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Nasal carriage of Methicillin resistant *Staphylococcus aureus* (MRSA) among health care workers in a tertiary care hospital

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***Abstract**: **Aim and Background**: The aim of this study was to detect the carrier rate of methicillin-resistant Staphylococcus aureus (MRSA) among the health care workers (HCWs) in a tertiary care hospital and determine the antimicrobial susceptibility for topically used antimicrobial agents. Increasing number of infections are caused by MRSA strains in the hospitals. About 5% of HCWs become colonized with MRSA and frequently act as vectors of transmission[1]. **Methods**: Nasal swabs from 200 healthcare workers were collected in the month of October 2017. These swabs were processed using standard laboratory techniques.*
***Results**: Of the samples of 200 HCWs we have collected, 52(26%) were nasal carriers of S. aureus and among them 17(32.7%) were carriers of MRSA. The overall carrier rate of MRSA was 8.5 %(17/200). All isolates were sensitive to bacitracin; 76.47 %(13/17) were sensitive and 23.5%(4/17) were resistant to minocycline; 82.35%(14/17) were sensitive and 17.6%(3/17) were resistant to mupirocin. **Conclusion**: This study emphasizes the need for active surveillance of HCWs to detect MRSA colonization and take appropriate measures. The carriers should be treated with topical mupirocin 3 times daily for 5 days for decolonization of MRSA. Strict adherence to infection control practices can limit the spread of MRSA infection by HCWs to susceptible individuals.*

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I. Background

Staphylococcus aureus, an important pathogen of the genus Staphylococcus, is a Gram positive coccus arranged in clusters and is frequently seen in association with infections both in the community and the hospital. MRSA strains are considered resistant to all beta-lactam antibiotics[1]. Increasing number of infections are caused by MRSA strains in the hospitals. Therapy has become problematic as these strains are often multidrug-resistant, resistant to several groups of broad-spectrum antibiotics that are used on a large scale in the hospital[2].

The ecological niches of *S. aureus* strains are the anterior nares. Multiple studies have shown that the anterior nares are the most consistent area from which this organism can be isolated[3]. Nasal carriage of *S. aureus* has also become a way of persistence and spread of multidrug-resistant Staphylococci especially MRSA[4]. Nasal carrier rate of *S. aureus* in the anterior nares vary between 10-40% in both community and hospital setting. About 5% of HCW's become colonized with MRSA and frequently act as vectors of transmission[1]. Studies have also shown that when the nares are treated topically to eliminate nasal carriage, in most cases the organism also disappears from other areas of the body[5]. Several studies performed across the globe have reported the nasal carriage rate of MRSA among health care workers as 12.7% by A.Shibabaw et al from Ethiopia[6] and 21.9% by R.Khanal et al from Nepal[7]. Therefore, screening of HCWs for the nasal carriage is an important component in the control of MRSA in any health care facility.

The aim of this study was to detect the carrier rate of MRSA among HCWs in a tertiary care hospital and test the strains for susceptibility for topical antibiotics.

II. Methods

This cross sectional study was carried out at Dr. PSIMS & RF, Chinnaoutapalli, Andhra Pradesh, India. This study was approved by the institutional ethical committee. Informed consent was taken from all the participants. Nasal swabs from 200 HCWs were collected in the month of October 2017.

Inclusion criteria: Medical and para-medical staff including the janitors attending outpatient and inpatient sections of various departments.

Exclusion criteria: Healthcare workers with history of allergic rhinitis, upper respiratory tract infection and fever were excluded. Patients and their attendants were also excluded from the study.

Nasal swabs were collected from the nasal cavity of each subject by gently rotating it through anterior nares and were transported immediately to Microbiology laboratory for further processing. Specimens were initially inoculated onto 5% sheep blood agar and incubated at 37^0 C for 24hrs. After incubation, growth was identified as *S. aureus* on the basis of colony morphology, Gram's stain, catalase and coagulase test.

Susceptibility Tests: All strains were tested by modified Kirby Bauer disc diffusion method on Mueller-Hinton agar with standardized procedures, according to the recommendations of the Clinical and Laboratory Standards Institute (CLSI) 2016 guidelines [8].

All the *S. aureus* isolates were tested for methicillin resistance with Cefoxitin 30 µg disc and CLSI breakpoints were used to determine all MRSA strains. Minimum inhibitory concentration (MIC) was also determined for all the *S. aureus* strains with cefoxitin and vancomycin Epsilometer-strip (E-Strip) (Hi-Media Vancomycin-Cefoxitin Ezy MIC™ Strip). Oxacillin Resistance Screen Agar (ORSA) was used to further confirm the MRSA strains. All the MRSA isolates were then tested for sensitivity to mupirocin 5µg, bacitracin 10 µg and minocycline 30 µg. For mupirocin 5 µg disc diffusion test, break points outlined in publications from the British Society for Antimicrobial Chemotherapy (BSAC) methods for Antimicrobial Susceptibility Testing were used[9], as break points were not available from CLSI guidelines[8]. No interpretative criteria were found for bacitracin 10 µg disc in CLSI or BSAC guidelines[8,9]. Food and Drug Administration (FDA) approved performance standards for antimicrobial discs obtained from drug manufacturers were used for our study (S≥13, Intermediate 9-12, R≤8). For interpreting zones of minocycline 30 µg disc, CLSI break points were used[8].

III. Results

Of the 200 samples of HCWs, 52 (26%) were nasal carriers of *S. aureus* and among them 17 (32.7%) were carriers of MRSA. The overall carrier rate of MRSA was 8.5 % (17/200) **(Fig 1)**. *S. aureus* carriage rate was high among doctors 28.57%(22/77) where as MRSA carriage rate was high among nurses 10.41% (5/48) **(Table 1)**. Nasal carriage of MRSA among male and female HCWs were 5.55% (3/54) and 9.58% (14/146) respectively **(Table 2)**.

Colonization of both *S. aureus* (31.08%) and MRSA (10.81%) were high in HCWs who have more than three years of clinical experience **(Table 3)**. The highest rate of *S. aureus* carriers were found in HCWs of gynaecology 14.81% and it is followed by opration theatre (OT) staff 13.33%, general surgery 10.71%, general medicine 9.3% and central laboratory 8% **(Table 4)**.

Antibiotic susceptibility tests were done for 52 isolates of *S. aureus*. Among 52 *S. aureus* isolates, 17(32.7%) were resistant to cefoxitin by disc diffusion method which were further confirmed by cefoxitin E-test. All these isolates were also tested for vancomycin MIC as we had a combined cefoxitin and vancomycin E-test strip and we found that all the MICs for vancomycin were within the sensitive range. All our MRSA isolates were further confirmed by their growth on the ORSA media. These MRSA were tested for their sensitivity to bacitracin, minocycline and mupirocin on Muller-Hinton media. All MRSA isolates were sensitive to bacitracin; 76.47% (13/17) were sensitive and 23.5% (4/17) were resistant to minocycline; 82.35% (14/17) were sensitive and 17.6% (3/17) were resistant to mupirocin **(Fig 3)**.

Fig 1: Percentage of Staphylococcus among study population

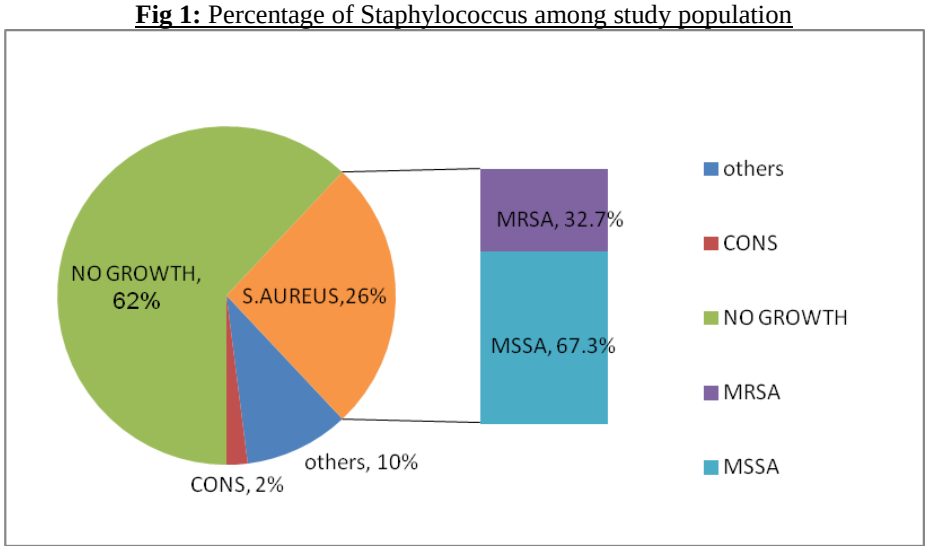


Table 1: Distribution of *S. aureus* and MRSA among HCW's:

Healthcare Workers	No of Samples	*S. aureus* (%)	MRSA (%)
Doctors	77	22 (28.57)	7(9.09)
Nurses	48	12 (25)	5(10.41)
Paramedical	36	9 (25)	2 (5.55)
Janitors	39	9 (23.07)	3 (7.69)

Table 2: Distribution of MRSA among males and females:

Healthcare Workers	No of Samples n=200	No of females (MRSA%) n=146	No of males(MRSA%) n=54
Doctors	77	6(7.79%)	1(1.3%)
Nurses	48	4(8.3%)	0
Paramedical	36	0	1(2.7%)
Janitors	39	4(10.25%)	1(2.56%)

Table 3: Distribution according to the clinical experience in the hospital

Experience in years	Total number	*S. aureus*(%)	MRSA(%)
<1 yr	53	13 (24.52)	4 (7.54)
1-3 yr	73	16 (21.91)	5 (6.84)
>3 yr	74	23 (31.08)	8 (10.81)

Table 4: Distribution of *S. aureus* and MRSA among healthcare workers of different wards

Wards/ Departments	No of Samples (no = 200)	*S. aureus* (%) (n= 52)	MRSA (%) (n= 17)
NICU	12	1(8.33)	0 (0)
PICU	12	0	0 (0)
ICU	15	3(20)	0 (0)
General surgery	28	11(39.28)	3(10.71)
General medicine	43	12(27.9)	4 (9.3)
Gynaecology	27	7(25.92)	4 (14.81)
Orthopedics	15	4(26.66)	1 (6.66)
Paediatrics	14	2(14.28)	1 (7.14)
OT	15	6(40)	2 (13.33)
Central Laboratory	25	6(24)	2 (8)

Fig 2: MRSA distribution among healthcare workers of different wards:

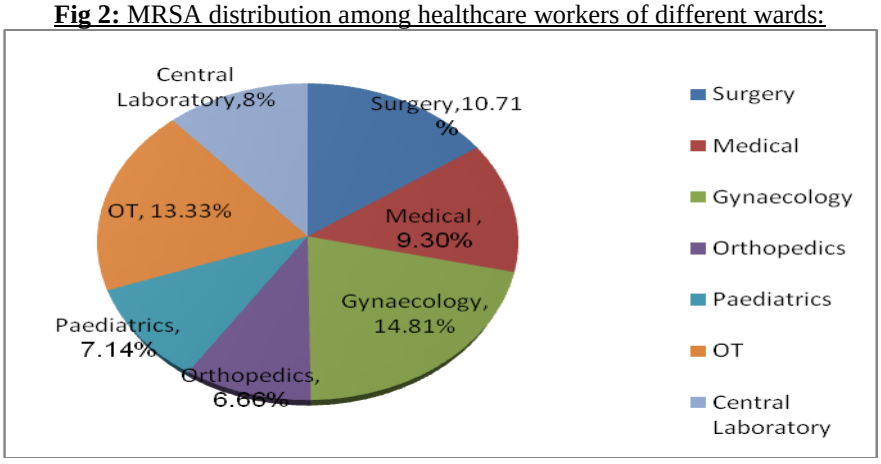
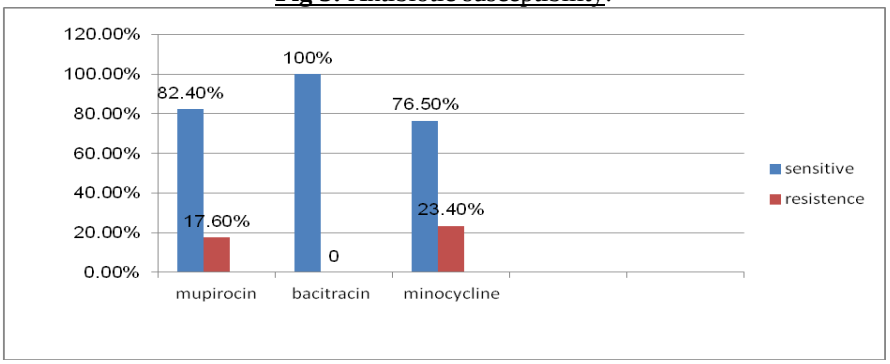


Fig 3: Antibiotic susceptibility:



IV. Discussion

Surveillance of HCWs is necessary to detect the MRSA carriers among the apparently healthy hospital staff as they pose a threat to infection control practices. These individuals act as a potential source of infection to their patients, resulting in their extended stay in the hospital. Regular screening of the HCWs and treating them till they become negative for MRSA will control this potential spread to the patients [10].

This study detected nasal carriage rate of *S. aureus* to be 26% (52/200). Similar findings were reported by Yazgi et al (27.5%)[11] where as low carriage rates of *S. aureus* were reported by L. Agarwal et al (14%)[12]. Our study showed the MRSA nasal carriage rate as 8.5% (17/200) among HCWs which is higher than that reported by studies in Western Nepal tertiary care hospital by Khanal R et al 3.43% (7/204) [7]. Similar findings were reported in studies by S.R.Rongharpi et al (11.43%)[13] and B.Shakya et al (7.1%) [14]. Our institute's MRSA carrier rate is lesser than that reported internationally by A.Shibabaw et al (12.7%) [6] and Nadia.e.Al-Abdli et al (21.4%) [15].

S. aureus carriage rate was high among doctors 28.57% where as MRSA carriage rate was high among nurses 10.41% in our study. Similar results were reported by Shibabaw et al [6] (12.7%). Frequent patient contact could be accounted for high risk of MRSA colonization strains among nurses.

In our Study, antibiotic susceptibility to commonly used topical antimicrobials, mupirocin (5µg), bacitracin (10 µg) minocycline (30 µg) for the eradication of nasal colonization of MRSA was performed. 100% sensitivity was found for bacitracin where as 82.35% and 76.47% sensitivity was found for mupirocin and minocycline respectively.

Mupirocin, a topical glycopeptide antibiotic, is commonly used antibiotic for nasal decolonization therapy of HCWs to prevent the emergence and transmission of MRSA in health care facilities[16]. Mupirocin resistance has been reported with the prevalence of 0.5% in Nigeria by Shittu AO et al[17]. to 14.6% in India by Gadepalli R et al [18]. In our study, 3/17 (17.6%) were found to be resistant to mupirocin 5µg disc. BSAC guidelines[9] recommend that an E-test or another MIC method should be performed on any mupirocin resistant strain when tested with 5 µg disc. The reason for this being, the isolates with low-level resistance to mupirocin (MICs 8–256 mg/L) may be eradicated more slowly than susceptible isolates. Although low-level mupirocin resistant strains (MICs 8–256 mg/L) can be controlled by normal dosage schedule of mupirocin, a few studies suggest that treatment failure may occur after few weeks. This emphasizes the importance of identification of both high and low-level resistant strains[19, 20, 21]. In this study, we have not performed MIC or E-test for mupirocin resistant strains, which is the limitation of our study.

V. Conclusion

This study highlights the need for active surveillance of HCWs to detect MRSA colonization and take appropriate measures. The carriers should be treated with topical mupirocin 3 times daily for 5 days for decolonization of MRSA. More attention should be given to the prevention of MRSA colonization in nursing staff, as this professional group has highest MRSA colonization rates. Adherence to infection control and prevention practices can limit the spread of MRSA infection by HCWs in hospitals. The knowledge of HCWs can be enhanced by regular training on infection control practices.

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Conflict of Interest: None declared

VI. References

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