



## Nasal Screening of Health Care Workers (Nursing staff) to Study the Prevalence of Methicillin Resistant Staphylococcus Aureus (MRSA) Carriage and its Antibiotic Sensitivity Profile in a Rural Tertiary Health Care Center

Ashiya Loomba<sup>1</sup>, Pragati Grover<sup>2\*</sup>, Amanjot Singh Nokwal<sup>3</sup>, Bharti Arora<sup>4</sup>

<sup>1</sup> MBBS student, MAMC Agroha (Hisar), Haryana, India

<sup>2</sup> Assistant Professor, Department of Microbiology MAMC Agroha (Hisar), Haryana, India

<sup>3</sup> MBBS student, MAMC Agroha (Hisar), Haryana, India

<sup>4</sup> Professor & Head, Department of Microbiology MAMC Agroha (Hisar), Haryana, India

\*Corresponding author: Pragati Grover, Address: Department of Microbiology MAMC Agroha (Hisar), Haryana, India

Email: pragatigrover79@gmail.com, Tel: +919569695607

### Abstract

**Background & Aims:** *Staphylococcus aureus* is a common bug responsible for infections ranging from minor skin infections to fatal sepsis. Common colonizing sites include anterior nares, hand surfaces. Inadequate use of antibiotics has led to development of resistance giving rise to bugs like MRSA. Nursing staff particularly has a greater duration of patient contact and is thus more likely to become MRSA carrier- hence chosen as study population. This study aimed to study the prevalence and antimicrobial sensitivity profile of MRSA isolated from nasal carriers among nursing staff.

**Material & Methods:** A short-term cross-sectional study done in which nursing staff members were screened for nasal carriage of MRSA by collecting swabs from anterior nares. *S.aureus* isolates were screened for Methicillin susceptibility using cefoxitin disc. MRSA thus obtained were studied for antibiotic sensitivity profile by using Vitek-2 compact.

**Results:** Study showed the nasal carriage of MRSA as 13.3%. Maximum carriage was in staff members with >5 years of work experience in hospital. All isolates showed 100% resistance to Ampicillin, Erythromycin, Amoxiclav. Sensitivity reported was 12.5% to Ciprofloxacin; 37.5% to Clindamycin and Amikacin; 87.5% to Cotrimoxazole. All isolates were 100% sensitive to Linezolid, Vancomycin, Teicoplanin and Rifampin.

**Conclusion:** This study showed a significant carriage of MRSA in the nursing staff. Considering that nurses are more involved in patient care activity, regular screening should be done. Also, the importance of handwashing should be emphasized. Strict implementation of hospital infection control norms is necessary.

**Keywords:** Antibiotic Sensitivity, Methicillin Resistant Staphylococcus Aureus, Nasal Carriage

Received 02 February 2023; accepted for publication 21 January 2024

### Introduction

*Staphylococcus aureus* is a gram-positive coccus colonizing external skin surfaces and upper respiratory

tract commonly nares (1). It can invade through any breach in skin and mucosal lining to cause infections ranging from minor skin infections like impetigo to fatal

sepsis and toxic shock syndrome. At the time of introduction of penicillin in 1944, about 94% strains of *S.aureus* were susceptible to it. Until the 1950s *S.aureus* was sensitive to treatment with penicillin but later developed resistance due to production of  $\beta$ -lactamase enzyme. This problem was overcome in 1959 with the introduction of methicillin (1). However, methicillin resistance was identified shortly after the introduction of methicillin in clinical practice (2,3). First case of methicillin-resistant *S.aureus* (MRSA) was identified in Europe from the nares of an infant admitted in the medicine ward (3). The use of various antibiotics has led to the development of multidrug-resistant strains of MRSA (1,4).

Since then, MRSA has spread worldwide, becoming a notorious bug responsible for difficult-to-treat infections both at community and hospital level. In context to the Indian scenario, MRSA prevalence grew from 12% in 1992 to 80.33% in 1999.(5) Many of the carriers of MRSA harbor pathogen in areas like nares, hand surfaces, axilla and are generally asymptomatic. Colonization in healthcare workers has increased the incidence of serious nosocomial infection wherein healthcare workers act as vectors for transmission of infection in already immuno-compromised patients (6,7). Furthermore, no stringent following of hospital infection control norms and overlooking of antimicrobial stewardship adds to the current disaster of pan drug resistance in microbes including MRSA, thereby making study of this organism significant.

Since nursing staff is often the first to come in contact with patients and also responsible for regular looking after of patients in wards, screening them for carriage of MRSA will not only detect carriers but also help the hospital infection control committee to take appropriate steps in limiting its spread. Also, little work has been done in peripheral healthcare settings regarding MRSA - contrast to most of the Indian population residing in rural settings - this study will thus help increase awareness among currently practicing healthcare workers and various other epidemiological studies being carried out. Keeping in mind all this the present study is carried to determine nasal carriage of

MRSA among nursing staff posted in Medicine and allied wards of a rural tertiary healthcare center in North India and antibiotic sensitivity profile of the isolated MRSA strains.

## Material & Methods

The study was carried out under the Department of Microbiology for a duration of 2 months (July-December) after obtaining ethical clearance from the Institute. The study undertaken was a cross-sectional type where in nursing staff was analyzed for nasal carriage of MRSA and antibiotic sensitivity profile of MRSA. The study was done on the nursing staff posted in medicine and allied wards of a rural tertiary healthcare center of North India.

**Inclusion criteria included:** Complete nursing staff posted in medicine and allied wards were studied.

**Exclusion criteria included:** staff members suffering from an active upper respiratory tract infection or skin infection were excluded. Nursing students were not included in this study. Staff members who did not give consent for being enrolled in the study were also excluded.

## Procedure:

Two sterile nasal swabs were taken from both the anterior nares of participants. Swab was inserted about 2 cm into the anterior nares and rolled clockwise thrice and collected in an airtight container was labeled and sent to the microbiology laboratory immediately. One swab was used for gram staining & another for culture on blood agar. Inoculated plates were incubated for at 37°C for 18-24 hours. *S.aureus* was identified by colony morphology, microscopic appearance on gram stained smears, catalase test, slide and tube coagulase test (8). Isolated strains of *S.aureus* were screened for methicillin susceptibility by modified Kirby-Bauer method using cefoxitin(30 ug) discs on Muller Hinton Agar(MHA) by using an inoculum density which was equivalent to MacFarland's 0.5 standards ( $1.5 \times 10^8$  CFU/ml) and then incubated at 35°C overnight (9). Isolates which showed inhibition zone size of diameter  $\leq 21$  mm were considered as MRSA stains (10). The isolated MRSA strains were further studied for

antimicrobial sensitivity profile by automated identification and antimicrobial susceptibility system using Vitek-2 compact system (Biomérieux, India) (11). In case of Vancomycin, the strains showing MIC of >4ug/ml by Vitek-2 compact system was considered as vancomycin-resistant *S.aureus* (VRSA)(12).

The data was compiled, tabulated and subjected to SPSS version 17.0 software statistical package for analysis. A p-value of < 0.05 was considered as

significant.

## Results

A total of 60 nursing staff members posted in medicine and allied wards were recruited in this study. A total of 34 (56.6%) were female and 26 (43.3%) were male. Their age ranged from 21 to 60 years of which maximum belonged to 21-30 years age group - 29(48.3%). Maximum nursing staff 32(53.3%) have a working experience of >5 years (Table-1).

**Table 1.** Characteristics of study participants

PARAMETERS	FREQUENCY (%) N=60
Age (in years)	
21-30	29 (48.3)
31-40	19 (31.6)
41-50	10 (16.6)
51-60	2 (3.3)
Sex	
Female	34 (56.6)
Male	26 (43.3)
No of years working in hospital (years)	
<1	2 (3.3)
1-5	26 (43.3)
>5	32 (53.3)

The nasal carriage rate of *S.aureus* was 20%(12/60), out of which MRSA was 13.3%(8/60) whereas Methicillin sensitive *S.aureus* (MSSA) was 6.7%(4/60) (Table-2).

**Table 2.** MRSA carriage status

No. of health care workers screened	No. positive for <i>S.aureus</i>	No. positive for MRSA
60	12(20%)	8(13.3%)

Our study showed maximum carriage of MRSA in the 31-40 age group of 50% (4/8), followed by 41-50 years of 25% (2/8). Females reported a higher carriage of 62.5%(5/8) compared to males 37.5% (3/8). Nursing

staff members who have a longer work duration in hospital (>5 years) reported a higher nasal carriage of MRSA 75%(6/8) compared to those with lesser years of work in hospital (1-5 years) 25%(2/8) (Table-3).

**Table 3.** Characteristics of MRSA carriers

PARAMETERS	MRSA FREQUENCY(%) N=8
Age(years)	
21-30	1(12.5)
31-40	4 (50)
41-50	2 (25)
51-60	1 (12.5)
Sex	
Female	5 (62.5)
Male	3 (37.5)
No. of years of working in the hospital(years)	
<1	0 (0)
1-5	2 (25)
>5	6 (75)

MRSA isolated was further analyzed for antibiotic sensitivity profile. All isolates showed resistance of 100% to Ampicillin, Erythromycin, Amoxyclav whereas sensitivity of 12.5% to Ciprofloxacin, 37.5% to

Clindamycin and Amikacin, 87.5% to Co-trimoxazole. All MRSA isolates were 100% sensitive to Linezolid, Vancomycin, Teicoplanin and Rifampin (Table-4).

**Table 4.** Antibiotic sensitivity profile of MRSA isolates

ANTIBIOTIC	SENSITIVITY (%) N=8
Amikacin	3 (37.5)
Amoxiclav	0 (0)
Ampicillin	0 (0)
Ciprofloxacin	1 (12.5)
Clindamycin	3 (37.5)
Cotrimoxazole	7 (87.5)
Erythromycin	0 (0)
Linezolid	8 (100)
Rifampin	8 (100)
Teicoplanin	8 (100)
Vancomycin	8 (100)

## Discussion

*S.aureus* can colonize multiple sites in the body like the anterior nares, axilla, perineum, pharynx and gastrointestinal tract; however, the most common site is anterior nares (1,12). Nasal colonization with *S.aureus* has been reported to range from 6.3% to 17.8% in the general population while in healthcare workers from 18.2% to 28.2%(13,14). In our study, the carriage of *S.aureus* in the anterior nares of nursing staff is 20% of

which MRSA is 13.3% and MSSA is 6.7. The prevalence of MRSA varies among different institutions and geographical areas. The differences in the study design such as sample size and the methodology which has been employed for MRSA detection, may account for the disparity in the carriage thus detected.

The prevalence of MRSA carriage worldwide among health care workers is reported to be around 10-40% (15). Various studies in health care settings report

different rates of MRSA carriage among healthcare workers. Studies in Indian health care settings report MRSA carriage of 1.8% in Pondicherry, 6.6% in Delhi and 2% in Madurai (16-20). In our study, MRSA carriage among nursing staff is 13.3% (Table-3) which is in accordance with the findings of study from Assam (11.4%) and Bangalore (10%) (26,27). A study by Kalyani K et al. reports a carriage of 7.5% among nursing staff (17). Another study in Saudi Arabia showed a carriage of 23% in nursing staff (22). These differences in the prevalence of MRSA might be due to the variability in geographical distribution, hospital settings, hospital specialties and areas within the hospital where the study was conducted.

In our study, nasal carriage was found to be higher in female staff (62.5%) as compared to males (37.5%) (Table-4). A study conducted at Bhubaneswar also reports higher carriage of MRSA among females (21). This might be due to the fact that more females constituted the study population. The highest rate of MRSA carriage (75%) is among the nursing staff who have worked for >5 years in the hospital (Table-4). In a study by Al Humaiden et al. in Saudi Arabia the highest rate of MRSA carriage was among the health care workers who have worked for 4-6 years (26%) (22). This can be due to the time required for developing resistance and colonizing the host.

All the MRSA isolates were 100% sensitive to Linezolid, Vancomycin and Teicoplanin (Table-5). A study conducted by Radhakrishnan et al. reported 100% sensitivity to Vancomycin, Linezolid and sensitivity of 80% to Teicoplanin (24). However, sensitivity to vancomycin was 84.3% in a study done by El Aila et al. (25). In our study, the sensitivity of MRSA isolates to Amikacin was 37.5%, Ciprofloxacin 12.5%, Clindamycin 37.5% and Cotrimoxazole 87.5%. All the MRSA isolates showed 100% resistance to Ampicillin, Amoxiciav and Erythromycin. In a study conducted by Radhakrishna et al., sensitivity of Erythromycin is 40%, gentamicin is 80% and Ciprofloxacin is 20% (24).

Thus, our study showed considerable MRSA carriage among the nurses and also reported a decreased sensitivity to commonly used drugs. Also, no resistance

was detected against higher antibiotics like Vancomycin, Teicoplanin and Linezolid which points to their use in eradication of infection caused by MRSA. The Hospital Infection Committee was informed regarding the detected resistance in nursing staff so that appropriate measures can be taken and regular extensive screening can be done to curb the spread of resistant nosocomial infections.

## Conclusion

In this study, the nasal carriage of MRSA among the nursing staff posted in the Medicine and allied branches is 13.3%. Considering the fact that nurses are more involved in patient care activities, it is necessary that they should be sensitized regarding this issue. Importance of hand-washing should be emphasized for all healthcare workers as it is the single most appropriate method to combat the spread of nosocomial infections including MRSA.

There is hence a need to strictly implement and follow the hospital infection control guidelines so as to reduce the spread of MRSA to susceptible persons.

## Acknowledgments

Nil.

## Conflict of interests

The authors declare that they have no conflicts of interest.

## Funding/Support

No funding was required for the study.

## Data Availability

The raw data supporting the conclusions of this article are available from the authors upon reasonable request.

## Ethical Statement

The study was carried out under the Department of Microbiology for a duration of 2 months (July-December) after obtaining ethical clearance from the Institute.

## References

1. Stapleton PD, Taylor PW. Methicillin resistance in *Staphylococcus aureus*: mechanisms and modulation. *Sci Prog* 2002;85(Pt 1):57-72.  
<https://doi.org/10.3184/003685002783238870>
2. Babber M. Methicillin-resistant staphylococci. *J Clin Pathol* 1961;14(4):385-93.  
<https://doi.org/10.1136/jcp.14.4.385>
3. STEWART GT, HOLT RJ. Evolution of natural resistance to the newer penicillins. *Br Med J* 1963;1(5326):308-11.  
<https://doi.org/10.1136/bmj.1.5326.308>
4. Livermore DM. Antibiotic resistance in staphylococci. *Int J Antimicrob Agents* 2000;16:S3-10.  
[https://doi.org/10.1016/S0924-8579\(00\)00299-5](https://doi.org/10.1016/S0924-8579(00)00299-5)
5. Verma S, Joshi S, Chitnis V, Hemwani N, Chitnis D. Growing problem of methicillin resistant staphylococci--Indian scenario. *Indian J Med Sci* 2000;54(12):535-40.
6. Albrich WC, Harbarth S. Health-care workers: Source, vector, or victim of MRSA? *Lancet Infect Dis* 2008;8:289-301. [https://doi.org/10.1016/S1473-3099\(08\)70097-5](https://doi.org/10.1016/S1473-3099(08)70097-5)
7. Vonberg RP, Stamm-Balderjahn S, Hansen S, et al. How often do asymptomatic healthcare workers cause methicillin-resistant *Staphylococcus aureus* outbreaks? A systematic evaluation. *Infect Control Hosp Epidemiol* 2006;27:1123-7. <https://doi.org/10.1086/507922>
8. Cheesbrough M. *District Laboratory Practise in Tropical Countries. Part 2.* Cambridge University Press, Cambridge, 2009:62-8.
9. Bauer AW, Kirby QMM, Sherns J C, Turik M. Antibiotic susceptibility testing by standardized single disk method. *Am J Clin Path* 1966;45:493-6.  
[https://doi.org/10.1093/ajcp/45.4\\_ts.493](https://doi.org/10.1093/ajcp/45.4_ts.493)
10. CLSI. Surveillance for Methicillin-Resistant *Staphylococcus aureus*: Principles, Practices, and Challenges; A Report. CLSI document X07-R. Wayne, PA: Clinical and Laboratory Standards Institute; 2010.
11. Clinical and Laboratory Standard Institute. Performance standards for antimicrobial susceptibility; 22nd informational supplement; CLSI document M100-S22. 2012;32(3)
12. Wertheim HF, Melles DC, Vos MC, van Leeuwen W, van Belkum A, Verbrugh HA, et al. The role of nasal carriage in *Staphylococcus aureus* infections. *Lancet Infect Dis* 2005;5:751-62.  
[https://doi.org/10.1016/S1473-3099\(05\)70295-4](https://doi.org/10.1016/S1473-3099(05)70295-4)
13. Pathak A, Marothi Y, Iyer RV, Singh B, Sharma M, Eriksson B, et al. Nasal Carriage and Antimicrobial Susceptibility of *Staphylococcus aureus* in healthy preschool children in Ujjain, India. *BMC Pediatrics* 2010;10(1). <https://doi.org/10.1186/1471-2431-10-100>
14. Kim OS, Yim J. Rates of *Staphylococcus Aureus* and Methicillin-resistant *Staphylococcus Aureus* Nasal Carriage Infections among Nursing Students. *Int J Bio-Sci Bio-Tech* 2015;7(5):21-32.  
<https://doi.org/10.14257/ijbsbt.2015.7.5.3>
15. Azeez-Akanda O. Global trend of methicillin-resistant *Staphylococcus aureus* and emerging challenges for control. *Afr J Clin Exp Microbiol* 2010;11:150-8.  
<https://doi.org/10.4314/ajcem.v11i3.57771>
16. Mathanraj S, Sujatha S, Sivasangeetha K, Parija SC. Screening for methicillin-resistant *Staphylococcus aureus* carriers among patients and health care workers of a tertiary care hospital in Southern India. *Indian J Med Microbiol* 2009;27:62-4. [https://doi.org/10.1016/S0255-0857\(21\)01758-8](https://doi.org/10.1016/S0255-0857(21)01758-8)
17. Goyal R, Das S, Mathur M. Colonization of methicillin resistant *Staphylococcus aureus* among health care workers in a tertiary care hospital of Delhi. *Indian J Med Sci* 2002;56(7):321-4.
18. Vinod kumar adithyaa A, Uma A, Srinivasan M, Ananthalakshmi I, Nallasivam, Thirumalai kolundusubramanian P. Nasal Carriage of Methicillin-Resistant *Staphylococcus aureus* among Surgical Unit Staff. *Jpn J Infect Dis* 2009;62:228-9.  
<https://doi.org/10.7883/yoken.JJID.2009.228>
19. Shakya B, Shrestha S, Mitra T. Nasal carriage rate of methicillin-resistant *Staphylococcus aureus* among at National Medical College Teaching Hospital, Birgunj, Nepal. *Nepal Med Coll J* 2010;12(1):26-9.
20. Fadeyi A, Adeboye MAN, Fowotade A, Nwabuisi C, Bolaji BO, Oyedepo O, et al. Methicillin Resistant *Staphylococcus aureus* Carriage amongst Healthcare Workers of the Critical Care Units in a Nigerian Hospital. *Am J Infect Dis* 2010;6(1):18- 23.  
<https://doi.org/10.3844/ajidsp.2010.18.23>

21. Singh N, Mohanty S, Panda SS, Sahoo S, Pattnaik D, Jena J. Methicillin resistant Staphylococcus aureus (MRSA) carriage among health care workers in a tertiary care hospital in Bhubaneswar. *Int J Community Med Public Health* 2018;5(8):3276. <https://doi.org/10.18203/2394-6040.ijcmph20182970>
22. Al-Humaidan O, El-Kersh T, Al-Akeel R. Risk factors of nasal carriage of Staphylococcus aureus and methicillin-resistant Staphylococcus aureus among health care staff in a teaching hospital in central Saudi Arabia. *Saudi Med J* 2015;36(9):1084-90. <https://doi.org/10.15537/smj.2015.9.12460>
23. Kalyani K, Jayakumari K, Kumar JS. Prevalence of MRSA among HCWs of Shri Satya Sai Medical College and Hospital - A tertiary care center. *J Dent Med Sci* 2012;3:23-27. <https://doi.org/10.9790/0853-0322327>
24. M Radhakrishna, Souza MD, Kotigadde S. Prevalence of Methicillin Resistant Staphylococcus aureus Carriage amongst Health Care Workers of Critical Care Units in Kasturba Medical College Hospital, Mangalore, India. *J Clin Diagnos Res* 2013;2:697-700.
25. Aila NAE, Laham NAA, Ayesh BM. Nasal carriage of methicillin-resistant Staphylococcus aureus among health care workers at Al Shifa hospital in Gaza Strip. *BMC Infect Dis* 2017;17(1):28. <https://doi.org/10.1186/s12879-016-2139-1>
26. Rongpharpi SR, Hazarika NK, Kalita H. The prevalence of nasal carriage of Staphylococcus aureus among healthcare workers at a tertiary care hospital in assam with special reference to MRSA. *J Clin Diagn Res* 2013;7(2):257-60. <https://doi.org/10.7860/JCDR/2013/4320.2741>
27. Harle JM, Km J. Methicillin resistant Staphylococcus aureus Carriage among the Health Care Workers in a Tertiary Care Hospital. *J Clin of Diagn Res* 2012;6(5):791-3.

This is an open-access article distributed under the terms of the [Creative Commons Attribution-noncommercial 4.0 International License](https://creativecommons.org/licenses/by-nc/4.0/) which permits copy and redistribute the material just in noncommercial usages, as long as the original work is properly cited.