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Brief report

Direct feedback with the ATP luminometer as a process improvement tool for terminal cleaning of patient rooms

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We assessed the adenosine triphosphate luminometer as a tool for point-of-cleaning education. Following a terminal cleaning, infection preventionists met with cleaning staff and used the luminometer to evaluate multiple surfaces; 820 surfaces in 210 rooms were sampled. The mean proportion of clean surfaces improved significantly over the study period, $P = .012$. These findings suggest that direct measurement and education at the point of cleaning with an objective tool is useful for improving terminal cleaning.

Developing a positive education and feedback system between environmental management services (EMS) and infection preventionists (IPs) to improve environmental cleaning is a major challenge affecting health care delivery.[1,2] Visual inspection on rounds, the traditional method of auditing cleaning, is typically received by EMS staff as punitive and is without objective measurement.[3]

Cleaning assessment technologies, such as the adenosine triphosphate (ATP) luminometer, are easy to use, can be implemented at the point of cleaning to provide immediate objective feedback, and foster communication and education on a one-on-one basis directly with EMS cleaning staff.[4] As part of a quality improvement initiative, we designed and implemented a direct educational feedback system using the ATP luminometer to determine whether terminal environmental cleaning could be improved.

METHODS

Boston Veterans Affairs Health Care System is a 200-bed inpatient facility with 64 EMS staff, 5 IPs, and an average of 40 terminal cleanings per day. Patient rooms that were labeled as being terminally cleaned by EMS staff were assessed for cleanliness using a single 3M Clean-Trace NG Luminometer (3M Corp, Minneapolis, MN). The assessments were unannounced and conducted based on staff availability. The EMS staff member responsible for room cleaning met with the IP at the bedside and observed the testing of multiple surfaces, including both high-touch (bedside rails, tops of over-bed tables, toilet seats) and low-touch surfaces (bottoms of over-bed tables). ATP readings were expressed as relative light units (RLUs), and, based on previously published work, a cutoff of 300 RLU was chosen to determine cleanliness of the surface; surfaces with less than 300 RLU postcleaning were considered appropriately cleaned.[4] Education regarding proper cleaning technique was provided in concert with direct observation of luminometer results. Immediate recleaning of dirty surfaces was then completed, with repeat RLU measurements after repeated cleaning. Repeat measurements after enhanced cleaning were performed as a teaching and quality improvement tool but are not included in data analyses.

The mean percentage of dirty surfaces after terminal cleaning were calculated and compared over time using analysis of variance. The toilet seat was sampled less than half the number of times as the other surfaces included in the study; thus, these data were excluded from the regression analyses.

RESULTS

During the project period, a total of 820 surfaces in 210 rooms was sampled, with an average of 4 samples taken per room and 5

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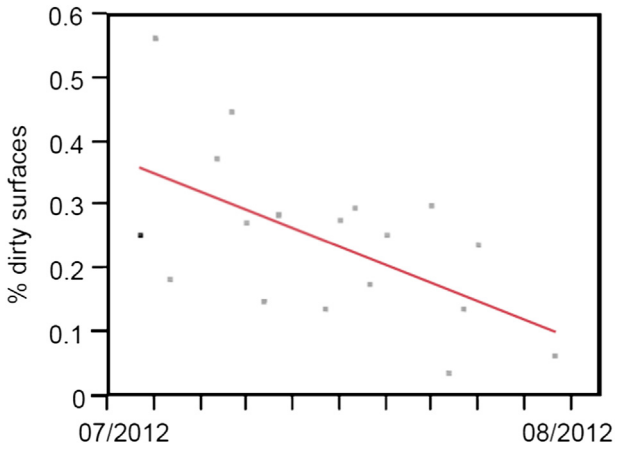

Fig 1. One-way analysis of variance of mean percent of surfaces found to be dirty after terminal cleaning using the ATP luminometer, $P < .02$.

to 12 rooms per day being assessed on 18 separate days over a 2-month-long period. The process of sampling followed by immediate education and feedback required approximately 15 to 20 minutes per room of IP time. A total of 25 different EMS staff members participated in the project, the majority of whom participated on multiple occasions.

The mean proportion of clean surfaces improved significantly during the course of the project, $P = .012$ (Fig 1). The underside of the over-bed table was the surface for which cleaning was enhanced the most over the study period, but improvements were universally seen for all surfaces over the study period (Table 1). The toilet seat had a high rate of cleanliness, with 82.6% (38/46) clean readings during the first month and 88.2% (30/34) during the second month of the study.

DISCUSSION

Terminal cleaning is a critical step in preventing the transmission of health care-associated pathogens.[5] However, improving environmental cleaning is challenging. In particular, practice improvement in this arena requires novel approaches for providing feedback in a nonjudgmental and effective manner. Our program of practical evaluation and immediate feedback utilizes principles clearly demonstrated to improve adult learning.[6] Other studies have employed similar methods of EMS staff education, all with positive improvement.[6-8]

Previous studies of the ATP luminometer tool have shown that it can be used to assess cleaning and for program improvement.[4] Although the luminometer does not directly identify pathogens and/or resistant organisms, it is proven in clinical trials to accurately assess environmental cleaning and compares favorably with other assessment methods, such as fluorescent marking and aerobic colony counts.[9] Boyce et al demonstrated that ATP luminometer readings correlated with colony counts.[4] Readings improved after an educational program was instituted, and cleaning staff were notified that cleaning was going to be assessed. We took this concept 1 step further by including the cleaning staff directly in the ATP measuring process so they could see firsthand the results of their work. EMS cleaning is enhanced when the staff are recognized for their important contributions, and, most importantly, collaborative and positive feedback is facilitated.[2] The effect is a significant reduction in mean dirty surfaces over time.

Improvement in cleaning is not in itself the end goal but is aimed toward reducing transmission of health care-acquired pathogens. In an intensive care unit study, environmental contamination with both methicillin-resistant *Staphylococcus aureus* and vancomycin-resistant *enterococci* were significantly reduced with enhanced environmental cleaning.[10] We did not formally study the association between our enhanced cleaning program and infection rates but did have a corresponding marked reduction in methicillin-resistant *Staphylococcus aureus* transmissions facility wide during the second part of the study (unpublished data). Although we are not able to specifically correlate this reduction to our cleaning improvement project, the reduction in infection rates provided additional encouragement to EMS staff as a tangible quality measure attributable to their work.

Table 1
Average proportion of clean surfaces by study month

	Side rail (right), n/N (%)	Side rail (left), n/N (%)	Over-bed table (top), n/N (%)	Over-bed table (bottom), n/N (%)	Toilet seat, n/N (%)
Period 1	94/114 (82)	81/115 (70)	79/93 (85)	56/94 (60)	38/46 (83)
Period 2	80/95 (84)	75/95 (79)	61/67 (91)	53/67 (79)	30/34 (88)
Delta	+2%	+9%	+6%	+19%	+5%

Our study is limited by being performed at a single institution over a relatively short time period. As our project was primarily geared toward process improvement, we did not have a systematic ascertainment of individual knowledge improvement. In addition, we do not have a comparator group and therefore are unable to determine the role of the immediate feedback independent of other potential improvement processes. We also do not have data on sustainability of the cleaning improvement, although interservice cooperation and respect has remained high.

CONCLUSION

We successfully implemented a quality improvement and education project to improve environmental cleaning in our hospital. Our study demonstrates that quality-assessment tools, such as the ATP luminometer, can be used at the point of cleaning to improve cleaning performance. Use of the tool in a positive feedback loop directly with front-line EMS staff resulted in enhanced collaboration, communication, and education among services.

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