



## **NASAL CARRIAGE OF METHICILLIN RESISTANT STAPHYLOCOCCUS AUREUS (MRSA) AMONG HEALTH CARE WORKERS AT A TEACHING HOSPITAL IN CENTRAL INDIA**

**Mousumi Kilikdar<sup>1</sup>, Nirmalya Saha<sup>2</sup>, Aakanksha Sharma<sup>3</sup> and Simran Panjwani<sup>4</sup>**

<sup>1</sup>Department of Microbiology, Rajshree Medical Research Institute and Hospital, Bareilly (UP), India

<sup>2</sup>Department of Medicine, Rajshree Medical Research Institute and Hospital, Bareilly (UP), India

<sup>3</sup>Department of Microbiology, Shri Shankaracharya Institute of Medical Sciences, Bhilai (Chattisgarh), India

<sup>4</sup>Shri Shankaracharya Institute of Medical Sciences, Bhilai (Chattisgarh), India

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### **ABSTRACT**

**Background:** Methicillin resistant *Staphylococcus aureus* (MRSA), a multidrug resistant organism emerging as a major cause of nosocomial infections can be transmitted to a patient from another patient or through the hands, clothes and equipment of health care workers in hospital setting. Screening of health care workers colonised with MRSA will be helpful in preventing the expansion of this organism in a hospital. With this background the present study was undertaken to estimate the carriage rate of MRSA among healthcare workers in our hospital.

**Methods:** Nasal swabs were collected from 150 health care workers working in Shri Shankaracharya Institute of Medical Sciences, Bhilai during the study period of 2 months. *S. aureus* was identified by standard methods. Antibiotic susceptibility test was performed by modified Kirby-Bauer disc diffusion method. MRSA was identified by using a cefoxitin 30 mcg disc and it was interpreted according to the CLSI guidelines.

**Results:** The prevalence of MRSA carriage among health care workers was 17.3% with the carrier rate being highest among nurses (42.3%). MRSA isolates were 100% resistant to cefoxitin and amoxycylav, 53.9% to cotrimoxazole, 61.5% to erythromycin and 42.3% to clindamycin.

**Conclusions:** Screening and decolonization may be effective in reducing the MRSA carriage rate among the HCWs. Stringent infection control practices should be employed in the hospitals to minimize either the carriage or the transmission rate.

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### **INTRODUCTION**

The resistance to antimicrobial agents is an increasing global problem, especially among nosocomial pathogens. MRSA has emerged as a major cause of hospital acquired infections which is defined as a strain of *S. aureus* that is resistant to a large group of antibiotics called  $\beta$ -lactams that include penicillin, cephalosporins and carbapenems.<sup>1</sup> Health care workers are the most important mergers between hospitals and community in the development of nosocomial infections.<sup>2</sup> In hospitals, MRSA can be transmitted to a patient from another patient or through the hands, clothes and equipment of health care workers.<sup>3</sup>

Nasal carriage of MRSA is reported to vary between 0.8% and 3% in general population and between 6% to 17.8% in health care workers.<sup>4</sup>

Infection with MRSA is associated with increased morbidity, requirement of longer duration of antibiotic therapy, high

healthcare costs, prolonged hospitalization and an increased risk of death.<sup>5</sup>

The methicillin-resistant Staphylococcal strains are usually multi-resistant including beta-lactams and one or more of the following: aminoglycosides, macrolides, lincosamides, tetracyclines and are generally susceptible to vancomycin, teicoplanin, rifampicin, quinolones. Vancomycin has been the cornerstone of treatment of patients with serious MRSA infections. Consequently, increase in use of vancomycin resulted in the emergence of MRSA with reduced susceptibility to vancomycin.<sup>6</sup>

### **MATERIAL AND METHOD**

**Place of study:** Department of Microbiology, Shri Shankaracharya Institute of Medical Sciences, Bhilai

**Study design:** Hospital based prospective study.

**Study period:** Two months from 01/March/2019 to 30/April/2019.

\*Corresponding author: **Mousumi Kilikdar**

Department of Microbiology, Rajshree Medical Research Institute and Hospital, Bareilly (UP), India

**Sample size:** 150

**Study Population**

**Inclusion Criteria:** Health care workers (doctors, nurses, laboratory technicians, housekeeping staff and any other allied health care worker) working in the management of admitted patients in the indoor were included in this study.

**Exclusion Criteria:** Health care workers with upper respiratory tract infection or any medication or antibiotic therapy and not willing to participate were excluded from this study.

The health care workers were enrolled after a written informed consent was obtained from them. Age, sex, work category, duration of working in the critical care unit, prior hospitalization, current skin infection/other illness and other relevant information about the participants were obtained in a proforma which was specifically designed for this purpose.

**Nasal Swab Collection**

Samples were collected from both anterior nares using sterile swabs with a standard rotating technique. Firstly, the swabs were moistened with sterile physiological saline. Then the tip of the swab were inserted into one nostril and were rotated against the inside of the nostril for 3 seconds. The same swab was used for swabbing the other nostril. The swab was returned to the plastic tube and closed tightly. The plastic tube was labelled properly and immediately transported to the microbiology laboratory for bacteriological analysis.

**Culture and Identification**

The samples were processed within 2 hours after their collection. The swabs were inoculated onto mannitol salt agar (MSA) plates, blood agar plates and were incubated at 37°C for 18-24 hours.

Any growth was identified as *S. aureus* by using standard procedures to study colony morphology, microscopic appearance on gram stained smears, catalase test, slide and tube coagulase test.

**Antimicrobial Susceptibility Testing**

The isolated strains of *S. aureus* were screened for methicillin susceptibility by modified Kirby-Bauer method, using cefoxitin (30µg) discs on Mueller-Hinton agar (MHA) by using an inoculum density which were equivalent to McFarland’s 0.5 standard ( $1.5 \times 10^8$  CFU/ml) and inoculated at 35°C overnight.

Isolates which show inhibition zone sizes of diameter  $\leq$  21mm were considered as MRSA strains.<sup>7</sup>

Antibiotic susceptibility testing for all isolates of *S. aureus* were done against other antibiotics like amoxicillin/clavulanic acid (20/10µg), ciprofloxacin (5µg), ceftriaxone (30µg), cotrimoxazole (23.75/1.25µg), erythromycin (15µg), gentamicin (10µg), linezolid (30µg), penicillin (10 units) and teicoplanin (30µg), clindamycin (2µg) and vancomycin (30µg) by the modified Kirby-Bauer method. All antibiotic susceptibility test were conducted by using *S. aureus* ATCC 25923, MRSA ATCC 29213 and MSSA ATCC 33591 as controls under similar conditions as used for test strains.<sup>8</sup> Antibiotic sensitivity testing and interpretation of results were done according to CLSI guidelines.<sup>9</sup>

**RESULTS**

A total of 150 health care workers were screened during the study of which 60 (40%) were staff nurses, 26 (17.3%) were doctors, 21 (14%) were laboratory technicians and 43 (28.7%) were other health care workers (physiotherapists, house-keeping staff). Of them, 106 (70.7%) were females and the rest were males. Maximum (46.8%) of them were in the age group of 25-35 years (Table 1).

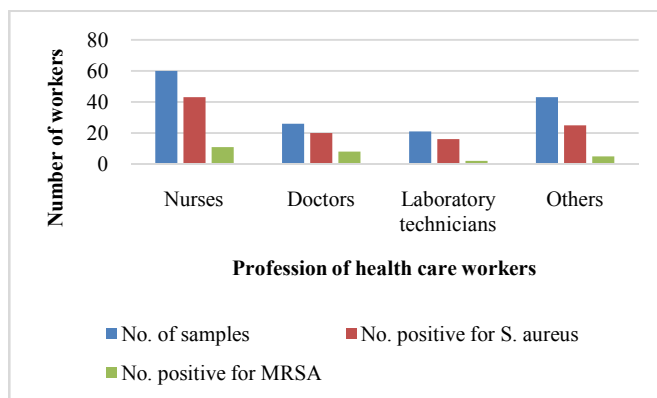
**Table 1** Characteristics of study participants

Parameters	Number of health care workers No. (%)N=150
Profession	
Doctors	26 (17.3)
Nurses	60 (40)
Laboratory Technicians	21 (14)
Other health care workers (physiotherapists, house keeping staff)	43(28.7)
Sex	
Male	44 (29.3)
Female	106 (70.7)
Age (in years)	
<25	42 (28)
25-35	70 (46.8)
36-45	27 (18)
46-55	6 (4)
56-65	3 (2)
66-75	1 (0.6)
>75	1 (0.6)

The nasal carriage rate of MRSA among health care workers was found to be 17.3% (26/150) and the prevalence of *S. aureus* carriage in nares was 69.3% (104/150) (Table 2). The prevalence of MRSA among doctors was 40% (8/20) followed by nurses 25.5% (11/43), other health care workers 20% (5/25) and laboratory technicians 12.5% (2/16) (Figure 1).

**Table 2** MRSA carriage status

No. of health care workers sampled	No. positive for <i>S. aureus</i>	No. positive for MRSA
150	104	26



**Figure 1** Profession/cadre related distribution of *S. aureus* and MRSA carriage

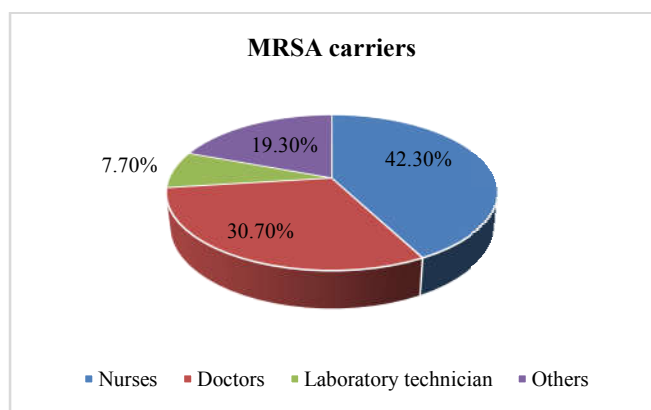
In ward wise prevalence of MRSA isolates NICU and PICU tops the list (50%), followed by SICU (40%), Emergency (23%), MICU (20%), Maternity (16.6%), General Medicine (13.6%), Central Clinical Laboratory (13.3%), Surgery (12.5%) (Table 3).

**Table 3** Distribution of *S. aureus* and MRSA among health care workers of different wards

Wards	Total sample Number =150	MRSA Number=26	<i>S. aureus</i> Number=104
General			
Medicine	22	3(13.6%)	18(81.8%)
Surgery	8	1(12.5%)	5(62.5%)
Maternity	18	3(16.6%)	11(61.1%)
Emergency	13	3(23.1%)	10(76.9%)
MICU	10	2(20%)	6(60%)
SICU	52	4(7.6%)	
NICU	42	3(7.1%)	
PICU	21	1(4.7%)	
Central Clinical			
Laboratory	30	4(13.3%)	21(70%)
Others	38	5(13.1%)	25(65.7%)

Our study shows that among the 104 health care workers who were positive for nasal carriage of *S. aureus* majority were nurses (43/104, 41.34%). 26 health care workers were positive for nasal carriage of MRSA, out of which 11 were nurses (42.3%) (Table 4). Among the total MRSA carriers, the carrier rate was highest among nurses (42.3%) (Figure 2).

**Distribution of MRSA carriers**



**Figure 2** Distribution of MRSA carriers

**Table 4** Profession/cadre related distribution of *S. aureus* and MRSA carriage status

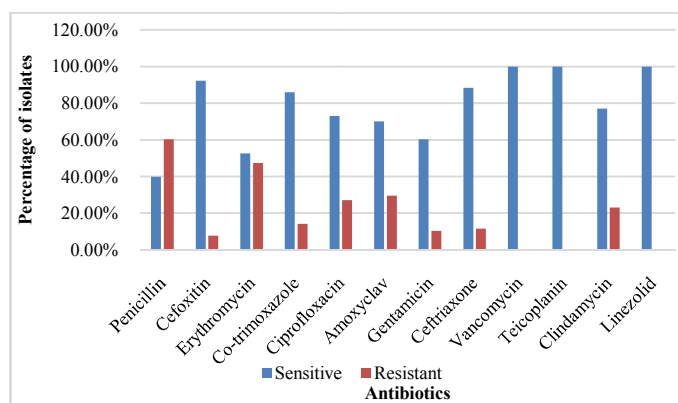
Designation	No. sampled (%)N=150	No. positive for <i>S. aureus</i> carriage (%) N=104	No. positive for MRSA carriage (%)N=26
Doctors	26(17.3)	20(19.2)	8(30.7)
Nurses	60(40)	43(41.3)	11(42.3)
Laboratory Technicians	21(14)	16(15.3)	2(7.7)
Other health care workers	43(28.6)	25(24)	5(19.2)

The carriage rate of MRSA among males was 20.4%(9/26) whereas it was 16.03% (17/26) in females. With respect to age group, the highest prevalence was among the health care workers in the age group 46-55 years (50%). Considering the number of years of working in the hospital, the prevalence of MRSA was highest (27.7%) among those who have worked for >10 years in the hospital (Table 5).

39.8% (31/78) isolates of *S. aureus* were sensitive to Penicillin. The sensitivity to Cefoxitin was 92.3% (72/78). The sensitivity to Erythromycin, Co-trimoxazole, Ciprofloxacin, Amoxycylav, Gentamicin, Ceftriaxone, Clindamycin was 52.6%(41/78), 85.9%(67/78), 73% (57/78), 70.5%(55/78), 60.2%(47/78), 88.4%(69/78), 77%(60/78) respectively. All the *S. aureus* strains were 100% sensitive to Vancomycin, Teicoplanin and Linezolid (Figure 3).

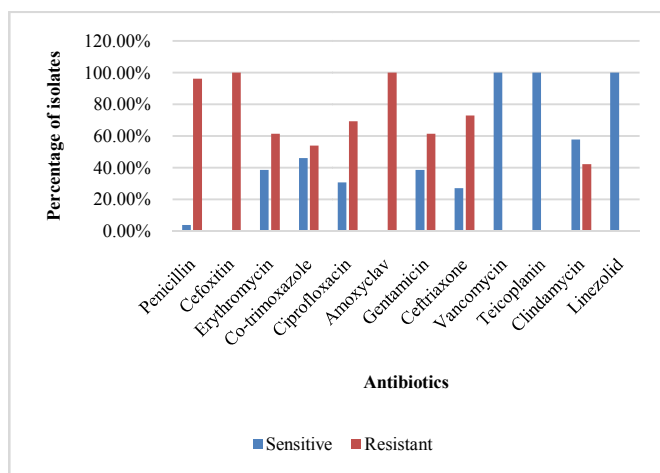
**Table 5** Characteristics of MRSA carriers

Parameters	No. of health care workers sampled (N=150)	No. positive for MRSA (%)
Sex		
Male	44	9 (20.4)
Female	106	17(16.03)
Age		
<25	42	8(19)
25-35	70	10(14.2)
36-45	27	4(14.8)
46-55	6	3(50)
56-65	3	1(33.3)
66-75	1	0
>75	1	0
No. of years of working in the hospital		
<1 year	29	3(10.3)
1-5 years	74	10(13.5)
6-10 years	29	8(27.5)
>10 years	18	5(27.7)



**Figure 3** Antibiotic susceptibility profile of *S. aureus* isolates

96.2% (25/26) MRSA isolates were resistant to Penicillin. The resistance to Cefoxitin was 100% (26/26). The resistance of MRSA isolates to Erythromycin, Co-trimoxazole, Ciprofloxacin, Amoxiclav, Gentamicin, Ceftriaxone, Clindamycin was 61.5%(16/26), 53.9%(14/26), 69.3%(18/26), 100% (26/26), 61.5%(16/26), 73%(19/26), 42.3%(11/26) respectively. The isolates were 100% sensitive to Vancomycin, Teicoplanin and Linezolid (Figure 4).



**Figure 4** Antibiotic susceptibility profile of MRSA isolates.

**DISCUSSION**

It is necessary to detect the MRSA carriers among the apparently healthy hospital personnel, particularly those working in the critical care areas. These individuals act as a potential source of infection to their patients, resulting in their extended stay in the hospital. This can be controlled by the

regular screening of the health care workers and treating them till they become negative for MRSA. *S. aureus* can colonise multiple sites in the body like the anterior nares, axilla, perineum, pharynx and gastrointestinal tract but the most common site of colonization of *S. aureus* are the anterior nares.<sup>10</sup>

According to our study, the prevalence of MRSA carriage in health care workers is 17.3%. This is similar with the internationally reported range of the MRSA carriage (5.8 to 17.8%) among the health care workers in the hospital setting by Shakya B *et al*<sup>11</sup>. Studies like Albrich *et al*<sup>12</sup> in 2006, revealed that 4.6% of the health care personnel were either infected or colonized with MRSA which is not in accordance with our study.

The highest prevalence of MRSA carriage is among nurses (42.3%) in our study. This is in accordance with the findings of Shinde RV *et al*<sup>13</sup> in Karad, India, where the carriage rate of MRSA among nurses is highest (34.61%). In contrast, the carriage rate among nurses is very low (2.7%) in the study conducted by Radhakrishna M *et al*<sup>14</sup> at Mangalore.

The prevalence of MRSA was more in males (20.4%) in our study. This is in accordance with the study conducted by Garoy *et al*<sup>15</sup> in Asmara where the prevalence of MRSA was highest in males (55.9%). This is in contrast to the study conducted by Wesolowska *et al*<sup>16</sup> in Southern Poland where the prevalence was highest among females (17.7%)

The highest rate of MRSA carriage (13.5%) is among the health care workers who have worked upto 5 years in this study. In a study conducted by Al Humaidan *et al*<sup>17</sup> in Saudi Arabia the highest rate (26%) of MRSA carriage was among the health care workers who have worked for 4-6 years whereas lowest was observed among those who have worked for >7 years.

In our study, the antibiogram of the *S. aureus* isolates revealed that all the isolates were 100% sensitive to Vancomycin, Teicoplanin and Linezolid which is correlating with the studies like Morelli *et al*<sup>18</sup> in St. Louis and Radhakrishna *et al*<sup>14</sup> in South India.

Among the MRSA isolates, 100% sensitivity to Vancomycin, Teicoplanin and Linezolid was observed. This is in accordance to the study conducted by Radhakrishna *et al*<sup>14</sup> in South India, Jindamwar *et al*<sup>19</sup> in West Bengal, Bhowmik *et al*<sup>20</sup> in North east part of India and Askarian *et al*<sup>21</sup> in Iran where no isolates were resistant to Vancomycin, Teicoplanin and Linezolid. However, sensitivity to Vancomycin was 84.3% in a study done by El Aila *et al*<sup>22</sup> in Gaza Strip.

The antibiogram of MRSA isolates also revealed that resistance to Amoxiclav, Erythromycin, Gentamicin was 100%, 61.5%, 61.5% respectively which is in accordance with the study conducted by Rutvi *et al*<sup>23</sup> in Gujarat, India.

It is encouraging finding that all the MRSA isolates are susceptible to Vancomycin. So, this drug can be used for eradication of the carrier state of MRSA as well as for treatment of patients infected with MRSA.

## CONCLUSION

In this study, nasal carriage of MRSA among the health care workers is 17.3% with the rate being highest among nurses (42.3%). Considering the fact that nurses are more involved in

the patient care activities, it is necessary that they should be sensitized regarding this issue. The single most important factor for preventing nosocomial infections is compliance of the health professionals with the sanitary and the antibacterial guidelines. To achieve this, the health care workers should be informed about the potential consequences of the nosocomial infection. Simple preventive measures like hand washing before and after the patient examination, use of sterile aprons and masks, isolation of colonized and infected patients can reduce the disease transmission rate considerably. The health care workers, with nasal carriage of MRSA, must be regularly screened and should be given warning of the presence of antimicrobial resistant pathogens.

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