American Journal of Infection Control ■■ (2016) ■■-■■

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Major Article

Surface cleaning effectiveness in a walk-in emergency care unit: Influence of a multifaceted intervention

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Key Words:
Patient safety
Quality management/improvement
Infection prevention
Equipment contamination
High-touch surfaces
Training
Staff work area

Background: Cleaning of surfaces is essential in reducing environmental bioburdens and health care-associated infection in emergency units. However, there are few or no studies investigating cleaning surfaces in these scenarios. Our goal was to determine the influence of a multifaceted intervention on the effectiveness of routine cleaning of surfaces in a walk-in emergency care unit.

Methods: This prospective, before-and-after interventional study was conducted in 4 phases: phase I (situational diagnosis), phase II (implementation of interventions—feedback on results, standardization of cleaning procedures, and training of nursing staff), phase III (determination of the immediate influence of interventions), and phase IV (determination of the late influence of interventions). The surfaces were sampled before and after cleaning by visual inspection, adenosine triphosphate bioluminescence assay, and microbiologic culture.

Results: We sampled 240 surfaces from 4 rooms. When evaluated by visual inspection and adenosine triphosphate bioluminescence, there was a progressive reduction of surfaces found to be inadequate in phases I-IV ($P < .001$), as well as in culture phases I-III. However, phase IV showed higher percentages of failure by culture than phase I ($P = .004$).

Conclusions: The interventions improved the effectiveness of cleaning. However, this effect was not maintained after 2 months.

BACKGROUND

Contaminated surfaces in health care facilities contribute to the transmission of pathogens and improvements in surface cleaning reduce rates of health care-associated infection (HAI).[1,2] Many studies report that environmental disinfection interventions, including education of personnel, creation of cleaning and disinfection protocols, auditing checklists, daily feedback, and standardization of equipment and supplies, enhance the efficiency of cleaning and disinfection practices.[3,4] In an effort to ensure quality in the practices of professionals who perform cleaning and disinfection operations, national and international health organizations have recommended objective monitoring of the efficacy of the cleaning of highly touched clinical devices (HTCD). Auditing tools such as fluorescent markers and, more recently, adenosine triphosphate (ATP) bioluminescence assay, are recommended to complement visual auditing of environmental cleaning and disinfection compliance.[5,6]

In critical care environments such as emergency units (UPA-24h), the need to provide emergency care, combined with the emotional stress involved, often leads to the breaking of strict aseptic standards during the performance of invasive procedures. This places

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This work was financed by the Foundation for Support (UNDECT/DECIT-MS/CNPq/SES N. 04/2013 PPSUS-MS) and Development of Education, Science, and Technology of the State of Mato Grosso do Sul (23/200.535/2013). OPF received a doctoral scholarship from the Coordination for the Improvement of Higher Education Personnel.

Conflicts of interest: None to report.

0196-6553/
http://dx.doi.org/10.1016/j.ajic.2016.05.033

patients at risk of HAIs and underscores the importance of high-quality HTCDs cleaning, and disinfection in these environments. However, studies that investigate surface cleaning and disinfection in such situations are rare or nonexistent. In light of this, the objective of this study was to determine the influence of a multifaceted intervention on surface cleaning routines in a UPA-24h.

MATERIALS AND METHODS

Study design, period, and setting

This prospective study was conducted March-November 2015 in a walk-in UPA-24h in Mato Grosso do Sul, Brazil. This UPA-24h had only been open for 14 months and was in good physical condition. It is a walk-in emergency care unit, of intermediate complexity, that is connected to other primary health care units, mobile emergency services, and hospitals, among others. It serves an estimated population of 100,000 inhabitants.

Surface selection and data collection procedure

Based on frequency of hand contact by health professionals and closeness to patients, HTCDs were selected for direct observation. Environments were selected where procedures with a high risk of acquiring HAIs are performed. Therefore, the study included the following HTCDs in each room in the study: medication benchtop 1, heart monitor panels (both from the emergency department), medication benchtop 2 (medication room), dressing cart (dressing room), and mattress (observation room). All the HTCDs were made of stainless steel, except mattresses (which were polyvinyl chloride and polyester mesh) and heart monitors (which were polyvinyl chloride and rubber).

The collection was done on random days before and after cleaning through visual inspection, aerobic colony count (ACC) and ATP bioluminescence assay. The surfaces were sampled—only by the author of this study and just once per day—immediately before and 10 minutes after completion of the morning cleaning session. This procedure enabled objects to dry completely to avoid the possibility that contact between sanitizers and reagents could alter the relative light unit (RLU) readings and ACC. It also ensured that the assessments were done as soon as possible after cleaning to avoid recontamination.[1,4]

In the visual inspection, the first method to be applied, HTCDs were considered dirty if there was waste (eg, blood, wound exudates, organic liquids, physiological saline crystals, ointments/creams, oils, and solutes), humidity, and spots.[1] For ATP detection using bioluminescence, a portable luminometer (Clean-Trace ATP System; The 3M Company, St Paul, MN) and swab (The 3M Company) were used. The collection was performed according to the manufacturer's recommendations and the surfaces were deemed inadequate when ≥5 RLU/cm^2 was collected from a 100-cm^2 surface.[1,3,7]

The microbiologic samples—the reference comparators[8]—were collected using replicate organism detection and counting contact plates that contained tryptic soy agar with neutralizers that inhibit different disinfectants to recover the microbial load present in a specific area, which in this study was 24 cm^2. The collections were taken immediately adjacent to the area collected by the ATP bioluminescence swab (both to the left and right). The plates were pressed for 10 seconds against the surfaces at ~25 g/cm^2, without any lateral movement, and incubated at 37°C for 24-48 hours.[3,6,9] In the ACC, an electronic digital colony counter was used (Logen LS6000; Texas Instruments Inc., Dallas, TX). The surfaces were deemed inadequate for results >2.5 CFU/cm^2; that is >60 CFU/plate.[4,7,9]

Search phases

This research was carried out in 4 2-month phases and surface samples were collected twice a week (except in phase II, which was completed during 1 week, with no collection of material). During phase I, without any intervention, a situational diagnosis of routine surface cleaning practices was identified, as well as their effectiveness. Nursing professionals were not notified about the monitoring to minimize the Hawthorne effect.[1] When questioned, the researchers told them they were collecting data to assess the biocide of the disinfectant recently recommended for the cleaning routine in the institution (6 months ago).

The cleaning routine was performed by the nursing team once a day (at the start of the morning shift) or whenever spills occurred, except for the mattresses, which were always disinfected after patients were discharged. The procedure included the use of Incidin Plus at 0.5% (Ecolab Deutschland GmbH, Düsseldorf, Germany). This is a disinfectant consisting of glucoprotamin (12.4%) and alkyl dimethyl benzyl ammonium chloride (15%). It promotes both cleaning (detergent) and disinfection (disinfectant). Sprayers and disposable cloths were made of 70% viscose and 30% polyester. Cleaning varied considerably among professionals: before rubbing, some sprayed the disinfectant on the surfaces or cloths, or both; some vigorously cleaned the mattresses in predefined patterns (circular movements from the center outward to the edges, unidirectional movement from head to foot), whereas others did so randomly.

During phase II, the participants were notified about the research being conducted. There were 4 main types of intervention: feedback on the results from phase I, standardization of cleaning procedures, replacement of disposable cloths with microfiber cloths containing 87% polyester and 13% nylon (The 3M Company), and training sessions with the nursing team. In training the team, theoretical and practical classes were given to all members, addressing biosafety measures, the role of contaminated surfaces in pathogen transmission, and the importance and practical demonstration of cleaning techniques for surfaces close to patients. Each session lasted approximately 40 minutes and was offered at 6 different times throughout the various shifts, to include all professionals. Participation was voluntary and anonymous.

The following practices were standardized: fold the microfiber cloth in 4 equal parts; spray the disinfectant on the microfiber cloth until it is completely moistened, without soaking it to the point that the product drips; and rub the entire surface with moderate pressure for 15 seconds or until all visible dirt is removed,[10,11] with no need to follow a specific direction or clean the surface in sections.[12] If there is abundant organic material, perform the cleaning with 2 cloths: Remove excess dirt with the first and clean with the second.[12] Use a single cloth per HTCD, and replace it if all 4 parts are visibly dirty.[1]

During phase III, initiated immediately after the end of phase II, the same procedures were used to collect the data as in phase I. However, the researcher supervised, guided, and answered questions from professionals regarding cleaning procedures and shared all the results of the analyses (visual and ATP bioluminescence immediately and ACC from previous days). Therefore, this phase allowed assessment of the immediate effect of the interventions.

Phase IV, initiated 4 months after the end of phase II (2 months of phase III and 2 months in standby), sought to evaluate whether, over time, the results of the intervention (phase II) were maintained or worsened, to determine whether the interventions had been incorporated into the practices of the participants. In this phase, the researcher did not supervise or guide the professionals in relation to cleaning procedures, or inform them of the results of the analyses. To minimize the Hawthorne effect, the researcher, when