

MRSA Colonization in Healthcare Professionals: a Systematic Review

Colonização por MRSA em profissionais de saúde: uma Revisão Sistemática

Ane Caroline Ribeiro¹, Carla Matheus Farah², Joana Lado Oliveira³, Patrícia Guedes Garcia⁴

¹ Pós-Graduação em Microbiologia e Análises Clínicas pela Faculdade de Ciências Médicas e da Saúde de Juiz de Fora, FCMS/JF, Brazil. E-mail: ane_kroline@hotmail.com

² Pós-Graduação em Microbiologia e Análises Clínicas pela Faculdade de Ciências Médicas e da Saúde de Juiz de Fora, FCMS/JF, Brazil. E-mail: carla.farah@hotmail.com

³ Pós-Graduação em Microbiologia e Análises Clínicas pela Faculdade de Ciências Médicas e da Saúde de Juiz de Fora, FCMS/JF, Brazil. E-mail: joanalado@yahoo.com.br

⁴ PHD, Professora Adjunta do Departamento de Ciências Farmacêuticas da UFJF. E-mail: pggfarm@gmail.com

ABSTRACT

Objective: Investigate through a systematic review the prevalence of health professionals colonized by *Staphylococcus aureus* methicillin resistant (MRSA) in hospital environments. **Methods:** A literature search in MEDLINE (National Library of Medicine) database was performed where cross-sectional studies and clinical trials were analyzed, performed in human health professionals colonized by MRSA in hospital environment, originally published in english in the last five years. Poorly described and inadequate studies were excluded for the topic, simulation and research, as well as those that evaluated animal health professionals and patients colonized and/or infected with MRSA or other type of microorganism. **Results:** A total of six studies were part of the scope of this review that met the selection criteria. MRSA colonization frequencies ranged from 2.4% to 73%. The professional nursing class and those who work in risk sectors were identified as the most likely to be colonized. **Conclusion:** Colonization of health professionals by *Staphylococcus aureus* methicillin resistant (MRSA) is a reality, indicating that a poor adherence to preventive measures may contribute to the dissemination of this micro-organism, causing impacts on patients, community and to the own health of these professionals.

Keywords: Methicillin-Resistant *Staphylococcus aureus*, Health Personnel, Cross Infection.

RESUMO

Objetivo: Investigar por meio de uma revisão sistematizada a prevalência de profissionais de saúde colonizados por *Staphylococcus aureus* resistente à meticilina (MRSA) em ambientes hospitalares. **Métodos:** Foi realizada uma busca da literatura na base de dados MEDLINE (National Library of Medicine), onde foram analisados estudos transversais e ensaios clínicos, realizados em profissionais de saúde humana colonizados por MRSA em ambiente hospitalar, publicados originalmente na Língua Inglesa nos últimos cinco anos. Foram excluídos estudos mal descritos e inadequados para o tema, simulação e investigação, bem como os que avaliaram profissionais de saúde animal e pacientes colonizados e/ou infectados por MRSA ou por outro tipo de micro-organismo. **Resultados:** Fizeram parte do escopo desta revisão um total de 6 estudos, que preencheram os critérios de seleção. As frequências de colonização por MRSA variaram desde 2,4% a 73%. Os profissionais da classe de Enfermagem e aqueles que trabalham em setores de risco foram apontados como os mais suscetíveis a serem colonizados. **Conclusão:** A colonização de profissionais de saúde por *Staphylococcus aureus* resistente à meticilina (MRSA) é uma realidade, indicando que uma má adesão em medidas preventivas pode colaborar para a disseminação desse micro-organismo, causando impactos para os pacientes, para comunidade e para própria saúde desses profissionais.

Palavras-chave: *Staphylococcus aureus* Resistente à meticilina, Pessoal de saúde, Infecção hospitalar.

Submission date: 02/09/2021.

Approval date: 05/30/2021.

INTRODUCTION

Staphylococcus aureus corresponds to a genus of bacteria, which appears in the form of Gram-positive cocci, with a cluster-shaped arrangement, are catalase positive, coagulase-negative and facultative anaerobes⁽¹⁾. They are present in the microbiota of the human body (skin, nostrils, throat, intestine, urinary tract, umbilical region, and armpits)⁽²⁾, however in special conditions, such as compromised immune system or even trauma that compromise the integrity of the skin barrier;⁽³⁾, added to the virulence factors characteristic of genus (capsule, peptidoglycan, teichoic acid, protein A, adhesins, extracellular enzymes, leukocidins and hemolysins)⁽¹⁻⁴⁾, become pathogenic bacteria, thus being an important etiological agent of several infections, from superficial to deep⁽³⁾.

What makes *Staphylococcus aureus* an agent of great clinical and epidemiological importance worldwide is its ability to develop resistance⁽¹⁾. Given this, it was of fundamental importance to know the resistant strains, called MRSA (methicillin-resistant *Staphylococcus aureus*)⁽³⁾, which, by definition, are resistant to this penicillin and all other beta-lactams⁽⁵⁾ and are also responsible for the high growth of infections within the nosocomial environment⁽²⁻⁶⁾.

This etiological agent has been considered a real challenge to public health, as the limitation of treatment caused by resistance⁽⁷⁾ has been a determining factor in the higher mortality rate when compared to infections caused by non-resistant strains (Methicillin-sensitive *Staphylococcus aureus* - MSSA)⁽²⁻⁸⁾. The emergence of these resistant strains is related to the indiscriminate use of antibiotics⁽³⁾, acquisition of the R plasmid⁽⁷⁻⁹⁾, hyperproduction of b-lactamases, and the presence of an altered penicillin-binding protein (PBP). This protein is called PBP2a, encoded by the *mecA* gene in the SCCmec chromosome cassette types I, II, and III, and has a low affinity for beta-lactam antibiotics⁽⁷⁻⁸⁻⁹⁾. Another complicating factor in staphylococcal infections is the form of transmission, as they can occur directly or indirectly, where infected or simply colonized by strains of (MRSA), they can be an important risk factor for the development of infections⁽²⁾.

The growing number of *staphylococcal* infections in hospitals, strains of methicillin-resistant *Staphylococcus aureus* (MRSA), and limited treatment point to the need for effective control of the spread of these strains and awareness about the indiscriminate use of antibiotics, factors that justify the performance of this study. Based on the aforementioned, the aim of the study was to analyze, through a systematic review, the presence of MRSA colonization in healthcare professionals, since these are possible vectors in healthcare-associated infections (HAIs).

METHODS

Search strategies

The most relevant studies originally published in English in the last five years were analyzed using the Humans filter, using the MEDLINE (National Library of Medicine) databases as a reference. The search strategy used the following search phrase: (“colonization methicillin-Resistant *Staphylococcus aureus*” OR “colonization MRSA”) AND “Carrier state” AND (“health personnel” OR “Health Care Providers” OR “Health Care Provider” OR “Healthcare Providers” OR “Healthcare Provider”). The inclusion and exclusion criteria were applied freely and independently by two reviewers based on the points raised in each exposed item (Chart 1).

Chart 1. Inclusion and exclusion criteria and main results.

Design - Clinical trials - Cross-sectional studies
Population - Human health professional
Intervention - Colonization by methicillin-resistant <i>Staphylococcus aureus</i> - Hospital Environment
English – language
Exclusion criteria
Design - Any other type of study that is poorly described and inappropriate - Simulation - Investigation
Population - Patients colonized or infected with methicillin-resistant <i>Staphylococcus</i> - Animal health professional
Intervention - Interventions that are unclear or poorly described - Colonization by other microorganisms.
Form of Publication - In summary only
Main outcomes
- Colonization rate by methicillin-resistant <i>Staphylococcus aureus</i> - Risk factor for contamination/transmission - Performance of periodic screening - Decolonization therapy - Continuing education

RESULTS

Initially, 35 studies were identified, involving MRSA colonization in healthcare professionals. However, based on the application of the

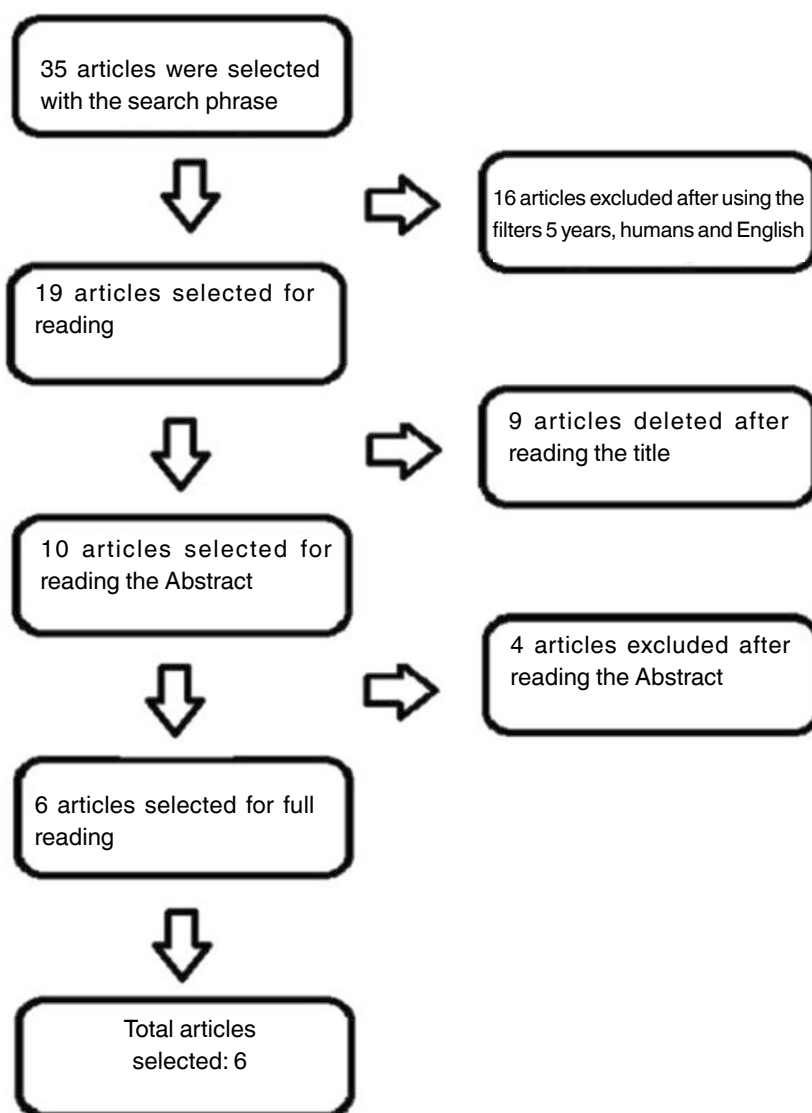
previously defined criteria, only 6 were part of the scope of this review. The selected studies were judged by independent reviewers and this process can be better visualized in the Flowchart (Flowchart 1).

In Chart 1, we can find the Summary of the studies that were part of the scope of this review as well as their main results, which verified the colonization of MRSA in healthcare professionals.

The results of the present study reveal the existence of healthcare professionals colonized by MRSA, which constitutes an important risk factor for the spread and possible cause of healthcare-associated infections - HAIs (1).

DISCUSSION

The target sectors of the studies performed by different authors were the most varied, among which the burn units, rehabilitation, pediatrics, ICU, and outpatient clinics stand out. The groups were composed of doctors, nurses, nursing technicians, physiotherapists, pharmacists, occupational therapists, administrative staff, general services, and customer service assistants, among others⁽⁵⁻¹⁰⁻¹²⁻¹¹⁻¹³⁾. However, only health professionals are part of this review, as described in the inclusion criteria. Thus, although some data indicate



Flowchart 1.

Table 1. Summary of studies related to MRSA colonization in healthcare professionals.

Study	Intervention Group	Analysis Performed	Result	Outcome
Iye <i>et al.</i> (2014).	100 individuals including doctors, nurses and technicians.	Nasal swab followed by isolation and identification by biochemical tests. TSA and PCR confirmation using primers for the <i>mecA</i> gene and coagulase gene.	73% of healthcare professionals were colonized by MRSA, 47% of whom were in the Burn Unit, 21% in the ICU and 5% in the outpatient clinic.	The rates found in the Burn Units and ICU were associated with contact with the group of high-risk patients present in these sectors. Screening programs and campaigns on the importance of hand hygiene to prevent spread.
Gomes IM <i>et al.</i> (2014).	178 healthcare professionals	Questionnaire and nasal swab followed by isolation, biochemical tests, TSA and confirmation by PCR.	51% of professionals colonized by MRSA. 16.7% of nurses were colonized.	Nurses are at the highest risk of MRSA colonization. The type of study performed may be related to the transport of MRSA within the hospital, requiring control of antibiotic resistance in the department and guidance for this class of professionals.
Ruiz A <i>et al.</i> (2014).	Administration employee, physiotherapy team, nursing, medical and others (cleaning and security staff).	Nasal swab followed by isolation and sensitivity testing. Real-time PCR was also used to detect MRSA.	24% of colonized cases detected by real-time PCR, and 1.4% by the culture and TSA method.	Hand hygiene measures, screening and decolonization therapy have been described as effective measures to control epidemics and outbreaks.
Immergluch LC <i>et al.</i> (2013).	227 health professionals including doctors, nurses and others.	Questionnaire and nasal swab followed by identification and biochemical tests. TSA and pulsed-field gel electrophoresis to identify SCCmec types II and IV, and PVL toxin.	3.1% colonized by MRSA.	Colonization rates in healthcare professionals were similar to rates reported for the general population, suggesting that current infection control and prevention standards in different outpatient clinics are adequate.
Verwer PEB <i>et al.</i> (2011).	1542 professionals divided between doctors, allied health nurses (pharmacists, physiotherapists, etc.), customer service assistant and others (students, hotel and cleaning services employees).	Questionnaire, nasal swab isolation, biochemical tests, TSA and confirmation by PCR.	3.4% of colonized professionals.	The most prevalent strains among healthcare professionals were similar to those found in the community, arguing in favor of acquisition in the community and importation into the hospital.
Legrand J <i>et al.</i> (2015).	343 professionals divided into: nurses, nursing assistants, nursing interns, administrative assistants and re-education team.	Nasal swab, identified and followed by TSA and mass spectrometry.	10% prevalence of MRSA.	Nursing assistants were those who presented a higher risk of colonization when compared to nurses, thus correlating the risk of transmission through physical contact.

that the problem goes beyond the correlation between caregivers and patients, as the authors Ruiz *et al.*, 2014 and Verwer *et al.*, 2011 highlighted general services, security, and care assistance professionals, equally colonized by MRSA data will not be considered as viable results for this discussion.

Studies performed by Gomes *et al.*, 2014, Verwer *et al.*, 2011 and Legrand *et al.*, 2015 pointed to the Nursing class as the professional most susceptible to contamination, with a colonization prevalence of

16.7%, 5.2%, and 16.1% respectively. Other authors such as Silva *et al.*, 2012, Moura *et al.*, 2011, Reinato *et al.*, 2015, Arantes *et al.*, 2013, also reveal the most varied percentages of colonization by methicillin-resistant *S aureus* 3.3%, 7.1%, 28.6%, 65.11%⁽¹⁴⁻¹⁵⁻¹⁶⁻¹⁷⁾, although their studies have assessed the susceptibility of the Nursing class alone, they all corroborate the premise that the colonization of these professionals are justified by direct contact with patients,⁽¹³⁻¹⁸⁾ as well as by delay in hospital environment⁽¹⁴⁻⁸⁾, thus leading them to a

position of transient or persistent carriers and consequently, possible spreaders of MRSA⁽¹⁴⁻¹⁸⁾. Legrand et al., 2015, in their discussion, also raises the existence of other factors involved in the dynamics of colonization by MRSA: type and pathological characteristics of the patient, the organization of Nursing care, clinical intervention performed and the variation in compliance with measures of hygiene between sectors, however, they report the inability of their study model to estimate the impact on transmission⁽¹³⁾.

It is interesting to highlight the outcome of the authors Immergluck et al., 2013 and Ruiz et al., 2014, who describe MRSA colonization rates in healthcare professionals as similar to those found in the population (3.1%) and those described in the literature (2.4%), respectively, a fact that should not be neglected, as there is extensive published evidence that attests to the great ease of dissemination of MRSA in the intra-hospital environment⁽¹⁹⁾, through direct contact⁽⁸⁻²⁰⁻²¹⁾ and, in addition, only a single carrier can be a risk factor in sectors where patients are more vulnerable⁽¹⁴⁾. It is worth noting that the reviewed literature by Albrich et al., 2008, concluded that around 5% of healthcare professionals become colonized by MRSA and develop the disease⁽²⁰⁻²¹⁾.

Evidence supports that the high percentage of 73% of healthcare professionals colonized by MRSA, according to Iyer et al., 2014, should be considered as a potential risk aspect in dissemination⁽²²⁾, however, their study did not evaluate the persistence or transience of colonization, since they are important factors related to the risk of transmission⁽¹⁴⁻²²⁾.

Direct contact with the patient, as well as prolonged time in a hospital environment, as risk factors for contamination⁽¹⁴⁻¹⁷⁾ are confirmed when evaluating the control group of Iyer et al., 2014, where 100% of students, without any exposure to this type of environment, did not show colonization by MRSA. In view of this, it is interesting to discuss the control measures for dissemination, suggested by the author, such as compliance with hand hygiene standards, continuing education, and MRSA screening. It is believed that adherence to hand hygiene standards has a positive impact on controlling the spread of this strain in hospitals since this microorganism is easily transported through the hands⁽⁸⁻¹⁴⁾. The need for continued investment in educational measures for the healthcare team is also highlighted, since through continued education it is possible to implement actions to protect, prevent, reduce, and treat MRSA infections⁽¹⁻²³⁾. Another point addressed is MRSA screening as a routine for healthcare professionals, however, it is still debatable, as despite being advantageous⁽²¹⁾, some authors suggest it only in sectors where patients are more vulnerable⁽²⁴⁾ and/or in cases of outbreaks⁽¹⁸⁻²⁰⁾, as their high cost still limits implementation⁽²⁰⁾.

In addition to the control measures mentioned by Iyer et al., 2014, the authors Ruiz et al., 2014 and Immergluck et al., 2013

also mention decolonization therapy and rational use of antibiotics. Decolonization therapy can be defined as the topical and/or systemic administration of antimicrobials or antiseptics with the aim of eradicating or suppressing the carrier's state, bearing in mind that the colonized person may be a transient, intermittent, or persistent carrier, however, still very controversial, as it seems that the heterogeneity of the results does not clearly demonstrate the benefits, being indicated by some authors as the procedure of choice in cases of outbreaks⁽²⁰⁾ or in sectors where patients are more susceptible and at risk of death⁽¹⁴⁾. It is known that the rational use of antibiotics is an important factor in minimizing the selection of antimicrobial resistance⁽²⁵⁻²⁶⁾, as MRSA strains are also frequently resistant to other classes of antibiotics such as aminoglycosides, macrolides, and quinolones, thus proving to be as a microorganism with great potential for multidrug resistance⁽⁵⁻⁷⁻¹⁹⁾.

It is worth mentioning that among the findings of Verwer et al., 2011, a high percentage of 81.1% of MRSA strains was found to be similar to those found in the CA-MRSA community (Community-associated-MRSA). It is suspected that importation into the hospital environment is more likely through the influx of contaminated and/or colonized patients⁽³⁻¹³⁾ than through healthcare professionals⁽¹³⁾. These strains have a different profile when compared to hospital HA-MRSA strains, as they carry the cassette chromosome mec (SCCmec) types IV and V⁽⁴⁾, which confers resistance to beta-lactam antibiotics while being susceptible to most other antimicrobials. A priori, these data can change the hospital epidemiological profile⁽³⁾ and exempt health professionals as responsible for transmission due to the increased prevalence of CA-MRSA in the community⁽²¹⁾. It can be seen that MRSA colonization in healthcare professionals has a worldwide distribution (Saudi Arabia, Brazil - Niterói/RJ, Ecuador - Quito, United States - Atlanta, Australia, and France) allowing to show that the problem of multi-resistance to antibiotics and infections related to healthcare are globalized issues⁽⁶⁻¹⁴⁻¹⁹⁾ and deserve special attention in the control and dissemination of these superbugs in the hospital environment⁽¹⁾.

CONCLUSION

This review demonstrates that there is colonization by MRSA in healthcare professionals and points to the risk of transmission of this microorganism through direct contact, which may therefore result in an increase in the occurrence of infections related to healthcare. Therefore, there is a need to raise awareness among the entire multidisciplinary team regarding compliance with hand hygiene standards, the rational use of antibiotics, and the importance of continued education as protection, prevention, and control measures, to contribute to patient safety and reduce the incidence of hospital infections.

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