

CLOTHING OF HEALTH CARE PROFESSIONAL AS POTENTIAL RESERVOIRS OF MICRO-ORGANISMS: AN INTEGRATIVE REVIEW

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ABSTRACT: It has been aimed to determine, through an integrative review of the literature, reports about the occurrence of contamination by micro-organisms and isolation in their white coats, gowns, uniforms of the healthcare professionals, and the similarity to those related to Healthcare Associated Infections considering the profile of antimicrobial resistance. Articles were searched in the following databases MEDLINE, LILACS, and SCOPUS, published from 2000 to 2010. Nine articles were selected and analyzed. These studies considered and evidenced white coat, gown and uniform contamination. The analyzed studies there was the presence of mainly bacteria on pockets, cuff and waist area. As to the profile of sensitiveness the recuperation of *Staphylococcus aureus* meticiline resistant/MRSA, followed by Gram negative antimicrobial resistance. These were a similarity between the strains in the clothing of health workers and those related to the occurrence of infections. Thus, white coats, gowns, uniforms must be considered part of the dissemination chain of micro-organisms.

DESCRIPTORS: Cross infection. Clothing. Health personnel.

VESTUÁRIO DE PROFISSIONAIS DE SAÚDE COMO POTENCIAIS RESERVATÓRIOS DE MICRORGANISMOS: UMA REVISÃO INTEGRATIVA

RESUMO: Objetivou-se identificar na literatura, artigos sobre a ocorrência de contaminação por microrganismos, em jalecos, aventais e uniformes dos profissionais de saúde, e a similaridade com aqueles associados às Infecções Relacionadas à Assistência à Saúde, considerando o perfil de resistência aos antimicrobianos. Realizou-se busca por artigos nas seguintes bases de dados: MEDLINE, LILACS e SCOPUS, publicados entre 2000 e 2010. Foram selecionados nove artigos. Os estudos evidenciaram a contaminação dos jalecos, aventais e uniformes. Nos estudos analisados, verificou-se a presença de bactérias, principalmente, nos bolsos, punhos e região abdominal. Quanto ao perfil de sensibilidade, verificou-se recuperação de *Staphylococcus aureus* metilina resistente, seguidos dos Gram negativos resistentes aos antimicrobianos. Identificou-se semelhança entre as cepas isoladas no vestuário dos profissionais de saúde e aquelas relacionadas à ocorrência de infecções. Assim, jalecos, aventais e uniformes devem ser considerados na cadeia de disseminação de microrganismos resistentes.

DESCRIPTORES: Infecção hospitalar. Vestuário. Pessoal de saúde.

VESTUARIO DE LOS PROFISIONALES SALUD COMO POSIBLES RESERVORIOS DE MICROORGANISMOS: UNA REVISIÓN INTEGRADORA

RESUMEN: Se objetivó identificar, por revisión integrativa de la literatura, artículos sobre la ocurrencia de contaminación por microorganismos en gabachas, delantales y uniformes de profesionales de salud, y su relación con las Infecciones presentadas al realizar el Cuidado de Salud, teniendo en cuenta el perfil de resistencia a los antimicrobiano. Se realizó la búsqueda por artículos en los bancos de datos MEDLINE, LILACS y SCOPUS, publicados desde 2000 hasta 2010. Fueron seleccionados y analizados nueve artículos. Se destacó en los estudios la presencia de bacterias, principalmente en los bolsillos, los puños y en la región abdominal. Sobre el perfil de sensibilidad se destacó la recuperación de *Staphylococcus aureus* metilino resistente/MRSA, seguidos por Gram negativos resistentes a los antimicrobianos. Se identificaron similitudes entre las cepas en el vestuario de los trabajadores de la salud y la aparición de infecciones. Por tanto las gabachas, delantales y uniformes de los profesionales en salud, deben ser considerados en la cadena de diseminación de microorganismos.

DESCRIPTORES: Infección hospitalaria. Vestuario. Personal de salud.

INTRODUCTION

Healthcare Associated Infections (HAIs) refer to those obtained during the provision of healthcare. They represent a major public health problem in both developed countries and developing countries, because they increase the rates of morbidity and mortality, prolong the period of hospitalization, and increase hospital costs.¹⁻²

Despite significant progress in infection control, there is an increase in the frequency and severity of cases of HAI, which may be favored by the spread of drug resistant microorganisms.³

The control of HAI and the spread of resistant bacteria constitute a challenge and a priority for the healthcare institutions, due to the reduced therapeutic options for the treatment of cases, the major complications related to the clinical care, and the social repercussions, such as decreased productivity and quality of life of the patient.⁴⁻⁵

The major route of transmission of microorganisms occurs between the hands of the healthcare professionals and patients.⁶⁻⁷ However, the possible participation of environmental factors, such as surfaces, equipment and clothing (white coats, gowns and uniforms) used by the professionals, draws the attention of researchers, society, and the infection control agencies and associations.⁸

With the emergence of resistant bacteria, the focus of the dissemination of these infections turned to some fomites that had been forgotten. In this context, the clothing used in the quotidian of the healthcare professionals begins to be considered a potential reservoir for the transmission of microorganisms involved in the occurrence of HAI, even if in small proportions.⁹⁻¹²

The spread of pathogens may occur in the hospital environment and also outside of this, i.e. in places in which the provision of direct care does not occur. The use by healthcare professionals, principally, of white coats outside the hospital environment has become common in areas close to the health institutions, on buses, in cafeterias and in other places.¹² Given the importance of the subject, this study aimed to identify articles in the literature on the occurrence of contamination by microorganisms of white coats, gowns and uniforms of healthcare professionals, and to highlight the similarity of these microorganisms with those related to Healthcare Associated Infections.

The methodological approach adopted was that of Evidence-Based Practice (EBP), which is

to organize the relevant information from the definition of a problem. This contributes to improving the quality and safety of patient care and encourages healthcare professionals to seek scientific knowledge already produced about the topic under investigation, providing the aggregation between the best available evidence, the clinical experience of the professional and the individuality of each patient assisted.¹³

METHODOLOGY

The recent EBP initiatives have increased the need to evaluate the production of all the literature review methods. In this study, the integrative literature review was selected, which is one of the evidence-based practice resources.¹³ The development of this integrative review took the following steps: 1st) identification of the hypothesis, or the guiding question, for the development of the integrative review; 2nd) selection of the sample, from the establishment of the inclusion and exclusion criteria for the studies; 3rd) definition of the information to be extracted from the studies selected/categorization of the studies; 4th) evaluation of the studies included; 5th) discussion and interpretation of the results, and 6th) presentation of the review and synthesis of the knowledge.¹³ The evidence is classified into seven levels: originating from I – a systematic review or meta-analysis of all the relevant randomized controlled clinical trials or from clinical guidelines based on systematic reviews of randomized controlled clinical trials; II – at least one well-designed randomized controlled trial; III – well designed clinical trials without randomization; IV – well designed cohort and case control studies; V – systematic reviews of descriptive and qualitative studies; VI – a single descriptive or qualitative study; and VII – the opinion of authorities and/or reports of expert committees.¹⁴

The development of the present review was defined using the following guiding question: what evidence is available in the literature regarding the recovery of microorganisms in white coats, gowns and uniforms of healthcare professionals and what is the similarity between these isolates and those related to HAI, considering the profile of antimicrobial resistance? For the selection of the articles three databases were used: MEDLINE (Medical Literature Analysis and Retrieval System online), LILACS (Latin American and Caribbean System on Health Sciences Information) and SCOPUS (Database of research literature). The descriptors used in this study were controlled; i.e. they

were used for the indexing of studies in databases, in order to facilitate access to the information. The following terms were defined for the search: a) in Portuguese: *infecção hospitalar, pessoal de saúde* and *vestuário*; b) in English: cross infection, health personnel and clothing; and c) in Spanish: *infección hospitalaria, personal de salud* and *vestuário*. The inclusion criteria for the studies selected for this integrative review were: those published in English, Spanish or Portuguese; primary articles which reflect the recovery of microorganisms in white coats, gowns and uniforms of healthcare professionals related to the occurrence of HAI and to bacterial resistance in healthcare institutions, with the application of laboratory (biochemical and/or molecular) and statistical tests; and published between 2000 and 2010. It was chosen to consider works in this period because it is still a poorly studied subject, which is gradually attracting the attention of researchers. The exclusion criteria consisted of: articles repeated in the databases; articles of opinion; articles of reflection; editorials; articles that did not directly address the theme of this review; and articles published outside the previously defined period.

In the MEDLINE database 100 references were found. Of these, 60 were not primary articles, 20 were articles of opinion or reflection, five were editorials, and nine had been published before the established period. Therefore, 94 were excluded. In searching SCOPUS, 35 articles were obtained, of which 33 were excluded due to duplication in MEDLINE, as well as four articles in LILACS. Overall, a sample of 140 studies was obtained, with 131 being excluded. The data obtained were transcribed for the instrument proposed and validated in a previous study,¹⁵ which considers the following items: identification of the original article, methodology of the study, and evaluation of the methodological rigor, the intervention measures and the results obtained. Critical reading of the articles was performed, highlighting the following aspects: authors, year of publication, journal, type of study design, evidence level and aim(s).

RESULTS

In this integrative review, the nine articles that met the previously established inclusion criteria were analyzed (Table 1).

Table 1 - Description of the studies included in the integrative review, showing the authors, year of publication, journal, type of study design, evidence level and aim(s)

Authors	Year	Journal	Study design	Evidence level	Aim(s)
Loh WNG, Holton J ¹²	2000	J Hosp Infect.	Cross-sectional	VI	To determine the level and type of bacterial contamination present in the white coats of medical students and to evaluate the risk of the spread of nosocomial infections by contact in a hospital environment.
Zachary KC, Bayne PS, Marrison VJ, Ford DS, Silver LC, Hooper DC ²⁰	2001	Infect Control Hosp Epidemiol.	Cross-sectional	VI	To identify the rate of contamination of gowns, gloves and stethoscopes, by VRE, during the care.
Osawa K, Baba C, Ishimoto T, Chida T, Okamura N, Miyake S, et al ²¹	2003	J Infect Chemother.	Cross-sectional	VI	To determine whether clinical isolates of MRSA during the occurrence of an outbreak were associated with environmental factors.
Pilonetto M, Rosa EAR, Brofman PRS, Baggio D, Calvário F, Schelp C, et al ¹⁷	2004	Braz J Infect Dis.	Cross-sectional	VI	To identify the presence of microorganisms and the amount of viable colonies on gowns of healthcare professionals of the intensive care unit, as well as their resistance profile.
Snyder GM, Thom KA, Furuno JP, Perencevich EN, Roghmann MC, Strauss SM, et al ¹¹	2008	Infect Control Hosp Epidemiol.	Cross-sectional	VI	To evaluate the rate and risk factors for the detection of MRSA and VRE in gowns and gloves of healthcare professionals.

Authors	Year	Journal	Study design	Evidence level	Aim(s)
Treakle AM, Thom KA, Furano JP, Strauss SM, Harris AD, Perencevich EN ¹⁶	2009	Am J Infect Control.	Cross-sectional	VI	To identify the prevalence of <i>Staphylococcus aureus</i> , including MRSA and VRE in white coats of healthcare professionals, as well as the potential risk factors.
Gaspard P, Eschbach E, Gunther D, Gayet S, Bertrand X, Talon D ¹⁹	2009	J Hosp Infect.	Descriptive	VI	To verify contamination by MRSA in the uniforms of healthcare professionals of geriatric clinics and the influence of personal protection equipment and of the continuing education programs in reducing contamination in the pockets.
Uneke CJ, Ijeoma PA ¹⁸	2010	World Health & Population.	Cross-sectional	VI	To identify the profile of microbial contamination of white coats used by physicians; to verify the relationship between the contamination of white coats and the practices of use and handling by the physicians; and to evaluate the susceptibility of the microbial isolates to antibiotics.
Morgan DJ, Stephen Y, Liang Y, Smith LC, Johnson K, Harris AD, et al ²²	2010	Infect Control Hosp Epidemiol.	Cross-sectional	VI	To determine the incidence of transmission of multiresistant <i>Acinetobacter baumannii</i> and <i>Pseudomonas aeruginosa</i> from patients to healthcare professionals during routine care.

Regarding the year of publication, the majority of the studies occurred between 2000 and 2004 (4), followed by 2010 (2), 2009 (2) and 2008 (1). Regarding the origin of the journals, eight are International and one is Brazilian. In relation to the target populations of the studies, the following were identified: multidisciplinary team – five articles; nursing staff – one; physicians of different specialties – one; medical students – one, and physicians and nurses – one article. Of these, three were performed in the Intensive Care Units (ICU) of hospitals; five in inpatient units; and one study in a geriatric clinic. Concerning the type of research design of the articles analyzed, one study was descriptive and eight cross-sectional. Thus, regarding the strength of evidence obtained in the articles, it was found that the nine studies were of level VI; i.e. not presenting strong evidence for clinical application. In addition, the cross-sectional type studies, which represent the majority of the articles analyzed, may present greater vulnerability to bias (mainly selection bias).

In seven articles, the rolling swab technique was used to collect the microbial samples from previously defined areas of the fabric of the white coats, gowns or uniforms of healthcare professionals.^{11,16-19,21-22} Direct contact of the areas analyzed with the agar plates was used in two articles for obtaining the microbiological samples.^{12,19} The bacterial species were identified by biochemical tests; and the antimicrobial susceptibility through the disc diffusion technique or by the identification of the Minimum Inhibitory Concentration (MIC).¹¹⁻

^{12,16-22} The pulsed field gel electrophoresis (PFGE) technique was used to verify the clonal relationship between the isolates, this being considered of broad application, as it enables the performance of genotyping and the comparison of similarity between microbial species.²²⁻²³

Of the microbial samples isolated from the white coats, gowns and uniforms of the healthcare professionals, the following were identified: Diphtheroids, Vancomycin Resistant *Enterococcus* (VRE), gram-negative bacteria (*Acinetobacter baumannii*, *Klebsiella pneumoniae* and *Serratia rubidae*) and methicillin-resistant *Staphylococcus aureus* (MRSA), which was most frequently isolated, including in outbreak situations. In the ICU a greater diversity of microorganisms resistant to penicillins, aminoglycosides and 1st, 2nd and 3rd generation cephalosporins were recovered.^{11-12,16-22} A higher level of contamination of clothing by VRE was observed during the care of patients with tracheostomy, gastrostomy, jejunostomy and ileostomy.^{11,20} In two studies the results of molecular tests confirmed the similarity between the strains of the patient and those recovered from the clothing of the multiprofessional team.²¹⁻²²

Among the studies included in the integrative review, there was consensus that white coats, gowns or uniforms of the healthcare professionals can be contaminated during patient care, becoming potential vehicles for the dissemination of microorganisms associated with HAIs. The main locations of contamination were: pockets, cuffs and the waist region. It is important to highlight

that, among the studies evaluated, the factors 'frequency of washing and changing', and 'complexity of the care provided to the patient' favored the contamination of the clothing.¹⁶⁻²² The use of white coats restricted to only areas of direct patient care was considered an important factor for lower levels of contamination of the coat ($p < 0.05$), compared to coats used in non-care areas, such as cafeterias and libraries.¹⁸

DISCUSSION

Regarding the aims of this review - to identify evidence in the literature concerning the recovery of microorganisms from white coats, gowns and uniforms of healthcare professionals; and to show the similarity of these with those related to HAI, considering the profile of antimicrobial resistance - it was observed in the articles that the clothing of healthcare workers can become contaminated with microorganisms of epidemiological relevance, contributing to the potential spread of pathogens between different patients and environments.

The results of the studies reviewed demonstrated the recovery of *Staphylococcus aureus*, *Acinetobacter baumannii*, *Klebsiella pneumoniae*, *Pseudomonas aureuginosa*, MRSA and VRE from white coats, gowns and uniforms. It should be highlighted that these constitute additional concerns for healthcare institutions worldwide, due to the high pathogenicity, the ease of cross transmission and the reduced profile of sensitivity to different antimicrobials.²³

The relevance of the contamination of the clothing of healthcare professionals is evident, due to the fact that many of the microorganisms recovered are resistant to antimicrobial agents, and are thus capable of causing serious infections in hospitalized patients, as well as in the community. This leads to the need to provide aggressive treatment, sometimes with reduced therapeutic options, increasing the costs for the healthcare institutions, prolonging the hospital stay and increasing the personal, social and family damage for the patient.²⁴⁻²⁵

The contamination of clothes may vary according to the type of hospitalization unit. It is higher in those that care for patients in critical health conditions, such as in the ICU, where normally there is a greater possibility of direct contact between the professional and the patient, with risk factors for infection of the patient, and also large amounts of equipment, which helps to promote

greater environmental contamination.^{8,20}

In this context of the discussion, the scarcity of studies with strong evidences for clinical application is highlighted. Furthermore, some studies indicate, through means of PFGE testing, the relationship between the similarity of the microbial samples recovered, especially from the white coats of healthcare professionals, and the epidemiologic profile of the bacteria causing outbreaks on the wards.¹⁹⁻²⁰

To prevent the cross transmission of HAI between patients and healthcare professionals is an indispensable issue for the safe care of the patient, which constitutes a great challenge. According to the Association for Professionals in Infection Control and Epidemiology (APIC), unsafe practices and behavior that put the health, and even the lives, of patients and professionals at risk are unacceptable. Therefore, it is indispensable that healthcare professionals perform measures to control the spread of microorganisms.^{18,26}

It appears, however, that the adherence of professionals to such measures is not taking place as required, citing as an example the use of the white coat outside the hospital environment, an increasingly common habit among healthcare professionals. Such behavior is repeated among students, who, without thinking critically, reproduce the same behavior without analyzing the possible repercussions in the chain of dissemination of microorganisms.²⁷

In relation to the areas of recovery of pathogens in the white coats, gowns and uniforms, the studies indicate the pockets, the cuffs and the waist region as those with greater contamination, due to the frequency of contact with the hands of the professionals when putting belongings in the pocket and when the waist and wrists come into contact with patients and the inanimate environment.^{11,20} The use of plastic and/or disposable aprons as protection for the clothes of the professional must be encouraged during the practices with greater risk of exposure to humidity and secretions.¹⁶

A point rarely discussed in the studies analyzed, which can be directly related to the contamination and maintenance of microorganisms in the clothing, is the type of fabric and fiber. In the fabrics composed of cotton fibers, pathogens may survive for longer periods in contrast to fabrics composed of synthetic fibers. This can be explained by the hydrophobicity of synthetic fabrics, which hinders the survival of pathogens.²⁹⁻³⁰

Another aspect to be considered is the pos-

sibility of reducing contamination of the clothing through the professionals cleaning their hands before and after patient care. The hands constitute the main route of the spread of microorganisms between patients and the clothing of the healthcare professionals. However, the procedure of the professionals in relation to hand hygiene is considered insufficient, with adherence values below 50% in various countries.^{6-7,12}

Another issue associated with the contamination of the clothes of healthcare professionals is the frequency of changing and of laundering them and the use of the same white coat, gown or uniform while providing care to patients in different clinical and epidemiological conditions.^{8,17} The white coats of medical students presented significant amounts of pathogens when considered dirty by the students themselves, however, the laundering of the clothes still only occurred occasionally.¹²

The restricted use of the white coat in patient care units contributed to the reduction in the contamination of the coat. The use of this clothing in related areas as well presented higher contamination by microorganisms.¹⁹ Faced with the need to promote safe care for patients and healthcare professionals, the following recommendations should be considered regarding the handling and storage of clothing used in healthcare institutions: to provide enough coats, gowns and uniforms to the healthcare professionals, thus favoring an increased frequency of changing them; to recommend the washing of such clothing at least once a week, and to prohibit the use of white coats in non-care areas i.e. outside the inpatient units.^{12,16}

Other recommendations should be observed, such as: to promote the involvement and participation of the health institution managers in the compliance with the actions of preventing the spread of microorganisms, foreseeing the establishment of the monitoring of the compliance with this measure; and to promote guidance regarding the cleaning of clothes and the adequation of the models, to facilitate hand washing.^{12,16,18}

The clarification regarding the role of clothes in the dissemination of pathogens can contribute to a change in attitude and to improve the adherence of healthcare professionals to the measures of control of the spread of microorganisms, including those with profiles of antimicrobial multiresistance.

It was possible to detect gaps in the studies analyzed with regard to the occurrence of infec-

tions related to the contamination of the clothing of the healthcare professionals. This results in the need to promote studies with greater methodological rigor, such as studies with evidence levels I and II, i.e. meta-analysis and randomized controlled clinical trials, which are able to present recommendations for use in the clinical practice.

FINAL CONSIDERATIONS

In total, nine articles were analyzed, one being descriptive and eight being cross-sectional. Regarding the strength of evidence obtained in the articles, it was found that the nine studies were of level VI; i.e. not presenting strong evidence for clinical application.

Even faced with this limitation and the small number of studies on the contamination of the clothing of healthcare professionals, there was agreement among them regarding the recovery of microorganisms, including strains resistant to antimicrobial agents, from the clothing of the healthcare professionals. In two studies, a similarity was observed between strains found in patients and in the occurrence of an outbreak and those isolated from white coats and gowns.

Considering the studies analyzed in this integrative review, it is suggested to revise and implement measures to guide healthcare professionals in care related to the storage and washing of clothes and their availability in sufficient numbers, favoring an increased frequency of changing and conscientization regarding their use in patient care areas.

Even though the contamination of clothes, especially of white coats, can seem obvious, the analysis and the registration of the presence of multiresistant bacteria can constitute a clear strategy concerning the importance of the role of each person in combating the dissemination of bacterial resistance.

In relation to EBP, the importance of developing new studies with strong levels of evidence in relation to the contamination of white coats, gowns and uniforms is emphasized, which could possibly contribute to the prevention and control of HAIs.

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