Original Research Paper

Volume - 14 | Issue - 10 | October - 2024 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Medical Microbiology

NASAL COLONISATION OF METHICILLIN RESISTANT STAPHYLOCOCCUS AUREUS [MRSA] AMONG HEALTHCARE WORKERS IN A TEACHING HOSPITAL AT BENGALURU, KARNATAKA

Dr. Spoorthi D C*	Intern, Shri Atal Bihari Vajpayee medical college and research institute, Bengaluru*Corresponding Author
Dr. Sunitha B U	MD Microbiology Associate professor, Department of Microbiology Shri Atal Bihari Vajpayee medical college and research institute, Bengaluru
Dr. Kala Yadhav M L	MD Microbiology Professor and Head of the Department, Department of Microbiology Shri Atal Bihari Vajpayee medical college and research institute, Bengaluru

ABSTRACT **BACKGROUND:** Staphylococcus aureus is the most virulent species among Staphylococci. It produces various infections ranging from localized pyogenic infections to life threatening systemic infections. Staphylococcus aureus shows resistance to beta-lactam antibiotics among which methicillin resistant strains [MRSA] are of current importance because there is an alarming increase in MRSA carriage rates especially among health care workers. We aimed to determine the rate of nasal carriage of MRSA among healthcare workers and to study the antibiotic susceptibility pattern of these isolates. **METHODS:** After collecting the nasal swab with sterile cotton swabs moistened with normal saline, Staphylococcus aureus was isolated using mannitol salt agar. Isolates were identified by examining colony characteristics, Gram staining, Catalase test, slide and tube coagulase test. All isolated Staphylococcus aureus were tested with 30 µg of cefoxitin on Mueller Hinton Agar [MHA] by Kirby-Bauer disk diffusion method. **RESULTS:** According to the findings of our study, nasal carriage of Staphylococcus aureus among healthcare workers was 23%. The Staphylococcus aureus carriage was particularly high among doctors (12%) and nursing personnel (6%) followed by group D workers (4.5%). Overall MRSA carriage rate among health care workers was 8%. MRSA carriage rate was particularly high among doctors (4.5%) followed by nurses (2.5%) and group D workers (1%). **CONCLUSION:** It is necessary to detect the MRSA carriers among health care workers (HCWs) in hospitals, particularly those who work in the critical care areas. These individuals act as a potential source of infection to their patients, causing hospital acquired infections and thereby causing extended stays in the hospital.

KEYWORDS : MRSA, Healthcare workers, Nasal carriage, Mueller hinton agar, hospital acquired infection

INTRODUCTION:

Staphylococcus aureus is the most virulent species among Staphylococci. It produces various infections ranging from localized pyogenic infections to life threatening systemic infections1. Staphylococcus aureus shows resistance to beta-lactam antibiotics among which methicillin resistant strains [MRSA] are of current importance because there is an alarming increase in MRSA carriage rates especially among health care workers2.It is one of the most important human pathogens especially in hospital environment because of its ability to develop drug resistance[3]

Currently it is emerging as a most important hospital acquired pathogen4. Colonised employees are generally asymptomatic although they are a potential reservoir of infections acquired by the patients[5]

In healthcare institutions MRSA can be transmitted between patients and also through the hands, clothes, equipments of healthcare workers6. Implementation of MRSA screening among healthcare workers has shown positive impact in outbreak management[7]

MRSA strains exhibit resistance to all beta-lactams. This is because of the Mec-A gene present on Staphylococcus Cassette Chromosome (SCC) which codes for penicillin binding protein known as PBP2a which has low antibiotic affinity and is responsible for resistance among MRSA strains8.The knowledge of frequency of nasal carriage of Staphylococcus aureus and MRSA among HCWs along with their current antimicrobial profile becomes necessary in the selection of appropriate treatment options for these carriers. Several studies have shown that the elimination of carriage in the anterior nares reduces the incidence of Staphylococcal infections[9]

In India MRSA rates varies with different geographical distribution. In 2019 it was reported as 42% (ICMR) 4. Therefore the purpose of this study was to identify the prevalence rate of MRSA as of now specially among healthcare workers in a tertiary health care hospital in Bengaluru, Karnataka.

MATERIALS AND METHODS:

Institutional ethical committee approval was obtained before carrying out the study.(IEC no. SABVMCRI/IEC/ARP/130/2022-23, certificate attached).

STUDY DESIGN: It's a hospital based prospective cross sectional study.

The study was conducted in Dept. of Microbiology for a period of 2 months from August 2022 to October 2022 among healthcare workers at Bowring and Lady Curzon hospital and GHSIS Gosha hospital in Bengaluru, Karnataka which are tertiary healthcare hospitals.

A total of 200 samples were taken.

SAMPLE SIZE CALCULATION:

Estimated sample size (N) = 4PQ/d2 where,

- P=Prevalence (from previous studies)10
- Q=100-P
- d=Allowable error (Taken as 5 approximately)

N=4×14.33[100-14.33] ÷52 =196.4 ~200
The sample size has been rounded off to 200

ELIGIBILITY CRITERIA:

INCLUSION CRITERIA:

All the hospital staff including Doctors, Nurses, Post graduate students, group D workers above 18 years of age with special preference to ICU, NICU, casualty, Post-operative wards

EXCLUSION CRITERIA:

Health care workers with wound and upper respiratory tract infections in last 3 months based on the history

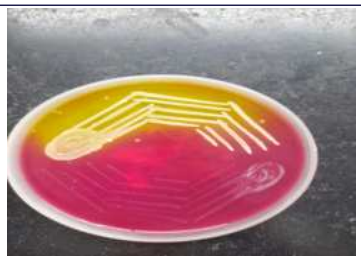
PROCEDURE

NASAL SWAB COLLECTION:

Cotton swab moistened with normal saline was introduced 1-2 cm in nasal cavity, rotated 2 to 3 times both in clockwise and anticlockwise direction in both nostrils. The specimens were inoculated on to chocolate agar and incubated at 370 C for 18 to 24 hours.

The growth from chocolate agar were subjected to Gram staining, catalase, slide and tube coagulase test. Isolates identified as Staphylococcus aureus were inoculated onto Mannitol salt agar and further confirmed by the golden yellow colour growth11. (Fig I)

Fig I: Golden yellow colonies of Staphylococcus aureus on Mannitol salt agar



SCREENING OF MRSA:
All isolated S. aureus were tested with 30µg cefoxitin on Mueller Hinton Agar [MHA] by Kirby-Bauer disk diffusion method. An inhibition zone diameter of less than or equal to 21mm was considered MRSA and more than or equal to 22 was reported as methicillin sensitive Staphylococcus aureus (MSSA). Zone size was interpreted according to CLSI-M100 2023 guidelines[12]

Other antibiotics that were tested are chloramphenicol (30 µg),ciprofloxacin (5 µg), clindamycin (2 µg), erythromycin (15 µg), gentamicin (10 µg), linezolid (30 µg), penicillin (10µg), teicoplanin (30 µg).The results were interpreted as per CLSI guidelines

DATA ANALYSIS:
Each sample was encoded an identification number. The data collected was tabulated, coded and analysed using Microsoft excel and Statistical package for Social Sciences (SPSS) version 21 for windows. Chi – square test was used to test the significance of difference between two proportions. For all the tests, P value <0.05 was considered significant.

RESULTS:
A total of 200 samples of healthcare workers whose ages ranged from 19 to 64 (mean= 31.07+9.838) were screened for MRSA (Table Ia). People aged between 25 to 35 years were the predominant group. Among them 94 were males and 106 were females (Table Ib). Females were the predominant group (53%).

Samples were collected from all healthcare workers including doctors, Staff nurses, group D workers and auxiliary workers (Plaster of paris worker, Ayushman bharath yojana workers). Among 200 samples collected Doctors and Staff nurses were the major study group (TableII).

Samples were collected from various units of hospital including OT, Post-op wards, casualty, ICU (Gen ICU, PICU, NICU, SNCU). Number of samples collected in each critical care area is shown in (Table III).

Various species of bacteria were isolated from anterior nares and are shown (Table IV). Out of 200 Healthcare workers screened, Staphylococcus species were 113(56.5%) which included Staphylococcus aureus (23%) and Coagulase negative Staphylococci (CoNS) (33.5%). Remaining 43.5% (87) were commensals.

Among 46 Staphylococcus aureus isolates, 16 (34.7%) were MRSA carriers. Overall MRSA carriage rates was 8% in our study. While the remaining 30 were MSSA (15%). (Table V)

Various types of organisms isolated from different high risk areas are shown in (Table VI) Operation theatres (10.5%) had the highest rate of Staphylococcus aureus carriage followed by Casualty (4.5%) and Post-op wards (3.5%).

Various cadre related distribution of different organisms shown in (Table VII). Doctors (12%) were the highest carriers of Staphylococcus aureus followed by Nurses(6%) and group D workers(4.5%).

From the findings of our study, Operation theatres (5%) have the highest carriage rate of MRSA infection among healthcare workers followed by post-op wards (1.5%) and Gen-ICU (1%) (Table VIII).

Various cadre related distribution of MRSA and MSSA is shown below (Table IX).In our study Doctors had the highest rate of MRSA carriage (4.5%) followed by Nurses (2.5%) and group-D workers(1%).

Antibiotic susceptibility patterns of Staphylococcus aureus isolates is shown in (Table X). In our study out of 46 Staphylococcus aureus isolates 34.8% were resistant to cefoxitin (MRSA) and most of them were resistant to Erythromycin(65.2%) and Penicillin(89.1%)

Antibiotic susceptibility patterns of MRSA has been shown in (Table XI) . All the MRSA isolates were 100% resistant to penicillin. All the MRSA isolates showed 100% sensitivity to Linezolid.

DISCUSSION:
It is necessary to detect the MRSA carriers among health care workers (HCWs) in hospitals, particularly those who work in the critical care areas. These individuals act as a potential source of infection to their patients, causing nosocomial infections and thereby causing extended stays in the hospital. Therefore regular screening of the healthcare workers and taking the appropriate preventive measures will help in controlling the rate of hospital acquired infections. The prevalence of MRSA varies between institutions and geographic areas. The differences in the study design, such as the sample size and the method which is employed for MRSA detection, and also the infection control protocols in different hospitals may account for the disparity in the carriage rate. Studies in our country revealed an MRSA carriage rate of 1.8% from Pondicherry 13, that of 6.6% from Delhi 14. A MRSA carriage of 5.2% was reported from Kathmandu, Nepal 15. Outside India, a very high MRSA nasal carriage rate of 38.9% was reported from Nigeria 16. According to the findings of our study, nasal carriage of Staphylococcus aureus among healthcare workers was 23%. The Staphylococcus aureus carriage was particularly high among doctors (12%) and nursing personnel (6%) followed by group D workers (4.5%). Overall MRSA carriage rate among health care workers was 8%. MRSA carriage rate was particularly high among doctors (4.5%) followed by Staff nurses (2.5%) and group D workers (1%). Our finding for MRSA was significantly high as compared to the earlier report (2.5%) which was obtained from KMC Manipal 17 but it was significantly low as compared to the findings of studies which were carried out in Western India (21.15%) 18and Assam (11.43%) [19]

This suggests that we need to implement additional infection control policies and also create awareness among nursing staff and group D workers by educating them, to eradicate MRSA carriage. Further, such actions would help in the prevention of MRSA transmission to their family members. Moreover, the financial burden of handling such nosocomial and community spreads of MRSA infection would be considerable and hence, MRSA has been considered a public health issue with economic consequences. Mupirocin is the topical antibiotic of choice for the decolonization of MRSA, as it is very effective for this use 20. In our study, healthcare workers with MRSA were treated with Mupirocin ointment for 14 days, later repeat swabs were taken to confirm the decolonisation of MRSA. This study helped us in creating a local antibiogram for our hospital to avoid indiscriminate use of antibiotics which prevents multidrug resistance.

ACKNOWLEDGEMENT: Department of Microbiology, SABVMCRI

CONFLICT OF INTEREST: None
SOURCE OF FUNDING: ICMR funded study

ETHICAL COMMITTEE APPROVAL: Taken
Ethical committee approval number -SABVMCRI/ IEC/ ARP/ 130/ 2022-23

TABLES
Table Ia: Age distribution

AGE GROUP	FREQUENCY	PERCENT
<25	57	28.5%
25-35	85	42.5%
35-45	34	17.0%
45-55	16	8.0%
>55	8	4.0%
MEAN	31.07+9.838	

Table Ib: Sex distribution

GENDER	FREQUENCY	PERCENT
M	94	47.0
F	106	53.0

Table II: Designation wise distribution of sample size

DESIGNATION	FREQUENCY	PERCENT
DOCTOR	116	58.0%
STAFF NURSE	63	31.5%
GROUP D	17	8.5%
AUXILIARY	4	2.0%

Table III: High risk area wise distribution of sample size

HIGH RISK AREAS		FREQUENCY	PERCENT
CASUALTY	29	14.5%	
ICU	GENERAL ICU	48	24.0%
	NICU	5	2.5%
	PICU	12	6.0%
	SNCU	4	2.0%
POST OP WARDS	30	15.0%	
OPERATION THEATRE	72	36.0%	

Table IV: Type of organisms isolated from anterior nares

TYPE OF ORGANISMS	FREQUENCY	PERCENT
S. AUREUS	46	23.0%
COMMENSALS	87	43.5%
CoNS	67	33.5%

Table V: Distribution of MRSA and MSSA among S.aureus isolates

SUB-TYPE OF ORGANISMS AMONG S. AUREUS (N=46)	FREQUENCY	PERCENT (out of 200samples)
MRSA	16	8.0%
MSSA	30	15.0%

Table VI: High risk area wise distribution of organisms.

HIGH RISK AREAS		TYPE OF ORGANISMS		
		Commensals	CoNS	S.aureus
CASUALTY	Count	10	10	9
	%	5%	5%	4.5%
GEN ICU	Count	21	23	4
	%	10.5%	11.5%	2%
NICU	Count	2	1	2
	%	1%	0.5%	1%
OPERATION THEATRE	Count	31	20	21
	%	15.5%	10%	10.5%
PICU	Count	5	5	2
	%	2.5%	2.5%	1%
POST OP WARDS	Count	16	7	7
	%	8%	3.5%	3.5%
SNCU	Count	2	1	1
	%	1%	0.5%	0.5%
TOTAL	Count	87	67	46
	%	43.5%	33.5%	23.0%

Table VII: Cadre wise distribution of various organisms.

DESIGNATION		TYPE OF ORGANISMS		
		Commensals	CoNS	S.aureus
AUXILIARY	Count	2	1	1
	%	1%	0.5%	0.5%
DOCTOR	Count	60	32	24
	%	30%	16%	12%
GROUP D	Count	3	5	9
	%	1.5%	2.5%	4.5%
STAFF NURSE	Count	22	29	12
	%	11%	14.5%	6%
TOTAL	Count	87	67	46
	%	43.5%	33.5%	23.0

Table VIII: High risk area wise distribution of MRSA and MSSA.

HIGH RISK AREAS		MRSA	MSSA
CASUALTY	Count	1	8
	%	0.5%	4%
GEN ICU	Count	2	2
	%	1%	1%
NICU	Count	0	2
	%	0.0%	1%
OPERATION THEATRE	Count	10	11
	%	5%	5.5%
PICU	Count	0	2
	%	0.0%	1%
POST OP WARDS	Count	3	4
	%	1.5%	2%
SNCU	Count	0	1
	%	0.0%	0.5%
TOTAL	Count	16	30
	%	8.0%	15.0%

Table IX: Cadre related distribution of MRSA and MSSA.

DESIGNATION		MRSA	MSSA
AUXILIARY	Count	0	1
	%	0.0%	0.5%
DOCTOR	Count	9	15
	%	4.5%	7.5%
GROUP D	Count	2	7
	%	1%	3.5%
STAFF NURSE	Count	5	7
	%	2.5%	3.5%
TOTAL	Count	16	30
	%	8.0%	15.0%

Table X: Antibiotic susceptibility pattern of S.aureus isolates

ANTIBIOTIC SENSIVIVITY		FREQUENCY	PERCENT (n=46)
CEFOXITIN	R	16	34.8%
	S	30	65.2%
CIPROFLOXACIN	R	21	45.65%
	I	4	8.7%
	S	21	45.65%
CLINDAMYCIN	R	7	15.2%
	I	1	2.2%
	S	38	82.6%
LINEZOLID	R	0	0%
	S	46	100%
CHLORAMPHENICOL	R	4	8.7%
	I	4	8.7%
	S	38	82.6%
ERYTHROMYCIN	R	30	65.2%
	I	3	6.5%
	S	13	28.3%
GENTAMYCIN	R	3	6.5%
	S	43	93.5%
PENICILLIN	R	41	89.1%
	S	5	10.9%
TEICOPLANIN	R	4	8.7%
	S	42	91.3%

Table XI: Antibiotic susceptibility pattern of MRSA isolates

ANTIBIOTIC SENSIVIVITY		FREQUENCY	PERCENT (n=46)
CEFOXITIN	R	16	100%
	S	0	0%
CIPROFLOXACIN	R	6	37.5%
	I	3	18.75%
	S	7	43.75%
CLINDAMYCIN	R	4	25%
	I	1	6.25%
	S	11	68.75%
LINEZOLID	R	0	0%
	S	16	100%
CHLORAMPHENICOL	R	0	0%
	I	3	18.75%
	S	13	81.25%
ERYTHROMYCIN	R	7	43.75%
	I	1	6.25%
	S	8	50%
GENTAMYCIN	R	3	18.25%
	S	13	81.75%
PENICILLIN	R	16	100%
	S	0	0%

TEICOPLANIN	R	3	18.75%
	S	13	81.25%

REFERENCES:

(1) Tong SY, Davis JS, Eichenberger E, Holland TL, Fowler VG Jr. Staphylococcus aureus infections: epidemiology, pathophysiology, clinical manifestations, and management. Clin Microbiol Rev. 2015 Jul;28(3):603-61, Available on pubmed

(2) Stapleton PD, Taylor PW. Methicillin resistance in Staphylococcus aureus: mechanisms and modulation. Sci Prog. 2002;85(Pt 1):57-72., Available on pubmed

(3) Ali Alghamdi B, Al-Johani I, Al-Shamrani JM, Musamed Alshamrani H, Al-Otaibi BG, Almazmomi K et al., Antimicrobial resistance in methicillin-resistant staphylococcus aureus. Saudi Journal of Biological Sciences 2023 Apr;30(4) Available on pubmed

(4) Antimicrobial Resistance Surveillance and Research Network January 2019 to December 2019: https://iamrsn.icmr.org.in/images/pdf/AMRSNAR.2019_29-07-2020.pdf

(5) Samuel P, Kumar YS, Suthakar BJ, Karawita J, Sunil Kumar D, Vedha V et al. Methicillin-Resistant Staphylococcus aureus Colonization in Intensive Care and Burn Units: A Narrative Review. Cureus. 2023 Oct 16;15(10), Available on pubmed

(6) Hardy KJ, Oppenheim BA, Gossain S, Gao F, Hawkey PM. A study of the relationship between environmental contamination with methicillin-resistant Staphylococcus aureus (MRSA) and patients' acquisition of MRSA. Infection Control and Hospital Epidemiology. 2006 Feb;27(2):127-32. Available on pubmed

(7) Blok HE, Troelstra A, Kamp-Hopmans TE, Gigengack-Baars AC, Vandenbroucke-Grauls CM, Weersink AJ et al. Role of healthcare workers in outbreaks of methicillin-resistant Staphylococcus aureus: a 10-year evaluation from a Dutch university hospital. Infection Control and Hospital Epidemiology. 2003 Sep;24(9):679-85. Available on pubmed

(8) Fishovitz J, Hermoso JA, Chang M, Mobashery S. Penicillin-binding protein 2a of methicillin-resistant Staphylococcus aureus. IUBMB Life. 2014 Aug;66(8):572-7 Available on pubmed

(9) Akhtar N. Staphylococcal nasal carriage of health care workers. Journal of the College of physicians and Surgeons-Pakistan: JCPSP ,2010;20(7):439–443

(10) Mangalgi, Agarwal, Sajjan, Math. Methicillin-resistant Staphylococcus aureus: Carriage Rate, Knowledge, Attitude, and Practice Levels Among HealthcareWorkers. September 2022,D Y Patil Journal of Health Sciences 10(1):6-11

(11) Cheesbrough M. District Laboratory Practise in Tropical Countries. Part 2. CambridgeUniversity Press, Cambridge, 2009; 62-68.

(12) CLSI supplement M100. Wayne, PA: Clinical and Laboratory Standards Institute; 32nd ed. 2022. —M100Performance Standards for Antimicrobial Susceptibility Testing, 32nd Edition.

(13) 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 south India. Indian Journal of Medical Microbiology. 2009 Jan-Mar;27(1):62-4.

(14) Goyal R, Das S, Mathur M. Colonisation of methicillin resistant Staphylococcus aureus among health care workers in a tertiary care hospital of Delhi. Indian Journal of Medical Sciences. 2002 Jul;56(7):321-4.

(15) Giri N, Maharjan S, Thapa TB, Pokhrel S, Joshi G, Shrestha O,et al. .Nasal Carriage of Methicillin-Resistant Staphylococcus aureus among Healthcare Workers in a Tertiary Care Hospital, Kathmandu, Nepal. International Journal of Microbiology. 2021 Aug 10;2021:8825746. doi: 10.1155/2021/8825746.

(16) Fadeyi A, MAN Adeboye, A Fowotade, C Nwabuisi, BO Bolaji, BO, Oyedepo O, et al. Methicillin Resistant Staphylococcus aureus Carriage amongst Healthcare Workers of the Critical Care Units in a Nigerian Hospital. American Journal of Infectious Diseases. 2010; 6(1):18-23.

(17) M R, D'Souza M, Kotigadde S, Saralaya K V, Kotian M S. Prevalence of Methicillin Resistant Staphylococcus aureus Carriage amongst Health Care Workers of Critical Care Units in Kasturba Medical College Hospital, Mangalore, Journal of Clinical and Diagnostic Research. 2013 Dec;7(12):2697-700. doi: 10.7860/JCDR/2013/5160.3735.

(18) Rana P, Sule PA, Kulkarni VV, Ubale MR. Prevalence of MRSA carriage among Health care workers (HCW) of tertiary healthcare centre in Western India. International Journal of Biomedical Research IJBR, 2019 May,10(5):e5168.

(19) 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):257-60.

(20) van Rijen M, Bonten M, Wenzel R, Kluytmans J. Mupirocin ointment for preventing Staphylococcus aureus infections in nasal carriers. Cochrane Database Syst Rev. 2008 Oct 8;2008(4):CD006216.