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Brief Communication

Assessment of hospital daily cleaning practices using ATP bioluminescence in a developing country



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ABSTRACT

Visual assessment of surfaces may not be enough to document the level of cleanliness in the hospital setting. It is necessary to introduce quantitative methods to document the results of this practice.

Objective: To evaluate the efficacy of hospital terminal cleaning procedures, using an adenosine triphosphate (ATP) bioluminescence method in a teaching hospital.

Method: During 2008 we conducted an evaluation using ATP bioluminescence LIGHTNING MVP™ (Arquimed) of external and internal housekeeping service. After conducting an initial evaluation we implemented education of cleaning practices and finally we did a post intervention evaluation. Using chi-square method we compared prior versus after cleaning, quality of cleaning performed by external versus internal personnel, single versus double terminal cleaning procedures and prior versus after intervention. A finding of three RLU or less was considered a clean surface.

Results: We performed 198 evaluations in 33 patient units and nine OR. Internal personnel accomplished 25.37% of clean surfaces before and 80% after the education intervention ($p=0.01$). In contrast, external personnel obtained 68.8% before and 73.33% after intervention ($p=0.3$).

Conclusions: This study suggests that visual assessment is not enough to ensure quality of the process and it is necessary to document the level of cleanliness by quantitative methods.

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High quality cleaning in a hospital environment is part of important measures to prevent the spread of healthcare-associated pathogens. Touching contaminated environmental surfaces may result in the acquisition of pathogens on hands.¹ The guidelines for Hand Hygiene in Health-Care Settings has therefore recommended healthcare workers routinely disinfecting their hands after contact with objects in the immediate environment of all patients.¹ Many studies have proved that cleaning practices are often suboptimal and the environment may remain contaminated after cleaning.^{2,3} Visual assessment of surfaces has proved to be unreliable to control cleaning. Therefore it is necessary to introduce quantitative methods to document the results of this practice. Measuring residual adenosine triphosphate (ATP), present in the cells of all live organisms, makes it an ideal biomarker of microbial contaminants and could be used as tool to evaluate the cleaning procedures inside the hospitals.

The aim of this study was to assess the quality of hospital terminal cleaning procedures using ATP bioluminescence in different situations in order to improve our cleaning protocols.

Methods

Our institution is a 500-bed teaching hospital. Cleaning procedures were performed by two different housekeeping services, an external private cleaning company and internal hospital staff. Both groups followed the same hospital policies and were supervised by the same group of registered nurses and general services managers. Patient units were cleaned with quaternary ammonium, except when patients had a *Clostridium difficile* associated diarrhea. In this case, chlorine 5000 ppm concentration was used to clean the units.

To evaluate the quality of the cleaning process ATP bioluminescence LIGHTNING MVP™ (Arquimed) was used. Sampling and processing was done following the manufacturer's recommendations. The surface was considered clean when the result of measurement was below the cut-off of three relative lights units (RLU).⁴

In the first phase of the study, housekeepers were not notified that monitoring of cleaning was being conducted. Then, in the second phase of the study, we implemented an intervention based mainly in education and the housekeeping staff was informed that they were going to be monitored.

Using chi-square method we compared RLU results before and after cleaning; single and double terminal cleaning procedures; internal versus external staff, and finally we compared the results before and after the intervention was implemented.

Results

We performed 198 evaluations in 33 patient units and nine operating rooms before and after terminal cleaning during 2008. Before intervention only 61/137 (44.53%) surfaces were considered clean according to the bioluminescence method. Once intervention was completed 15/20 (75%) surfaces were clean ($p=0.01$). Before intervention, cleaning was satisfactory in 17/67 (25.37%) done by internal personnel and in 48/70 (68.8%) surfaces performed by external personnel ($p<0.001$).

After intervention internal personnel accomplished cleaning satisfactory in 4/5 (80%) surfaces ($p=0.01$), while external personnel achieved 11/15 (73.33%) clean surfaces with no statistical difference ($p=0.44$). Single terminal cleaning showed $RLU<3$ in 31/53 (58.49%) of surfaces in contrast with 13/17 (76.47%) with double terminal cleaning. However, results were not significantly different ($p=0.18$).

Discussion

Contaminated environmental surfaces play an important role in transmission of healthcare-associated pathogens.^{1,3} Exposure to a contaminated environment has shown to be a risk factor for the acquisition of vancomycin-resistant *Enterococcus* (VRE), methicillin-resistant *Staphylococcus aureus* (MRSA) and *Acinetobacter baumannii*.⁵

It has been proved that enforcing routine environmental cleaning measures is associated with decreased VRE contamination on surfaces and healthcare workers hands, and also with a significant reduction in VRE cross-transmission.² In the case of MRSA it has been observed that it is frequently identified on hands of investigators after contact with contaminated objects from the patient's environment and care equipment. High environmental cleaning standards play an important role in controlling outbreaks of *A. baumannii* in intensive care units, and environmental decontamination has been associated with reductions of *C. difficile* infection.⁵

In this study we aimed to support that it is necessary to introduce quantifiable methods to ensure the quality cleanliness levels. A useful method is environmental culture that allows identifying the organism and its susceptibility, but it is time-consuming and depends on the organism's viability, adequate transportation, and the costs are high. These limitations do not allow environmental cultures to be used in daily work.

ATP bioluminescence LIGHTNING MVPTM assesses cleaning effectiveness in real time indicating trouble spots, making possible to improve the process. But, this technique has some limitations such as impossibility to identify the organism and no direct relation between RLU and bacterial load. Results depend on time between sanitation and bioluminescence measurement (ATP disappears within 2 h of living matter death) and high cost of implementation for some institutions.⁴

Using this method we demonstrated that the efficacy of cleaning was not as expected. Only 25.37% of surfaces cleaned by internal personnel and 68.8% of surfaces cleaned by external personnel were considered clean by this method. This correlates with Boyce et al.⁴ who also used ATP bioluminescence and found that after cleaning 24% of the surface samples were still contaminated with MRSA and 16% of the surface samples still yielded VRE.

Our results support that an intervention including education and monitoring improves the quality of cleaning. The internal personnel improved from 25.37% to 80% ($p=0.01$), while external personnel improved from 68.8% to 73.33% without significant difference for both periods ($p=0.44$). We also did not find a significant difference between single and double terminal cleaning.

Since this was an evaluation of a routine practice rather than a randomized trial, healthcare workers could make improvements just because they knew they would be monitored. In addition, samples were too small and with size differences before and after intervention. Finally, only one hospital was included, so our findings may not be applicable to all institutions.

In conclusion, visual assessment is not enough to ensure the quality of the cleaning process and it is necessary to document the level of cleanliness by quantitative methods. This study used ATP bioluminescence to demonstrate the adequacy of cleaning practices, and the impact of educational intervention. We recommend the use of ATP bioluminescence to control the cleaning of hospital environment associated with feedback and education in order to improve cleaning in the hospital settings.

Conflicts of interest

The authors declare no conflicts of interest.

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