Equipment contamination in an intensive care unit

Contaminação de equipamentos em unidade de terapia intensiva

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Keywords
Equipment contamination; Disinfection; Intensive care units; Nursing research; Nursing service hospital

Descritores
Contaminação de equipamentos; Desinfecção Unidades de terapia intensiva; Pesquisa em enfermagem; Serviço hospitalar de enfermagem

Submitted
October 6, 2014

Accepted
November 3, 2014

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DOI
http://dx.doi.org/10.1590/1982-0194201500027

Abstract

Objective: To assess the contamination of equipment in an intensive care unit before and after the cleaning/disinfection routine.

Methods: The researchers used 26 sterile swabs, moistened in 0.9% saline solution, rolled in their own axis, before and immediately after cleaning/disinfection, on surfaces of collectively handled equipment in an intensive care unit, for laboratory culture.

Results: In pre-disinfection, all computer keyboards presented growth of coagulase-negative *Staphylococcus*; *Staphylococcus hominis* was found on the workbench of drug preparation and in the electrocardiogram machine; and *Staphylococcus haemolyticus* was found on the telephone and on the service schedule chart. The keyboards remained contaminated after being cleaned. The bench also presented *Pseudomonas aeruginosa* after the use of a multi-purpose cleaning product. Pieces of equipment disinfected with 70% alcohol did not present bacterial growth.

Conclusion: The contamination of equipment in the studied intensive care unit was confirmed, as well as the efficacy of 70% alcohol in its disinfection.

Resumo

Objetivo: Analisar a contaminação de equipamentos em uma unidade de terapia intensiva antes e após a rotina de limpeza/desinfecção.

Métodos: Foram utilizados 26 *swabs* estéreis umedecidos com soro fisiológico 0,9%, rolados em seu próprio eixo, antes e imediatamente depois da limpeza/desinfecção, sobre superfícies de equipamentos de manipulação coletiva em uma unidade de terapia intensiva, para realização de cultura laboratorial.

Resultados: Na pré-desinfecção, todos os teclados de computadores apresentaram crescimento de *Staphylococcus* coagulase negativo; na bancada de preparo de medicação e no aparelho de eletrocardiograma foi encontrado *Staphylococcus hominis*; no telefone e na escala de serviço foi encontrado *Staphylococcus haemolyticus.* Os teclados continuaram contaminados após limpeza. Na bancada também foi encontrado *Pseudomonas aeruginosa* após uso de limpador multiuso. Nos equipamentos desinfetados com álcool 70% não houve crescimento bacteriano.

Conclusão: A contaminação de equipamentos na unidade de terapia intensiva foi comprovada, assim como a eficiência do álcool a 70% na desinfecção.

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Conflicts of interest: there are no conflicts of interest to declare.

Introduction

Surfaces of equipment in intensive care units are potential sources of infection and vehicles of contamination for both the health team and patients. A study conducted in American hospitals for acute care showed that, every day, approximately one out of 25 patients have at least one healthcare-associated infection.[1-3]

Intensive care units deserve special attention as for the rigor in the cleaning and disinfection of equipment and their physical structure, which favor the dissemination of pathogens, added to the unfavorable clinical condition of patients, with greater risk of acquiring infections, aggravated by the use of mechanical ventilation, vesical catheters and intravenous devices.[4]

In this context and in the light of varied sources of bacterial transmission and infection, pieces of equipment that are not used in invasive procedures, and which are collectively and repeatedly handled by the team providing care to critical patients in the intensive care unit are potential reservoirs of pathogenic agents, which may survive or persist on their surfaces for months, besides being a continuous source of transmission if regular disinfection is not performed in these pieces of equipment, such as telephones, workbenches for the preparation of medications, computer keyboards, glucometers, electrocardiogram machines, health personnel schedule charts and medical records.[5,6]

The procedure performed to sanitize these pieces of equipment of continuous and collective handling in a critical environment should be appropriate and efficient as a measure to prevent and control hospital infections, aiming at better quality and greater safety in care, both for patients and professionals.[7]

The general objective of this study was to analyze the contamination of equipment in an intensive care unit before and after the cleaning/disinfection routine.

Methods

This study was conducted in the intensive care unit of a medium sized hospital, located in the city of Salvador, state of Bahia, northeast region of Brazil. The research considered the surfaces of 12 pieces of equipment which are routinely and collectively handled by professionals from this service. A total of 26 swabs were used, distributed as follows: two telephones (four swabs), a workbench for preparing drugs (two swabs), six computer keyboards (12 swabs), a glucometer (two swabs), an electrocardiogram machine (two swabs) and the nursing personnel schedule chart (two swabs).

Data were collected by the researchers in a single moment, as well as two swabs from each piece of equipment: one before applying the cleaning/disinfection product and another one right after the equipment was dried, without a pre-established waiting time. Each swab was identified with the moment they were collected and the types of equipment with more than one item were numbered.

The researchers used sterile swabs, which were moistened in 0.9% saline solution and rolled in their own axis on the examined surfaces, before and after cleaning/disinfection.

The cleaning/disinfection procedure followed the pattern of directly applying the product, without previously washing it with water and soap, in a single direction, and repeating it several times until the apparent dirt was cleaned. In average, at least three consecutive movements were observed, without waiting for each movement to dry.

The analyzed pieces of equipment were submitted to a cleaning/disinfection routine, more than once a day, performed by a cleaning worker, who used a rubber glove for all objects; standard cleaning cloth soaked in 70% alcohol, being one for each type of equipment; multi-purpose cleaning product; and a brush for removing dust.

There was no cleaning/disinfection routine for the glucometer and the personnel schedule chart. Computer keyboards were cleaned on a daily basis with a brush for removing dust. The electrocardiogram machine was disinfected with 70% alcohol after every use. A multi-purpose product made of dodecanol, ether, sodium sulfate and solvent was used on the workbench of medications. Telephones were disinfected with 70% alcohol.

After collections, the swabs were sent to the laboratory for automatized culture. Samples were seeded on petri plates in MacConkey and blood agar culture medium, and incubated in autoclave at 37 °C for 24 hours. Results were issued in five working days.

The development of this study complied with national and international ethical guidelines for research.

Results

The microorganisms found in the equipment, before and after the use of cleaning/disinfection procedures, are presented in chart 1 with the identification of the location where they were found and the professionals who handled the equipment.

Of the 12 surfaces analyzed before cleaning/disinfection, one did not present bacteria (glucometer) and 11 presented bacterial growth, six being contaminated with non-specified coagulase-negative *Staphylococcus* (five keyboards and one telephone), one with *Staphylococcus epidermidis* (computer keyboard), two with *Staphylococcus haemolyticus* (one telephone and one service schedule chart) and two with *Staphylococcus hominis* (an electrocardiogram machine and a workbench for preparing drugs).

After cleaning/disinfection of these surfaces, seven presented bacterial growth, six being contaminated with non-specified coagulase-negative *Staphylococcus* (computer keyboards which were submitted only to dust removal with a brush). On the workbench for preparing drugs, which was disinfected with the multi-purpose product, *S. hominis* was eliminated but there was a post-cleaning/disinfection contamination with *Pseudomonas aeruginosa*.

These findings regarding the workbench for preparing drugs led to the belief that it was necessary to repeat the collection on this surface for confirming the results. Three more swabs were used, two being from the workbench, before and after disinfection with 70% alcohol, and one from the multi-purpose product (dodecanol, ether, sodium sulfate and solvent) used to disinfect the workbench. These samples were processed with the same laboratorial technique and the data were confirmed.

There was an absence of bacterial growth in the glucometer, which was significantly handled by all professionals and but which was not submitted to the cleaning/disinfection routine at the moment of collection, since it was being used at that time.

The surfaces of telephones, the electrocardiogram machine and the service schedule chart, which were contaminated before, did not present bacterial growth after cleaning/disinfection with 70% alcohol.

Chart 1. Microorganisms present in the intensive care unit (ICU) equipment, before and after cleaning/disinfection

Equipment/number of items	Equipment location	Professionals who handle it	Bacteria found before cleaning/ disinfection	Procedure used for cleaning/ disinfection	Bacteria found after cleaning/ disinfection
Computer keyboard /1	Intensive care unit center	Multiprofessional team	*Staphylococcus epidermidis*	Dust removal with a brush	Non-specified* coagulase-negative *Staphylococcus*
Computer keyboard / 2, 3 and 4	Intensive care unit center	Multiprofessional team	Non-specified*coagulase-negative *Staphylococcus*	Dust removal with a brush	Non-specified* coagulase-negative *Staphylococcus*
Computer keyboard / 5 and 6	Physicians' office	Physicians	Non-specified*coagulase-negative *Staphylococcus*	Dust removal with a brush	Non-specified* coagulase-negative *Staphylococcus*
Telephone / 1	Nursing center	Multiprofessional team	*Staphylococcus haemolyticus*	Use of 70% alcohol	Absence of bacterial growth
Telephone / 22	Administrative center	Administrative technician	Non-specified*coagulase-negative *Staphylococcus*	Use of 70% alcohol	Absence of bacterial growth
Glucometer	Mobile	Nursing team	Absence of bacterial growth	Use of 70% alcohol	Absence of bacterial growth
Electrocardiogram machine	Mobile	Nursing team	*Staphylococcus hominis*	Use of 70% alcohol	Absence of bacterial growth
Workbench for preparing medications	Intensive care unit main center	Nursing team	*Staphylococcus hominis*	Use of a multi-purpose product made of dodecanol, ether, sodium sulfate and solvent	*Pseudomonas aeruginosa*
Service schedule chart	Mobile	Nursing team	*Staphylococcus haemolyticus*	Use of 70% alcohol	Absence of bacterial growth

*It was not possible to specify some coagulase-negative *Staphylococci* through the used laboratorial technique.

Discussion

The limitations of this study are related to the small sample size, the restricted period of collection and the lack of more specific molecular data regarding coagulase-negative *Staphylococci* (for a better comparison of the results), besides the poor resources available for the use of swabs and the development of laboratorial cultures.

The applicability of this study was verified in the scope of the studied hospital, with immediate changes in the routine of the procedures for cleaning/disinfecting equipment surfaces, in a more comprehensive manner for the several sectors of patient care and with the training of the cleaning personnel. Moreover, it allowed to provide more knowledge and to alert the authorities of the hospital organization and the professionals who worked in the intensive care unit as for the importance of properly cleaning and disinfecting equipment handled by the professionals, as well as the hygiene of their hands, before and after any contact with patients or with pieces of equipment, so as to control hospital infections.

The equipment analyzed in this study are commonly present in the intensive care unit and serve as support to the working process of the care and administrative teams, being frequently used in the delivery of care to patients. Coagulase-negative *Staphylococcus* bacteria belonging to the *epidermidis*, *haemolyticus* and *hominis* species were found in these pieces of equipment before cleaning/disinfection. These bacteria may be disseminated from the hands of professionals to patients, to other pieces of equipment and to other hospital environments, constantly, due to the high frequency in which they are used and the flow of these professionals.

S. hominis and *S. haemolyticus* were present before cleaning/disinfection on the electrocardiogram machine, on the workbench for preparing drugs, on a telephone located in the nursing center and on the service schedule chart, which are only handled by the nursing team. It is worth highlighting the presence of these bacteria, as studies indicate they are part of the normal flora of the human skin and the bacteria that are most commonly present in the infections of patients hospitalized in intensive care units, who are normally more frail due to their low immunity, the use of invasive devices which lead to a greater exposure to contaminations and due to their susceptibility to nosocomial bacteremia in several sites of the organism. The presence of the *S. haemolyticus* species in the equipment was a reason for concern, since it is responsible for several complications, such as endocarditis, sepsis, peritonitis, urinary tract infections, osteoarticular infections and surgical wound infections, as evidenced by other studies.[8-10]

Hence, despite being pieces of equipment that are not directly used in the care of patients, such as telephones, workbenches and computers, the surfaces on which these pathogens were found constituted potential sources that can colonize and infect patients through the hands of professionals.

Special attention is recommended to hospital computer keyboards, as these are frequently and collectively used by professionals during the entire period of delivery of intensive care. Recommendations to make the dissemination of bacteria difficult include the use of a transparent cover on keyboards, made of a material that is resistant to the products used in periodical disinfection; the use of gloves when typing; hands hygiene; and the establishment of computer use policies by the Committee of Hospital Infection Control.[11]

Regarding the contamination of the two telephones from the nursing and the administrative center, *S. haemolyticus* was found. Telephones were another source with a high potential for contamination, as they are collectively and frequently used, mainly by the nursing team, which performs most of the therapeutic procedures. A study with 100 mobile telephones revealed that all devices presented a mean bacteria count of 9.915x107 cfu/mL, with a total of 11 pathogenic bacteria from the *Pseudomonas* group isolated, representing, thus, potential sources of contamination and demanding the application of appropriate hygiene measures as a preventive method.[12]

The nursing personnel schedule chart, which is frequently handled by the team, also presented

S. haemolyticus. As observed, paper can be contaminated by bacteria and serve as a vehicle for cross contamination of bacteria in healthcare environments, especially if the recommendations on hands hygiene are not carefully followed. Bacteria can survive 72 hours and still be cultivable after seven days. It is worth noting that, in studies with test organisms, these were transferred to paper, survived and could be retransferred back to the hands.(13)

The glucometer of collective use for all patients did not present bacteria, however, it is not viable to state that such material cannot be colonized, since it is used near patients' beds. In this matter, a further study, with a greater number of samples, is recommended.

A multi-purpose product (dodecanol, ether, sodium sulfate and solvent) was used on the workbench for preparing drugs, eliminating the *S. hominis* bacterium, present in the culture before disinfection, however, after using the product, the equipment presented *P. aeruginosa,* a Gram-negative bacterium that is commonly found in the skin and in mucous membranes, and spreads through direct contact, representing a high risk of infection for immunosuppressed patients. An additional culture was performed in this product, but the presence of bacteria was not identified. Hence, other possibilities of contamination cannot be ignored, such as the cloth or the gloves used in the process.

The use of 70% alcohol to disinfect the surfaces of the equipment analyzed in this study was effective and eliminated the existing bacteria immediately after its use, even without a previous cleaning procedure with water and soap. Other studies point to the efficacy of 70% alcohol in the disinfection of stethoscopes, telephones and computer keyboards.(14) It is important to highlight that alcohols are organic chemical compounds used as bacterial agents in antisepsis procedures and to disinfect materials or surfaces in health organizations, with an antimicrobial action through the denaturation of proteins and presenting a bactericidal, anti-fungal, virucidal and tuberculocidal effect, despite not being sporocidal. The aqueous solution of alcohol is more effective in relation to the absolute alcohol, as it promotes the reduction of the superficial tension of the bacterial cell, with the 70% alcohol being more indicated, since it is hydrated and eliminates gram-negative and gram-positive bacteria in 10 seconds, and lipid and non-lipid viruses, as well as mycobacteria, in 30 seconds. In addition, 70% alcohol is indicated for intermediate- and low-level disinfection, and friction for 30 seconds is recommended once the surface has been previously submitted to a cleaning procedure.(15)

It is worth highlighting that the adequate control of hospital infections also depends on strategies of actions that promote compliance with evidence-based practice, education and investments in measures to improve knowledge, the development of basic epidemiological research, and the continuous assessment of the improvements implemented. Several studies confirmed that determining factors for infections arise from the normal microbiota and the interaction of patients with the environment where they are, from which the authors highlighted the equipment used in the health care provided in intensive care units. The conditions of the patient and those of the environment, as well as the inadequacy of the cleaning/disinfection processes lead to the development of infections in several sites, and it is proved that the adequate hygiene of the hospital environment and the hands of professionals contribute, decisively, to prevent hospital infections.(16,17)

Conclusion

The contamination of equipment in the studied intensive care unit was confirmed, as well as the efficacy of 70% alcohol in its disinfection.

Collaborations

Cordeiro ALAO; Oliveira MMC; Fernandes JD; Barros CSMA and Castro LMC contributed with the conception and development of the research, data collection and analysis, writing of the article and review of the final version to be published.

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