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Major Article

An evaluation of cleaning practices at a teaching hospital

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A B S T R A C T

Background: The COVID-19 outbreak has highlighted the role of hospital-acquired infections in spreading epidemics. Adequately cleaning surfaces in patient rooms is an essential part of this fight to reduce the spread. Traditional audits, however, are insufficient. This study assesses surface cleaning practices using ultravoilet (UV) marker technology and the extent to which this technology can help improve cleaning audits and practices.

Methods: One hundred and forty-four audits (1,235 surfaces) were retrieved. UV-marker cleaning audits conducted at a major teaching hospital in 2018 after implementing a new cleaning protocol. In addition, semi-structured interviews were conducted with cleaning staff and supervisors.

Results: On average, 63% of surfaces were appropriately cleaned. Toilet handles (80%) and toilet seats underside (83%) scored highest while main room sink fixtures (54%), light switch (55%), and bedrails (56%) scored lowest. Training, staffing and time constraints may play a role in low cleaning rates.

Discussion: The high-touch patient surfaces in the bedroom remain neglected and a potential source of infections. UV marker audits provided an objective measure of cleaning practices that managers and staff were unaware of.

Conclusions: UV-markers audits can play a key role in revealing deficiencies in cleaning practices and help in raising awareness of these deficiencies and improving cleaning practices.

INTRODUCTION

According to the WHO, hospital acquired infections account for 7% of all infections in developed countries and 10% in developing countries.[1] Several outbreaks within long-term care facilities and acute care facilities have been reported across Canada from COVID-19 and many were reported in acute-care facilities during the SARS epidemic.[2-4] The recent outbreak of COVID-19 has caused many countries to go to extreme measures of setting up dedicated health care facilities as a containment measure, which clearly highlights the continuous importance of managing nosocomial infections to control epidemics.[5]

Frequent systematic cleaning and disinfecting practices (CDP) are key in controlling the spread of infection[6] within in-patient settings, since pathogens can persist on surfaces for several weeks if left uncleaned.[7-9] Technological advancements have resulted in new cleaning and disinfecting tools and processes to improve the effectiveness of CDP to support infection control[10,11] but cleaning standards and best practices are useful only if they are actually followed. Despite its importance, environmental cleaning and disinfecting remains inadequate in hospitals.[12,13] A 2008 study across 23 acute care hospitals across the United States showed that only 49% of 14 high risk surfaces (33% chance of contamination) were appropriately cleaned and disinfected.[14] It remains unclear whether these rates are improving.

One of the challenges to improve CDP is to obtain feedback on actual practices. Traditionally, CDP are monitored through visual assessment audits, which are limited by the invisible nature of the cleaning outcome. Ultraviolet (UV) marker technology is an innovation that measures whether physical wiping of surfaces occurred to the necessary level to result in removal of the invisible gel.[15] The visual aid of UV marker auditing is helpful in identifying CDP efficacy, identifying where correction is needed and providing the information to fuel staff training on effective cleaning procedures.[15-17]

In this paper, we leverage UV-marker technology to assess environmental cleaning at a large academic teaching hospital in Canada.

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The objectives are firstly to determine the extent to which surface cleaning meets cleaning standards and secondly to assess how UV markers can improve cleaning audits andCDP.

METHODOLOGY

Design

This study analyzes the retrospective quantitative data from cleaning audits conducted at a major acute care and teaching hospital in Canada. In this section, we describe the empirical setting and its CDP before describing our data collection and our analysis methodology.

The Infection Control Department of that hospital trained all cleaning staff on provincial standards of CDP and on the application of a Standard Operating Procedure for Cleaning (SOP), which details appropriate cleaning methods and is attached to all cleaning carts. Notably, the SOP:

a) Contains a checklist of high-touch surfaces that must be cleaned and disinfected along with diagrams to highlight high-touch surfaces in patient rooms and washrooms (Refer to Appendix A for the list of high-touch surfaces to clean and disinfect and to Appendix B for a visual illustration).
b) Requires that cleaners apply a sporicidal agent, Virox 5, to wet environmental surfaces. Virox 5 is a 7% Accelerated Hydrogen Peroxide Concentrate Solution.
c) Requires that surface should remain wet for 10 minutes, in conformance with Virox 5 manufacturer recommendations and public health standards
d) After the minimum time period, the cleaner returns to repeat the same process, allowing the second application of the agent to sit for another 10 minutes. In practice, by the time the employees have cleaned all high touch areas, 10 minutes would have elapsed and they would commence the second cleaning in the same succession of steps, Alternatively, cleaners would go to another room and then come back for the second cleaning. To ensure the double cleaning, the cleaner signs off on a checklist outside of the patient room and returns it to the supervisor to verify that the double cleaning procedure was followed
e) Requires the use of microfiber cloths for all CDP in the hospital.

To track compliance, the environmental cleaning services implemented a UV-marker audit system. An internal auditor applied a UV visible marker to several identified frequently touched surfaces in patient rooms (refer to Appendix C for details on the auditing methodology). The high-touch surfaces reflected in the SOP and the provincial standards are 5 surfaces in the bathroom and 5 within the patient room (6 if a patient-room had a sink). These marked surfaces were then evaluated between 48 hours to up to 144 hours later (6 days), after the markers were set. This long interval between UV-marker application and auditing was decided to minimize the chance that no cleaners would have gone into a room before the audit was performed. This conservative decision was made considering that based on admissions and priorities, a shift may completely skip a room. If there was visible agitation or removal of the visual marker, the surface was considered "marker not visible"; any remaining intact marker is a fail (see Appendix C for illustrations). The UV marker cannot rub off by mere contact that a patient may have with the surface. Auditing staff tested and confirmed that it takes moisture and repeated force to remove the UV marker.

The auditor then entered results into an electronic auditing tool via a tablet. See Appendix E for a sample room audit. Information about the audits also included the location (unit and department) and whether they were a standard or discharge cleaning. Discharge cleaning requires an enhanced cleaning protocol after a patient is discharged.

Table 1
Audit sample distribution (sample of 144 audits)

Program	Standard cleaning	Discharge cleaning	Total
Surgery and Oncology	47	26	73
UCC	60	11	71
Total	107	37	144

Data collection

Audits were extracted from the electronic auditing tool. Auditing results from an initial observation period were excluded as the observer present in the room added a confounding variable to the results. Data were collected over a two-month period (July and August 2018) between 2 departments, Surgery and Oncology (96 beds) and the Urgent Critical Care/Medicine department (UCC, 104 beds). The total audit sample size consisted of 144 audits and 1,235 surface measurements obtained. See Table 1 for a summary of the distribution of audits.

To complement this data, A. Cumming interviewed the cleaning staff and their supervisors to determine their knowledge of the environmental auditing program and cleaning methods.

Data analysis

Cleaning rates were calculated by dividing the count of surfaces marked "marker not visible" by the total number of surfaces measured. Average cleaning pass rates were broken down by surface and department.

Two binomial tests were performed to assess whether the differences in pass rates between Surgery and Oncology and UCC were statistically significant and whether the differences between discharge cleaning and standard cleaning were statistically significant.

FINDINGS

Audit findings

Table 2 summarizes the cleaning rates, broken down by surface, by department and between discharge and standard cleanings.

Overall, 63% of surfaces were marked with "marker not visible" (ie, have been cleaned) for all audits conducted on all surfaces. The 2 surfaces with the highest score for "marker not visible" were the toilet handle (80%) and the underside of the toilet seat (83%). In contrast, bed rails (56%), and bed/stretcher bedrails (56%) scored lowest.

The pass rates were 65% in the UCC Department and 62% in the Surgery and Oncology department. The *P*-value of the binomial test was .066, suggesting that the null hypothesis could not be excluded and that there was no statistically significant difference in cleaning rates between the 2 departments' cleaning rates.

The data also showed a 67% pass rate for discharge cleaning versus a 62% for standard cleaning. The *P*-value of the binomial test was .027, suggesting that discharge cleaning had a significantly higher pass rate than standard cleanings.

Interview findings

Staff indicated knowledge of the practices and procedures for effective cleaning and disinfecting and understood the importance of discharge cleaning. However, they noted that time constraints and workload were often a barrier to effective CDP. Specifically, they

Table 2
Proportion of surfaces cleaned broken down by type of surface, by room location and by department (sample of 1,235 surfaces audited)

Cleaning and disinfection rates, as % of markers not visible/surfaces cleaned (audit count)		UCC	Surgery and Oncology	*Total*
Bathroom	Assist bar	58% (52)	58% (76)	***58% (128)***
	Dispenser soap	74% (53)	45% (76)	***57% (129)***
	Sink fixtures	69% (51)	71% (76)	***70% (127)***
	Toilet (Seat) underside	84% (51)	83% (75)	***83% (126)***
	Toilet handle	77% (52)	83% (75)	***80% (127***
Main room	Bed/stretcher bedrails	55% (74)	58% (73)	***56% (147)****
	Sink fixtures	40% (10)	59% (27)	***54% (37)***
	Hand sanitizer	63% (73)	58% (76)	***60% (149)****
	Light switch	63% (56)	49% (74)	***55% (130***
	Table-bedside edge	57% (60)	57% (75)	***57% (135)***
Total		***65% (532)***	***62% (703)***	***63% (1,235)***

*Some rooms had multiple bedrails and hand sanitizers and were therefore audited multiple times on that same surface.

pointed out that the pressure of admitting new patients to a room sometimes negatively impacted discharge cleanings (even though they recognized that they should to be more thorough than standard cleaning). Staff also provided feedback on the auditing process, suggesting approaches for improving the electronic auditing tool to reflect auditor information, discharge versus standard cleaning and other factors outside of the scope of this study.

DISCUSSION

The results indicate relatively low environmental auditing score results with only 63% of surfaces cleaned appropriately, well below the department or hospital standards of 80%.[18] These low rates are compounded by the 2-6 days delay between UV marker application and the audit, a time period during which several cleanings may have happened. This means that the rate of single room cleanings being appropriate may be significantly lower and further studies should audit single cleanings. These findings highlight the need for improved cleaning standards, particularly as both hospitals and long term care facilities continue to treat COVID-19 patients and need to reduce the risk of hospital acquired cases.

Among high-touch surfaces, also associated with a high risk of surface contamination,[19,20] toilet surfaces (83% for toilet seat and 80% for toilet handles) were reassuringly above the 80% threshold, but bed rails (56%) and bedside tables (57%) were concerningly low. Standard room cleanings are done with the permission of the patient, and patients allowing the UV marker to be placed would be likely to allow it to be cleaned as well. However, in some instances, bedridden patients may have rejected cleaning and disinfecting bed rails and bedside tables or cleaners may have been reluctant to disturb patients.. These largely uncleaned high-touch surfaces in a patients' room, however, can be a reservoir for pathogens and transmission to other patients.[20,21] The study results suggest that there is a need to increase the focus of CDP, most importantly to these high-touch surfaces close to the bed where patients spend a lot of their time, which is consistent with other studies.[22] Specific protocols may have to be designed for bedrails and bedside tables in case patients are in bed and/or sleeping.

Discharge cleaning is far more detailed in comparison to standard cleaning and it requires a deep cleaning of all patient-bed surfaces, the mattress, and all surrounding surfaces and fixtures.[12] Despite this emphasis, actual discharge cleaning on common surfaces was below standards and barely above standard cleaning. An insufficiently cleaned room poses a serious risk to an incoming patient given that pathogens can remain on uncleaned surfaces for several weeks.[23]

These findings align with other similar studies of UV marker auditing[24] and suggest the usefulness of such audits. The cleaning staff and supervisors of the site were unaware that their CDP were falling so far below provincial standards. These findings confirm that UV marker auditing can provide reliable feedback and novel insights into actual cleaning practices,[25-27] which are difficult to objectively determine with the naked eye. These elements are essential to improve staff awareness, knowledge, understanding, and cleaning practices and for supervisors to effectively monitor cleaning quality and performance.[25] Insufficient resources often contribute to infrequent or incomplete cleaning within the hospital.[28] Objective audit results may help highlight the need for sufficient resources to yield quality CDP standards.

Implications for practice

Hospitals should take steps to ensure that the quality of CDP remains a priority over rapidity, especially at discharge when rooms need to be made available to new patients. While patient turnover is important, controlling the spread of hospital-acquired infections is paramount, particularly since the onset of the COVID-19 outbreak. An approach combining continuous UV marker auditing to identify areas for cleaning improvement and consistent feedback to staff on the audit results, combined with tailored training to address any noted cleaning deficiencies, together can increase CDP compliance.[17] The more timely the feedback is provided to staff, the more quickly auditing results can improve, thereby increasing CDP compliance.[17,29]Annual staff training on infection control measures, standard precautions, cleaning techniques and specialized cleaning protocols may also improve CDP adherence.[30]

Limitations

These results need to be interpreted with caution. First, the sample size was limited. For instance, patient-room sink cleaning was only available on a sample of 6 audits because of the lack of rooms with a patient sink. Likewise, the sample for discharge cleaning was only 15 rooms. Second, there were variations in the underlying processes being observed. While all staff had some kind of knowledge about the audits, some staff were unaware if they had been audited, while others knew they had been audited. Moreover, there were variations in the application of the electronic auditing tool, such as the time interval elapsed between marker placement and audit. There were also variations in room configurations, some having multiple beds, multiple rails per bed, additional sinks or hand sanitizers, which were added to the total count of surfaces measured. Third, the surface marker in this study had to only be disturbed to be measured as a "marker not visible" instead of being completely removed as suggested in some guidelines.[18]

CONCLUSIONS

This study suggests that CDP in teaching hospitals may not be up to the standards required to contain pandemics such as COVID-19. It

also suggests that UV markers can play a key role in a systematic auditing program to measure effective cleaning of patient rooms. This auditing technique coupled with rapid feedback and training to cleaners can lead to increased awareness and improvement in cleaning practices and outcomes. This approach can best be achieved as part of a continuous improvement effort rather than as a reaction to emergencies and outbreaks.

SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.ajic.2020.06.187.

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