillin, erythromycin-clindamycin, and sulfamethoxazole. *This specific strain was recovered in high numbers from two rooms.* Our data do not address how it spread from room to room.**

Conclusions

Hypochlorous acid applied as an 85 micron positively (+) charged electrostatic spray provided additional killing of the bacteria remaining after the routine cleaning and disinfection procedures.

Species level identification of the isolates combined with susceptibility testing demonstrated the presence of multiple-resistant strains in all the rooms sampled.

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David W. Stroman, PhD, Stella M. Robertson, PhD*, Michael Stoltz, MD, and Rodney E. Rohde, PhD are consultants and E-Mist Scientific Advisory Board members. Brandi S. Whiteley* is an employee of E-Mist (*indicates investors in the company).