

Fogging HOCl for Patient Room Disinfection Brings Added Benefit of Floor Pathogen Reduction





INTRODUCTION

Terminal cleaning typically refers to a process where the entire patient room is cleaned and disinfected after occupancy. During a patient's stay, pathogens responsible for healthcare-associated infections (HAIs) can quickly accumulate on room surfaces, which include floors. Floors may be an undercalculated source of pathogen dissemination as bacteria and viruses can easily be transferred to high-touch room surfaces, posing the risk for patient exposure and potential infection.¹

Healthcare-associated infections are estimated to affect 1.7 million patients in the US annually, leading to 99,000 deaths.² As enhanced infection control practices are developed to reduce HAIs, the use of EPA registered, hospital-grade disinfectants should be considered as part of the routine terminal cleaning process for patient room floors.

Ideal disinfectants must be nontoxic, noncorrosive, effective and environmentally friendly.³ This case study demonstrates the use of fogged hypochlorous acid (HOCl) as an effective adjunct floor disinfection protocol for hospital rooms during the terminal cleaning process.

BACKGROUND

Despite innovative advances in medicine and medical technology, the E.H. Spaulding classification system developed in the 1950s remains widely used by US Center for Disease stakeholders (including the FDA and healthcare facilities) to define device and environment disinfection practices that mitigate patient risks, including the acquisition of infection.⁴

The three-part framework disinfection strategy is based on the severity of perceived risk and includes the categories of: critical, semi-critical and non-critical levels.⁵ Devices and environmental room surfaces are classified and then disinfected based on the assignment of high, medium or low risk level.

The CDC generally considers patient room floors as a non-critical surface that poses little threat for pathogen transfer.⁶ Current environmental guidelines include the use of neutral detergents and water as acceptable terminal cleaning solutions for general patient room floors. Areas of exception include intensive care areas, isolation rooms, procedural rooms and immunocompromised patient care units where EPA registered, hospital-grade floor disinfectants should be used.

However, two recent studies conducted in a VA Medical Center demonstrate the migration of HAI-causing bacteria and viruses in standard patient care rooms from floors to occupants and their immediate surroundings.⁷ This evidence suggests that floors are a pathogen reservoir that require a higher level of floor disinfection.

SOLUTION

The effectiveness of disinfecting floors by fogging hypochlorous acid after manual cleaning was tested to determine if floors require a higher level of disinfection than presumed. The study was conducted in a real-world healthcare setting at a regional hospital located in Detroit, Michigan, rather than within a seeded lab environment. To reduce floor bioburden, the hospital reviewed the results of their manual floor cleaning using a hospital-grade quaternary-based disinfectant followed by the adjunct use of the automated Nimbus whole-room fogging of Microburst™ hypochlorous acid (HOCl).

METHODOLOGY

The Nimbus fogging of Microburst™ HOCl was incorporated into the discharge cleaning protocol for all patient rooms in the medical intensive care unit (MICU) and on a selected patient unit (4W).

The MICU and 4W room configurations and dimensions were assessed to determine fogging cycle times. A 30-minute automated Nimbus cycle was programmed for MICU rooms and a 29-minute time was assigned for 4W rooms.

Environmental Service (EVS) staff members were trained on the products and manufacturer's instructions for use (IFU). Fogging of patient rooms occurred upon completion of surface cleaning and after the room's final manual floor mop-out. Per EVS policy, a hospital grade quaternary-based disinfectant was used in the mop-out procedure.

To demonstrate the effectiveness of the disinfection fogging of Microburst™ HOCl for the reduction of floor aerobic bioburden, swab sample testing of floor surface locations was conducted at three different selected times for twenty random discharge rooms on the MICU and 4W units. A total of sixty samples were collected and analyzed. Floor samples were collected immediately after patient discharge (baseline), ten minutes after manual cleaning and mop out, and again ten minutes after the completion of the Microburst™ fog application. (FIG 1)

The aseptic, 3M™ quick swab system consisting of a five-inch, rayon-tipped swab with letheen neutralizing buffer facilitating the recovery of bacteria was used to collect samples per manufacturer's instructions for use. A sampling area of 100 cm² was selected. Samples were labeled with date, time, sequence and room number location then logged on a designated collection form and immediately refrigerated.

A total of 60 samples from 20 discharge rooms were obtained and cultured on 3M Petrifilm™ plates. For chain of custody exactness and consistency, one trained individual conducted the sampling collection. Inoculated plates were processed, labeled and photographed at an independent location. Samples were incubated according to lab protocol and manufacturer's instructions. Colony forming unit (CFU) counts were documented and counted in triplicate for accuracy.

FIGURE 1: Sampling Time Sequence



RESULTS

Over the course of a two-week period a total of 60 samples were collected and analyzed from 20 random discharge rooms incorporating Nimbus fogging of Microburst™ into their disinfection protocol. Fourteen of the rooms were in MICU; six rooms were located on the 4W stepdown unit.

BASELINE

A total number of 9,263 CFUs were cultured from floor swab samples obtained from the rooms immediately after patient discharge. Notably, all testing was conducted in a working healthcare environment rather than a seeded lab environment.

AFTER MANUAL CLEANING

Post manual floor mop-out using a quaternary based disinfectant, 7,837 aerobic pathogen colonies were cultured from the floors. The average LOG reduction after floor manual cleaning was 0.07.

Three of the 20 rooms had higher colony counts after completion of the manual cleaning compared to their original baseline CFU numbers. Applying the 2.5 CFU/cm² cleanliness criterion, only 7 of the 20 room floors were sufficiently cleaned during the manual process. Thirteen of the 20 rooms failed to meet the acceptable level of pathogen CFU reduction.

AFTER NIMBUS DISINFECTION

Nimbus delivered an average 1.67 LOG reduction for floor disinfection beyond the manual clean and achieved a maximum LOG reduction of 3.32 in one room. A total of only 169 CFUs were cultured from all twenty rooms after Nimbus use, compared to 7,837 CFUs collected post manual mop-out.

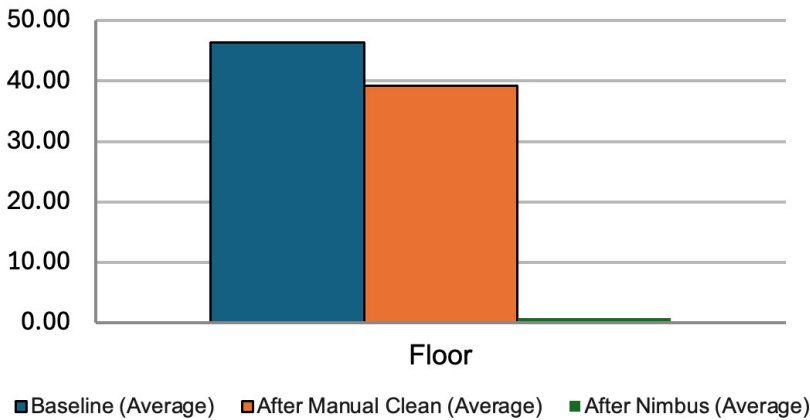
The fogging of Microburst™ HOCl delivered a 97.84% average decrease in pathogen CFU reduction beyond manual cleaning. (FIG 2) Using the 2.5 CFU/cm² cleanliness criterion, only 35% of the manually cleaned rooms met the cleanliness requirement, while 85% of rooms met the requirement when Nimbus was used.

FIGURE 2: Total Aerobic Colony Unit Counts and Reduction Data

Aerobic Colony Count - Floors Only								
Average Colony Forming Units (CFU/cm ²) by Surface				Percent Change		Log Reduction		
Location	Baseline	After Manual Clean	After Nimbus	Average Manual Clean from Baseline Reduction	Average Nimbus from Manual Clean Reduction	Average Manual Clean Log Reduction from Baseline	Average Nimbus Log Reduction from Manual Clean	Maximum Nimbus Log Reduction from Manual Clean
Floor	46.32	39.1850	0.8450	-15.39%	-97.84%	0.07	1.67	3.32

FIGURE 3: Pathogen Reduction After Manual Clean and Nimbus

Efficacy - Average Colony Forming Units per cm² By Cleaning Event



DISCUSSION

Research has confirmed hospital room floors are quickly and frequently contaminated, serving as pathogenic reservoirs that contribute to the risk of a patient developing an HAI. Epidemiological models have established that room air movement easily transfers microorganisms from floor to non-floor surfaces, ultimately resulting in hand to patient contamination.^{8,9}

Floors remain designated as non-critical surfaces in non-specialty patient units suggesting little risk of microbial transmission and no need for disinfectant use on floors during terminal cleaning practices. However, studies show that pathogens are frequently shed by patients, staff and visitors, whereupon they contaminate floor surfaces and increase the risk of infection.¹⁰

One study determined colony counts on floors cleaned with a disinfectant were 3-3 c.f.u./10 cm², while room floors cleaned with only detergent had colony counts remaining elevated at 44-8 and 71-4 c.f.u./10 cm² respectively.¹¹ This demonstrates significant pathogen kill from the use of a disinfectant. Additional studies have shown that manual cleaning is suboptimal with less than 50% of surfaces being cleaned, which supports the need for automated disinfection for the elimination of human error.¹²

The fogging of HOCl for whole-room surface disinfection, inclusive of floors disinfected via Nimbus technology, has been proven to be effective against common viral, bacterial and fungi pathogens including spores and *C. auris*.¹³ HOCl has been proven to be more bactericidal than quaternary based disinfectants, suggesting that it should be used as a surface disinfectant in healthcare facilities.¹⁴ The automated Nimbus disinfection solution using HOCl delivers consistent floor surface disinfection, eliminates bioburden and reduces the opportunity for pathogen transfer.¹⁵

CONCLUSION

Manual mopping techniques used in the terminal cleaning of patient room floor surfaces do not consistently provide the required level of pathogen reduction for the prevention of HAIs. Incorporating automated whole-room fogging technology using Nimbus with Microburst™ hypochlorous acid as part of a facility's terminal cleaning practices provides the additional benefit of high-level floor disinfection reducing pathogen bioburden. The use of the Nimbus Microburst™ solution should be considered a part of the hospital's comprehensive cleaning protocol for enhanced infection prevention.



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