Colonization of methicillin-resistant Staphylococcus aureus among healthcare students: an integrative review

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INTRODUCTION

Staphylococcus aureus is considered to be a persistent member of the human endogenous microbiota and has historically been associated with important and serious cases of infection. It has the ability to rapidly develop resistance to antibiotics. Methicillin-resistant Staphylococcus aureus (MRSA) is considered to be a paradigm for bacterial infections, since it is associated with high rates of morbidity and mortality.¹-³

In assisting carriers of bacterial infections or colonized or infected patients, or in handling contaminated objects, healthcare workers’ hands can become contaminated. These workers may subsequently transmit the microorganism to other patients. However, this situation is not exclusive to the hospital environment. Clinically manifested diseases in the community or in professionals and/or patients may lead to situations in which some individuals are asymptomatic carriers, also called colonized individuals or simply carriers, when the disease is present in the host organism without causing apparent manifestations.¹,⁴ In the United States and Taiwan, the prevalence of strains acquired in the community is 52%, thus exceeding the proportion of strains acquired in hospital environments.⁵ There have also been reports of cases of MRSA acquired in the community.⁶-⁷

Healthcare students play an important role in the epidemiology and pathogenesis of Staphylococcus aureus infection and can act as a source of dissemination both in the community and in hospital environments, and for carrying bacteria from one of these environments to another.¹

In Brazil, this topic has been little addressed, but it is known that the presence of MRSA among students has been gradually spreading.¹ Hence, it has become relevant to summarize the knowledge of MRSA that has resulted from research on this subject.

OBJECTIVE

The objective of this study was to identify in the literature the prevalence of colonization by methicillin-resistant Staphylococcus aureus among healthcare students.
METHODS

Research design
This study was an integrative review of the literature, incorporating a method of searching for secondary data. To preserve methodological rigor, the following steps were taken to conduct this review: formulation of the research question; idealization of sampling plan and data collection strategies; extraction of relevant data from studies included in the review; and, finally, analysis and interpretation of the data.

The research question was elaborated in accordance with the PVO strategy (P – population; V – variable of interest; O – outcome). Thus, in line with the objective of the study, the following structure was used: P - healthcare students; V – methicillin-resistant Staphylococcus; O – prevalence. Therefore, the following question was asked: “What evidence is available in the literature regarding the prevalence of methicillin-resistant Staphylococcus aureus colonization among healthcare students?”

Data collection period
Searching for and selection of studies took place between the months of November 2019 and January 2020 and were carried out by two independent reviewers. Any divergences were resolved by a third reviewer.

Selection criteria
After the search stage, original articles were selected, based on reviewing their titles and abstracts, in accordance with the following inclusion criteria: original articles covering the population of undergraduate students in the field of healthcare who experienced clinical activities that brought them into direct contact with patients.

The full text of each article was then read, with a view to choosing studies that answered the research question. Through this process, articles involving high school or technical students, those that did not comply with selection criteria mentioned above, those that did not answer the research question and those that were duplicates were excluded, as also were opinion articles, theoretical reflections, dissertations and book chapters.

Data collection
The following databases were selected: Medical Literature Analysis and Retrieval System online (MEDLINE) via National Library of Medicine National Institutes of Health (PubMed); Cumulative Index to Nursing and Allied Health Literature (CINAHL); Web of Science; Scopus; and Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS) via Biblioteca Virtual em Saúde (BVS).

The descriptors and keywords used in the search were applied in accordance with particularities of each database. They were obtained by consulting the Descritores em Ciências da Saúde (DeCS), Medical Subject Headings (MeSH) and titles from CINAHL. During the search, descriptors were cross-referenced with each other using the Boolean operators “or” and “and”. Descriptors were inserted in the English language, since all journals indexed in these databases have descriptors in English in their articles; with the exception of BVS, in which descriptors were inserted in English and Portuguese. To expand the search, there was no limitation on the time of publication or language. Table 1 shows the descriptors used in this study and summarizes how the search was carried out.

Table 1. Descriptors used in the search strategy for primary articles. Teresina (PI), Brazil, 2020

| Data Source          | Descriptors and Keywords                                                                 |
|----------------------|-------------------------------------------------------------------------------------------|
| BVS                  | Estudantes OR Estudantes de Ciências da Saúde OR Estudantes de Enfermagem OR Estudantes de Farmácia OR Estudantes de Medicina OR Aluno OR Alunos OR Estudante OR Enfermeiras Estudantes OR Alunos de Enfermagem OR Estudante de Enfermagem OR Enfermeiros Estudantes Staphylococcus aureus Resistência à meticilina |
| PubMed/ WEB OF SCIENCE/ SCOPUS | “Students” OR “Students, Health Occupations” OR “Students, Nursing” OR “Students, Pharmacy” OR “Students, Medical” OR Students, Dental” OR “Health Occupations Students” OR “Health Occupations Student” OR “Student, Nursing” OR “Nursing Student” OR “Nursing Students” OR “Pharmacy Students” OR “Student, Pharmacy” OR “Pharmacy Student” OR “Medical Students” OR “Student, Medical” OR “Medical Student” OR “Dental Students” OR “Student, Dental” OR “Dental Student” |
|                      | “Staphylococcus aureus” OR “Methicillin Resistance” OR “Resistance, Methicillin” OR “Methicillin-Resistant” OR “Methicillin Resistant” |
| CINAHL               | Students, Health Occupations Staphylococcus aureus Methicillin-Resistant Staphylococcus Aureus |
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Data processing and analysis

The studies thus found were exported to the Endnote reference manager software, version 20 (Clarivate Analytics, Philadelphia, United States), in order to identify duplicates and gather together all publications. In addition, the reference lists of these articles were consulted in order to find any additional studies. The selection of studies followed the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)9 (Figure 1).

For data analysis and extraction, a data collection instrument that had been validated by Ursi was chosen for this study and was adapted for use in it.10 Furthermore, the protocol for this review was previously assessed by experts in the method used. After fully evaluating the texts, a descriptive analysis on the results found was carried out, in which a synthesis of all the studies included in the review was presented, along with comparisons between them.

RESULTS

The final sample for this review comprised 30 primary articles, which were characterized taking into account the authors, year of publication, country, objective and main results (Table 2). These studies were published in the years 2010, 2012, 2013, 2014, 2015, 2016, 2017, 2018 and 2019.3,5,7,11-37

Regarding the locations of the studies, they were carried out in Brazil, Malaysia, Colombia, China, Palestine, Spain, Brunei, India, Turkey, Czech Republic, Saudi Arabia, Madagascar, Pakistan, Nepal, Tanzania, South Korea, Iran, Ireland, Jordan, Italy, Nigeria, Poland and Ethiopia.3,5,7,11,12,14-22,24-37

The populations addressed by the researchers of these 30 studies were nursing students, medical students, health science students and dental students.3,5,7,12-14,20,21,23-25,27-29,30,33-37 Two studies involved students from more than one undergraduate course.11,22,28

To detect colonizing microorganisms, samples were collected using the technique of swab smears from nasal specimens, in all of these studies except for four studies, in which specimens were collected from more than one anatomical site.3,5,7,15-17,23,27,30,33-37

Regarding the prevalence of MRSA, the student population in some studies was divided into groups before exposure to healthcare and after such exposure.14,19,21,23,26 The percentages found are shown in Table 3.

Figure 1. Study selection flowchart. Teresina (PI), Brazil, 2020.
Table 2. Characterization of studies included in this review (n = 30). Teresina (PI), Brazil, 2020

| Article | Authors/Year | Location | Objective | Site |
|---------|--------------|----------|-----------|------|
| A1      | Prates et al.11 2010 | Brazil | To determine the prevalence of nasal transportation of S. aureus in university students. | Nostrils |
| A2      | Syafinaz et al.12 2012 | Malaysia | To determine the prevalence of S. aureus nasal carriers among medical students. | Nostrils |
| A3      | Bettin et al.13 2012 | Colombia | To investigate the nasal transportation of Panton-Valentin leukocidin-positive S. aureus strains, categories of transportation and risk factors associated with colonization, in medical students. | Nostrils |
| A4      | Chen et al.14 2012 | China | To investigate whether clinical exposure in the hospital affects MRSA nasal transportation among medical students. | Nostrils |
| A5      | Sabri et al.16 2013 | Palestine | To determine the prevalence of nasal transportation of S. aureus and MRSA. | Nostrils |
| A6      | López-Aguilera et al.18 2013 | Spain | To determine the prevalence of nasal carriers of sensitive and methicillin-resistant S. aureus and evaluate knowledge of and adherence to hand hygiene among students. | Nostrils |
| A7      | Mat Azis et al.17 2014 | Malaysia | To evaluate the transportation of S. aureus and its persistence in students of health sciences. | Nostrils |
| A8      | Malik et al.19 2014 | Brunei | To determine the prevalence of the status of nasal carrier of S. aureus and MRSA among healthy young people. | Nostrils |
| A9      | Krishnamurthy et al.19 2014 | India | To examine the influence of exposure to the hospital environment on MRSA transportation, MRSA antimicrobial resistance patterns and presence of genes that encode five determinants of extracellular pathogenicity. | Nostrils, throat and hand palms |
| A10     | Demirel et al.20 2014 | Turkey | To investigate the prevalence of methicillin-sensitive (CA-MSSA) and resistant (CA-MRSA) S. aureus, including inducible sleepers (ID-MRSA), in S. aureus and MRSA strain genotypes from nasal cultures. | Nostrils |
| A11     | Renushri et al.21 2014 | India | To assess the influence of exposure to the hospital environment on MRSA transportation. | Nostrils and throat |
| A12     | Ribeiro et al.22 2014 | Brazil | To identify S. aureus and MRSA in university students. | Nostrils and palm hands |
| A13     | Holý et al.24 2015 | Czech Republic | To determine the prevalence of nasal transportation of S. aureus and MRSA in healthy people aged 18–26 years. To find out whether the prevalence of nasal transportation strains of S. aureus and MRSA varies over the years of studies. To compare general medical students from year 1 and year 5 for nasal transportation of S. aureus and MRSA strains. | Nostrils |
| A14     | Zakai et al.23 2015 | Saudi Arabia | To identify MRSA nasal carrier status among medical students during their clinical rotations. | Nostrils |
| A15     | Collazos Marín et al.25 2015 | Colombia | To establish the genetic diversity of S. aureus isolates and detect the presence of mecA gene in isolated strains in asymptomatic medical students who were in their clinical rotation phase in a hospital. | Nostrils |
| A16     | Petti et al.26 2015 | Italy | To evaluate the MRSA carrier rate in a sample of dental students. | Nostrils, throat and palm hands |
| A17     | Hogan et al.27 2016 | Madagascar | To examine the prevalence and clonal epidemiology of nasal S. aureus and MRSA among healthcare professionals and non-medical university students. | Nostrils |
| A18     | Javaeed et al.28 2016 | Pakistan | To assess the prevalence of MRSA transportation in healthy medical students. | Nostrils |
| A19     | Subri et al.29 2016 | Malaysia | To determine the prevalence of nasal colonization of S. aureus and its susceptibility to antibiotics among pre-clinical and clinical physicians and nursing students. | Nostrils |
| A20     | Ansari et al.30 2016 | Nepal | To evaluate the rate of nasal colonization of S. aureus, its methicillin-resistant strains and risk factors in medical students before clinical exposure. | Nostrils |
| A21     | Okamo et al.31 2016 | Tanzania | To determine the prevalence of S. aureus and MRSA nasal transportation among medical students, and the antimicrobial susceptibility of isolated profiles of S. aureus, and to verify the association of S. aureus nasal transportation with demographic and clinical characteristics. | Nostrils |

Continue…
DISCUSSION
Worldwide, occurrence of healthcare-associated infections (HAI) is one of the main public health problems, with severe human and economic repercussions. According to the Centers for Disease Control and Prevention (CDC), MRSA infections have outperformed HIV as the leading cause of morbidity and mortality in the United States.38

Studies have revealed high prevalence of MRSA in patients and healthcare professionals with exposure to the healthcare system.23,38,39 However, the results systematized in the present study revealed that presence of MRSA has also been reported among non-hospitalized healthy individuals, such as undergraduate students, ranging from 0.0% to 15.3%.14,25,26

Data in the literature have highlighted occurrences of MRSA infection in healthy populations that live in agglomerations or experience such conditions but which have little or no contact with healthcare services, as is the case of undergraduate students within the field of healthcare.1,40 This was observed in the present study, thus indicating that MRSA infection was present in students who were not exposed to hospital environments. This may indicate the presence of community-acquired MRSA strains.1 It needs to be borne in mind that in the studies discussed here, students who had been hospitalized within the last few months had been excluded, considering that hospitalization could be a confounding factor for occurrences of MRSA.

Identification of high frequencies of MRSA in students before they were exposed to experiences of clinical care is a matter for concern. It indicates that there is a need for effective infection prevention and control policies, in relation to hygiene and surveillance.5

Clinical practice among students in the field of healthcare is part of the teaching-learning process. In relation to this process, there is exposure to occupational risks, especially through recognition of the variability of care provided to patients.1,5 In this regard, studies that have addressed the prevalence of MRSA among students after exposure to hospital environments can provide evidence that exposure to MRSA in hospitals can play a critical role in achieving nasal colonization by MRSA.

According to the literature, the nostrils are the main colonization site for Staphylococcus aureus, whose prevalence reaches, on average, 40% in the adult population.12,6 Possibly for this reason, the nasal
The throat and palms are also important reservoirs for MRSA.19,21,22,26 It is known that students in the field of healthcare, as they progress through the curriculum with increasing complexity of care practices, whether in hospitals or other healthcare delivery environments, become carriers of microbes. In this, acquisition of Staphylococcus aureus is considered to be a major concern, especially with regard to MRSA.1

Thus, MRSA rates in students may increase according to their clinical exposure, as well as from isolated occurrences. In another study, there was greater potential for virulence in samples from groups working in clinics.3 This aspect of infection could not be analyzed in the present study, since the studies included in this review were cross-sectional, which did not allow the study sample to be monitored.

The prevalences found need to be analyzed with caution, considering that occurrences of infections caused by MRSA may differ according to the scenarios within which they occur. This may be due to measures that are taken to control infection and may be dependent on effective implementation.5 Likewise, the MRSA rate also varies in different locations.27,41

This study presented some limitations due to the choice of databases and keywords. Use of the CINAHL database may have restricted the search, as it is a specific database for the field of nursing. In addition, the choice of databases and keywords may have camouflaged studies on the same topic that were not indexed in the same database. Hence, it can be suggested that similar investigations should be conducted, with cross-referencing of other databases, in order to investigate Brazilian scientific production on colonization by Staphylococcus aureus among healthcare students.

CONCLUSION

The prevalence of colonization by methicillin-resistant Staphylococcus aureus among healthcare students is high, and the nasal cavity was cited in this study as an important reservoir for these microorganisms.

Efforts need to be made to implement standards and routines that are designed to limit the spread of MRSA strains among students, given that once MRSA has become established within a community, its eradication and control is difficult. Furthermore, in view of the high morbidity and mortality and exponential growth of series of microbial resistance, implementation of control strategies is prudent.

Therefore, education on infection control measures in undergraduate healthcare courses is of great importance, as also is implementation of adequate and effective infection control programs to reduce the prevalence of MRSA.

REFERENCES
1. Carvalho MS, Andrade DF, Sousa AF, et al. Nasal colonization with Staphylococcus aureus in nursing students: ground for monitoring. Rev Bras Enferm. 2016;69(6):1046-51. PMID: 27925079; https://doi.org/10.1590/0034-7167-2016-0210.
2. Abulkasim GS, Shukla HK, Masih H. Antimicrobial resistance of staphylococcus aureus among healthy and adult students. Int J Pharm Sci Res. 2017;8(12):5247-51. Available from: https://ijpsr.com/bft-article/antimicrobial-resistance-of-staphylococcus-aureus-among-healthy-and-adult-students/?view=fulltext. Accessed in 2021 (May 10).
3. Hogan B, Rakotozandrindrainay R, Al-Emran H, et al. Prevalence of nasal colonisation by methicillin-sensitive and methicillin-resistant Staphylococcus aureus among healthcare workers and students in Madagascar BMC Infect Dis. 2016;16(1):420. PMID: 27526771; https://doi.org/10.1186/s12879-016-1733-6.
4. Almeida GCM, Lima NG, Santos MM, Melo MCN, Lima KC. Colonização nasal por Staphylococcus sp. em pacientes internados. Acta Paul Enferm. 2014;27(3):273-9. https://doi.org/10.1590/1982-0198201400046.
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5. Efa F, Alemu Y, Beyene G, Gudina EK, Kebede W. Methicillin-resistant Staphylococcus aureus carriage among medical students of Jimma University, Southwest Ethiopia. Helyon. 2019;5(1):e01191. PMID: 30775580; https://doi.org/10.1016/j.helyon.2019.e01191.

6. Moremi N, Claas H, Vogel U, Mshana SE. The role of patients and healthcare workers Staphylococcus aureus nasal colonization in occurrence of surgical site infection among patients admitted in two centers in Tanzania. Antimicrob Resist Infect Control. 2019;8:102. PMID: 31236269; https://doi.org/10.1186/s13756-019-0155-y.

7. Abroo S, Hosseini Jazani N, Sharifi Y. Methicillin-resistant Staphylococcus aureus nasal carriage among healthy students of medical and nonmedical universities. Am J Infect Control. 2017;45(7):709-12. PMID: 28359610; https://doi.org/10.1016/j.ajic.2017.02.034.

8. Galvão CM, Mendes KDS, Silveira RCCP. Revisão integrativa: método de revisão para sintetizar as evidências disponíveis na literatura. In: Brevidelli MM, Sertónio SCM, editors. Trabalho de conclusão de curso guia prático para docentes e alunos da área da saúde. São Paulo: Iátria; 2010. p. 105-26.

9. Abd-El-Hamid MM. Methicillin-resistant Staphylococcus aureus carriage among medical students at a Taiwanese university. Int J Infect Dis. 2012;16(11):e799-823. PMID: 22846119; https://doi.org/10.1016/j.ijid.2012.06.017.

10. Prates KA, Torres AM, Garcia LB, et al. Nasal carriage of methicillin-resistant Staphylococcus aureus in university students. Braz J Infect Dis. 2010;14(3):316-8. PMID: 20835520.

11. Syafinaz AM, Nur Ain NZ, Nadzirahi SN, et al. Staphylococcus aureus nasal carriage among medical students of Malaysian nonmedical universities. Am J Infect Control. 2017;45(6):636-8. PMID: 23770966.

12. Efa F, Alemu Y, Beyene G, Gudina EK, Kebede W. Methicillin-resistant Staphylococcus aureus isolates in three different Arab world countries. Eur J Microbiol Immunol (Bp). 2011;3(3):183-7. PMID: 24265936; https://doi.org/10.1556/EuMI.3.2013.3.5.

13. Mat Azis N, Hamid AAB, Punng-HP, et al. Staphylococcus aureus infection risk in a population of health sciences students at a public university. Iranian J Publ Health 2014;43(Suppl 12):112-6. Available from: https://jipm.tums.ac.ir/index.php/jipm/article/view/4887. Accessed in 2021 (May 10).

14. Malik NFA, Muharram SH, Abiola O. Staphylococcus aureus nasal carriage in young healthy adults in Brunei Darussalam. Brunei Int Med J. 2014;10(2):78-84.

15. López-Aguilera S, Goñi-Yeste M del M, Barrado L, et al. Colonización nasal por Staphylococcus aureus en estudiantes de medicina: importancia en la transmisión hospitalaria [Staphylococcus aureus nasal colonization in medical students: importance in nosocomial transmission]. Enferm Infeccc Microbiol Clin. 2013;31(8):500-5. PMID: 23352260; https://doi.org/10.1016/j.eimc.2012.12.005.

16. Sabri I, Adwan K, Essawi TA, Farraj MA. Molecular characterization of methicillin-resistant Staphylococcus aureus isolates in three different Arab world countries. Eur J Microbiol Immunol (Bp). 2011;3(3):183-7. PMID: 24265936; https://doi.org/10.1556/EuMI.3.2013.3.5.
28. Subri NIBM, Hlaing SS, Myint, T, et al. Nasal Carriage of Staphylococcus aureus and Its Antibiotic Susceptibility Pattern among Medical and Nursing Students. Asian J Pharm. 2016;10(4):736-40. https://dx.doi.org/10.22377/ajp.v10i04.917.

29. Ansari S, Gautam R, Shrestha S, et al. Risk factors assessment for nasal colorization of Staphylococcus aureus and its methicillin resistant strains among pre-clinical medical students of Nepal BMC Res Notes. 2016;9:214. PMID: 27068121; https://doi.org/10.1186/s13104-016-2021-7.

30. Okamo B, Moremi N, Seni J, et al. Prevalence and antimicrobial susceptibility profiles of Staphylococcus aureus nasal carriage among pre-clinical and clinical medical students in a Tanzanian University. BMC Res Notes. 2016;9:47. PMID: 26817605; https://doi.org/10.1186/s13104-016-1858-0.

31. Baek YS, Baek SH, Yoo YJ. Higher nasal carriage rate of methicillin-resistant Staphylococcus aureus among dental students who have clinical experience. J Am Dent Assoc. 2016 May;147(5):348-53. PMID: 26778005; https://doi.org/10.1016/j.adaj.2015.12.004.

32. Radhakrishna M, Taneja A, Rao P. Nasal carriage of Staphylococcus aureus with special emphasis on methicillin-resistant Staphylococcus aureus among students of a south Indian medical college - prevalence and antibiogram pattern. Asian J Pharm Clin Res. 2016;9(8):129-32. https://doi.org/10.22159/ajpcr.2016.v9i8.13274.

33. Budri PE, Shore AC, Coleman DC, et al. Observational cross-sectional study of nasal staphylococcal species of medical students of diverse geographical origin, prior to healthcare exposure: prevalence of SCCmec, fusC, fusB and the arginine catabolite mobile element (ACME) in the absence of selective antibiotic pressure. BMJ Open. 2018 Apr 20;8(4):e020391. PMID: 29678979; http://dx.doi.org/10.1136/bmjopen-2017-020391.

34. Al-Tamimi M, Himswai N, Abu-Raideh J, Jazar DA, Al-jawaldeh H, Mahmoud SAH. Nasal colonization by methicillin-sensitive and methicillin-resistant Staphylococcus aureus among medical students. J Infect Dev Ctries 2018;12(5):326-35. https://doi.org/10.3855/jidc.9908

35. Suhali Z, Raife P, Mat Azis N, et al Characterization of resistance to selected antibiotics and Panton-Valentine leukocidin-positive Staphylococcus aureus in a healthy student population at a Malaysian University. Germs 2018(8):121-30. PMID: 29564245; https://doi.org/10.1186/s40141-018-02129.

36. Onanuga A, Eboh DD, Okou GT. Antibiogram and Virulence Characteristics of Multi-drug Resistant Staphylococcus aureus from Nasal Cavity of Healthy Students of Niger Delta University, Amassoma, Bayelsa State, Nigeria. Journal of Clinical and Diagnostic Research. 2019;13(7):24-9. https://doi.org/10.7860/JCDR/2019/41396.13031.

37. Szymanek-Majchrzak K, Kosiński J, Żak K, et al. Prevalence of methicillin resistant and mupirocin-resistant Staphylococcus aureus strains among medical students of Medical University in Warsaw. Przegl Epidemiol. 2019;73(1):39-48. PMID: 31134773; https://doi.org/10.32394/pe.73.05.

38. Centers for disease control and prevention (CDC). Healthcare-associated infections. Current HAI Progress Report. 2019 National and State Healthcare-Associated Infections Progress Report. Available from: http://www.cdc.gov/hai/progress-report/index.html. Accessed in 2021 (May 10).

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