



## Brief report

## Effectiveness of a hydrogen peroxide spray for decontamination of soft surfaces in hospitals



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In a survey of two hospitals, soft surfaces were commonly present in inpatient and outpatient settings, and contamination with health care-associated pathogens was frequently detected. An improved hydrogen peroxide cleaner disinfectant was effective for decontamination of soft surfaces when applied as a spray with no mechanical wiping.

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Contaminated environmental surfaces are an important source for transmission of health care-associated pathogens.<sup>1</sup> Although most cleaning and disinfection efforts have focused on hard surfaces, there is increasing evidence that contamination of soft surfaces is also common in health care facilities. For example, hospital privacy curtains are often contaminated with pathogenic microorganisms that can be transferred to hands of health care workers or patients.<sup>2-5</sup> Because soft surfaces are not amenable to cleaning and disinfection with many of the products used on hard surfaces, there is a need for new strategies to disinfect soft surfaces.

Clorox Healthcare Hydrogen Peroxide Cleaner Disinfectant (The Clorox Company, Oakland, CA) is a 1.4% improved hydrogen peroxide (IHP) disinfectant registered by the Environmental Protection Agency for use on hard surfaces.<sup>6</sup> In addition, the IHP solution applied as a spray without manual wiping has proven effective for disinfection of privacy curtains.<sup>6</sup> In the present study, we evaluated the effectiveness of the IHP solution for decontamination of a wide range of soft surfaces in inpatient and outpatient settings in 2 Cleveland area hospitals.

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## METHODS

In the laboratory, we compared the efficacy of the IHP and a 1:10 dilution of household bleach (ie, ~5,000 ppm free chlorine) for killing pathogens inoculated onto a soft surface. Three strains of methicillin-resistant *Staphylococcus aureus* (MRSA; pulsed-field gel electrophoresis types USA300 and USA800 and ATCC strain 43,300) and 3 strains of vancomycin-resistant enterococci (VRE; C68, a VanB-type isolate, and C37 and C25, VanA-type isolates) were tested. Then 10- $\mu$ L aliquots containing ~6 log<sub>10</sub> colony-forming units (CFU) of the organisms suspended in deionized water with or without simulated organic load (0.5% bovine serum albumin, 5% tryptone, and 0.4% mucin) were spread to cover 1 cm<sup>2</sup> sections cut from a hospital privacy curtain (American Drapemasters, Chicago, IL).

Once the inoculum dried, the carriers were positioned vertically to mimic the vertical hanging of privacy curtains and sprayed with a 1:10 dilution of household bleach, IHP, or sterile water. After a contact time of 1 minute, the carriers were placed in 1 mL of Dey-Engley neutralizing medium (Remel Products, Lenexa, KS), serially diluted, and plated onto selective media for quantification. Log reductions for bleach and IHP were calculated in comparison to counts for sterile water exposure. The experiment was repeated 3 times.

For 2 hospitals, including a Veterans Affairs hospital and community hospital, we surveyed 10 hospital rooms from multiple wards, 25 outpatient clinic rooms, the physical therapy department, and patient waiting rooms. For each hospital, we tested the efficacy of IHP for decontamination of soft surfaces in hospital and outpatient clinic rooms and in physical therapy departments (200

**Table 1**  
Distribution of soft surfaces and percentage contaminated before application of IHP, by health care setting

Setting	Soft surfaces, n, mean (range)	Positive samples, n (%) <sup>a</sup>		
		MRSA	VRE	Gram-negative bacilli <sup>b</sup>
Inpatient rooms (n = 45)	4.5 (3-6)	4 (8.8)	7 (15.6)	4 (8.8)
Chair (n = 107)	2.3 (0-5)	7 (6.5)	4 (3.7)	3 (2.8)
Blood pressure cuff (n = 31)	0.7 (1-3)	1 (3.2)	1 (3.2)	0 (0)
Curtain (n = 57)	1.3 (1-3)	4 (7)	2 (3.5)	2 (3.5)
Other (n = 10) <sup>c</sup>	0.2 (0-1)	0 (0)	2 (20.0)	2 (33.0)
Outpatient rooms (n = 29)	4.5 (2-7)	5 (17.2)	0 (0)	15 (51.7)
Chair (n = 49)	1.9 (1-3)	2 (4.1)	0 (0)	10 (20.4)
Blood pressure cuff (n = 20)	0.7 (0-2)	1 (5.0)	0 (0)	3 (15.0)
Curtain (n = 32)	1.1 (1-2)	1 (3.1)	0 (0)	3 (9.4)
Exam table (n = 25)	0.7 (0-1)	2 (8.0)	0 (0)	4 (16.0)
Physical therapy rooms (n = 6)		4 (66.7)	1 (16.7)	2 (33.3)
Miscellaneous equipment (n = 84)	21.3 (4-46)	11 (13.0)	1 (1.2)	7 (8.3)
Waiting rooms (n = 6)		1 (16.7)	0 (0)	3 (50)
Chairs (n = 18)	4.5 (3-8)	3 (16.7)	0 (0)	6 (33.0)

<sup>a</sup>The percentages indicate either the percentage of rooms (ie, inpatient, outpatient, physical therapy, or waiting rooms) or the percentage of individual items (eg, chair, curtain, blood pressure cuff) with positive cultures.

<sup>b</sup>All of the facultative and aerobic gram-negative bacilli recovered before application of IHP were non-lactose-fermenting organisms.

<sup>c</sup>Other surfaces in inpatient rooms included walkers, canes, wheelchair, lift slings, and physical therapy equipment.

**Table 2**  
Bacterial contamination on soft surfaces before versus after spray application of IHP

Bacteria	No. positive/no. sampled (%)			Mean CFU, mean (range)		
	Before	After	P value	Before	After	P value
Total aerobic and facultative bacteria	389/433 (90)	32/430 (7)	.009	152 (1->1,000)	7.78 (1-56)	<.001
Gram-negative Bacilli <sup>a</sup>	36/393 (9)	0/391 (0)	.08	19.6 (1-50)	0 (0)	<.001
VRE	11/433 (3)	0/433 (0)	.05	8.7 (1-50)	0 (0)	.01
MRSA	30/433 (7)	2/433 (0.4)	.004	11.5 (1-100)	4.5 (4-5)	.03

<sup>a</sup>All of the facultative and aerobic gram-negative bacilli recovered before application of IHP were non-lactose-fermenting organisms.

total surfaces in 1 hospital and 233 in the other). For each surface, cultures were collected from one-half of the surface area using a sterile swab (BBL CultureSwab, BD Biosciences, San Jose, CA) pre-moistened with Dey-Engley neutralizing medium (Remel Products). The surfaces were then sprayed with IHP in sufficient quantities to thoroughly wet the surfaces (~6 sprays per surface). After a contact time of 1 minute, the remaining surface area was cultured using a swab (CultureSwab) premoistened with Dey-Engley neutralizer.

VRE, MRSA, and facultative and aerobic gram-negative bacilli were cultured by plating swabs on selective media as described previously.<sup>7,8</sup> In preliminary studies, the limit of detection for recovery of these organisms from inoculated surfaces using swabs was ~1 log<sub>10</sub> CFU. To quantify total heterotrophic bacteria, swabs were plated on trypticase soy agar containing 5% sheep blood (BD Diagnostic Systems, Hunt Valley, MD) and incubated aerobically at 37°C for 48 hours; colonies consistent with *Bacillus* spp were excluded from counts of total bacteria, because IHP does not have sporicidal activity. VRE and MRSA colonies with unique morphology and a subset of gram-negative bacilli were subjected to identification and susceptibility testing in accordance with Clinical and Laboratory Standards Institute guidelines.<sup>9</sup> Fisher's exact test was used to compare the percentages of cultures positive before versus after application of IHP, and Student's *t* test was used to compare mean CFU counts recovered before versus after IHP.

## RESULTS

On carriers made from privacy curtain fabric, both IHP and the 1:10 dilution of household bleach resulted in a ≥6 log<sub>10</sub> CFU reduction in VRE and MRSA with a 1-minute contact time in the

presence or absence of organic load. The mean number of soft surfaces present was 4.5 (range, 3-6) in hospital rooms, 4.5 (range, 2-7) in outpatient clinic rooms, 21.3 (range, 4-46) in physical therapy departments, and 4.5 (range, 3-8) in patient waiting areas. The numbers and types of soft surfaces were similar in the 2 hospitals. Table 1 provides an overview of the types of soft surfaces present in each location.

As shown in Table 2, spray application of IHP significantly reduced recovery of total heterotrophic bacteria, facultative and aerobic gram-negative bacilli, MRSA, and VRE from soft surfaces. All 36 of the facultative and aerobic gram-negative bacilli recovered before IHP application were non-lactose-fermenting organisms. Of 19 gram-negative isolates subjected to susceptibility testing, 7 (37%) were resistant to imipenem, including isolates of *Pseudomonas oryzihabitans*, *Pantoea agglomerans*, *Acinetobacter baumannii*, *Stenotrophomonas maltophilia*, *Ochrobactrum anthropi*, and *Bordetella bronchiseptica*.

## DISCUSSION

In the 2 hospitals studied, soft surfaces were common in both inpatient and outpatient settings. These surfaces were frequently contaminated with health care-associated pathogens, such as MRSA and VRE. Many of the soft surfaces are high-touch items, which could potentially serve as a source for contamination of the hands of health care personnel and patients. Our results suggest that spraying soft surfaces with IHP could provide a simple and effective means to reduce contamination with health care-associated pathogens.

Spraying soft surfaces with IHP offers several potential advantages over standard cleaning methods. These include efficiency, the

ability to thoroughly apply disinfectant on objects with irregular surfaces that might be difficult to reach with a cloth, and a good safety profile allowing application while patients are present. As has been noted by others,<sup>6</sup> spraying privacy curtains with IHP could be much less costly than replacing curtains between each patient. There are also some disadvantages of the use of IHP as a spray for soft surfaces. These include increased cost compared with some other disinfectants, lack of activity against *Clostridium difficile* spores, dependence on the operator to apply sufficient disinfectant to wet surfaces, and lack of mechanical removal of pathogens and organic material.

Our study has some limitations. In laboratory testing, a small number of organisms and strains were tested, and only 1 disinfectant was tested as a competitor to IHP. In practice, IHP often may be applied using a wipe; however, we did not assess the efficacy of IHP in the presence or absence of mechanical removal. Although we observed no adverse effects on the surfaces tested, it should be noted that the manufacturer does not recommend that the IHP product be used on aluminum, copper, galvanized steel, or silver. Finally, the IHP product has a fragrance and potentially could be irritating to some individuals. However, no complaints regarding the fragrance were noted during this study.

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