Improved Cleaning of Patient Rooms Using a New Targeting Method

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We developed a new method using an invisible fluorescent marker to target standardized high-touch surfaces in hospital rooms. Evaluation of 1404 surface objects in 157 rooms in 3 hospitals revealed that 47% of targets had been cleaned. Educational interventions were implemented, leading to sustained improvement in cleaning of all objects and a >2-fold improvement in cleaning of surfaces previously cleaned <85% of the time ($P \leq .001$).

Reducing the spread of health care–associated pathogens to patients constitutes one of the most challenging aspects of health care epidemiology [1, 2]. Despite improvements in hand hygiene through the development of alcohol-based hand cleansers and ongoing efforts to optimize isolation practices, the prevalence of infection with increasingly resistant nosocomial pathogens continues to increase [3]. Specific guidelines were developed independently in 2002 by the Centers for Disease Control and Prevention (CDC) [4], the Society for Healthcare Epidemiology of America [5], and the National Health Service in Great Britain [6], which specifically recommend that surfaces, particularly surfaces designated "high touch objects" (HTOs) by the CDC [4, p. 25]. Although each of these standards recommends that health care facilities ensure the adequacy of cleaning and disinfection activities, there is no standard method to assess the effectiveness of such activities. To address this issue, we developed a novel, simple method to objectively evaluate the thoroughness of terminal cleaning activities in patient rooms.

Methods. We studied 3 hospitals, 2 of which were multiservice community hospitals. Hospital A had 172 medical/surgical beds and 15 intensive care unit beds, and hospital B had 154 medical/surgical beds and 14 intensive care unit beds. The administrative, clinical, and housekeeping staffs of the 2 hospitals were completely independent. The third hospital was an acute care, short-term rehabilitation hospital. During the study, staff levels of environmental services remained stable at all hospitals, as did the time allocated for patient-room cleaning activities.

A viscous, translucent targeting solution was formulated using a stable, nontoxic base, to which was added a chemical marker that fluoresces under black light. The material is inconspicuous, dries rapidly on surfaces, and remains stable for several weeks. Approximately 0.2 mL of solution was applied to 12 standardized sites in each room to create well-circumscribed targets with diameters of ~1.5 cm (figure 1). These sites were chosen on the basis of the CDC's recommendations that "enhanced cleaning activities" should be directed at HTOs frequently contaminated with hospital-associated pathogens [4]. Targeting material was placed on areas easily accessible to cleaning. Although the dried marking solution resists abrasion, once moistened with spray disinfectant, it was completely removed by wiping with a damp cloth for 5 s using light finger-tip pressure. Applications were made after a room had been terminally cleaned, following hospital discharge of its occupant. After at least 2 new patients had occupied the room and the room had been terminally cleaned, a hand-held black light was used to determine whether the marked HTOs in the room had been cleaned. Whereas almost all targets that had been cleaned contained no residual marker, we accepted as being clean the few targets that showed substantial removal of the marker.

When analysis of the thoroughness of terminal cleaning of 157 rooms in the 3 hospitals disclosed suboptimal cleaning of many HTOs, a structured, multidisciplinary educational intervention was developed for the environmental services staff of each hospital. The role of the staff in infection prevention and safety improvement within the hospital was explained, and expectations with respect to cleaning HTOs were defined. Statistical data analysis was performed using a 2-tailed Fisher's exact test, and data were calculated using GraphPad software for Windows (GraphPad Software).

Results. Over study periods lasting several months, 60, 54, and 43 rooms were evaluated at the 3 hospitals. Overall, 47% of the 1404 HTOs evaluated were found to have been cleaned after 2–3 terminal cleanings. Similar rates of cleaning (45%, 42%, and 56%) were found in each of the hospitals. Whereas high rates of cleaning (85.3%–92%) were found for sinks, toilet tops, and tray tables, other HTOs, including bedpan cleaning equipment,

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Figure 1. The manner in which a target is made visible on a bedside telephone, using a portable black light

toilet area handholds, and patient-room and bathroom doorknobs (or door pulls) were cleaned in only 12.3%–17% of rooms, as noted in figure 2*A*. The difference in incidence of cleaning between objects in the first category (well cleaned objects, ⩾85%) and objects in the second category (poorly cleaned objects, ⩽20%) was highly significant ($P \leqslant .001$). The frequency of cleaning of the remaining objects fell between the frequencies of the above 2 categories. Although more thoroughly cleaned than the group of poorly cleaned objects, the remaining objects were still significantly less frequently cleaned than the objects cleaned >85% of the time (mean frequency, 54% for remaining objects vs. 91% for well cleaned objects; $P \leqslant .001$).

After the educational interventions with the environmental services staff, 98 rooms and 744 targets were evaluated in a manner identical to that used prior to the interventions. Cleaning of objects improved from a mean of 64% to 92% in hospital A ($P \leqslant .001$), from 53% to 82% in hospital B ($P \leqslant .001$), and from 44% to 76% in hospital C ($P \leqslant .001$). As noted in figure 1*B*, the most striking improvements occurred in the cleaning of previously poorly cleaned objects. Whereas improvement was noted in the cleaning of all evaluated HTOs, cleaning of previously poorly cleaned objects (frequency, <20%) remained relatively low, compared with the improvement observed for other objects. Over the next 14 months, during which up to 2 educational sessions were held at each hospital, postintervention rates of cleaning remained stable.

Discussion. When a covert evaluation of the effectiveness of terminal-room cleaning and disinfecting activities disclosed suboptimal cleaning of many HTOs, educational interventions were implemented that resulted in a consistent and statistically significant improvement in these activities, as noted in figure 1. The improvements were sustained thereafter, with only occasional focused educational activities. Although modest improvements were noted in the thoroughness of cleaning of relatively well-cleaned objects, such as call boxes, telephones, and siderails (132% average improvement), the greatest improvement was observed for HTOs that had been cleaned <20% of the time, such as toilet handholds, bedpan cleaners, and door handles, which showed more than a 3-fold improvement (370% average improvement). Given the potential for contamination with highly resistant environmental pathogens, such as *Clostridium difficile,* vancomycin-resistant enterococcus, and methicillin-resistant *Staphylococcus aureus,* the improvement in the cleaning of the latter group of HTOs was particularly notable. These improvements were related exclusively to redirecting the cleaning activities of the environmental services personnel through educational intervention, because staffing levels remained stable at all 3 hospitals during the study. The simplicity of the targeting method allowed us to undertake this initiative with minimal use of infection-control personnel resources. Because targeting objects and their subsequent evaluation following cleaning took <2 min per room for each activity, a relatively large number of targets and/or rooms were able to be evaluated before and after intervention activities.

It is widely accepted that surface cleaning and disinfection of the near-patient environment represents an important com-

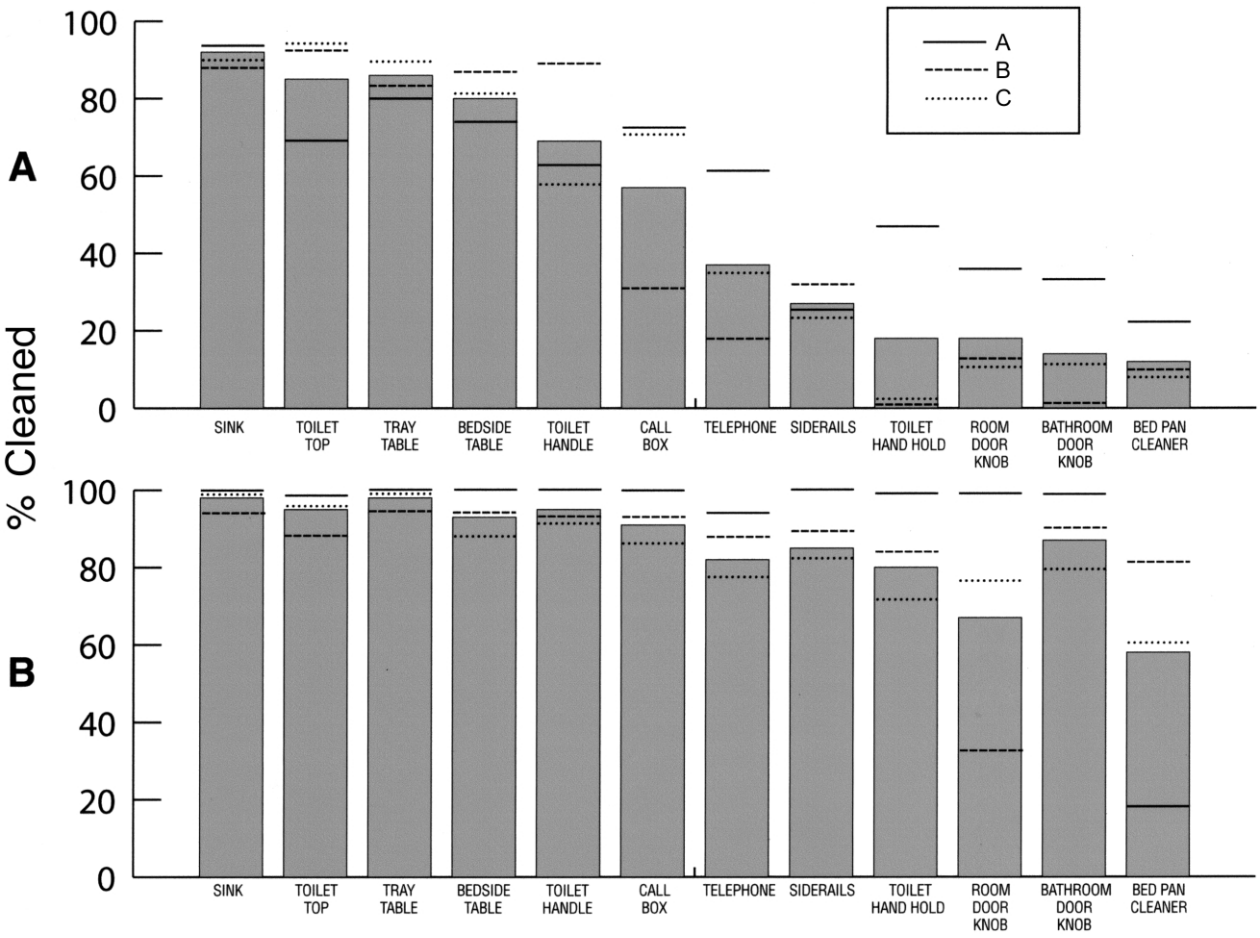

Figure 2. The percentage of high-touch objects cleaned prior to *(A)* and after *(B)* educational interventions in 3 hospitals (A, B, and C)

ponent of institutional health care [4–7]. Although >$900 million per year are spent by US hospitals on environmental cleaning solutions alone [8], the programmatic evaluation of these activities has not been previously analyzed over an extended period of time. Using an ATP-bioluminescence tool on several occasions in 4 hospitals to detect the presence of organic matter on surfaces, Malek [9] found evidence of suboptimal cleaning of patient rooms. The fact that only 10% of visibly clean objects in this study also met bacteriologic food-handling standards suggests that it may not be feasible to use such a tool to evaluate routine cleaning and disinfecting activities in hospitals. Although several studies have utilized environmental cultures to evaluate the effectiveness of cleaning and disinfecting activities in a limited number of patient rooms [10–13], the cost and logistical complexity of such investigations has precluded their use in ongoing routine monitoring [14]. Although a product known as GloGerm (DMA International) has been used since 1968 to teach hand washing techniques, it is formulated as a powder and its use in evaluating the programmatic thoroughness of cleaning practices has not been reported.

The major limitation of this report relates to the fact that only 3 hospitals participated in the project, thereby limiting generalization of our findings. Although it would have been useful to have undertaken an evaluation of the impact of the enhancement of cleaning and disinfecting activities on actual environmental contamination with health care–associated pathogens, limited resources precluded the incorporation of such an analysis into the current study.

Given the widespread concerns regarding the ability of current interventions, including hand hygiene and antibiotic management programs intended to decrease transmission of resistant pathogens in hospitals [1, 2, 15], and in light of the fact that several studies have clearly shown that enhanced cleaning and disinfecting activity significantly decreases environmental contamination with a range of health care–associated pathogens [10, 16–17] and has led to decreased nosocomial infections [18–20] or the transmission of health care associated–pathogens [21, 22], it is important to optimize environmental cleaning and disinfecting activities in hospitals. We believe that the use of the indirect targeting method described in this article has

the potential to quantitatively assess cleaning and disinfecting practices. By combining this assessment with educational interventions that incorporate direct-objective feedback for the environmental services staff, cleaning and disinfecting practices can be improved, and the gains can be sustained.

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