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**Original Article**

# Methicillin-resistant *Staphylococcus aureus* (MRSA) carriage among the critical care personnel in a tertiary care hospital in Sikkim: An observational study

Anusha Subba & Dechen Chomu Tsering

*Department of Microbiology, Sikkim Manipal Institute of Medical Sciences, Sikkim Manipal University, Gangtok, India*

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***Background & objectives*: Persistent nasal colonisation of methicillin-resistant *Staphylococcus aureus* (MRSA) among healthcare personnel (HCP) remains a significant challenge. MRSA carriers are crucial to the spread of the infection, with healthcare professionals often acting as vectors for both hospital- and community-acquired MRSA. This study aimed to evaluate the MRSA carriage rate among healthcare professionals from critical care units at a tertiary care hospital in Gangtok, Sikkim. Furthermore, the study undertook to analyse antibiotic susceptibility patterns of isolated MSSA and MRSA strains, and identify associated risk factors for MRSA infection.**

***Methods*: Three hundred samples from healthcare workers (HCW) posted in the critical care units of a tertiary care hospital were cultured and identified by routine biochemical methods. Antibiotic susceptibility test was performed by Kirby Bauer disk diffusion method for all MRSA and MSSA isolates. Association with various risk factors was understood by the Chi square test.**

***Results*: Nineteen of the 300 participants were identified as nasal MRSA carriers having an overall carriage rate of 6.33 per cent in this study. The prevalence of MRSA was seen to be the highest among the attendants (9.52%), and the highest carriers were from the surgical Intensive Care Unit (ICUs). All the MRSA and MSSA isolates showed 100 per cent resistance to penicillin and 100 per cent susceptibility to linezolid. A significant correlation among hand hygiene practices and patient contact was reported from this study.**

***Interpretation & conclusions*: Despite existing infection control policies, the MRSA carriage seen in HCWs in critical care units was 6.33 per cent, highlighting the need for regular systematic screening and decolonisation of all healthcare professionals to decrease the carrier status and prevent the spread of infection.**

**Key words** Carriers - critical care units - healthcare workers - hospital infection control - methicillin resistant *Staphylococcus aureus*

*Staphylococcus aureus,* a prevalent bacterial pathogen, is known for its ability to induce a diverse array of infections and acquire resistance to antimicrobial agents. It is notably adept at spreading through cross

transmission between patients in healthcare facilities and other institutional settings[1].

Methicillin-resistant *S. aureus* (MRSA) isolates exhibit resistance to all penicillin and β-lactam antibiotics and were initially documented in 1961, a year after the introduction of semisynthetic penicillin, leading to its dissemination in both hospital settings and community environments[2]. Currently it is a high group priority pathogen linked to the emergence of antibiotic resistance[3]. It is an important agent of healthcare-associated infections. A systemic review and meta-analysis done from 2000 to 2021 in South Asia reported a pooled prevalence to be 9.23 per cent among HCWs (range 0.69%- 36.06%)[4]. Another systemic review and meta-analysis conducted from 2008 to 2017 reported the MRSA nasal colonisation rate among Indian healthcare workers (HCW) to be 11 per cent[4,5].

Widespread prevalence of MRSA in healthcare settings and the increasing transmission from HCWs to patients are well-documented. Previous studies have highlighted a significant rise in nosocomial MRSA transmission[6,7]. MRSA infections are linked to higher morbidity, mortality, longer hospital stays, and increased healthcare costs compared to methicillin-susceptible *S. aureus* (MSSA) infections[8]. Public health agencies have issued global directives to reduce nosocomial MRSA transmission. Despite these measures, persistent nasal colonisation of healthcare personnel (HCP) by MRSA remains a significant challenge[9]. Carriers significantly contribute to its spread, with healthcare professionals acting as vectors for both hospital- and community-acquired MRSA[10]. The World Health Organisation (WHO), Centers for Disease Control and Prevention (CDC), and Indian Council for Medical Research (ICMR) have standard guidelines for infection control practices with strategies to prevent MRSA transmission and infection[11-13].

With this context in mind, this study aimed to assess the MRSA carriage rate among healthcare professionals assigned to critical care units at a tertiary care hospital in Gangtok, Sikkim, to analyse the pattern of antibiotic susceptibility of the isolated *S. aureus* and MRSA strains and ascertain the risk factor associated with MRSA infection.

## Materials & Methods

This is a hospital based observational study conducted among all the healthcare workers posted in various critical care units [medicine Intensive Care Unit (ICU), surgical ICU, neonatal and paediatric ICU, cardiac care units, neurosurgical ICU, and post operative wards, Intensive trauma unit] of a Central Referral Hospital, Gangtok, Sikkim from July 2022 – June 2023. Approval was taken from the Institutional Ethics Committee prior to the start of the study. A written informed consent was taken from the participants.

All eligible candidates were provided with a questionnaire (which was developed in-house and validated) for the assessment of various risk factors like proper hand hygiene, history of close contact with any patient, history of hospitalisation or any chronic illness, *etc.*

*Sample collection and processing*: Sterile premoistened nasal swabs were collected from the anterior nares using a standard rotating technique and sent to the laboratory for analysis. Swabs were then inoculated in blood agar and mannitol salt agar. After overnight incubation, *S. aureus* was identified using standard procedures by studying colony morphology, Gram staining and routine biochemical tests[14].

*Screening for MRSA*: All isolated *S. Aureus* strains were screened for methicillin resistance by the Kirby-Bauer disc diffusion method by using cefoxitin discs (30 µg) on Mueller-Hinton agar (MHA).The colony was considered methicillin-resistant if the zone of inhibition was ≤21 mm as per the CLSI guideline[15].

*Antibiotic Susceptibility Test*: Antimicrobial susceptibility test for MSSA and MRSA isolates was done by Kirby Bauer's disc diffusion in Mueller Hinton agar against erythromycin (15 µg), penicillin (10 units), ciprofloxacin (5 µg), linezolid (30 µg), tetracycline (30 µg), clindamycin (2 µg), trimethoprim-sulfamethoxazole (23.75/1.25 µg), rifampicin (5 µg) and gentamicin (10 µg) as per the CLSI guideline[15].

*Statistical analysis*: IBM SPSS system version 27.0 was used for statistical testing. A Chi-square test was conducted to analyse the association between categorical variables. A $P$ value < 0.05 was considered significant for all tests.

## Results

Out of the 300 participants, 70 (23.22%) were males, and 230 (76.66%) were females. Maximum participants, 202 (67.33%), belonged to the age group of 25-35 yr, the rest were (18.33%) between 36 and 45 yr. The age of the participants ranged from 23-58

**Table I**. Demographic profile of the participants

| Parameters | Number | Percent (%) |
|---|---|---|
| Age (yr) | | |
| <25 | 21 | 7 |
| 25–35 | 202 | 67.33 |
| 36–45 | 55 | 18.33 |
| 46–55 | 21 | 7 |
| >56 | 1 | 0.33 |
| Sex | | |
| Male | 70 | 23.33 |
| Female | 230 | 76.67 |
| Profession | | |
| Doctors | 81 | 27 |
| Staff nurses | 140 | 46.66 |
| Attendants | 39 | 13 |
| Housekeeping staff | 21 | 7 |
| Others | 19 | 6.33 |
| Work experience (yr) | | |
| <1 | 42 | 14 |
| 1-5 | 155 | 51.6 |
| 6–10 | 64 | 21.33 |
| 11–20 | 35 | 11.66 |
| 21–40 | 5 | 1.33 |
| Educational qualification | | |
| Primary school | 10 | 3.33 |
| Secondary school | 34 | 11.33 |
| High secondary school | 15 | 5 |
| Graduate | 171 | 27 |
| Post graduate | 70 | 23.33 |

yr (mean=31.94, SD=7.222). Among the participants, 44.66 per cent were staff nurses, 27 per cent were doctors, 13 per cent were attendants, seven per cent were housekeeping staff, and 6.33 per cent were physiotherapists and OT technicians. Most participants (51.6%) had 1-5 yr experience in critical care, 21.33 per cent had 6-10 yr, 11.66 per cent had 11-20 yr, and 1.33 per cent had 21-40 yr. Educationally, 27 per cent were graduates, 23.33 per cent were postgraduates, and 3.33 per cent had only primary education (Table I).

The most predominant organism isolated was coagulase-negative *Staphylococci,* 194 (64.7%). A total of 79 (26.3%) *S. aureus* colonies were isolated, among which 19 (24.05%) were methicillin-resistant. Nineteen (6.3%) nasal swabs processed showed no growth, and 4 (1.3%) swabs each showed growth of other organisms (namely gram-negative bacilli, micrococci, and candida species).

Of all the HCWs screened from critical care units, 19 were identified as MRSA carriers with nasal colonisation, while 281 were non-carriers. This study found a 6.33 per cent prevalence of MRSA nasal carriage in HCWs working in critical units.

Among the 230 female participants screened, 5.65 per cent were MRSA nasal carriers, compared with 10 per cent in the 70 male participants. Educationally, 26.67 per cent of MRSA carriers had completed Higher Secondary School, 6.44 per cent were graduates, 5.89 per cent had secondary education, and 5.72 per cent were postgraduates. The highest MRSA prevalence of 9.52 per cent was among attendants, followed by 7.69 per cent of housekeeping staff, 6.17 per cent doctors, and 6.42 per cent staff nurses. No MRSA carriers were reported among physiotherapists and OT technicians (Table II).

MRSA carriers were distributed across various critical care units: 16.66 per cent in the neurosurgical ICU, 12.12 per cent in the orthopaedic ITU, 10.86 per cent in the surgical ICU, 6.81 per cent in the post-operative OT, and 2.56 per cent in the medicine ICU. No MRSA carriers were reported from the paediatric ICU, neonatal ICU, post-operative OBG unit, or cardiac care units (Table III).

*Antibiotic susceptibility test*: All the MSSA isolates were 90 per cent sensitive to gentamicin, 85 per cent to tetracycline, and 60 per cent to trimethoprim/ sulfamethoxazole. MSSA isolates showed 40 per cent sensitivity to erythromycin and 14 per cent sensitivity to ciprofloxacin. All the MSSA isolates showed 100 per cent susceptibility to linezolid and rifampicin. All the MSSA isolates were resistant to penicillin (Fig. 1).

All the isolates of MRSA showed 100 per cent sensitivity to linezolid, 94.73 per cent to rifampicin, 84.21 per cent to tetracycline, 78.94 per cent to trimethoprim sulfamethoxazole and 73.68 per cent to gentamicin. While MRSA isolates were 47.36 per cent sensitive to clindamycin, 42.1 per cent sensitive to erythromycin and 10.52 per cent to ciprofloxacin (Fig. 2).

*MRSA carriage rate and its association with various risk factors*: Among MRSA carriers, 92.85 per cent rarely followed hand hygiene practices, 7.4 per cent

**Table II.** Demographic analysis of the participants

| Parameters | Non carriers (%) | MRSA carriers (%) | Total (%) | *P* value |
|---|---|---|---|---|
| Age (yr) | | | | |
| < 25 | 19 (90.47) | 2 (9.53) | 21 (7) | 0.599 |
| 25–35 | 188 (92.61) | 15 (7.38) | 203 (67.66) | |
| 36–45 | 54 (98.18) | 1 (1.82) | 55 (18.33) | |
| 46–55 | 19 (95) | 1 (5) | 20 (6.66) | |
| >56 | 1 (100) | 0 | 1 (0.33) | |
| Sex | | | | |
| Male | 64 (91.42) | 6 (8.57) | 70 (23.33) | 0.38 |
| Female | 217 (94.34) | 13 (5.65) | 230 (76.67) | |
| Profession | | | | |
| Doctors | 76 (93.82) | 5 (6.17) | 81 (27) | 0.881 |
| Staff nurse | 131 (93.57) | 9 (6.42) | 140 (46.66) | |
| Housekeeping | 36 (92.30) | 3 (7.69) | 39 (13) | |
| Staff | | | | |
| Attendants | 19 (90.47) | 2 (9.52) | 21 (7) | |
| Others | 19 (100) | 0 | 19 (6.33) | |
| Work experience (yr) | | | | |
| <1 | 39 (92) | 3 (7.14) | 42 (14) | |
| 1-5 | 145 (93.54) | 10 (6.45) | 155 (51.6) | 0.189 |
| 6–10 | 60 (93.75) | 4 (6.25) | 64 (21.33) | |
| 11–20 | 33 (94.28) | 2 (5.71) | 35 (11.66) | |
| 21–40 | 5 (1000) | 0 | 5 (1.33) | |
| Education | | | | |
| Primary school | 10 (100) | 0 | 10 (3.33) | |
| Secondary school | 32 (94.11) | 2 (5.89) | 34 (11.33) | 0.041* |
| H S school | 11 (73.33) | 4 (26.67) | 15 (5) | |
| Graduate | 160 (93.56) | 11 (6.44) | 171 (57) | |
| Post Graduate | 66 (94.28) | 4 (5.72) | 70 (23.33) | |

*P*<0.05 significant association

followed them occasionally, and only 0.86 per cent adhered to them regularly. This observation was made following a regular hand hygiene audit done by the hospital infection control team of the hospital. The association between hand hygiene practices and MRSA carriage was found to be clinically significant (*P*<0.05).

**Table III.** Distribution of MRSA carriers in different critical care units

| Location | Non-carriers (%) | MRSA carriers (%) | Total (%) |
|---|---|---|---|
| Medicine ICU | 38 (97.43) | 1 (2.56) | 39 (13) |
| Surgical ICU | 41 (89.13) | 5 (10.86) | 46 (15.33) |
| Neurosurgical ICU | 30 (83.33) | 6 (16.66) | 36 (12) |
| Orthopedic ITU | 29 (87.87) | 4 (12.12) | 33 (11) |
| Paediatric ICU | 24 (100) | 0 | 24 (8) |
| Neonatal ICU | 22 (100) | 0 | 22 (7.33) |
| Post operation observation (OT) | 41 (93.18) | 3 (6.81) | 44 (14.66) |
| Post Operation OBG | 36 (100) | 0 | 36 (12) |
| Cardiac care unit | 20 (100) | 0 | 20 (6.66) |
| Total | 281 (93.66) | 19 (6.33) | 300 (100) |

ICU, intensive care unit; OT, operation theatre; OBG, obstetrics and gynecology; ITU, intensive trauma unit

Among the 200 participants with recent history of close contact with a patient within last four weeks, nine per cent (n=18) were MRSA positive, and one per cent (n=1) MRSA carriers had no history of close contact with any patient. Among 72 participants with a recent history of close contact with MRSA patients within the last four wk, 22.23 per cent (n=16) were MRSA carriers. Seven per cent of the participants were diabetic, 5.66 per cent had a history of chronic respiratory illness, 25.66 per cent had used antibiotics in the last six months, and 3.66 per cent had been hospitalised in the previous year.

This study revealed significant associations between MRSA carriage and hand hygiene practices, as well as close contact with patients. Among MRSA carriers, 92.85 per cent reported rarely following hand hygiene protocols, while only 0.86 per cent consistently adhered to them, showing a significant correlation between hand hygiene and MRSA carriage (*P*<0.05). Furthermore, nine per cent of participants with recent close patient contact were MRSA positive, indicating a significant link between patient contact and MRSA carriage (*P*<0.05). Additionally, 22.23 per cent of those with close contact with MRSA patients in the past four wk were carriers, reinforcing this association (*P*<0.05). No significant associations were found between MRSA carriage and diabetes, chronic respiratory illness, recent antibiotic use, or hospitalisation within the past year. These findings highlight the importance of hand hygiene, and the risks associated with close patient

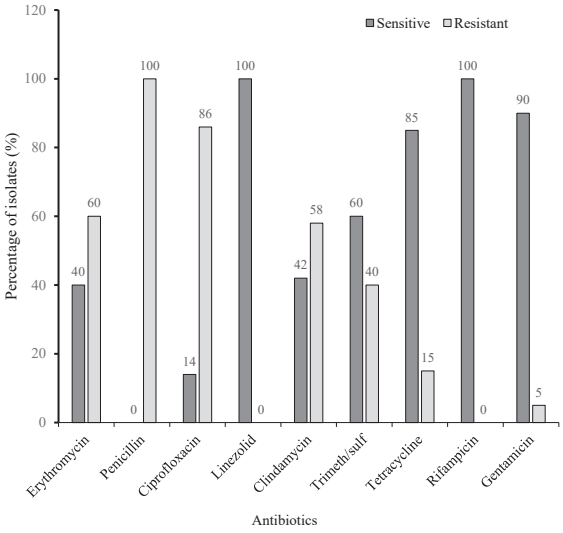


**Fig. 1**. Antibiotic susceptibility pattern of MSSA.

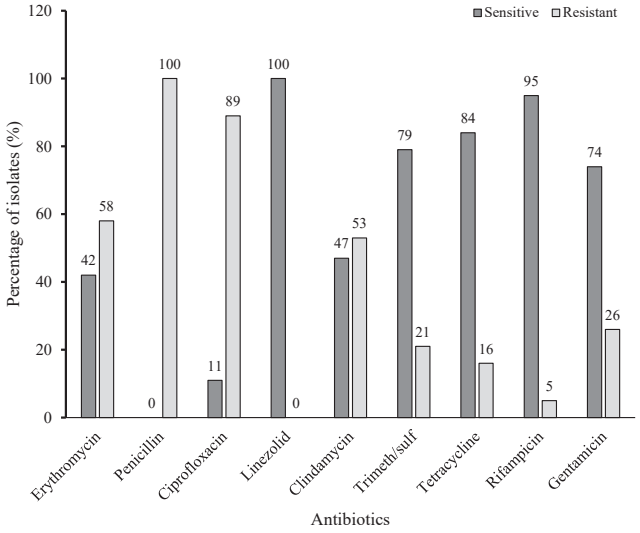


**Fig. 2**. Antibiotic susceptibility pattern of MRSA isolates.

interactions with respect to controlling MRSA spread (Table IV).

## Discussion

It is essential to identify the carriers of MRSA among HCWs within hospital settings, specifically those employed in critical care units, as they serve as potential conduits for the spread of nosocomial illnesses, which prolong hospital stays.

In this study, 300 nasal swabs from HCWs in critical care units identified a 6.33 per cent MRSA carriage rate, which was comparable to previous studies conducted by Goyal *et al*[16] in Delhi (6.6%), a study from Mysore (6.5%)[17], Latha *et al*[18] in Manipal (6.4%), and Singh *et al*[19] in Bhubaneswar (7.5%)[16-19]. Contrary to our findings, other studies have reported varying MRSA colonisation rates among HCWs. Another study from Mangalore, Karnataka[20] documented a 2.5 per cent prevalence in Mangalore, while Sridharan *et al*[21] reported an 11.5 per cent carriage rate in Meerut.

A global study by Albrich and Harbarth, involving a literature review of 33,318 HCWs screened from January 1980 to March 2006, found a 4.6 per cent MRSA infection or colonisation rate[10]. Additionally, a systematic review and meta-analysis by Latha *et al*[5] reported a pooled MRSA nasal carriage prevalence of 11 per cent among Indian HCWs.

This disparity can be attributed to differences in study design, including variations in sample size, methodologies, and detection techniques. Additionally, geographical regions and institutions may exhibit different MRSA prevalence rates.

In our study, 8.57 per cent (6) of the total MRSA carriers were males, and 5.65 per cent (13) were females. Similar results were seen in a study conducted by Singh *et al*[19] where the carriage rate of MRSA among males was 9.1 per cent and 6.5 per cent among females. Giri *et al*[22] from Nepal also reported a higher prevalence among males (8.7%) than females.

In this study, MRSA prevalence was highest among attendants (9.52%), followed by housekeeping staff (7.69%), staff nurses (6.42%), and doctors (6.17%). This contrasts with a study[17] in Mysore, where the highest prevalence was among doctors (28.4%) and nursing interns (21.1%)[17]. Other Indian studies like the one by Singh *et al*[19] have also reported a higher MRSA carriage prevalence among the staff nurses (22.1%), which is in contrast to this study.

The mechanism underlying MRSA nasal carriage is complex and not fully understood. The increased rate among nurses presents a notable epidemiological concern, as their frequent patient interactions make them potential reservoirs for infection, thereby perpetuating MRSA within the hospital setting.

This study reports the highest MRSA nasal carriage prevalence among HCWs in the neurosurgical ICU (16.66%), followed by the orthopedics ITU (12.12%), surgical ICU (10.86%), post-operative OT (6.81%), and medicine ICU (2.56%). Similarly, Khanal *et al*[23] found a high frequency of MRSA carriers in the surgical ICU and post-operative ward (28.6%). This may be due to high workload, overcrowding, and frequent wound care in these units, increasing MRSA transmission[23].

**Table IV**: MRSA carriage rate and its association with various risk factors

| Parameters | Non carriers (%) | MRSA carriers (%) | Total (%) | *P* value |
|---|---|---|---|---|
| Hand hygiene | | | | |
| Always | 230 (99.13) | 2 (0.86) | 232 (77.33) | 0.000* |
| Occasionally | 50 (92.59) | 4 (7.40) | 54 (18) | $\chi^2 = 188.49$ df = 2 |
| Rarely | 1 (7.14) | 13 (92.85) | 14 (4.66) | |
| Close contact with patients in the last 4 wk | | | | |
| Yes | 182 (91) | 18 (9) | 200 (66.66) | 0.007* |
| No | 99 (99) | 1 (1) | 100 (33.33) | $\chi^2 = 7.192$ df = 1 |
| Close contact with MRSA patients | | | | |
| Yes | 56 (77.77) | 16 (22.23) | 72 (24) | 0.000* |
| No | 225 (98.68) | 3 (1.31) | 228 (76) | $\chi^2 = 40.31$ df = 1 |
| Known case of diabetes mellitus | | | | |
| Yes | 19 (90.47) | 2 (9.52) | 21 (7) | 0.534 |
| No | 262 (93.90) | 17 (6.09) | 279 (93) | |
| Known case of chronic respiratory illness | | | | |
| Yes | 15 (88.23) | 2 (11.76) | 17 (5.66) | 0.344 |
| No | 266 (93.99) | 17 (6.01) | 283 (94.34) | |
| Use of antibiotics in the last 6 months | | | | |
| Yes | 70 (90.90) | 7 (9.01) | 77 (25.66) | 0.249 |
| No | 211 (94.61) | 12 (5.38) | 223 (74.34) | |
| Inpatient hospital treatment in the last 12 months | | | | |
| Yes | 10 (90.90) | 1 (9.10) | 11 (3.66) | 0.702 |
| No | 271 (93.77) | 18 (6.22) | 289 (96.34) | |

*$P^*$<0.05 significant association

MRSA is associated with adverse clinical outcomes in ICUs and poses a significant challenge to hospital infection control. ICUs play a critical role in the widespread dissemination of MRSA, as individuals frequently move between various healthcare settings, including hospital wards and other medical facilities[19]. A significant association between MRSA carriage and educational qualification was seen in this study ($P$=0.041). This aligns with the study by Maroof *et al*[24] from Srinagar, which also found a higher prevalence among graduates.

The main obstacle to effective infection control protocols is rigorous adherence. Regular education and skill development for new HCWs, with active participation, can be a straightforward and efficient strategy to prevent the transmission of antibiotic-resistant bacteria like MRSA.

In this study, *S. aureus* isolates exhibited 100 per cent resistance to penicillin, consistent with findings by Bala *et al*[25] and Goyal *et al*[16], though Kausalya *et al*[26]. and Rahman *et al*[27] reported 71.5 per cent and 75 per cent resistance, respectively. Resistance to ciprofloxacin was 86 per cent, aligning with Ramakrishnan *et al*[20] and Singh *et al*[19] (80 per cent), while Rahman *et al*[27] and Agarwal *et al*[28] reported lower resistance rates of 47.5 per cent and 50 per cent, respectively[27,28]. Resistance rates in our study were 60 per cent for erythromycin, 58 per cent for clindamycin, and 40 per cent for trimethoprim/sulfamethoxazole, similar to Singh *et al*[19] (58% for erythromycin) and Ramakrishnan *et al*[20] (60%). Lower clindamycin resistance was reported in Singh *et al*[19] (20%) and Rahman *et al*[27] (15.91%) as compared to the present study. Gentamicin and tetracycline susceptibility were 90 per cent and 85 per cent, respectively, similar to Aila *et al*[29] (96.8% and 85.8%) and Giri *et al*[22] (100% and 90.9%). Linezolid and rifampicin susceptibility was 100 per cent, consistent with Bala *et al*[25], and Giri *et al*[22].

Among MRSA isolates, 100 per cent resistance to penicillin was observed, consistent with Bala *et al*[25] and Goyal *et al*[16]. Resistance rates were 89.47 per cent for ciprofloxacin, 57.89 per cent for erythromycin, and 52.63 per cent for trimethoprim/sulfamethoxazole. MRSA strains showed 100 per cent susceptibility to linezolid and high sensitivity to rifampicin (94.73%), tetracycline (84.21%), trimethoprim/sulfamethoxazole (78.94%), and Gentamicin (73.68%). This aligns with Aila *et al*[29], who reported 88.2 per cent sensitivity to rifampicin, 86.3 per cent to tetracycline, and 92.2 per cent to gentamicin. In contrast, Khanal *et al*[23] reported higher resistance to gentamicin (42.9%) and lower resistance to ciprofloxacin (14.3%) and trimethoprim/sulfamethoxazole (28.6%)[23]. Clindamycin resistance in the present study was 52.63 per cent, similar to Singh *et*

*al*[19] (50%) and Maroof *et al*[24] (62.5%), but contrasting with Giri *et al*[22], who reported high sensitivity (83.3%).

The variability in resistance rates among different antimicrobial agents reflects factors such as regional prescribing practices, patient demographics, and microbial characteristics. Antibiotic resistance in hospitals is primarily driven by the overuse, misuse, and inappropriate prescription of antibiotics for both community-acquired and hospital-acquired infections. Routine *in vitro* susceptibility testing for clindamycin is not reliable for identifying inducible resistance mediated by the *erm* gene, leading to treatment failure. This can be avoided by implementing a simple D-test for routine diagnostic procedure for accurate detection of inducible clindamycin resistance[30]. The absence of strict regulations on antibiotic prescriptions, coupled with the accessibility of over-the-counter antibiotics, further aggravates this problem. Consequently, treating *S. aureus* infections in hospitals with these antibiotics may be ineffective due to high resistance rates.

Our study identified significant risk factors for MRSA colonisation, including non-adherence to hand hygiene practices ($P$<0.05), recent close interactions with patients ($P$=0.007), and proximity to MRSA carriers ($P$<0.05). However, antibiotic use, hospitalisation, and chronic medical conditions did not show a statistically significant association with MRSA carriage. The Healthcare Infection Control Practices Advisory Committee emphasises that the absence of an outbreak does not eliminate transmission risk[31]. Therefore, healthcare institutions should implement regular screening protocols for healthcare personnel, both during recruitment and periodically thereafter.

Some limitations of this study only include that it focussed on the HCPs posted in critical care units. Also, follow up of the identified carriers was not done. Inducible clindamycin resistance test (D test) was not done for the isolates as this study was for screening of nasal carriers and not patients. Furthermore, the absence of comparison with genotypic methods to ascertain the presence of resistance genes represents another notable limitation due to constraints pertaining to time, funding, and the availability of laboratory infrastructure.

Overall, this study found an MRSA nasal carriage rate of 6.33 per cent among HCWs in critical care units, with the highest prevalence among attendants and housekeeping staff. This highlights the need for targeted education and training to enhance infection control practices in these groups. Asymptomatic MRSA carriers among HCPs are of significance due to their potential to transmit the pathogen, increasing patient morbidity, mortality, and healthcare costs. Therefore, strict enforcement of infection control measures is crucial to reduce MRSA carriage and transmission in hospital settings.

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*For correspondence*: Prof. Dechen Chomu Tsering, Department of Microbiology, Sikkim Manipal Institute of Medical Sciences, Sikkim Manipal University, Gangtok 737 102, Sikkim, India
e-mail: drdechen@gmail.com