Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 9 (2025): September 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i9.2087
Original Article

Prevalence of asymptomatic carriage of methicillin-resistant Staphylococcus aureus (MRSA) among healthcare workers and its infection control implications: A retrospective observational study.

Nirmala Kumari[1]*, Sanjay Kumar[2], Rajesh Kumar[3], Satyendu Sagar[4]
[1]Senior Resident, Department of Microbiology, NMCH, Patna, Bihar, India.
[2]Professor, HOD, Department of Microbiology, NMCH, Patna, Bihar, India.
[3]Professor, Department of Microbiology, NMCH, Patna, Bihar, India.
[4]Associate Professor, Department of Microbiology, NMCH, Patna, Bihar, India.

Abstract

Background

In 1961, a year after semisynthetic penicillin was introduced, methicillin-resistant *S. aureus* (MRSA) isolates were first identified. They are resistant to all penicillin and β-lactam medicines, and this has led to their spread in both hospital and community settings.

Objectives

Determining the frequency of MRSA colonization among healthcare professionals and evaluating related risk factors were the study's objectives.

Materials and methods

It was a retrospective, observational study. The study was carried out at Nalanda Medical College and Hospital (NMCH), Patna, Bihar, India. The study data that was retrieved was for one year, i.e., from February 2023 to January 2024. Data from 220 participants were retrieved for the study. Healthcare professionals working in different intensive care units (ICUs) and high-risk hospital departments, including physicians, nurses, attendants, housekeeping personnel, and technicians, met the study's inclusion criteria.

Results

The participants' average age was 31.4 ± 7.2 years, and 71.3% of them were female. The largest group was made up of nurses (46.4%) and doctors (26.8%). 13.6% of healthcare workers were found to have MRSA carriage. Workers with less education ($p = 0.03$) and staff nurses ($p = 0.002$) had considerably higher carriage. The neurosurgical intensive care unit had the greatest percentage of MRSA carriers (13.3%). Gender did not significantly correlate ($p = 0.18$).

Conclusion

The study found that MRSA colonization was significantly more common among healthcare workers, with staff nurses and individuals with less education having higher rates. MRSA carrier rates were also greater in certain ICU sites, such as the surgical and neurosurgery ICUs.

Recommendations

For early detection and prevention, healthcare staff must undergo routine MRSA screening, particularly in high-risk settings like intensive care units.

Keywords: *Methicillin-resistant Staphylococcus aureus, Healthcare Workers, Carriage, Infection Control.*
Submitted: *July 10, 2025* ***Accepted:*** *August 30, 2025* ***Published:*** *September 25, 2025*

Corresponding Author: *Nirmala Kumari*
Email: ***nirmala.mehta47@gmail.com***
Senior Resident, Department of Microbiology, NMCH, Patna, Bihar, India.

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Introduction

One common bacterial pathogen, Staphylococcus aureus, is well-known for its capacity to cause a wide range of diseases and develop resistance to antibiotics. In hospitals and other institutional settings, it is particularly skilled at spreading by cross-transmission between patients [1].

In 1961, a year after semisynthetic penicillin was introduced, methicillin-resistant S. aureus (MRSA) isolates were first identified. They are resistant to all penicillin and β-lactam medicines, and this led to their spread in both hospital and community settings [2]. It is currently considered a high-priority pathogen that is connected to the rise in antibiotic resistance [3].

It is a significant cause of infections linked to healthcare. According to a South Asian comprehensive review and meta-analysis conducted between 2000 and 2021, the pooled prevalence among HCWs was 9.23% (range: 0.69%–36.06%) [4]. According to a different systematic study and meta-analysis carried out between 2008 and 2017, 11% of Indian healthcare workers (HCW) have MRSA nasal colonization [5].

The colonization of MRSA in several human body orifices, with the anterior nares being the major location, is one of the risk factors for MRSA infection [6]. Additionally, MRSA colonizes several bodily parts, including the digestive system, hands, skin, and axillae [7, 8]. Although the majority of colonized individuals do not exhibit any symptoms, those who have intestinal and nasal carriage have been linked to a higher risk of infection [9]. Clinical infections are thought to occur in approximately 25% of those who have had MRSA colonization for more than a year [10].

Continuous exposure to the hospital environment puts Health Care Workers (HCWs) at higher risk of colonization and plays a significant role in the spread of MRSA in hospital environments [11,12]. HCWs operate more as a vector of MRSA transmission than a cause of MRSA transmission [13, 14]. HCWs are susceptible to clinical infections in addition to being MRSA carriers. Long-term stigmatization and negative effects on one's career can result from persistent MRSA colonization in healthcare workers [15].

Research has indicated that a number of infection control measures, such as screening and decontamination initiatives, have contributed to a reduction in the prevalence of MRSA infections [16]. Therefore, accurate management of hospital-acquired infections and antimicrobial stewardship depend on knowing the prevalence of nasal carriage of HCWs by S. aureus, MRSA, CoNS, and MRCoNS as well as their antimicrobial profile.

Determining the frequency of MRSA colonization among healthcare professionals and evaluating related risk factors were the study's objectives.

Methodology

Study design

It was a retrospective, observational study.

Study settings

The study was carried out at Nalanda Medical College and Hospital (NMCH), Patna, Bihar, India. The study data that was retrieved was for one year, i.e., from February 2023 to January 2024.

Study population

Data from 220 participants were retrieved for the study.

Inclusion criteria

Healthcare professionals working in different intensive care units (ICUs) and high-risk hospital departments, including physicians, nurses, attendants, housekeeping personnel, and technicians, met the study's inclusion criteria. Participants were only included if they gave their informed consent and did not exhibit any active MRSA infection symptoms at the time of sample collection.

Exclusion criteria

Those who had received systemic antibiotics in the two weeks before sample collection, healthcare personnel with known or ongoing MRSA infections, and those who did not give their consent were not allowed to participate in the study.

Bias control

A single laboratory protocol and a blinded microbiologist ensured consistency.

Ethical consideration

Approved by the Institutional Ethics Committee, NMCH. Informed consent was obtained from all participants.

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Data collection

220 healthcare professionals had their data retrospectively gathered utilizing hand and nasal swab sampling, as well as structured questionnaires. Details about occupation and demographics were noted. The microbiology lab tested the swabs and used cefoxitin disc diffusion to identify MRSA in accordance with CLSI standards. Data were grouped according to clinical site, role, education, age, and sex.

Study procedure

A standardized questionnaire collecting demographic and occupational data was filled out by each participant. Then, under aseptic conditions, sterile cotton swabs were used to collect hand and nasal swabs. After being delivered to the microbiology lab, the samples were cultivated on certain media. Standard microbiological methods, such as the cefoxitin disc diffusion method, were used to identify Staphylococcus aureus and detect MRSA in accordance with CLSI guidelines.

Statistical analysis

SPSS version 26.0 was used for statistical analysis. Data were initially entered in Microsoft Excel. The data has been presented as the number of participants (n) and percentages (%).

The independent t-test and chi-square test were used for statistical analysis. Statistical significance was defined as a p-value of less than 0.05.

Results

With 102 participants, staff nurses made up the biggest group of study participants (46.4%). Doctors (26.8%) come in second with 59 participants, followed by attendants (13.2%) with 29, housekeeping workers (7.3%) with 16, and others (6.4%) with 14. Among the 125 participants, graduates made up the majority (56.8%). 52 participants, or 23.6% of the sample, were postgraduates. There were 25 people (11.4%) with a secondary school education, and 11 people (5.0%) with a higher level of education. Just seven individuals (3.2%) had finished elementary school. The study participants' baseline demographics are shown in Table 1.

Table 1. Baseline demographics of study participants

Parameters	Number (n)	Percentage (%)
Age (in years)		
<25	15	6.8%
25–35	148	67.3%
36–45	40	18.2%
46–55	16	7.3%
>56	01	0.4%
Male Participants	63	28.6%
Female Participants	157	71.3%
Healthcare Workers		
Doctors	59	26.8%
Staff Nurses	102	46.4%
Attendants	29	13.2%
Housekeeping	16	7.3%
Others	14	6.4%
Educational Qualification		
Primary School	7	3.2%
Secondary School	25	11.4%
Higher Secondary	11	5.0%

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Graduate	125	56.8%
Postgraduate	52	23.6%

Participants less than 25 years of age were 15 (6.8%), while the majority of participants fell in the 25–35 years age group, comprising 148 individuals (67.3%). Those aged 36–45 years were 40 (18.2%), followed by 16 (7.3%) in the 46–55 years group, and only 1 participant (0.4%) was above 56 years. Figure 1 shows the distribution of age groups among study participants.

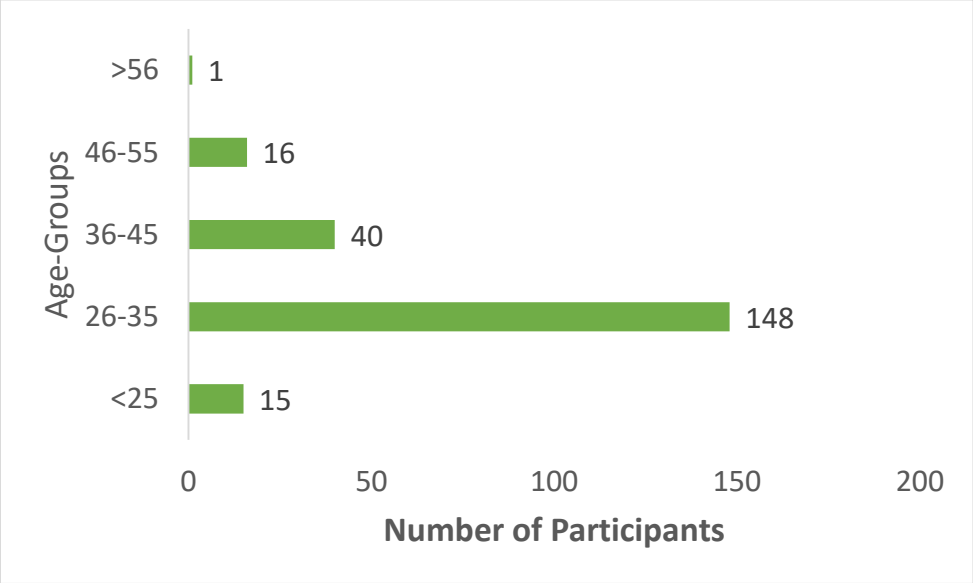

Figure 1. Distribution of age groups among study participants

Among MRSA-positive individuals, the majority were aged between 25–35 years, accounting for 19 (63.3%) participants, followed by 6 (20.0%) in the 36–45 age group, 4 (13.3%) aged 46–55, and 1 (3.3%) aged below 25 years. None was older than 56 years. In the MRSA-negative group, most were also in the 25–35 age range with 129 (67.9%) participants, followed by 34 (17.9%) aged 36–45, 14 (7.4%) under 25, 12 (6.3%) aged 46–55, and 1 (0.5%) above 56. The age distribution difference was statistically significant ($p = 0.04$). Table 2 shows the demographic profile and association with MRSA colonization.

Table 2. Demographic profile and association with MRSA colonization

Parameters	MRSA Positive (n=30)	MRSA Negative (n=190)	P-value
Age (in years)			
< 25	1 (3.3%)	14 (7.4%)	
25–35	19 (63.3%)	129 (67.9%)	
36–45	6 (20.0%)	34 (17.9%)	**0.04**
46–55	4 (13.3%)	12 (6.3%)	
> 56	0 (0.0%)	1 (0.5%)	

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Sex			
Male Participants	12 (40%)	51 (26.8%)	0.18
Female Participants	18 (60%)	139 (73.2%)	
Healthcare Workers			
Doctors	05 (16.7%)	54 (28.4%)	**0.002**
Staff Nurses	16 (53.3%)	86 (45.3%)	
Housekeeping Staff	7 (23.3%)	9 (4.7%)	
Attendants	01 (3.3%)	18 (9.5%)	
Others	1 (3.3%)	23 (12.1%)	
Educational Qualification			
Primary School	2 (6.7%)	5 (2.6%)	**0.03**
Secondary School	6 (20.0%)	19 (10.0%)	
Higher Secondary School	2 (6.7%)	9 (4.7%)	
Graduate	15 (50%)	110 (57.9%)	
Postgraduate	5 (16.7%)	47 (24.7%)	

Methicillin-Resistant *Staphylococcus aureus* (MRSA) colonization was statistically significantly correlated with occupation (p = 0.002) and educational attainment (p = 0.03) among the demographic and occupational factors examined. Doctors and attendants had relatively low MRSA transmission rates, while the greatest rates were found among staff nurses (53.3%) and housekeeping personnel (23.3%). Compared to graduates and postgraduates, colonization rates were greater among those with lower education levels (primary and secondary). The age group was also significantly correlated (p = 0.04), with the majority of MRSA-positive people being between the ages of 25 and 35. There was no gender-related statistically significant correlation (p = 0.18).

Out of the total 220 participants, 63 (28.6%) were males and 157 (71.3%) were females. Figure 2 shows the gender distribution among study participants.

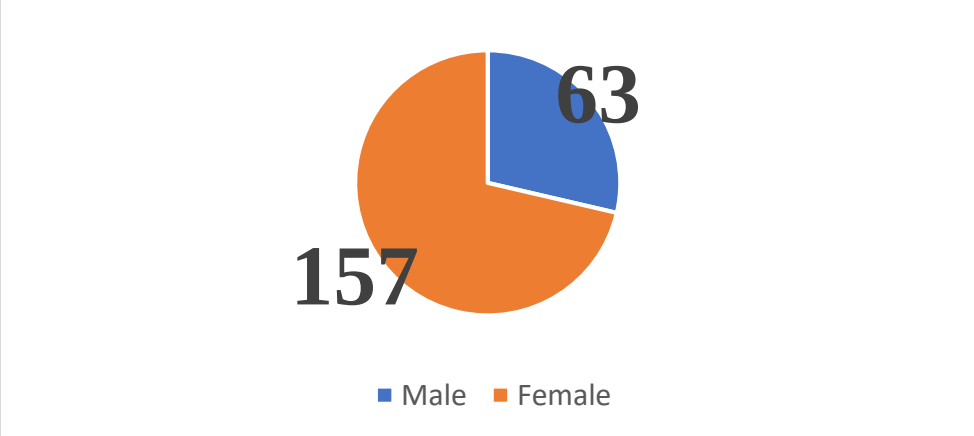

Figure 2. Distribution of gender among study participants

The highest number was in the neurosurgical ICU with 4 individuals, accounting for 13.33%, followed by 4 individuals (11.42%) in the surgical ICU, 3 individuals (11.11%) in the orthopedic ITU, 2 individuals (5.55%) in the

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post-operative observation unit, and 1 individual (3.44%) in the medicine ICU. The p-value was not found to be statistically significant at 0.398.

Table 3. Distribution of MRSA carriage among healthcare workers across different clinical units

Location	Non-carriers n (%)	MRSA carriers n (%)	P-value
Medicine ICU	28 (96.55)	01 (3.44)	
Surgical ICU	31 (88.57)	04 (11.42)	
Neurosurgical ICU	26 (86.66)	04 (13.33)	
Orthopedic ITU	24 (88.88)	03 (11.11)	
Pediatric ICU	19 (100.0)	00 (0.0)	0.398
Neonatal ICU	16 (100.0)	00 (0.0)	
Post-op Observation (OT)	34 (94.44)	02 (5.55)	
Post-op OBG	30 (100.0)	00 (0.0)	
Cardiac Care Unit	15 (100.0)	00 (0.0)	

Discussion

The prevalence of nasal MRSA colonization among HCWs in a tertiary care hospital was examined in this study, along with its correlation with occupational and demographic factors. The 13.6% colonization rate that was discovered is in line with earlier Indian research that found that MRSA carriage rates among healthcare workers varied from 6% to 16%, depending on the population, region, and technique [17, 18].

Staff nurses and cleaning employees had the greatest rates of MRSA colonization. Housekeeping staff, who often handle contaminated garbage and surfaces, and nurses, who have extended and intimate contact with patients, are particularly vulnerable [19]. Occupation and MRSA carriage were found to be statistically significantly associated ($p < 0.05$), underscoring the occupational risk that frontline and ancillary health personnel confront.

A substantial link was found between educational qualification and MRSA colonization rate, with lower-educated personnel (primary and secondary levels) having a greater rate. Previous study indicates that MRSA transmission risk is increased by ignorance and noncompliance with infection control measures [20], which supports our findings. This risk could be reduced by raising awareness and reiterating hand hygiene guidelines.

The gender difference was not statistically significant, even though there were more colonized females than males in absolute terms. Although this trend was not statistically significant, the age-wise distribution revealed that younger healthcare workers (less than 35 years old) had somewhat increased MRSA carriage, perhaps as a result of their more frequent direct patient care duties.

Different hospital units had different MRSA transmission rates. Compared to pediatric, neonatal, or cardiac units, the carriage rates were greater in surgical, neurosurgical, and orthopedic intensive care units (ICUs); however, this difference was not statistically significant ($p > 0.05$). This pattern is consistent with data showing that MRSA contamination is more likely to occur in high-risk settings with invasive operations and immunocompromised individuals [21].

In order to reduce nosocomial transmission, our results highlight the necessity of systematic decolonization procedures, frequent screening of healthcare workers in high-risk locations, and rigorous adherence to infection prevention measures. Additionally, the study highlights the importance of focused educational interventions, particularly for employees with less formal education or training.

Generalizability

Tertiary-care hospitals and other healthcare facilities where medical staff frequently interact with patients and are exposed to invasive procedures are most suited to use the study's findings. However, care should be used when extrapolating these findings to all healthcare facilities, especially rural or resource-constrained hospitals, as the study was carried out at a single metropolitan institution with a small sample size.

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Conclusion
The study found that MRSA colonization was significantly more common among healthcare workers, with staff nurses and individuals with less education having higher rates. MRSA carrier rates were also greater in certain ICU sites, such as the surgical and neurosurgery ICUs. In order to reduce MRSA transmission in hospital settings, these findings emphasize the necessity of routine screening, focused infection control procedures, and training for healthcare personnel.

Limitations
Since this study was conducted in a single urban tertiary care facility, it may not be feasible to extrapolate the findings to the broader population. Additionally, the study's sample size was too small to draw conclusions and extrapolate findings.

Recommendations
For early detection and prevention, healthcare staff must undergo routine MRSA screening, particularly in high-risk settings like intensive care units. Strict infection control procedures, such as using personal protective equipment (PPE), cleaning surfaces, and maintaining good hand hygiene, should be promoted. Treatment for decolonization is required for identified carriers.

Acknowledgment
The authors express their gratitude to the Department of Microbiology, Nalanda Medical College and Hospital, Patna, for providing laboratory facilities and technical assistance during the study.

Data availability
The data supporting the findings of this study are available from the corresponding author upon reasonable request. All patient and participant information has been anonymized to ensure confidentiality.

List of abbreviations
MRSA – Methicillin-Resistant *Staphylococcus aureus*
HCWs – Healthcare Workers
CoNS- Coagulase Negative Staphylococci
MRCoNS- Methicillin-resistant Coagulase Negative Staphylococci
NMCH- Nalanda Medical College and Hospital
ICU – Intensive Care Unit
OPD – Outpatient Department
OBG – Obstetrics and Gynecology
IEC – Institutional Ethics Committee
SD – Standard Deviation
SPSS – Statistical Package for the Social Sciences

Source of funding
No source of funding

Conflict of interest
No conflict of interest

Author contributions
All authors equally contributed

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PUBLISHER DETAILS:

Student's Journal of Health Research (SJHR)
(ISSN 2709-9997) Online
(ISSN 3006-1059) Print
Category: Non-Governmental & Non-profit Organization
Email: studentsjournal2020@gmail.com
WhatsApp: +256 775 434 261
Location: Scholar's Summit Nakigalala, P. O. Box 701432, Entebbe Uganda, East Africa