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LITERATURE INTEGRATIVE REVIEW ARTICLE

CONTAMINATION OF HOSPITAL MATTRESSES BY MICROORGANISMS OF EPIDEMIOLOGICAL RELEVANCE: AN INTEGRATIVE REVIEW

CONTAMINAÇÃO DE COLCHÕES HOSPITALARES POR MICROORGANISMOS DE RELEVÂNCIA EPIDEMIOLÓGICA: UMA REVISÃO INTEGRATIVA

CONTAMINACION DE COLCHONES HOSPITALARIOS POR MICROORGANISMOS DE IMPORTANCIA EPIDEMIOLOGICA: UNA REVISION INTEGRADORA

Adriana Cristina de Oliveira¹, Roberta El Hariri Viana², Quésia Souza Damasceno³

ABSTRACT

Objective: to identify in the literature the possible factors associated with contamination of hospital mattresses in units of adult patients as well as the main microorganisms involved. **Method:** it is an integrative literature review of articles published in LILACS, MEDLINE, Science Direct, SCOPUS and ISI Web of Knowledge databases. The research question was: What factors can contribute to contamination of hospital mattresses in units of adult patients and what are the main microorganisms involved? **Results:** the implementation of the cleaning of mattresses with distilled water without soap or detergent, re-use of cleaning cloths for subsequent disinfection and the improper application of the disinfectant were verified in the analyzed studies. **Conclusion:** the surface contamination of mattress was basically associated with faults in the process of its cleaning and disinfection, while the contamination of their content was related to the state of preservation of its coverage. **Descriptors:** Beds; Mattresses; Disinfection; Drug Resistance, Microbial.

RESUMO

Objetivo: identificar na literatura os possíveis fatores associados à ocorrência da contaminação dos colchões hospitalares em unidades de pacientes adultos bem como os principais microorganismos envolvidos. **Método:** revisão integrativa da literatura, com busca nas bases de dados MEDLINE, LILACS, Science Direct, SCOPUS e plataforma virtual de pesquisa Isi Web of Knowledge a partir da questão << Quais fatores podem contribuir para a contaminação dos colchões hospitalares em unidades de pacientes adultos e quais os principais microorganismos envolvidos? >>. **Resultados:** a limpeza dos colchões com água destilada sem associação com sabão ou detergente, a reutilização dos panos de limpeza para posterior desinfecção e a aplicação inadequada do desinfetante foram verificadas nos estudos analisados. **Conclusão:** a contaminação da superfície dos colchões esteve associada essencialmente às falhas no processo de limpeza e desinfecção destes enquanto que a contaminação do seu conteúdo foi relacionada ao estado de conservação das suas coberturas. **Descritores:** Leitos; Colchões; Desinfecção; Resistência Microbiana a Medicamentos.

RESUMEN

Objetivo: identificar en la literatura los posibles factores asociados con la contaminación de colchones hospitalarios en unidades de pacientes adultos y los principales microorganismos involucrados. **Método:** revisión integradora de literatura con artículos de las bases LILACS, MEDLINE, Science Direct, SCOPUS e ISI Web of Knowledge. La pregunta de investigación fue: Qué factores pueden contribuir a la contaminación de colchones de hospital en unidades de pacientes adultos y cuáles son los principales microorganismos involucrados? **Resultados:** la ejecución de la limpieza de los colchones con agua destilada sin estar asociada con jabón o detergente, el re-uso de paños de limpieza para posterior desinfección y la aplicación inadecuada del desinfectante fueron verificadas en los estudios analizados. **Conclusión:** la contaminación de la superficie de los colchones estuvo asociada principalmente con fallas en el proceso de limpieza y desinfección de los mismos, mientras que la contaminación de su contenido estaba relacionada al estado de conservación de su cobertura. **Descriptores:** Camas; Colchones; Desinfección; Farmacorresistencia Microbiana.

¹Nurse. Post-PhD from New York University/USA. Associated Professor of Department de Basic Nursing, in the Nursing School, from Universidade Federal de Minas Gerais /UFMG. Belo Horizonte (MG), Brazil. E-mail: adrianaoliveira@gmail.com; ²Nurse. Graduated by the Nursing School, from Universidade Federal de Minas Gerais/UFMG. Belo Horizonte (MG), Brazil. E-mail: robertahv@yahoo.com.br; ³Nurse. Master. Doutorate's Student of Nursing by Post-graduate Program, of the Nursing School, from Universidade Federal de Minas Gerais/UFMG. Belo Horizonte (MG), Brazil. Scholarship Student from CAPES. E-mail: qdamasceno@yahoo.com.br

INTRODUCTION

The infections related to health care - in Portuguese with the initials (IRAS) - are defined as those associated with patient care in any environment of the health system and that are manifested during hospitalization or after hospital discharge. The spreading of IRAS is often related to cross-contamination, being the patients colonized and / or infected and the hands of health professionals are the main sources involved of pathogen transmission.¹

Nevertheless, microorganisms of epidemiological relevance have been isolated in different locations of the hospital, and although it is not clear that the role of these agents in the acquisition of potential pathogens, there are evidences that the environment is an important reservoir in the health services and that once occupied by patients infected with resistant bacteria, it can become contaminated and, thus, favoring the spreading of these bacteria.²⁻⁶

The frequency of touch by health professionals and people who move in the sector and the proximity of patients colonized and/or infected may be risk factors for contamination of environmental surfaces. The surfaces that share these characteristics, in the hospital environment deserve special attention as the process of cleaning and disinfection, since they are more prone to contamination, may contribute to secondary transmission of microorganisms.^{4,7-11}

Despite being considered noncritical environmental surface, which makes contact only with intact skin and not with mucous membranes, the hospital bed, including the mattress, through direct contact with the patient may become contaminated by resistant microorganisms that colonize the skin, by body fluids such as feces, urine and wound exudates and becomes itself a reservoir of microorganisms. The high microbial load found on the surfaces of mattresses of the hospital bed can potentially contribute to horizontal transmission of microorganisms and among other surfaces and patients too.^{9,12-4}

Clarifying the role of environmental surfaces in the chain of transmission of pathogens, especially, those in direct contact with patients such as mattresses, it should be highlighted the need for strategies to control the spreading of microorganisms that can directly impact on the occurrence of the IRAS and mainly of bacteria resistant to antimicrobial medicaments.¹⁵⁻⁶

OBJECTIVE

- To identify in the literature the possible factors associated with the occurrence of contamination of hospital mattresses in units of adult patients as well as major microorganisms involved.

METHOD

It is a study of integrative literature review. The method aims to gather and synthesize research findings on a certain topic or issue, in a systematic and orderly manner, and contribute to the deepening of the research theme and for evidence-based practice.¹⁷

To guide the integrative review, we formulated the following question: What factors can contribute to contamination of hospital mattresses in units of adult patients and which the principal microorganisms involved?

To select the articles five databases were used, namely: Medical Bibliography (MEDLINE), the Latin American and Caribbean Health Sciences (LILACS), Science Direct, SCOPUS (Database of research literature) and the virtual platform for research ISI Web of Knowledge. We still tried original references present in the articles identified in this survey.

The inclusion criteria of the publications selected for this present integrative review were original articles published in English or Portuguese, with identification of contamination of hospital mattresses, in units of adult patients in situations of outbreaks and endemic diseases in the period from 1981 to 2011.

We used the descriptors available in the Decs / Mesh: beds, *leitos*, disinfection, *desinfecção*; microbial drug resistance, *resistência microbiana a medicamentos* and mattresses, *colchões*. The searching was conducted by online access and, initially, 910 articles were obtained. Of these, we excluded those who were not related to the topic (887) through the careful reading of the title and online abstract. Subsequently, the full reading of the remaining publications of the first selection (23) still allowed excluding those that were repeated in the databases (08). Using the inclusion criteria of this review, the final sample consisted of 15 items.

To data collection of the articles that were included in this review, it was drawn up a form including the following items: identification of the original article,

publication type, study design, objectives, sample, main results and conclusions.

For analysis and subsequent synthesis of the publications, we used a synoptic framework built for this purpose, which included the following aspects: name of the article, materials and methods, results and conclusions.

The presentation of the review and discussion on the data were performed in a descriptive manner, in order to allow for the reader can doing a critical evaluation of the results and their applicability.

RESULTS

In this integrative review, 15 articles that met the inclusion criteria previously established were analyzed.

During the analysis of studies, we found that the literature on this theme is still scarce. It was observed that the countries whose frequency of identified articles stood out in the theme of interest were: Brazil 33.33% (5/15) and the United Kingdom 33.33% (5/15), followed by the United States 13.33% (2/15), Ireland 6.66% (1/15), France 6.66% (1/15) and Japan 6.66% (1/15).

In the studies analyzed, the contamination of mattresses has focused on the following approaches: contamination of the mattress surfaces or contamination of its contents.

Of 15 articles selected, 07 (46.66%) analyzed the microbiological conditions of the surfaces of the mattresses, aiming to evaluate the effectiveness of cleaning and disinfection carried out or the degree of environmental contamination in the isolation rooms, and 08 (53.33%) investigated content of the mattress as possible reservoir of microorganisms and / or causes of outbreaks of infections.^{5,13-4,18-29}

The contamination of the mattresses surfaces was associated, primarily, with failures in the execution of cleaning and disinfection.^{18-9,21-3}

The use of distilled water for cleaning mattresses, unassociated with soap or detergent, the execution of disinfection with cloths previously used for cleaning and moistened with disinfectant, instead of soaking, the non observance of time of surface exposure to the disinfectant and the direction of application, using circular motions, and lack of standardization of the procedure and also lack of training for

professionals who perform it, were facts seen in studies that examined the effectiveness of the procedure for cleaning and disinfecting of mattresses and recognized as potential factors associated with persistent contamination of these surfaces.¹⁸⁻²³

Of the 07 studies that had samples of the surface of mattresses, 71.43% (5/7) occurred immediately after the execution of the terminal cleaning and disinfection of mattresses and 28.57% (2/7) after contestant cleaning.^{5,18-23}

In three studies analyzed, terminal cleaning and disinfection of hospital mattresses was performed by members of the nursing team.^{19-20,22}

With regard to the existence of cleaning protocols, 28.57% (2/7) of the studies that evaluated the microbiological conditions of the surface of the mattress, referred the execution of cleaning and disinfection of this objects according to the protocol of the institution.^{5,21}

The periodic guidelines for the hygiene / cleaning team of hospital beds for the execution of cleaning and disinfection of the mattresses were evidenced in two of the selected studies.^{5,21}

The conservation conditions of the covers of the mattresses, that is to say, the loss of the impermeability of the surface due to tears or holes stood out as a factor associated with contamination of their contents. In these studies, the cover and the contents of mattresses were analyzed regarding signs of damage and contamination, respectively, but the effectiveness of cleaning of their surfaces were not verified concomitantly.^{13-4,24-9}

Stood out as major microorganisms involved in the **contamination of hospital mattresses**: *Staphylococcus aureus*, including methicillin-resistant *Staphylococcus aureus* (MRSA), *Pseudomonas aeruginosa*, *Acinetobacter spp* and *Enterobacter cloacae*.^{5,13-4,18-21,24-9}

In Figures 1, 2, 3, 4 and 5 is presented the synthesis of the articles included in this review.

Title	Materials and methods	Results	Conclusions
Environmental reservoirs of methicillin-resistant <i>Staphylococcus aureus</i> in isolation rooms: correlation with patient isolates and implications for hospital hygiene. ⁵	Microbiological analysis of samples obtained from the air and surfaces of the isolation rooms, including mattresses, 24h after the last contestant cleaning.	MRSA isolated from 53.57% (45/84) of samples obtained from mattresses and 28% (70/250) of samples of the air. Genetic similarity between species isolated from patients and environments had been verified.	The results suggest that patients with MRSA contaminate the environment, among others; by direct contact and / or air spreading and that the ineffectiveness of the conventional process of cleaning and disinfection of surfaces may contribute to persistent contamination.
An outbreak of infections with <i>Acinetobacter calcoaceticus</i> in burn patients: contamination of patients' mattresses. ¹³	Microbiological analysis of samples obtained with swabs of the environment and foam of the mattresses of an intensive care unit for burn victims.	Only on the mattress there was significant isolating ($p < 0.005$) of <i>Acinetobacter calcoaceticus</i> . Most of the mattresses with a positive culture for the microorganism had coverage damaged and the contents wet.	The study shows that the mattresses contaminated with <i>Acinetobacter</i> served as an environmental reservoir and were listed as cause of the outbreak.
Gentamicin resistant <i>Pseudomonas aeruginosa</i> infection from mattresses in a burns unit. ¹⁴	Microbiological analysis of samples obtained with swabs of the mouth, rectum, and burn patients on admission and at regular intervals, and contact boards, fingers, team uniforms; bed linen of patients, mattresses, sinks and other.	Species of <i>Pseudomonas</i> resistant to gentamicin isolated only from mattresses of Unit for burned patients.	Preparations with silver nitrate, used in burns, make the covers for mattresses brittle and provide infiltration of body fluids in the content of the mattresses. Mattresses with damaged coverings increase the risk of infection for the patient.

Figure 1. Synthesis of publications included in the integrative review, according to the title of the article, materials and methods, results and conclusions.

Title	Materials e methods	Results	Conclusions
Avaliação da presença de <i>Staphylococcus aureus</i> nos leitos do centro de terapia intensiva do hospital escola da faculdade de medicina do triangulo mineiro, em relação à posição no colchão antes e após a limpeza. ¹⁸	Microbiological analysis of samples obtained from the mattresses of the beds of a hospital-school, using sterile swabs, before and after terminal cleaning and disinfection.	Growth of <i>Staphylococcus aureus</i> in 15.6% (94/600) of samples obtained from mattresses, being 87.2% (82/94) before cleaning and disinfection; and 12.8% (12/94) after it. There was not significant reduction ($p > 0.05$) of the colonies in the lower position of the bed after the process of cleaning and disinfection.	The authors note that the mattresses were being cleared from the upper to the lower position regardless of the patient who had occupied the bed and its illness; and they suggest careful review of cleaning and disinfection procedures currently used in mattresses.
A bacteriological study of hospital beds before and after disinfection with phenolic disinfectant. ¹⁹	Microbiological analysis of the contact boards used to obtain samples of the mattress before and after their terminal disinfection.	Of the total of 1.040 samples obtained from the mattresses, 500 were positive for colonies (48.1%), being 263 (52.6%) were obtained before the cleaning and disinfection, and 237 (47.4%) after this procedure.	The usual procedure for disinfection only shifted the microbial load from one position to another on the mattress, without, however, reduce it.
Avaliação da técnica de desinfecção dos colchões de uma unidade de atendimento a saúde. ²⁰	Microbiological analysis of samples obtained from the mattresses, using swabs, before and after disinfection, in a Unit of Medical Clinic.	Reduction of contamination of mattresses by <i>Staphylococcus aureus</i> with both techniques of disinfection, but only when performed the disinfection process in circular motions, there was a reduction of the microbial counting in 100% of the mattresses.	Disinfection of mattresses when performed with circular motions has greater reduction in microbial counting, but suggests further research to increase the number of mattresses to be investigated.

Figure 2. Synthesis of publications included in the integrative review, according to the title of the article, materials and methods, results and conclusions.

Title	Materials e methods	Results	Conclusions
Isolation of <i>Acinetobacter baumannii</i> Complex and Methicillin-Resistant <i>Staphylococcus aureus</i> from Hospital Rooms Following Terminal Cleaning and Disinfection: Can We Do Better? ²¹	Microbiological analysis of samples obtained from the surfaces of isolating rooms vacated by patients colonized and / or infected with <i>Acinetobacter baumannii</i> (ABC) and MRSA, after various schemes of terminal cleaning and disinfection, using for that sterile swabs.	Approximately 1 in each 4 rooms remained contaminated with ABC or MRSA, even after undergoing four procedures for cleaning and disinfection with sodium hypochlorite. Genetic similarity between species isolated from the environment and those isolated in the patients had been verified.	The authors suggest that the non elimination of ABC and MRSA strains of the hospital rooms may be related to environmental cleaning. However, the addition of hydrogen peroxide vapor to conventional cleaning seems to be effective in removing such microorganisms.
Condição microbiológica dos leitos hospitalares antes e depois da sua limpeza. ²²	Microbiological analysis of contact boards used to obtain samples from mattresses before and after their terminal cleaning and disinfection in a Public General Hospital for Education and Research.	Of the total of 520 samples obtained from the mattresses, 98.8% (514/520) were positive for colonies, being 50.4% (259/514) of these before the cleaning and 49.6% (255/514) after cleaning.	The authors note that the cleaning performed caused the displacement of the microbial load to other parts of the mattress, instead of decreasing it.
Condição microbiológica de colchões hospitalares antes e após a sua desinfecção. ²³	Microbiological analysis of contact boards used to obtain samples from mattresses before and after their terminal cleaning and disinfection in a Private Hospital.	On the Nutrient Agar, 28.5% (4/14) of the mattresses showed a reduction in the number of colony forming units (CFU) after cleaning and disinfection and in the BHI Agar 35.7% (5/14) of the mattresses analyzed had decreased quantity of CFU.	The procedure for disinfecting of the mattresses was in disagreement with the recommendations of the Brazilian Ministry of Health, and may be inappropriate or inadequately standardized.

Figure 3. Synthesis of publications included in the integrative review, according to the title of the article, materials and methods, results and conclusions.

Title	Materials e methods	Results	Conclusions
Anti-static mattress as reservoir of <i>Pseudomonas</i> infection. ²⁴	Inspection of mattresses and bacteriological survey of the environment of urological surgery room.	<i>Pseudomonas</i> SSP isolated in fluids that poured out the content of the mattresses in the urologic surgery room when they were pressed.	Moistened mattresses can become themselves an ideal niche for many different species of <i>Pseudomonas</i> . A checking of the mattresses of surgery rooms for possible "pockets" of contamination containing fluids should be encouraged.
<i>Pseudomonas</i> septicaemia from plastic mattresses. ²⁵	Microbiological analysis of water samples from taps and mattresses from the cardiac surgery room and the patient's hemocultures.	Contamination of tubes and pumps of the mattress of the surgery room by <i>Pseudomonas aeruginosa</i> . Hemocultures (Blood samples) of patients and samples of the mattress of the surgery room showed the same species of <i>Pseudomonas</i> .	The plastic mattresses are easily pierced by needles, instruments and other sharp objects. Small holes can be overlooked, which can act as a route of contamination of mattresses.
Costs of an outbreak of wound infection in an orthopaedic ward. ²⁶	Microbiological analysis of environmental samples of an orthopedic unit and foam of the mattresses with covers damaged. The costs caused by the outbreak of infections were calculated using a comparative retrospective study.	<i>Staphylococcus aureus</i> , <i>E. faecalis</i> , <i>Pseudomonas</i> spp., <i>S. epidermidis</i> , <i>Bacillus</i> spp., and coliforms were isolated from the contents of the mattresses from an orthopedic unit. The costs caused by the outbreak were £ 22,199.19 and for the replacement of the five damaged mattresses - £ 181.17.	The discard of five damaged and contaminated mattresses was associated with the end of the outbreak of infections. Authors point to the need for investment in infection control, since, among other things, that the cost of infections acquired in hospitals was much higher than the replacement of damaged mattresses.
Multiresistant <i>Enterobacter cloacae</i> outbreak in an intensive care unit associated with therapeutic beds. ²⁷	Visual inspection of mattresses and microbiological examination of swabs obtained from the inner surface of the cover and foam of the mattresses.	<i>Enterobacter cloacae</i> , genetically similar to the species of the patients, was isolated from the contents of the mattresses from a surgical intensive care unit.	The loss of impermeability of the covers for mattresses provided the penetration of fluids inside them, making them capable of sustaining the growth of <i>Enterobacteriaceae</i> .

Figure 4. Synthesis of publications included in the integrative review, according to the title of the article, materials and methods, results and conclusions.

Title	Materials e methods	Results	Conclusions
Mattresses as reservoirs of epidemic methicillin-resistant <i>Staphylococcus aureus</i> . ²⁸	Microbiological analysis of samples obtained from swabs of the environment and a professional team of post-natal unit.	MRSA and other microorganisms were isolated from foam of the "old" mattresses and permeable to water.	Damaged mattresses can be associated as the causes of the outbreak.
A maternity hospital outbreak of methicillin resistant <i>Staphylococcus aureus</i> . ²⁹	Microbiological examination of swabs obtained from patients, the environment and the content of the mattresses of a Maternity.	MRSA isolated in areas of likely contact with the mother's perineum, such as toilets; basins; chairs; sinks; baths and content of mattresses.	The authors of the study, despite not discarding other routes of transmission of MRSA, suggesting that contaminated mattresses may had been the source of colonization of mothers and babies admitted in the same hospital bed.

Figure 5. Synthesis of publications included in the integrative review, according to the title of the article, materials and methods, results and conclusions.

The bacteria isolated from both *surfaces of the mattresses and inside them* were *Staphylococcus aureus*, MRSA, *Pseudomonas aeruginosa* and *Acinetobacter spp.*^{5,13-4,18-21,24-6,28-9} *Enterobacter cloacae* were present only in samples obtained from the content of the mattress.²⁷

In endemic situations prevailed *Staphylococcus aureus* and in outbreak moments prevailed *Pseudomonas aeruginosa*. MRSA was isolated from mattresses in both situations, endemic and outbreak.^{5,13,18-21,24-6,28-9}

MRSA, *Acinetobacter baumannii* and *Enterobacter cloacae* genetically similar to clinical specimens of the patients were isolated, respectively, from the surfaces of mattresses from isolating rooms and the content of the mattresses that comprised an intensive care unit.^{5,21,27}

Of 15 articles analyzed, 13.33% (2/15) did not perform the identification of the microorganism isolated in the mattresses.²²⁻³

DISCUSSION

The persistent contamination of surfaces of hospital mattresses was observed after the execution of its terminal cleaning and disinfection. The persistence of pathogens in these areas was probably related to the manner of performing this procedure, in disagreement with the recommendations of national and international regulatory bodies.¹⁸⁻²³

The studies evaluating the efficacy of terminal cleaning and disinfection of the mattresses found that the procedure performed was not effective, since the microbiological conditions of the mattresses, in most cases, were maintained after the procedure. However, they did not directly investigate the factors that led to this result.

Although not investigated, using a cloth moistened with distilled water for cleaning, disinfecting friction with circular motions and

for once, the reuse of wet cloths for disinfecting, the non observation of exposure time of the surface to the disinfectant, the lack of standardization of the process of cleaning and disinfecting of mattresses, and lack of qualification for professionals who perform it, were factors associated in an inferential form to the contamination of these hospital surfaces.¹⁸⁻²³

According to the Brazilian National Health Surveillance Agency - *Agência Nacional de Vigilância Sanitária* (ANVISA) and the Guideline for disinfection and sterilization in healthcare establishments, 2008, the surface cleaning consists in the removal of debris deposited on them using mechanical means, chemical or physical, and the disinfection; in the thermal or chemical destruction of most pathogenic microorganisms, but not necessarily of all microbial life forms.^{9,30}

The non-critical surfaces such as the hospital mattresses usually require only cleaning, but there are situations where intermediate disinfection is indicated. In Brazil, the ANVISA and the Ministry of Health (MS), recommend that the cleaning of mattresses consist routinely of using water and soap or detergent, followed by rinsing and drying stages of the surfaces and the use of disinfectants are restricted to specific situations, that is to say, those in which there is the presence of organic matter and / or resistant microorganisms. In this case, it is advisable to remove the organic matter with towel paper or cloth, cleaning with soap or detergent and perform disinfection with alcohol 70% or other disinfectant defined by the local committee of hospital infection control. In the case of ethanol 70%, this product should be applied in unidirectional direction, rubbed for three consecutive times to complete the action time of ten minutes, with spontaneous drying.³⁰⁻¹

It should be noted that the alcohol 70% associates germicidal action with lower toxicity and cost, but the product can damage

plastic and rubber.³¹

The Guideline for disinfection and sterilization in healthcare establishments, 2008, released by the Centers for Disease Control (CDC) recognizes the effective use of disinfectants as part of multiple strategies to prevent the IRAS and presents some reasons, based on epidemiological and microbiological data, so that the non-critical surfaces are disinfected on regular schemes, among them, the chance of contamination of nearby surfaces to the patients with microorganisms of epidemiological relevance and able to survive in the environment for long periods and the need to simplify and facilitate both the training of those professionals involved in the process of cleaning and disinfection of surfaces and the respective practice.⁹

After being submitted to cleaning and disinfection, it is recommended that the hospital bed should be protected by a cover, in order to avoid recontamination, and identified with a warning or a sign indicating that this was decontaminated and when it occurred. However, it is necessary to consider the reality of Brazilian hospitals that due to high turnover and shortage of beds, with a need to be occupied immediately after the vacancy, not intended for the cleaning of these surfaces the attention and care that they deserve as a recognized measure for the controlling and prevention of IRAS.¹⁰

Another important issue verified in selected studies refers to the small number of articles that specified the professional category responsible by the execution of cleaning and disinfection of hospital mattresses.

The distribution of cleaning tasks in the area next to the patient varies according to the routine of the institution. In some health services, the nursing staff is responsible for cleaning and disinfection of certain equipment and surfaces such as mattresses, because these professionals are in closer proximity with the patient. Other institutions give this responsibility to the professional of cleaning. It should be noted that the clarity of assignments plays a fundamental role to fulfill them, thus making essential the definition of functions and previous training of professionals for the effective implementation of cleaning.^{7,30}

The cleaning of mattresses by the nursing staff can contribute to an efficient process, since these professionals have specific knowledge as a result of their training that enables them to realize the importance of cleanliness in the control and prevention of

infections. On the other hand, the overlap of activities associated with the deficit in the number of nurses in the Brazilian hospitals can directly impair the job done.³²

As for the mechanisms used to evaluate the effectiveness of cleaning and disinfection performed on mattresses, we stood out visual inspection and microbiological analysis.¹⁸⁻²³

The method visual of evaluation of the cleaning process could be used as a preliminary step followed by more reliable tests, such as ATP bioluminescence, the application of fluorescent dye, counting of the total aerobic colony or the presence of indicator organism, as the visual evaluation alone does not necessarily correspond to microbial risk when present. However, in most cases, only the visual inspection has been used in Brazilian hospitals. Some difficulties related to the use of these tests are associated with higher costs, with consequent unavailability of these technologies in most healthcare establishments, besides being a laborious task in the example of microbiological analysis.^{7-8,33}

The difficulty to evaluate the efficiency of cleaning is still associated to the elusiveness of the permissible levels of contamination of the surfaces in the hospital environment. It is known that the development of an infection depends not only on quantitative of colony forming units (CFU), but, specially, of the conditions and characteristics of individual inoculated as its resistance. So, few units colonies viable acquired from environment for vulnerable patients can result in infection.³⁴

The quantity of total aerobic colony (ACC) of $<5\text{ufc/cm}^2$ has been recognized internationally in food processing, and could be used as a starting point for the cleaning of surfaces with frequent contact with hands, among them, hospital mattresses. Whether in the food industry, that bacteriological standard allows evaluating the hygiene of surfaces and managing the risk in food preparation, in the hospital environment it would provide to evaluate the patient's risk of acquiring infection.³³

The simple reduction of microbial load on surfaces can reduce the chances of presence and environmental spread of pathogens, but the definition of bacteriological standards to assess their hygiene status would allow, in addition to these, the conduction of hospital hygiene on scientific bases.^{16,33}

The findings in the articles analyzed, on contamination of mattresses predominantly by *Staphylococcus aureus*, including MRSA,^{5,18-21,26,28-9} reaffirm the possibility of this

microorganism to survive in the hospital environment for prolonged periods, particularly, around the infected or colonized patients and, consequently, spreading itself among the patients and the environment. The presence of MRSA in cultures made on the mattresses confirms the increasing prevalence of this microorganism in the hospital environment since 1980. For exemplification, around 1990, MRSA accounted for 20 to 25% of isolated *Staphylococcus aureus* from the hospitalized patients. In 1999, the National Nosocomial Infection Surveillance (NNIS) reported that over 50% of the isolated of *S. aureus* from ICU patients constituted MRSA. In 2003, new strains of MRSA have been associated with the emergence of cutaneous infections and serious pneumonia acquired in the community.^{4,15,35}

Recently, MRSA has been remarkable, though, both for producing serious infections in hospitalized patients and in children and adults non hospitalized and previously healthy.³⁵

The high prevalence of microorganisms isolated from both surfaces, as in the content of mattresses, although not confirm that the environment is a potential source of microorganisms to the patients, suggests that contaminated sites may contribute to the spreading of certain bacteria and / or serve like reservoir.²¹

Given these considerations, it is possible to say that an effective process of cleaning and disinfection is essential to unbalance such environmental reservoirs and that the results depend directly on how the cleaning is performed and the importance that is given to it.

In this sense, new researches are necessities to seek clarifying the best techniques for execution and evaluation of cleaning and disinfection of hospital mattresses, the effectiveness of disinfectants on microorganisms of epidemiological importance and the relevance of cleaning protocols.

As for the factors associated with contamination of hospital mattresses, their approach is still scarce, it is important the performance of studies directly toward this goal, because, among other things, the growing need of establishing measures for the controlling and prevention of IRAS.

CONCLUSION

In the analyzed studies, we stood out as factors associated with contamination of the surfaces of mattresses, the fails in the

execution of the process of cleaning and disinfection. While that the contamination of its contents was primarily related to the conservation status of their coverage.

The microorganisms most frequently isolated in hospital mattresses were: *Staphylococcus aureus*, including MRSA, *Pseudomonas aeruginosa*, *Acinetobacter calcoaceticus* and *Enterobacter cloacae*.

We should reaffirm the importance of attention to surfaces such as mattresses, and the revision of cleaning protocols to reduce and control the potential spreading of microorganisms for the environment, patients and health professionals, since this is a fundamental aspect for the prevention of IRAS.

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Corresponding Address

Roberta El Hariri Viana
Universidade Federal de Minas Gerais
Escola de Enfermagem
Av. Alfredo Balena, 190
CEP: 30130-100 – Belo Horizonte (MG), Brazil