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Evaluation of Environmental Cleaning of Patient Rooms; Impact of Different Fluorescent Gel Markers.

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Abstract

Systematic evaluation of metered applicator purpose-made (MA), and cotton swab (CS) non-purpose made, fluorescent gel markers (FGM) found high touch surfaces removal rates of 60.5% (476/787), 64.3% (506/787) respectively. MA-FGM removal interpretation was more consistent, 83% vs 50% not removed, possibly due to less varied application, and more adhesive gel.

Background:

Targeted evaluation and performance improvement to enhance patient room cleaning is important for healthcare-associated infection prevention.^{1,2} The Centers for Disease Control and Prevention recommends fluorescent gel markers (FGM) as a tool for Evaluation of Environmental Cleaning (EEC).³ However, the optimal FG formulation, method of application, and evaluation of removal remains to be determined.

At Johns Hopkins Hospital (JHH), a 1,020 bed academic hospital in Maryland, FGM has been a part of our EEC program since 2012. A FGM, only visible with UV light is placed on high touch surfaces (HTS) in selected patient rooms and bathrooms. After a period of time, removal is assessed using UV light. Removed FGM (e.g. not visible using black light) indicates a cleaned HTS, remaining FGM indicates an uncleaned HTS. Since establishing the program, we have evaluated multiple different fluorescent markers with varied compositions and application methods (e.g. fluorescent gel, paint, and pen marker). Many fluorescent markers were quickly eliminated, due to being clearly visible to the naked eye, or not removed by expected best cleaning. However, two FGM types did not overtly appear

to have these problems. Therefore, the aim of this study was to evaluate these two different FGM products: a purpose-made metered applicator FGM (MA-FGM) and a cotton swab FGM (CS-FGM), a lotion with a fluorescent glow dispensed using a cotton swab. We hypothesized that use of a purpose-made MA-FGM allowing for a more standardized application would be associated with 1) decreased FGM removal because it is less visible to the naked eye, and 2) less variability in size of FGM at placement and more standardized interpretation of FGM removal.

Methods

Phase 1:

Over a 2-day period at JHH, we randomly selected rooms from nine hospital units via block randomization. We placed both MA-FGM (DAZO©) and CS-FGM (GloGerm©) simultaneously on as many of 24 HTS as possible per room. For each room, we alternated the side of the HTS assessed by each method, to account for handedness that might influence the likelihood of FGM removal. The location and types of FGM for each room were recorded, and presence of each FGM checked one day later. A discharge clean was deemed to have occurred if there was a new patient in the room at time of FGM assessment.

Phase 2:

In the Johns Hopkins Biocontainment unit, in an unoccupied patient room used for training and simulations, 8 trained “markers” (3 research assistants, 2 infection control epidemiologists, 1 infectious diseases physician, 1 research coordinator, 1 infection control assistant), placed dots three times with each product on a bedside table, using their usual practice. The FGM dot diameters were measured, and visibility to the naked eye assessed. The FGM dried for 2.5 hours after which an observer wiped each FGM with disinfectant using two strokes to mimic real world cleaning, and FGM removal was assessed.

Cohen’s Kappa was used to measure agreement and McNemar’s test was used to compare the removal rate between the two types of FGMs. We also used logistic regression models to compare removal rate across different HTS for each type of FGMs.

Results:

Phase 1:

MA-FGM and CS-FGM were placed on 787 HTSs in 38 randomly selected rooms in nine different units. Overall removal rate was higher for the CS-FGM (64.3% vs 60.5%, $p < 0.001$). Concordance between removal of the two products was high (Kappa = 0.83, 95% CI = 0.79 – 0.87). Table 1 compares the odds of FGM removal for each type by HTS.

Phase 2:

For the simulated FGM experiment, each of the 24 MA-FGM placed had a standard diameter of 0.5 cm while the CS-FGM dots varied in diameter from 0.1 cm to 2 cm based on the “marker.” The CS-FGM appeared more visible by naked eye than MA-FGM as judged

by the observers. See supplemental material for images (figure 1a, 1d). More CS-FGMs (vs MA-FGM) were judged as removed after wiping; (12/24; 50% vs 4/24; 17%), see Table 2.

Discussion

We found the CS-FGM product more frequently removed from HTS in patient rooms than MA-FGM product (64.3% vs 60.5%). We hypothesized that there were two reasons. Firstly, the CS-FGM product was more visible to the naked eye and preferentially removed. Secondly, the MA-FG formulation was more adhesive to HTS and therefore not as easily removed with wiping. We explored these hypotheses in phase two of the study. We found large variability in FGM size for the CS-FGM, demonstrating that dipping a cotton swab into the FG (vs metered applicator) is subjective and dependent on the marker's approach, even after training in the methodology. The MA-FGM was less easily removed compared with CS-FGM (17% vs 50% removed respectively), possibly related to different gel constituents and resultant adhesiveness. The need for manual pressure to remove biofilm from dry surfaces in the patient environment is increasingly recognized and supports a less easy to remove FGM, as a better surrogate for biofilm removal.⁴ The CS-FGM lacks standardization and reproducibility, and may be a sub-optimal product choice for accountability and performance improvement.

We did expect a larger difference in removal rate between the two products. Potentially, if either FGM was visible the full HTS was cleaned, thus removing both products. In addition, some of the small HTS did not have much distance between the two FGMs, and likely, both removed simultaneously. We chose this method of placing the FGM on alternating sides of the same HTS, rather than each room with a different FGM method, to eliminate confounding due to cleaning practices of the individual EVC associate.

Infection control or facilities programs implementing EEC programs should carefully consider the type and method of application of FGM, to standardize and optimize measurement of FG removal.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.Odds of High Touch Surface FGM removal by FGM type.^I

Dependent variable: FGM removal (Yes/No)	Metered Applicator FGM			Cotton Swab FGM	
Removal: Yes/No	OR	95% CI	P value	OR	95% CI
High touch surfaces					
Main Room					
Side bed rail	1.00	(Reference)		1.00	(Reference)
Vital signs monitor	0.30	(0.08 – 1.08)	0.065	0.21	(0.06 – 0.71)
Call bell	1.97	(0.64 – 6.11)	0.240	2.00	(0.65 – 6.15)
Bedside tray table	5.78	(2.08 – 16.07)	0.001	2.74	(1.02 – 7.35)
Supply cart	1.82	(0.53 – 6.25)	0.344	1.08	(0.32 – 3.71)
IV pole (grab area)	0.54	(0.16 – 1.87)	0.332	0.31	(0.09 – 1.06)
IV pump (touch area)	0.57	(0.16 – 1.97)	0.370	0.33	(0.10 – 1.12)
Side table	6.13	(1.74 – 21.63)	0.005	5.04	(1.40–18.12)
Telephone	2.38	(0.77 – 7.38)	0.133	1.13	(0.37 – 3.42)
Chair	4.30	(1.54 – 12.05)	0.006	2.38	(0.87 – 6.52)
Sink rim	4.87	(1.77 – 13.42)	0.002	3.51	(1.26 – 9.74)
Door handle	3.32	(1.23 – 8.92)	0.017	2.32	(0.87 – 6.19)
Light switch	2.61	(0.98 – 6.97)	0.055	2.04	(0.77 – 5.40)
Sink faucet	5.59	(2.00 – 15.59)	0.001	4.10	(1.45–11.59)
Bathroom					
Grab bar	4.44	(1.63 – 12.05)	0.003	3.14	(1.15 – 8.53)
Flush handle	9.14	(3.10 – 26.97)	<0.001	5.95	(1.99–17.76)
Toilet seat	5.78	(2.08 – 16.07)	0.001	9.13	(2.78–29.99)
Outside door handle	3.32	(1.23 – 8.93)	0.017	1.58	(0.61 – 4.15)
Inside door handle	6.67	(2.36 – 18.83)	<0.001	4.22	(1.50–11.90)
Light switch	8.88	(3.00 – 26.27)	<0.001	3.03	(1.11 – 8.29)
Sink rim	7.76	(2.70 – 22.35)	<0.001	5.95	(1.99–17.76)
Sink faucet	10.93	(3.59 – 33.25)	<0.001	5.95	(1.99–17.76)
Soap dispenser	4.44	(1.63 – 12.05)	0.003	4.22	(1.50–11.90)
Towel bar	2.74	(1.03 – 7.28)	0.043	1.48	(0.57 – 3.84)
Constant	0.40	(0.17 – 0.93)	0.032	0.97	(0.43 – 2.23)

^IFrom logistic regression models adjusting for daily vs. discharge cleaning, and under contact precautions (y/n).

* No clustering was adjusted. Possible clustering includes the same cleaning workers, the same observer, building, unit, etc.

Table 2:

Metered applicator FG, cotton swab FG and removal from bedside table post wiping.

	Person #1	Person #2	Person #3	Person #4	Person #5	Person #6	Person #7	Person #8	% removed
Metered Applicator FG									
Dot 1	0	0	0	1	0	0	0	0	13%
Dot 2	0	0	0	1	0	0	0	0	13%
Dot 3	1	0	0	1	1	0	0	0	38%
Cotton Swab FG									
Dot 1	0	1	0	1	1	1	0	0	50%
Dot 2	0	1	0	1	1	1	0	0	50%
Dot 3	0	1	0	1	1	1	0	0	50%

* 0 = Not removed

1 = removed