RESEARCH

Disinfection conditions of inanimate surfaces in intensive therapy units

Condições de desinfecção de superfícies inanimadas em unidades de terapia intensiva

Condiciones de desinfección de superficies inanimadas en unidades de terapia intensiva

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ABSTRACT

Objective: The study's purpose has been to describe the cleaning conditions of inanimate surfaces common to both patients' and healthcare team's touch after terminal cleaning in an intensive care unit. **Methods:** It is a prospective and experimental study that was carried out from November to December 2016. Forty-four spaces close to patient areas were assessed by visual inspection and microbiological method. **Results:** Visually, all surfaces were dry and clean. Gram staining method showed microorganisms in 81.8% of the beds. Microorganisms were found in 40.9% of the surfaces, mainly in beds. No microorganisms were observed in infusion pumps. Gram-negative bacilli were found in 38.8% of the samples. **Conclusion:** It is necessary to promote changes in the health team's behavior, as well as to stimulate the revision of disinfection protocols aiming to reduce Health Care-Related Infections.
Descriptors: Hospital-acquired infection, hospital cleaning service, equipment contamination, nursing.

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RESUMO

Objetivo: Descrever as condições de limpeza de superfícies inanimadas comuns ao toque dos pacientes e da equipe de saúde após limpeza terminal em unidade de terapia intensiva. **Método:** Estudo prospectivo, experimental, desenvolvido entre novembro e dezembro de 2016. Foram avaliadas 44 superfícies próximas ao paciente, por meio da inspeção visual e método microbiológico. **Resultados:** Visualmente, todas as superfícies encontravam-se secas e limpas. Pelo método de coloração de Gram, verificaram-se microrganismos em 81,8% dos leitos. Foram encontrados microrganismos em 40,9% de superfícies, principalmente nas grades de camas. Em bombas infusoras não foram observados microrganismos. Em 38,8% das amostras encontrou-se Bacilos Gram negativos. **Conclusão:** Há necessidade de mudanças no comportamento da equipe de saúde, assim como a revisão dos protocolos de desinfecção como formas de reduzir às Infecções Relacionadas à Assistência à Saúde.

Descritores: Infecção Hospitalar, Serviço Hospitalar de Limpeza, Contaminação de Equipamentos, Enfermagem.

RESUMEN

Objetivo: Describir las condiciones de limpieza de superficies inanimadas comunes al tacto de los pacientes y equipo de salud después de la limpieza terminal en una unidad de terapia intensiva. **Método:** Estudio prospectivo, experimental, desarrollado entre noviembre y diciembre de 2016. Se evaluaron 44 superficies cercanas al paciente, por medio de la inspección visual y método microbiológico. **Resultados:** De forma visual, todas las superficies se encontraban secas y limpias. Por el método de tinción de Gram, se verificaron microorganismos en el 81,8% de los lechos. Se encontraron microorganismos en 40,9% de superficies, principalmente en las rejillas de camas. En bombas infusoras no se observaron microorganismos. En el 38,8% de las muestras se encontró Bacilos Gram negativos. **Conclusión:** Hay necesidad de cambios en el comportamiento del equipo de salud, así como la revisión de los protocolos de desinfección como formas de reducir las Infecciones relacionadas con la Atención de la Salud.

Descriptores: Infección Hospitalaria, Servicio de Limpieza en Hospital, Contaminación de Equipos, Enfermería.

INTRODUCTION

Health Care-Related Infections (HCRI), formerly called Hospital Infections, represent an important public health problem since it involves morbidity, mortality and high costs for the health system.[1]

HCRI is defined as any infection acquired during the provision of healthcare. In the last decades, its indexes have been growing significantly, requiring greater vigilance and measures to prevent its spread as the cleaning of the environment in which care is provided to patients.[2,3]

In the hospital environment, it is worth mentioning the Intensive Care Units (ICU), where the most severe patients are found, most of who are submitted to invasive procedures and can be affected by various types of HCRI. Furthermore, it is emphasized that the immunological response of the ICU patient is usually deficient, making possible infectious processes.[3] Considering that ICU patients are debilitated, they are particularly vulnerable to colonization and infection by bacteria present in the environment of these units. It is estimated that about 30% of patients admitted to these units have at least one infectious episode.[4]

Given the aforementioned context, hospitals in the world are constantly facing a crisis situation, involving the spread of bacteria, particularly those that can cause HCRI in ICU patients.[3] Many inanimate surfaces that surround the patient in this hospital environment accommodate pathogenic microorganisms, keeping close relation to hospital infections, being able to provide foci of contact and transmission of these microorganisms.

These surfaces, often touched by the hands of patients and health professionals, are considered to be a risk for the transmission of microorganisms,[5] so that the portion of responsibility related to hygiene and disinfection standards in the hospital environment cannot be overlooked, as well as the incidence of hospital infections.[6] Thus, the identification and disinfection of these sources can contribute to the prevention and control of an HCRI outbreak.[7,8]

Hence, the aim of the study was to describe the cleaning conditions of inanimate surfaces common to both patients' and healthcare team's touch after terminal cleaning in an ICU.

METHODS

It is a prospective and experimental study that was carried out from November to December 2016, in an adult ICU from a hospital in the border region of Western *Paraná* State.

The sites analyzed were inanimate surfaces common to the touch of patients and professional staff,[9] forming a sample set with four points as follows: bedside table, bed rails, beds and infusion pump; after the terminal cleaning with disinfectants with bactericidal, virucidal, fungicidal, tuberculocidal and sporicidal characteristics, all of them standardized by the hospital institution.

Aiming to collect the culture material, Swabs were used for the collection and transport of samples with STUART sterile medium (tube). The Swabs were individually scrubbed, three times, with rotating movements, in each object defined 10 minutes after the final cleaning. After the collection, for safety, the samples were transported in hermetically sealed packaging to the Laboratory of Microbiology from the *Universidade Estadual do Oeste do Paraná*, Campus at *Foz do Iguaçu* city, where they were transferred to Petri dishes with Agar (20 mL each agar plate) by means of the surface sowing technique and incubated at 36°C for 24 hours for identification. Each Swab colonized a plaque.

In order to visualize the bacterial morphology, Gram staining was performed, being macroscopically and microscopically analyzed.

Sample collection followed aseptic technique, with surfaces visibly clean. The study was conducted without communicating the cleaning workers or nursing staff in order to minimize changes in their cleaning and sanitation behaviors.

RESULTS

During the study period, 11 beds were assessed by considering the following components: bedside tables, bed rails, beds, infusion pumps, then totaling 44 surfaces.

All surfaces were visibly dry and clean at the time of material collection, which occurred 10 minutes after the final cleaning by the cleaning staff and nursing staff (**Table 1**).

Concerning the evaluation of the final cleaning of the surfaces using the microbiological method of Gram staining, it was found that of the 11 sample sets, in 09 (81.8%), microorganisms were found. It was found that of the 44 surfaces, 18 (40.9%) had microorganisms after disinfection (**Table 1**).

Table 1 - Visual and microbiological evaluation of the sampled surfaces from the Intensive Care Unit. *Foz do Iguaçu* city, *Paraná* State, Brazil, 2016.

Sample		Bed	Analyzed	Surfaces	Infusion pump
			Bed rails	**Bedside table**	
01	Visual inspection	Clean	Clean	Clean	Clean
	Bacterial genus	---	*Staphylococcus*	*Staphylococcus* spp.	---
02	Visual inspection	Clean	Clean	Clean	Clean
	Bacterial genus	Gram-negative bacillus - *Klebsiella**	Gram-negative bacillus -*Klebsiella**	---	---
03	Visual inspection	Clean	Clean	Clean	Clean
	Bacterial genus	---	Gram-positive bacillus	*Staphylococcus* spp.	---
04	Visual inspection	Clean	Clean	Clean	Clean
	Bacterial genus	Gram-negative bacillus -*Pseudomonas**	Gram-negative bacillus - *Pseudomonas**	---	---
05	Visual inspection	Clean	Clean	Clean	Clean
	Bacterial genus	---	Gram-negative bacillus -*Pseudomonas**	---	---
06	Visual inspection	Clean	Clean	Clean	Clean
	Bacterial genus	*Staphylococcus* spp.	*Staphylococcus* spp.		
07	Visual inspection	Clean	Clean	Clean	Clean
	Bacterial genus	---	---	---	---
08	Visual inspection	Clean	Clean	Clean	Clean
	Bacterial genus	---	---	---	---
09	Visual inspection	Clean	Clean	Clean	Clean
	Bacterial genus	*Streptococcus* spp.	*Staphylococcus* spp.	---	---
10	Visual inspection	Clean	Clean	Clean	Clean
	Bacterial genus	Gram-negative bacilli	*Streptococcus* spp.	---	---
11	Visual inspection	Clean	Clean	Clean	Clean
	Bacterial genus	*Streptococcus* spp.	*Streptococcus* spp.	---	---

Source: Researchers.
Note: *strong indication of *Pseudomonas* spp. and *Klebsiella* spp.

The surfaces with the highest incidence of contamination by microorganisms were bed rails 09 (81.8%), bed 05 (45.5%) and bedside table 04 (36.3%). The infusion pumps were at the assessed surfaces where no microorganisms were found (**Table 2**).

Table 2 - Frequency of contaminated inanimate surfaces in the Intensive Care Unit. *Foz do Iguaçu* city, *Paraná* State, Brazil, 2016.

Surface	Quantity	Frequency
Bed rails	09	81.8%
Bed	05	45.4%
Bedside table	04	36.3%
Infusion pump	0	0.00%

Source: Researchers.

The Gram-negative bacilli were found on 07 (38.8%) surfaces, being the genus most found; followed by the genus *Staphylococcus* spp. found on 06 (33.3%) surfaces, the genus *Streptococcus* spp. in 4 (22.2%) surfaces and in 1 (5.5%) surface the genus of Gram-positive bacillus (**Table 3**).

Table 3 - Major frequencies of microorganisms found in the analyzed surfaces from the Intensive Care Unit. *Foz do Iguaçu* city, *Paraná* State, Brazil, 2016.

Microorganism	Quantity	Frequency
Gram-negative bacillus	07	38.8%
Staphylococcus spp.	06	33.3%
Streptococcus spp.	04	22.2%
Gram-positive bacillus	01	5.5%

Source: Researchers.

DISCUSSION

Hospital cleaning and disinfection consist of the removal of dirt or contaminants found on surfaces, constituting the most effective measures for the prevention and control of microorganisms present on the surfaces of benches, appliances, beds and various other materials.[5] These procedures should be (mechanical) (friction), physical (temperature) or chemical (disinfection) for a certain period of time. Therefore, it is important to establish a routine daily cleaning or whenever necessary, taking into account the hospital area, the visible presence of dirt, discharge, transfer or death of a patient.[5,10]

Cleaning in the hospital environment has the main objective of reducing organic matter and microbial load on surfaces and equipment. In the adult ICU of the institution studied, it was observed that in terminal cleaning, after discharge, transference or death of the patient, the entire unit was cleaned and decontaminated with bactericidal, virucidal, tuberculocidal and fungicidal products. Nevertheless, the results of the microbiological tests indicate the presence of bacteria in 81.8% of the samples collected in the beds (bedside table, bed railings, beds and infusion pump).

The presence of microorganisms in a hospital environment is widely studied and it is emphasized that equipment and surfaces close to the patient, constantly touched by professionals who provide assistance to the patient can become easily contaminated, constituting a reservoir of multiresistant pathogens.[8]

Considering the visual inspection after terminal cleaning, it was observed that the surfaces were dry and clean, without the presence of blood, secretions, rust or stains. Using only the visual inspection, the cleaning of the surfaces would have been considered acceptable, however, with the application of the analysis method adopted in the study, only 18.2% were considered clean after the terminal disinfection. This result indicates that only the visual inspection is not enough to define the surface as clean. Some researchers have shown that the only norm for assessing ICU cleaning is, most of the time, visual inspection, then making the cleaning process inefficient.[11]

What is striking in the results and what is considered worrying is the presence of microorganisms after the final cleaning process with soap and water and biocide products, since, analyzing the presence of microorganisms on surfaces alone and not in the sample set, it was found that 40.9% of them had microorganisms after disinfection. Biocides are disinfectant and antiseptic products consisting of chemical substances such as aldehydes, phenols, alcohol, biguanides, peroxides, halogenated compounds, heavy metals and quaternary ammonia. With this composition, biocides become more effective in their action than antibiotics, acting on multiple targets of the protein coat, cell wall, cytoplasmic membrane and/or cytoplasm.[12,13]

If such biocide products are not used correctly, both in their shelf-life, storage and, above all, the correct concentration and there is no cleaning protocol in health institutions, their action will be inefficient and there will be no disinfection. This fact may be an indication of the reason for the results found in the evaluation of the decontamination of the surfaces of this study.

It is possible to observe that the microorganisms found in the results are basically the same on the different surfaces of a sample set. This type of contamination is a transmission of the microorganisms within one or more hospital units called cross-transmission, which occur by air, contaminated surfaces, but mainly by contact between people. The frequency with which cross-infection occurs in a hospital setting ranges from 13.0% to 34.6%.[14] Most responsible for this type of contamination are the cleaners themselves and health professionals,[14] mainly transmitted by hands.[15]

Still, on the cross-contamination, it is necessary to reflect that even the cleaning of the surfaces being effective, the microorganisms dispersed in the air will continue causing subsequent contamination of the surface. Only cleaned surfaces will have a significant reduction in microbial load, so it is of great importance to control ventilation, the entrance of people, materials and the way of cleaning this environment so as not to cause a high dispersion of bacteria, fungi, and viruses.[16]

Among the evaluated surfaces, the ones with the highest frequency of contamination were bed rails. This area was also considered to be the most contaminated compared to other surfaces analyzed in ICUs in other studies.[3,5] In relation to the microorganisms found, Gram-negative bacilli with 38.8%,

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followed by *Staphylococcus* spp. with 33.3% and *Streptococcus* spp. with 22.2%.

The presence of Gram-negative bacilli with strong suspicion for *Pseudomonas* spp. and *Klebsiella* spp. is a fact of great concern, since these bacteria are considered opportunistic pathogens, possessing resistance to many antimicrobial agents, with minimum nutritional and environmental requirements. So, they are composed of skills that guarantee their survival in the hospital environment. *Pseudomonas* spp. mainly Pseudomonas aeruginosa is the species that has become one of the main causes of hospital infection worldwide, frequently isolated from clinical samples, being a common cause of urinary infection, pneumonia, surgical site infection and sepsis.[17]

Another microbial genus present in the results was *Staphylococcus* spp. Among this genus *Staphylococcus aureus* is the most colonizing microorganism in the skin and the human nose, being frequently inoculated during invasive procedures or carried out by the health team, as well as Streptococcus spp.[7]

The ICU is a unit where patients are treated seriously commonly sick people with multidrug-resistant pathogens, in addition, these units are located in a large structure where you can find multiple disease-causing microorganisms, which is the hospital.[18]

Therefore, it is suggested to reflect on the major principle stated as the precursor to the prevention of HCRI, in other words, hand hygiene, as it refers to simple and effective measure, and less costly to prevent cross-transmission of microorganisms in the hospital environment and in the reduction of related infections and patient care provided by the health teams.[16,19]

Given the aforesaid, it emphasizes the need for continuing education of professionals in regard to washing techniques hands, in addition to periodic disinfection of surfaces and equipment.[13,19] Such care can be enhanced through the articulation of the Systematization of Nursing Care with the prevention and control of infection in more complex environments such as the ICU, thus making possible the safety principles of the seriously ill patient.[20]

It is important to emphasize that HCRI can lead to sepsis, which is considered the main cause of death in ICUs in the world, especially in underdeveloped and developing countries, such as Brazil.[21]

As a measure of standard precaution in the control of HCRI, the Center for Disease Control (CDC) states that standard cleaning and disinfecting methods are applied to inanimate present surfaces in the hospital environment, since many microorganisms pathogens can survive for long periods in inanimate surfaces and equipment found near the beds if they are not adequately cleaned and disinfected,[22] which was evidenced here.

FINAL CONSIDERATIONS

Bearing in mind the high rates of microorganisms recognized as pathogens capable of causing infections in several anatomical sites found on the assessed surfaces, it is believed that only the visual evaluation is not enough to judge how really clean is a particular surface, then requiring more sensible methods.

Continuing education with regards to the importance of decontamination of inanimate surfaces in ICUs, as well as the understanding of behavioral aspects of hand hygiene, should be considered as fundamental tools towards the HCRI control.

It is assumed that changes in the behavior and awareness of the multi-professional health team, and also the revision of the cleaning protocols established in this institution, can significantly reduce the rates of microorganisms present on these surfaces.

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