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Frequency of Methicillin Resistant *Staphylococcus Aureus* carriers in Intensive Care Unit Staff of Tertiary Care Hospitals

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ABSTRACT

Objective: To investigate and compare the frequency of MRSA carriers among medical and surgical Intensive Care Unit staff in Tertiary Care Hospitals.

***Study Design*:** Cross-sectional comparative study.

***Place and Duration of Study*:** Department of Medicine, Two Tertiary Care Hospitals, Rawalpindi Pakistan, from Mar to May 2022.

Methodology: A total of 134 ICU staff in different working shifts, including consultants, residents, nurses, paramedics, ward attendants, and sanitary workers, were subjected to nasal swabs, which were sent for culture and sensitivity. The nasal swab culture was found to be positive and negative for MRSA.

Results: Out of 70 individuals from the surgical ICU, 12(17.14%) tested positive for MRSA, while 8(11.4%) out of 64 individuals from the medical ICU tested positive for MRSA (p=0.568). The overall MRSA carriage among ICU staff was found to be 14.9%. Out of these 20(14.9%) individuals, 3 were doctors, 4 nurses, 10 paramedical staff, 1 ward attendant, and 2 sanitary workers. Only 7(35%) had confirmed contact with MRSA patients within the last 2 months, and 15(11.2%) had received prior decolonization. A total of 44(32.8%) out of 134 individuals had contact with a MRSA-carrier patient in the last 2 months. 27(20.1%) individuals had received prior decolonization for MRSA carriage, with a mean duration of 5.37±4.404 months.

Conclusion MRSA is an important superbug in our ICUs. With the use of prophylactic and gunshot therapies in intensive care units, these bacteria tend to acquire resistance to the anti-microbial agents, rendering our most expensive and last line of defence ineffective.

Keywords: Decolonization, Intensive care unit staff, MRSA carrier.

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INTRODUCTION

Methicillin-resistant *Staphylococcus aureus* was discovered in 1961, sometime after Methicillin was developed for *Staphylococcus aureus* strains that had become resistant to penicillin. Its use led to the emergence of Methicillin-Resistant S. aureus (MRSA).[1,2] Literature has shown that 13-74% of worldwide *Staphylococcus aureus* infections are resistant to Methicillin. The prevalence of *S. aureus* infections in Asia and the Western Pacific region is difficult to establish; however, data from these regions identify *MRSA* as an important superbug, with an incidence ranging from 2.3 to 69.1%.[3] The prevalence of MRSA varies in different areas of the world, ranging from low prevalence in some European countries to the highest prevalence in some parts of America and Asia.[4,5]

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Methicillin-resistant *Staphylococcus aureus* (MRSA) has become a cause for serious concern in the intensive care units of hospitals because of the expensive treatment and care of MRSA-infected patients.[6] However, rather than originating from the community, MRSA is typically acquired through hospital-based patient care, as many healthcare staff members carry this superbug as an occupational hazard. They usually acquire it from the patients they look after, who receive a number of antibiotics during their stay in the intensive care unit.[7] Therefore, it is of paramount importance that healthcare staff are routinely screened and treated for MRSA carriage in order to avoid transmission to patients.[8] Studies conducted in ICU settings have questioned the need for MRSA screening even among ICU staff and suggested that simpler strategies aimed at preventing all health-care-associated infections, including MRSA, such as hand hygiene and scrubbing with antiseptic soaps, are a much better strategy to adopt in a resource-limited setting.[9,10]

All healthcare staff caring for patients in the wards should adopt this practice, as it will significantly reduce hospital expenses. The study was conducted to determine and compare the frequency of MRSA carriers among medical and surgical intensive care unit staff at the tertiary care hospitals.

METHODOLOGY

The cross-sectional comparative study was conducted at the Medical and Surgical Intensive Care Units of two Tertiary Care Hospitals, from March 2022 to May 2022 after obtaining approval from the Hospital Ethical Committee (ERC Certificate A/28/203/EC/468/2022). Consecutive sampling was conducted, and all individuals working in the intensive care units of both hospitals were considered for the study.

Inclusion Criteria: All ICU staff working in different shifts, including consultants, residents, nurses, paramedics, ward attendants, and sanitary workers, who have been working in the intensive care unit for a minimum of 2 months, were enrolled in the study.

Exclusion Criteria: All individuals who did not consent for the nasal swab test were excluded.

Out of a total of 174 individuals of all ranks and files working the 2 units, after exclusion criteria, a total of 134 individuals were subjected to nasal swabs sent for culture and sensitivity to the microbiology department. Swabs were taken by an experienced technician from the microbiology department using dry swabs sterilised with ethylene oxide. Blood, McConkey, and DNAse agar were used for inoculation. A positive catalase and coagulase test on day 1 showed that the growth on blood and McConkey agar was indeed Staphylococcus aureus. This was further confirmed by a zone of clearing around the inoculation on DNAse agar as compared with the positive control. A 0.5 Macfarland unit suspension was made from the colony and streaked on Wilkins Charlegreen agar with a 0.7-mm cefoxitin disc. On day 2, the sensitivities' results were noted. A zone of ≤23 mm was interpreted as positive for MRSA. After 5 days, culture reports of the swabs were collected, and the results were compiled in a tabulated proforma.

Statistical Package for Social Sciences (SPSS) version 23.0 was used for the data analysis. Quantitative variables were expressed as Mean±SD and qualitative variables were expressed as frequency and percentages. Chi-square test was applied to explore the inferential statistics. The *p*-value of ≤0.05 was set as the cut-off value for significance.

RESULTS

A total of 134 individuals were subjected to nasal swabs for culture and sensitivity. They had a mean age of 32.6±7.5 years. 70(52.2%) individuals were working in the surgical intensive care unit, while 64(47.8%) were working in the medical intensive care unit. 4(2.9%) were consultants or Intensivists. 19(14.2%) residents worked eight hourly shifts in two-person teams (Figure-1). Twelve (8.9%) house officers were also present round the clock, working in 12-hour shifts as two-person teams. There were 24(17.9%) nurses, 57(42.5%) were paramedical staff, 9(6.7%) were ward attendants, and 9(6.7%) were sanitary workers.

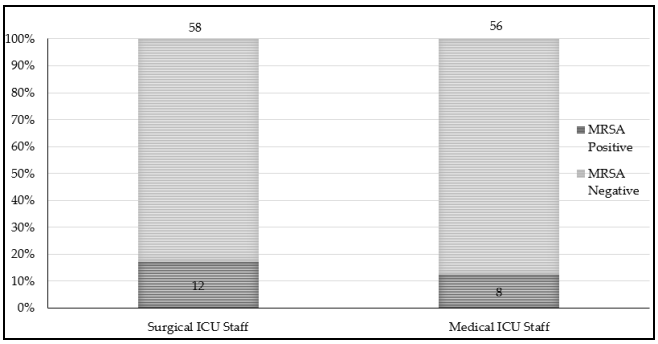

Figure-1: MRSA Carriage in Surgical / Medical ICU

Out of 70 individuals from the surgical ICU, 12(17.14%) tested positive for MRSA, while 8(11.4%) out of 64 individuals from the medical ICU tested positive for MRSA (<0.001). The frequency of MRSA carriage among ICU staff was found to be 14.9% (Table).

Table-I: Frequency of MRSA Carriage in Different Individuals (n=134)

Job Description	MRSA Culture Result		*p*-value
	Positive 20(14.8%)	Negative 114(85.0%)	
Consultant 4(2.9%)	0	4(2.9%)	<0.001
Resident 19(14.1%)	1(0.7%)	18(13.4%)	
House Officer 12(8.9%)	2(1.49%)	10(7.4%)	
Nurse 24(17.9%)	4(2.9%)	20(14.8%)	
Paramedical Staff 57(42.5%)	10(7.4%)	47(35.0%)	
Ward Attendant 9(6.7%)	1(0.7%)	8(5.9%)	
Sanitary worker 9(6.7%)	2(1.49%)	7(5.2%)	

Out of these 20(14.9%) individuals, 3 were doc-tors, 4 nurses, 10 paramedical staff, 1 ward attendant, and 2 sanitary workers. Out of these individuals, only 7(35%) had confirmed contact with a MRSA patient within the last 2 months, while 13(65%) individuals did not recall any such encounter. A total of 44(32.8%) individuals had contact with a MRSA-carrier patient in the last 2 months. For MRSA carriage, 27(20.1%) individuals had received prior decolonization, with a mean duration of 5.37±4.404 months and a range of 2–24 months. Out of 20(14.9%) individuals who tested positive for MRSA carriage, 15(11.2%) had received prior decolonization (Figure-2).

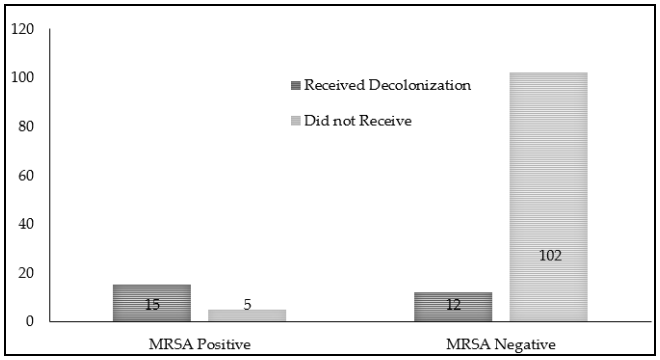

Figure-2: Prior Decolonization of ICU Staff

DISCUSSION

The study was carried out with the aim of highlighting the burden of MRSA in our country's intensive care settings and bringing to the attention of higher authorities that antimicrobial stewardship is of paramount importance if we want to sustain our healthcare system for the underprivileged class as well. Antibiotics have changed our healthcare for the better because starting them promptly saves lives and improves outcomes. However, even in a developed country like the USA, where practices are strictly within the confines of the guidelines, more than 50% of the antibiotic prescriptions are either unnecessary or suboptimal.[11,12] This has led to the development of resistance among the microbes, causing multidrug-resistant strains to emerge.

Because MRSA infections kill more people when they are very sick, new research shows that MRSA nasal assays that use PCR can be used to quickly check for MRSA pneumonia. These assays have been shown to have high negative predictive values and thus allow clinicians to provide shorter empiric coverage.[13]

Our study demonstrated that the frequency of MRSA in ICU staff was 14.9%, which is quite high when compared to the previous study, i.e., 13%.[14] Reasons for such a high frequency in our healthcare setups largely remain a lack of resources and training for handling infectious materials and barrier nursing.

Most of the individuals with MRSA carriage were nurses or paramedical staff because of their close involvement in patient care. Compared to the nursing staff, doctors do not frequently interact with patients in intensive care, which could explain the higher rate of MRSA carriage in this group. The few times a doctor does make contact with the patient, it has been observed that he or she usually takes adequate measures for infection control, such as hand hygiene before and after the contact and wearing disposable personal protective equipment.[15] It was initially thought that the higher prevalence was probably due to working hours per week and physical fatigue. A general inquiry from the paramedical staff, however, revealed that they had 48 working hours per week, with a 40-hour break period per week. This is consistent with the standards set by the NHS21 in the United Kingdom. The training standards of the paramedical staff were unfortunately not up to the mark.[16]

Another observation revealed a lower MRSA frequency (12.5%) among medical ICU staff compared to surgical ICU staff (17.1%), a finding that is quite contradictory given the perceived superiority of surgical ICU practices over those of the medical ICU. However, this result does not have statistical significance (p<0.001). Less than half of the individuals who had tested positive for MRSA had a confirmed encounter with a MRSA-positive patient within the last 2 months, and most of them did not recall dealing with such a patient in the near past. In both ICUs, there was a separate room or area for isolating such patients. It had a dedicated donning and doffing area with gowns, gloves, head and shoe covers, and hand sanitizer.

Out of the 20(14.9%) carriers, 15(11.1%) had received prior decolonization for MRSA carriage with intranasal mupirocin and chlorhexidine baths. This indicated either MRSA re-acquisition or failed bug clearance despite repeated decolonization. A total of 44 individuals had received prior decolonization, indicating that it had been successful for at least 65.9% of individuals. This rate of success is similar to that reported by Langford *et al*.[17] Another study by Pineda

et al. found that MRSA decolonization with the same regimen was successful at 39%.[18]

Our study has specifically targeted the population of health care workers presumed to be at the highest risk of acquiring MRSA because they work in a closed environment in a tertiary care hospital ICU. The worst of the resistant infections are found in ICU environments, owing to the use of prophylactic antibiotic coverage for the critically ill. With the overall rise of drug-resistant infections in Pakistan, surveillance is mandatory not only for patients and the general population, but also for doctors.[19,20]

CONCLUSION

MRSA is an important superbug in our ICUs. With the use of prophylactic and gunshot therapies in intensive care units, these bacteria tend to acquire resistance to the antimicrobial agents, rendering our most expensive and last line of defence ineffective.

Conflict of Interest: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

MH & AM: Data acquisition, data analysis, data interpretation, critical review, approval of the final version to be published.

AA & MY: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

HAS: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Andrade MM, Luiz WB, Souza RDO, Amorim JH. The History of Methicillin-Resistant Staphylococcus aureus in Brazil. Can J Infect Dis Med Microbiol 2020; 1721936. https://doi.org/10.1155/2020/1721936
2. Benner EJ, Kayser FH. Growing clinical significance of methcillin-resistant Staphylococcus aureus. Lancet 1968; 2(7571): 741-744. https://doi.org/10.1016/s0140-6736(68)90947-1
3. Lim WW, Wu P, Bond HS, Wong JY, Ni K, Seto WH, et al. Determinants of methicillin-resistant Staphylococcus aureus (MRSA) prevalence in the Asia-Pacific region: A systematic review and meta-analysis. J Glob Antimicrob Resist 2019; 16: 17-27. https://doi.org/10.1016/j.jgar.2018.08.014
4. European Centre for Disease Prevention and Control. Antimicrobial resistance in the EU/EEA (EARS-Net) - Annual Epidemiological Report 2019. Stockholm: European Centre for Disease Prevention and Control; 2020.
5. Magill SS, O'Leary E, Janelle SJ, Thompson DL, Dumyati G, Nadle J, et al; Emerging Infections Program Hospital Prevalence Survey Team. Changes in Prevalence of Health Care-Associated Infections in U.S. Hospitals. N Engl J Med 2018; 379(18): 1732-1744. https://doi.org/10.1056/NEJMoa1801550
6. Lakhundi S, Zhang K. Methicillin-Resistant Staphylococcus aureus: Molecular Characterization, Evolution, and Epidemiology. Clin Microbiol Rev 2018; 31(4): e00020-18. https://doi.org/10.1128/CMR.00020-18
7. Kluytmans J, van Belkum A, Verbrugh H. Nasal carriage of Staphylococcus aureus: epidemiology, underlying mechanisms, and associated risks. Clin Microbiol Rev 1997; 10(3): 505-520. https://doi.org/10.1128/CMR.10.3.505
8. Eriksen NH, Espersen F, Rosdahl VT, Jensen K. Carriage of Staphylococcus aureus among 104 healthy persons during a 19-month period. Epidemiol Infect 1995; 115(1): 51-60. https://doi.org/10.1017/s0950268800058118
9. Sim BL, McBryde E, Street AC, Marshall C. Multiple site surveillance cultures as a predictor of methicillin-resistant Staphylococcus aureus infections. Infect Control Hosp Epidemiol 2013; 34(8): 818-24. https://doi.org/10.1086/671273
10. Cobos-Trigueros N, Solé M, Castro P, Torres JL, Hernández C, Rinaudo M, et al. Acquisition of Pseudomonas aeruginosa and its resistance phenotypes in critically ill medical patients: role of colonization pressure and antibiotic exposure. Crit Care 2015; 19(1): 218. https://doi.org/10.1186/s13054-015-0916-7
11. Bonten MJ, Weinstein RA. Bird's-eye view of nosocomial infections in medical ICU: blue bugs, fungi, and device-days. Crit Care Med 1999; 27(5): 853-854. https://doi.org/10.1097/00003246-199905000-00001
12. Huskins WC, Huckabee CM, O'Grady NP, Murray P, Kopetskie H, Zimmer L, et al; STAR*ICU Trial Investigators. Intervention to reduce transmission of resistant bacteria in intensive care. N Engl J Med 2011; 364(15): 1407-1418. https://doi.org/10.1056/NEJMoa1000373
13. Derde L, Cooper B, Goossens H, Malhotra-Kumar S, Willems R, Gniadkowski M et al; MOSAR WP3 Study Team. Interventions to reduce colonisation and transmission of antimicrobial-resistant bacteria in intensive care units: an interrupted time series study and cluster randomised trial. Lancet Infect Dis 2014; 14(1): 31-39. https://doi.org/10.1016/S1473-3099(13)70295-0 Erratum in: Lancet Infect Dis 2014; 14(1): 11.
14. Kohler P, Bregenzer-Witteck A, Rettenmund G, Otterbech S, Schlegel M. MRSA decolonization: success rate, risk factors for failure and optimal duration of follow-up. Infection 2013; 41(1): 33-40. https://doi.org/10.1007/s15010-012-0290-1
15. Lee AS, de Lencastre H, Garau J, Kluytmans J, Malhotra-Kumar S, Peschel A, Harbarth S. Methicillin-resistant Staphylococcus aureus. Nat Rev Dis Primers 2018; 4: 18033. https://doi.org/10.1038/nrdp.2018.33
16. Rhodes A, Evans L, Alhazzani W, Levy M, Antonelli M, Ferrer R et al. Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016. Intensive Care Med 2017; 43(3): 304-377. https://doi.org/10.1007/s00134-017-4683-6

17. Langford BJ, So M, Raybardhan S, Leung V, Westwood D, MacFadden DR, et al. Bacterial co-infection and secondary infection in patients with COVID-19: a living rapid review and meta-analysis. Clin Microbiol Infect 2020; 26(12): 1622-1629. https://doi.org/10.1016/j.cmi.2020.07.016
18. Pineda R, Kanatani M, Deville J. 102. Effects of an Antimicrobial Stewardship-guided MRSA Nasal Screening Review on Vancomycin Utilization for Respiratory Infections: A Quasi-Experimental Study. Open Forum Infect Dis 2020; 7(Suppl 1): S65. https://doi.org/10.1093/ofid/ofaa439.147
19. Turner SC, Seligson ND, Parag B, Shea KM, Hobbs ALV. Evaluation of the timing of MRSA PCR nasal screening: How long can a negative assay be used to rule out MRSA-positive respiratory cultures? Am J Health Syst Pharm 2021; 78(Supplement_2): S57-S61. https://doi.org/10.1093/ajhp/zxab109
20. Dulon M, Peters C, Schablon A, Nienhaus A. MRSA carriage among healthcare workers in non-outbreak settings in Europe and the United States: a systematic review. BMC Infect Dis 2014; 14: 363. https://doi.org/10.1186/1471-2334-14-363