

TO STUDY THE CARRIAGE AND ANTIMICROBIAL SENSITIVITY PROFILE OF MRSA AMONG NURSING STAFF OF RURAL TERTIARY HEALTH CARE CENTRE OF NORTH INDIA

Abstract:

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. Many of the carriers of MRSA harbour pathogen in areas like nares, hand surfaces, axilla and are generally asymptomatic. Colonisation in healthcare workers has increased the incidence of serious nosocomial infection wherein healthcare workers act as vectors for transmission of infection in already immunocompromised patients. The study undertaken was a cross sectional type where in nursing staff was analysed for nasal carriage of MRSA and antibiotic sensitivity profile of MRSA. 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 females and 26 (43.3%) were males. 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. There is a need to strictly implement and follow the hospital infection control guidelines so as to reduce the spread of MRSA to susceptible persons.

Keywords: MRSA, HCW, VRSA

1. INTRODUCTION

Staphylococcus aureus (*S. aureus*) is a gram-positive coccus colonising 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.² Until the 1950s, *S. aureus* was sensitive to treatment with penicillin but later developed resistance due to production of β -lactamase enzyme. This problem was overcome in 1959 with the introduction of methicillin. However, methicillin resistance was identified shortly after introduction of methicillin in clinical practice. First case of

methicillin resistant *S.aureus* (MRSA) was identified in Europe from the nares of an infant admitted in the medicine ward ^{3,4}The use of various antibiotics has led to 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 harbour pathogen in areas like nares, hand surfaces, axilla and are generally asymptomatic. Colonisation 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 pandrugresistance 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 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.

Hence pointing to the fact that control of carriage rates and regular screening of people working in healthcare settings is the single most effective way to tackle the problem of antimicrobial resistance which is thus the prime objective of carrying out this study.

2. AIM AND OBJECTIVE

- To determine nasal carriage of MRSA among nursing staff posted in Medicine and allied wards of a rural tertiary healthcare centre in North India.
- Isolated MRSA strains were studied for antibiotic sensitivity profile.

3. MATERIAL AND METHOD

The study was carried out under Department of Microbiology for a duration of 2 months (August - September)

- **STUDY TYPE-** The study undertaken was a cross sectional type where nursing staff was analysed for nasal carriage of MRSA and antibiotic sensitivity profile of the same.
- **POPULATION STUDIED-** The study was done on the nursing staff posted in medicine and allied wards of a rural tertiary healthcare centre of North India.
- **INCLUSION EXCLUSION CRITERIA-**
 - Inclusion-
 - Complete nursing staff posted in medicine and allied wards was studied.
 - Exclusion-
 - 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.
- **INFECTION CONTROL CONSIDERATION-**
 - Samples were collected under aseptic conditions by following standard procedure.
 - Each sample was labelled appropriately and transported to the Microbiology department immediately.

● PROCEDURE-

- 2 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.
- Sample collected in an airtight container was labelled and sent to the Microbiology Laboratory immediately.
- Samples were inoculated on the Blood Agar. Direct Gram Staining was done.
- Plates were incubated overnight at 37°C
- *S.aureus* was identified by using standard procedures to study 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(30ug) discs on Muller Hinton Agar by using an inoculum density which was equivalent to McFarland's 0.5 standard (1.5×10^8 CFU/ml) and then incubated at 35°C overnight.⁹
- Isolates which showed inhibition zone size of diameter <21mm were considered as MRSA stains.⁹
- The isolated MRSA strains were further studied for antimicrobial sensitivity profile by automated identification and antimicrobial susceptibility system using Vitek-2 compact system (bioMerieux).¹⁰
- In case of Vancomycin, the strains showing MIC of >4ug/ml by Vitek-2 compact system were considered as vancomycin resistant *S.aureus* (VRSA).

4. 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 females and 26 (43.3%) were males. Their age ranged from 21-60 years of which maximum belonged to 21-30 years age group - 29(48.3%). Maximum 32(53.3%) nursing staff have working experience of >5 years [Table-1].

[Table-1 Characteristics of study population]

<u>PARAMETERS</u>	<u>FREQUENCY(%) N=60</u>
<u>AGE(YEARS)</u>	
21-30	29 (48.3)
31-40	19 (31.6)
41-50	10 (16.6)
51-60	2 (3.3)
<u>GENDER</u>	
Female	34 (56.6)
Male	26 (43.3)
<u>WORK EXPERIENCE (YEARS)</u>	
<1	2 (3.3)
1-5	26 (43.3)
>5	32 (53.3)

[Table-2 Isolated organisms from samples collected]

<u>ISOLATED ORGANISM</u>	<u>NUMBER OF SAMPLES FREQUENCY(%) N=60</u>
<i>S.aureus</i>	12 (20)
CoNS	46 (76.6)
Others	2 (3.3)

[Table-3 Distribution of *S.aureus*]

<u>DISTRIBUTION OF <i>S.aureus</i></u>	<u>NUMBER ISOLATED FREQUENCY(%) N=60</u>

MRSA	8 (13.3)
MSSA	4 (6.7)

Samples collected showed *S.aureus* carriage of 20%(12/60) out of which Methicillin sensitive *S.aureus* (MSSA) was 6.7%(4/60) and MRSA was 13.3%(8/60); coagulase negative *Staphylococcus* (CoNS) 76.6%(46/60) and others 3.3%(2/60) [Table-2,3].

[Table-4 Characteristics of MRSA carriers]

<u>PARAMETERS</u>	<u>MRSA DETECTED FREQUENCY(%) N=8</u>
<u>AGE(YEARS)</u>	
21-30	1(12.5)
31-40	4 (50)
41-50	2 (25)
51-60	1 (12.5)
<u>GENDER</u>	
Female	5 (62.5)
Male	3 (37.5)
<u>WORK EXPERIENCE (YEARS)</u>	
<1	0 (0)
1-5	2 (25)
>5	6 (75)

Our study showed maximum carriage of MRSA in the 31-40 age group 50% (4/8), followed by 41-50 years 25% (2/8).

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). None of those who worked for <1 year in our hospital setting showed MRSA carriage.

Also, in our study, females reported a higher carriage of 62.5% (5/8) compared to males 37.5% (3/8) [Table-4]

[Table-5 Antibiotic sensitivity profile of MRSA isolates]

<u>ANTIBIOTIC</u>	<u>SENSITIVITY (%) N=8</u>
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)

MRSA isolated was further analysed for antibiotic sensitivity profile. All isolates showed resistance of 100% to Ampicillin, Erythromycin, Amoxiclav. Sensitivity of 12.5% to Ciprofloxacin; 37.5% to Clindamycin and Amikacin; 87.5% to Cotrimoxazole. All MRSA isolates were 100% sensitive to Linezolid, Vancomycin, Teicoplanin and Rifampin [Table-5]

5. DISCUSSION

S.aureus can colonise multiple sites in the body like the anterior nares, axilla, perineum, pharynx and gastrointestinal tract, however, the most common site is anterior nares.^{11,12} 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%).²¹⁻²² A study by Kalyani K et al reports a carriage of 7.5% among nursing staff and another study in Saudi Arabia showed a carriage of 23% in nursing staff.²³⁻²⁴

These differences in the prevalence of MRSA might be due to the variability in geographical distribution, hospital settings, hospital specialities 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.²⁵ 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%) This can be due to the time required for developing resistance and colonising the host.²⁷

In our study, 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.²⁶ However, sensitivity to vancomycin was 84.3% in a study done by El Aila et al.²⁷ 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, Amoxiclav and Erythromycin. In a study conducted by Radhakrishna et al, sensitivity of Erythromycin is 40%, Gentamicin is 80% and Ciprofloxacin is 20%.²⁶

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.

6. CONCLUSION

In this study, 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.

- **ETHICAL APPROVAL AND CONSENT-**

The study was undertaken after obtaining approval from the Institutional Ethical Committee (Ref no. MAMC/IEC/2022/10). Valid documented consent was taken from each subject after explaining to them the procedure and significance of the study. Details of the participants were kept as confidential throughout and after completion of the study. Each participant and sample was treated as equal.

SUMMARY

The study undertaken was a short term cross-sectional study done under the Department of Microbiology wherein nursing staff posted in Medicine and allied branches of a rural tertiary healthcare centre was screened for nasal carriage of MRSA and its antibiotic sensitivity was studied.

MRSA is one of the notorious bugs causing serious infections. Since hospital settings are continuously exposed to contamination by various infections and also extensive antibiotic use, a lack of appropriate infection control can lead to healthcare workers being carriers of these harmful bugs - harboring them on surfaces like hands and nares.

In our study, we detected the nasal carriage of MRSA among nursing staff is 13.3%. Carriage is more among females (62.5%) and in those who are working for >5 years in the hospital setting (75%). All the MRSA isolates were found to be 100% sensitive to Vancomycin, Linezolid, Teicoplanin and Rifampin.

This data helped the Infection Control Committee to take appropriate steps to keep check on MRSA carriage. Mupirocin blanket was advised to the nursing staff which is likely to reduce the carriage and transfer of MRSA from nursing staff to patient and also to other healthcare workers in the hospital.

8. REFERENCES

1. Stapleton PD, Taylor PW. Methicillin resistance in *Staphylococcus aureus*: mechanisms and modulation. *Sci Prog.* 2002;85(Pt 1):57-72.
2. BARBER M. Methicillin-resistant staphylococci. *J Clin Pathol.* 1961 Jul;14(4):385-93.
3. STEWART GT, HOLT RJ. Evolution of natural resistance to the newer penicillins. *Br Med J.* 1963 Feb 2;1(5326):308-11.
4. Livermore DM. Antibiotic resistance in staphylococci. *Int J Antimicrob Agents.* 2000 Nov;16 Suppl 1:S3-10.
5. Verma S, Joshi S, Chitnis V, Hemwani N, Chitnis D. Growing problem of methicillin resistant staphylococci--Indian scenario. *Indian J Med Sci.* 2000 Dec;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.
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.
8. Cheesbrough M. *District Laboratory Practise in Tropical Countries. Part 2.* Cambridge University Press, Cambridge, 2009: 62-68.
9. 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.

10. Clinical and Laboratory Standard Institute. Performance standards for antimicrobial susceptibility; 22nd informational supplement; CLSI document M100-S22. 2012;32(3).
11. Ruiz A, Mora M, Zurita C, Larco D, Toapanta Y, Zurita J. Prevalence of methicillin-resistant *Staphylococcus aureus* among health care workers of intensive care units in Ecuador. *J Infection Developing Countries*. 2014;8(1):116-9
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.
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).
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.
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.
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.
17. Goyal R, Das S, Mathur M. Colonisation of methicillin resistant *Staphylococcus aureus* among health care workers in a tertiary care hospital of Delhi. *Indian J of Med. Sciences* 2002;56(7):321-4.
18. Vinodhkumaradithyaa A, Uma A, Srinivasan M, Ananthalakshmi I, Nallasivam P, Thirumalaikolundusubramanian P. Nasal Carriage of Methicillin – Resistant *Staphylococcus aureus* among Surgical Unit Staff. *Jpn J Infect Dis*. 2009;62:228-9.

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
21. 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. *Journal of Clinical and Diagnostic Research : JCDR.* 2013 Feb;7(2):257-260. DOI: 10.7860/jcdr/2013/4320.2741.
22. J. M, Harle SA, M. P, B.L. U, B.V. N, J. KM, M.S. G. Methicillin resistant *Staphylococcus aureus* Carriage among the Health Care Workers in a Tertiary Care Hospital. *J Clin of Diagn Res.* 2012; 6(5):791-793.
23. 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.
24. Kalyani K, Jayakumari K, Kumar JS. Prevalence of MRSA among HCWs of Shri Satya Sai Medical College and Hospital – A tertiary care centre. *J Dent MedSci.* 2012;3:23–7.
25. Singh, Nipa et al. Methicillin resistant *Staphylococcus aureus* (MRSA) carriage among health care workers in a tertiary care hospital in Bhubaneswar. *International Journal Of Community Medicine And Public Health*, [S.l.], v. 5, n. 8, p. 3276-3282, july 2018. ISSN 2394-6040.
26. 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.
27. 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.

