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EVALUATION OF TERMINAL CLEANING USING ATP METHODOLOGY: COMPARISON OF BLEACH AND QUATERNARY AMMONIUM COMPOUND PLUS BIGUANIDE

Paola Cristini Gama Silva[1,2,3], Caroline Deutschendorf[3], Thiago Costa Lisboa[3,4,5,6], Cristófer Farias da Silva[1,3,4]

Abstract

Distinct protocols can be used to clean the hospital environment. This study used the ATP tool to evaluate cleaning protocols composed of either a quaternary ammonium compound plus biguanide (QACB) or bleach only. No statistical difference was found ($p = 0.450$) between QACB and bleach protocols, both being effective in hospital ward cleaning. So, it is possible to conclude that the use of QACB or bleach protocols ensures appropriate cleaning in health care, promoting a safe environment for patient use.

Keywords: *ATP; Environmental cleaning; Environmental cleanliness assessment; Hospital environment; Room decontamination*

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1 Programa de Residência em Controle de Infecção Hospitalar, Residência Integrada Multiprofissional em Saúde, Hospital de Clínicas de Porto Alegre. Porto Alegre, RS, Brasil.

2 Serviço de Farmácia, Hospital de Clínicas de Porto Alegre. Porto Alegre, RS, Brasil.

3 Comissão de Controle de Infecção Hospitalar, Hospital de Clínicas de Porto Alegre. Porto Alegre, RS, Brasil.

4 Programa de Pós-Graduação em Ciências Pneumológicas, Universidade Federal do Rio Grande do Sul. Porto Alegre, RS, Brasil.

5 Departamento de Medicina Intensiva, Hospital de Clínicas de Porto Alegre. Porto Alegre, RS, Brasil.

6 Instituto de Pesquisa HCOR. São Paulo, SP, Brasil.

Corresponding author:
Cristófer Farias da Silva
far.cristofer@gmail.com
Hospital de Clínicas de Porto Alegre
Rua Ramiro Barcelos, 2350
90035-903, Porto Alegre, RS, Brasil.

INTRODUCTION

Environment cleaning is a relevant process for infection prevention in health institutions. Cleaning is defined as the removal of visible soil by the mechanical action of water and/or detergents[1,2], which may be followed by a disinfectant product to reduce the risk of environmental contamination.

Currently, many products with different use processes are found in health institutions. Quaternary ammonium compounds (QAC) and sodium hypochlorite (bleach) solutions are frequently used in the hospital cleaning process[3]. QAC has cleaning and disinfection properties, completing the cleaning process in one step, but bleach has only disinfection properties, which brings a necessity of a cleaning step before bleach use. Differences in cleaning protocols, mainly in products and techniques, may affect the quality of environmental cleaning, which must be measured using quality control tools such as adenosine triphosphate (ATP) bioluminescence devices[4]. ATP is the primary energy source for enzymatic reactions in living beings, including the bioluminescence reaction mediated by the luciferase enzyme, which provides light, measured in Relative Light Units (RLU) directly proportional to the amount of ATP used[5].

Since there is a possibility of different results due to different cleaning protocols, the goal of this study was to compare quaternary ammonium compound plus biguanide (QACB) versus bleach protocols for environmental cleaning of hospital wards, using the ATP tool.

METHODS

We designed a retrospective study, comparing two protocols for hospital environment cleaning in a tertiary university hospital in southern Brazil. For the aims of this study, terminal cleaning consists of the complete cleaning of the patient's environment after the patient's discharge. Wards cleaning routine is performed using one of the following established protocols: 1) one-step protocol, which adopts only QACB 0.5%; or 2) two steps protocol using multipurpose detergent, followed by rinsing, drying, and disinfection with hypochlorite solution 0.1% (bleach).

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The protocol's choice is determined by an institutional algorithm based on local epidemiology – hospital beds that patients had *Clostridioides difficile* identified undergo terminal cleaning with the bleach protocol, and the others were cleaned with QACB protocol. Both processes were evaluated by visual inspection and the ATP tool on high-touch surfaces. Terminal cleaning and evaluation are performed by different teams, and ATP measurement is done by random surface sampling, without prior notice to the cleaning staff. For this study, data were collected by convenience sampling from a routine database for terminal cleaning quality control, carried out between January 2019 and December 2021. Data were excluded if they: i) included bathroom cleaning, ii) presented RLU values > 1000, or iii) were incomplete. All surfaces that met the inclusion criteria were included in the statistical analysis. The surfaces were categorized according to the original classification of the institution's cleaning service. The cleaning process was considered approved if RLU values were ≤ 100 and this categorical data was used for cleaning approval rate analysis. To compare the outcomes by RLU between bleach and QACB, the samples were paired according to surface type, hospital unit, and operator. Descriptive and analytical statistics were performed using the PSAW Statistics Version 18® software. We performed the Mann-Whitney U-test for independent samples and Pearson's Chi-Square test for median RLU values comparison, at a two-sided significance level of 0.05. Test power was calculated afterward, using the PSS Health tool, available online[6].

RESULTS

During the period of the study, 331 registers of terminal cleaning met the inclusion criteria and were included in the data analysis (bleach N = 166; QACB N = 165). We found a cleaning process approval rate of 82.5% for bleach and 86.1% for QACB, with no significant difference (p = 0.450) (Table 1), and test power of 11.4% for the sample number obtained. In the RLU median ATP values analysis, the assay was 29.5 for bleach and 25.0 for QACB, ranging from 1-790 and 1- 454, respectively, without statistical difference in the comparison among sanitizers (p = 0.111) (Figure 1). We normalized data by the natural logarithm transformation. We performed a parametric analysis, and there was no significant difference in results, which reinforces data confidence. The biggest median value for RLU (49) was found in bed rails disinfected with bleach, as done per surface analysis. On other hand, the lowest median value of RLU (15) was found in headboards, also disinfected with bleach.

Table 1: The approval rate of hospital ward cleaning using distinct processes.

	Rate of approval (%)		
Surface	Bleach	QACB*	*p*
Total	82.5 (N = 166)	86.1 (N = 165)	0.450
Overbed table	84.4 (N = 45)	86.7 (N = 45)	
Headboard/Footboard	83.9 (N = 31)	83.9 (N = 31)	
Bed rails	77.3 (N = 22)	87.0 (N = 23)	
Bed control	90.0 (N = 20)	90.0 (N = 20)	
Mattress	83.3 (N = 12)	91.7 (N = 12)	
Bedside table	80.0 (N = 10)	88.9 (N = 9)	
Others**	76.9 (N = 26)	80.0 (N = 25)	

*QACB: Quaternary ammonium compound plus biguanide; **Nº of surfaces tested for each disinfectant (bleach/QACB): bed curtain (n = 8/8), cabinet (n = 5/4), armchair (n = 5/5), bedside lamp (n = 3/3), light switch (n = 2/2) alcohol dispenser (n = 2/2), sink (n = 1/1).

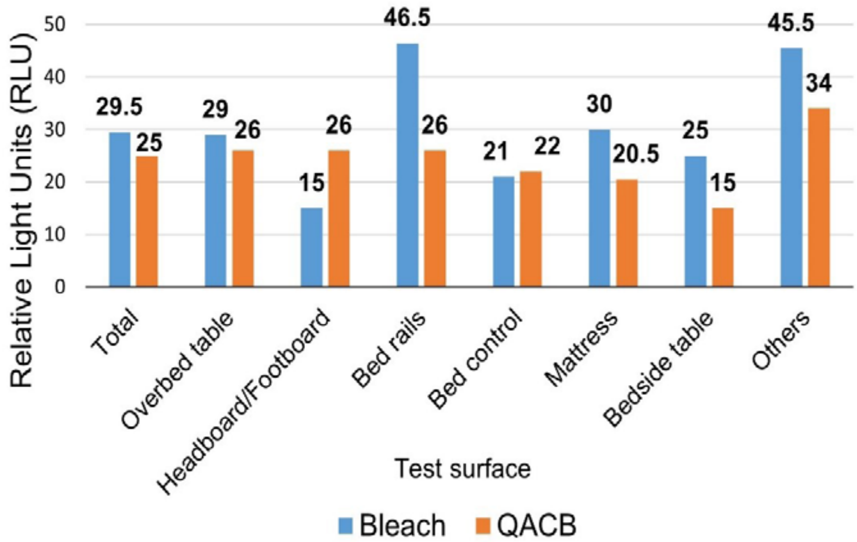

Figure 1: Comparison of relative light units (RLU) medians between bleach and quaternary ammonium compound plus biguanide (QACB) on the surfaces analyzed in the study.

DISCUSSION

In this study, we compared QACB versus bleach protocols for environmental cleaning of hospital wards using the ATP bioluminescence methodology and measured the approval rate of cleaning processes per protocol. No statistical difference was found (p = 0.450) between the bleach and QACB cleaning processes. Furthermore, the approval rate of cleaning processes, i.e., ATP values ≤ 100, were predominantly within the cut-off established for this study and showed similar results in both protocols.

Many factors influence ATP results as distinct cleaning protocols[2], surface's nature and complexity[7], and even ATP tool brand[8], that promote a considerable difficulty in comparing ours and literature published results. Despite these issues, usual cut-off points of 250 or 100 RLU are used in various studies and have good acceptance for defining a clean and safe environment[9,10]. Smith et al.[9] found an approval rate of 52% using 250 LRU as a cut-off. We use a 100 RLU cut-off point for approval of the cleaning process. We adopted a rigorous cut-off and yet we have achieved a satisfactory environmental cleanup approval rate for both protocols. The obtained results must be related to quality processes linked to the institutional environmental cleaning guide: cleaning team training, continued supervision with systematic ATP testing, feedback of results to the cleaning team, and quality control of chemical products[11]. We consider that simple but rigorous and systematic management of basic cleaning principles is the main contributor to achieving good results such as found in our study.

When comparing QACB and bleach protocols results on each surface we did not identify a difference. Bed rails showed the main discordance of results within distinct protocols used, for both statistical analyses used, being a 9.7% approval rate difference and 20.5 RLU median difference. We mainly attribute this discordance to the structural complexity of the surface and material composition of the bed rails, factors that impact directly hospital bed rail cleaning, as shown by Boyle et al.[7] in a previous review. This characteristic potentially interferes with the cleaning process and promotes certain variability in ATP results. Although identified an apparent difference in results for QACB and bleach protocols in bed rails cleaning, the overall cleaning result was not affected, since both protocols showed results within the established cut-off point for this surface.

This study has some limitations. It is a single-centered retrospective and not controlled, which may be subjected to bias, such as register inconsistencies and cleaning process variability. The restricted number of samples was insufficient for statistical analysis per surface type and diminished the power of the analysis. We did not assess the microbiological contamination of surfaces, which could contribute to a better understanding of environmental cleanliness. Despite the limitations, our study showed a glimpse of the actual practice of hospital cleaning in the institution, indicating a satisfactory environmental cleaning and no difference in the use of distinct products, QACB or bleach. So, it is possible to conclude that the use of QACB or bleach protocols promote a clean and safe environment. Considering the differences in the spectrum of action of both products, further studies are necessary to analyze the interchangeability between the cleaning protocols according to the expected microbiological contamination.

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Ethics and other permissions

The study was approved by the Institutional Research Ethics Committee, under registration CAAE 53036721.4.0000.5327.

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