

DETECTION OF METHICILLIN RESISTANT STAPHYLOCOCCUS AUREUS AMONG HEALTH CARE WORKERS IN ATERTIARY CARE HOSPITAL IN EASTERN PART OF BIHAR

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**Abstract**

Background: The objective of this study was to determine the prevalence of MRSA carriage among health care workers of our hospital and to study the antibiotic susceptibility pattern of the MRSA strains isolated. **Materials and Methods:** This study was carried out by the Department of Microbiology at JLNMC, Bhagalpur, Bihar the study period was March 2022 to February 2023. The study was conducted on health care workers who volunteered for the study and were on duty during the study period. The total number of health care workers who were included in the study was 150. Approval of the Institutional Ethics Committee was obtained prior to starting the study. The health care workers were enrolled after a written informed consent was obtained from them. A brief write-up explaining the essential facts of MRSA was given to the participants of the study. 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 was inserted into one nostril and 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. **Result:** Out of 150 Sample the nasal carriage rate of MRSA was found to be 10.7% and the prevalence of S. aureus carriage in nares was 42.7%. **Conclusion:** Hand Hygiene is the single most important measure that should be practiced in an appropriate manner to prevent the occurrence of nosocomial infections including MRSA.

INTRODUCTION

One of the commonest bacterial pathogens responsible for causing wide spread infection in the community as well as in hospital settings is Staphylococcus aureus. This organism causes significant morbidity and mortality and its treatment has become difficult since the emergence of Methicillin resistant Staphylococcus aureus (MRSA). MRSA is defined as a strain of S. aureus that is resistant to a large group of antibiotics called β -lactams that includes penicillin's, cephalosporins and carbapenems.^[1] As it is a multidrug resistant organism (MDRO), it is more virulent than MSSA (Methicillin Sensitive Staphylococcus aureus) strains.^[2] This antibiotic resistant form of Staphylococcus aureus is one of the main causes of hospital acquired infection.^[3] MRSA has become endemic worldwide in the last two decades and hospital acquired infections due to MRSA are

associated with longer hospital stay and increased costs.^[4]

An important link between hospitals and communities in the development of nosocomial infections are the health care workers.^[5] In hospitals, MRSA can be transmitted to a patient from another patient or through the hands, clothes and equipment of health care workers.^[6] The health care workers harbouring the MRSA strains are mostly asymptomatic and serve as carriers of these strains. The anterior nares are the ecological niche for the S. aureus and most of the invasive S. aureus infections are thought to arise from the anterior nares.^[7] The other sites where MRSA can colonize are the axilla, groin, perineum, gastrointestinal tract and less commonly rectum and vagina. Nasal carriage of MRSA is reported to vary between 0.8% and 3% in the general population and between 6% to 17.8% in health care workers.^[4] As MRSA strains are multidrug resistant it is important that these strains

are detected and eradicated whenever possible. In a health care setting, screening of health care workers for MRSA carriage will be helpful in preventing spread from colonized health care workers to patients. Although mass screening of health care workers is still a much-debated issue, nevertheless it has been studied that the magnitude of the problem of nosocomial transmission of MRSA strains from health care workers to patients is quite alarming and needs active interventions.^[8,9] Some studies have suggested that healthcare workers should be aggressively screened to help reduce MRSA rates.^[10] To control the spread of this organism in a health care facility, it is imperative that we estimate the extent of the problem and find the effectiveness of our hospital infection control policy.

It is with this background that the present study was undertaken to find out the carriage rate of MRSA among health care workers in a tertiary care Hospital, Bihar and also to provide a holistic approach to the problem of infections caused due to MRSA. This study will also help the infection control committee to formulate a MRSA policy based on the outcomes. The objective of this study was to determine the prevalence of MRSA carriage among health care workers of our hospital and to study the antibiotic susceptibility pattern of the MRSA strains isolated.

MATERIALS AND METHODS

This study was carried out by the Department of Microbiology at JLNMC, Bhagalpur, Bihar the study period was March 2022 to February 2023. The study was conducted on health care workers who volunteered for the study and were on duty during the study period. Health care worker implied any staff member (doctors, nurses, laboratory technicians, housekeeping staff and any other allied health care worker) working in the management of admitted patients in the indoor and students (medical and nursing) who were on clinical rotation to the units. Health care workers who were not willing to participate in the study were excluded from the study. The total number of health care workers who were included in the study was 150. Approval of the Institutional Ethics Committee was obtained prior to starting the study. The health care workers were enrolled after a written informed consent was obtained from them. A brief write-up explaining the essential facts of MRSA was given to the participants of the study.

Self-administered questionnaire was used to obtain demographic data like age, sex, designation, previous MRSA carriage statuses of the individuals and treatment for the same, duration of stay in the unit, the hospital wing to which they belonged to and other relevant information about the consenting participants. 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 was inserted into one nostril and 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 labeled properly and immediately transported to the microbiology laboratory for bacteriological analysis. The samples were processed within 2 hours after their collection. The swabs were inoculated onto mannitol salt agar (MSA) plates and incubated at 37°C for 18-24 hours.⁴ Any growth was identified as *S. aureus* by using standard procedures to study colony morphology, microscopic appearance on gram-stained smears, catalase test, tube coagulase test and deoxyribonuclease test.^[11] The isolated strains of *S. aureus* were screened for Methicillin susceptibility by modified Kirby- Bauer method, using cefoxitin (30 µg) discs on Mueller-Hinton agar (MHA) by using an inoculum density which was equivalent to McFarland's 0.5 standard (1.5×10⁸ CFU/ml) and inoculating it at 35°C overnight.¹² Isolates which show inhibition zone sizes of diameter ≤21 mm were considered as MRSA strains.^[13] Antibiotic susceptibility testing for all isolates of *S. aureus* was done against other antibiotics like amoxicillin/clavulanic acid (20/10 µg), ciprofloxacin (5 µg), ceftriaxone (30 µg), cotrimoxazole (23.75/1.25 µg), erythromycin (15 µg), gentamicin (10 µg), linezolid (30 µg), penicillin (10 units) and teicoplanin (30 µg), clindamycin (2 µg) and vancomycin (30 µg) by the modified Kirby-Bauer method. All antibiotic susceptibility tests 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. Antibiotic sensitivity testing and interpretation of results was done according to CLSI guidelines.^[14] In case of vancomycin, isolates with inhibition zone sizes of diameter ≤15 mm were considered as vancomycin resistant. Confirmation of vancomycin susceptibility or resistance was done by detection of MIC by automated identification and antimicrobial susceptibility system using Vitek-2 Compact system (Biomerieux, India).^[14] Strains that showed an MIC of more than 4 µg/ml were considered as vancomycin resistant *S. aureus* (VRSA). Repeat samples were collected from the participants who showed a nasal carriage of MRSA after an interval of 15 days and they were processed in the same manner as has been mentioned above, for confirmation. The data was entered in Microsoft Excel worksheet 2010 and analyzed.

RESULTS

A total of 150 health care workers were recruited during the study of which majority were staff nurses (46%), followed by doctors (18%), laboratory technicians (8) and other health care workers including pharmacists, physiotherapists and

housekeeping staff (28%). Of them, 64.7% were females. Maximum of them were in the age group of 36–45 years. The nasal carriage rate of MRSA was found to be 10.7% and the prevalence of *S. aureus* carriage in nares was 42.7%. The prevalence of MRSA carriers among various categories of health staffs has been shown in [Figure 1].

Among the total MRSA carriers, the carrier rate was highest among nurses. The carriage rate of MRSA among males was more as compared to females. With respect to age group, the highest prevalence was among the health care workers in the age group of 36-45 years. Considering the number of years of working in the hospital, the prevalence of MRSA was highest among those who have worked for >5 years in the hospital [Table 1].

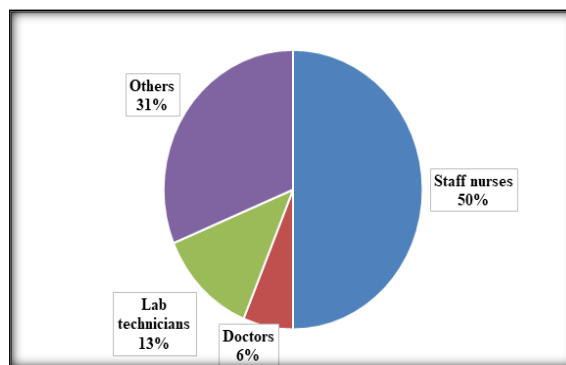


Figure 1: Pie distribution of HCWs carrying MRSA

Table 1: Table showing distribution of carriers based of various attributes

Characteristics	Number of HCWs sampled	Numbers found positive for MRSA
Gender		
1. Female	97 (64.7%)	7 (43.8%)
2. Male	53 (35.3%)	9 (56.2%)
Age group		
1. <25 years	19 (12.7%)	1 (0.7%)
2. 25-35 years	44 (29.3%)	4 (2.7%)
3. 36-45 years	62 (41.3%)	8 (50%)
4. >45 years	24 (16%)	3 (18.8%)
Duration of service		
1. < 5 years	57 (38%)	4 (25%)
2. ≥5 years	93 (62%)	12 (75%)

The MRSA isolates were 100% sensitive to linezolid and vancomycin. (MIC of vancomycin was in the range 1-2 ug/ml.) All the MRSA isolates were 100% resistant to Penicillin. Resistance to amoxyclav was 90%, to cotrimoxazole and erythromycin it was 60% and was 50% to clindamycin.

DISCUSSION

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.^[15] According to a study in Thailand the nasal carriage of *S. aureus* is 29.7% among the health care workers.^[16] Nasal colonization with *S. aureus* have been reported to range from 6.3 to 17.8% in the general population and in health care workers it varies from 18.2 to 28.2%.^[17,18]

In our study, the prevalence of MRSA among health care workers is 10.7% which is comparable to the findings of Cesur et al.^[19] It has been found that the prevalence of MRSA carrier state worldwide among the health care workers is around 10-40%.^[20] Literature search done by Albrich and Harbarth from January 1980 to March, 2006, which involved 127 investigations and screening of 33,318 health-care participants, revealed that 4.6% of the health care personnel were either infected or colonized with MRSA.^[10] Various studies in Indian health care settings have different rates of MRSA carriage

among health care workers. An MRSA carriage rate of 1.8% from Pondicherry, 6.6% in Delhi and 2% in Madurai was revealed. Outside India, nasal carriage was 2% in Nepal and 38.9% in Nigeria.^[21-25] These differences in prevalence of MRSA are due to the variability in geographical distribution, hospital settings, hospital specialities and areas within hospital where the study was conducted.

The highest prevalence of MRSA carriage is among nurses in this study. This is in accordance with the findings of Kalyani et al where the carrier rate of MRSA among nurses is 7.5%.^[26] Study done by Al Humaidan et al showed a very high carrier rate of 23% among nurses.^[27] In contrast, the carriage rate among nurses is very low (2.7%) in the study conducted at Kasturba medical college.^[4] This finding is similar to the study findings of Sridharan et al where 10 out of the total 17 MRSA carriers (58.8%) were nurses.^[28]

The highest rate of MRSA carriage (14.2%) is among the health care workers who have worked for >5 years in this study. In a study conducted by Al Humaidan 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%) whereas lowest was observed among those who have worked for >7 years.^[27]

Although the prevalence of MRSA among health care workers in our hospital is not alarming, it is important to emphasize the need for stringent hospital infection control policies. It is also important to stress the importance of hand hygiene

among health care workers to prevent transmission of MRSA within the hospital and also to their family members. Among the MRSA isolates, 100% sensitivity to vancomycin and linezolid was observed. However, sensitivity to vancomycin was 84.3% in a study done by El Aila et al.^[29] As disc diffusion test is not reliable for vancomycin we determined MIC of the MRSA isolates by automated Vitek 2 system. All the isolates showed MIC ≤ 2 $\mu\text{g/ml}$ and hence were taken to be susceptible to Vancomycin which was similar to the findings of Radhakrishna et al.^[4] The sensitivity of MRSA isolates to erythromycin, teicoplanin, ciprofloxacin and gentamicin is 40%, 80%, 20% and 80% respectively. This can be compared to the antibiotic susceptibility pattern of MRSA strains isolated in Kasturba medical college where the sensitivity to erythromycin is 40%, to teicoplanin and gentamicin is 80% and to ciprofloxacin is 20%.^[4] We informed the hospital infection control committee of our hospital regarding the findings of our study so that they could initiate decolonization measures.

CONCLUSION

Considering the fact that nurses are more involved in the patient care activities, it is necessary that they should be sensitized regarding this issue and the importance of hand washing should be emphasized upon them. This study highlights the fact that we need to adhere to infection control practices to reduce the spread of MRSA to susceptible individuals. Hand Hygiene is the single most important measure that should be practiced in an appropriate manner to prevent the occurrence of nosocomial infections including MRSA.

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