

Carriage of Methicillin Resistant *Staphylococcus Aureus* Among Healthcare Workers in a Tertiary Care Hospital

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Abstract

Background: Methicillin-resistant *Staphylococcus aureus* causes numerous illnesses, from relatively minor skin and soft tissue infections to potentially fatal systemic infections, are known to be caused by the multidrug-resistant bacterium. Methicillin Resistant *Staphylococcus aureus* (MRSA) mostly spread through contact between patients and health care workers. Screening healthcare professionals who have been exposed to MRSA could help stop the spread of the organism.

Aim: Carriage of Methicillin Resistant *Staphylococcus aureus* among health care workers in a tertiary care hospital.

Objectives: To detect *Staphylococci* from hand and nasal swab samples of health care workers (HCWs), to differentiate MRSA from isolated organism and to determine percentage of MRSA from different categories of health care workers.

Methods: Two samples were collected from 198 Health care workers, including samples from anterior nares and web spaces of both hands. MRSA and *Staphylococcus aureus* strains were identified by standard operating procedure.

Results: About 58(29.2%) were carriers of *Staphylococcus aureus* and 20(34.4%) were carriers of MRSA. Among the MRSA carriers, Nurses were 10 (50%) followed by doctors 5 (25%), Lab technicians were 4 (20%) and housekeeping staff 1(5%).

Conclusions: Despite having infection control policies in place, the MRSA carriage rate was higher in the nasal than in the hand. This signifies the importance of periodic systematic screening of all HCWs and decolonization, which may help eliminate the burden of MRSA carrier status and the spread of infection in the healthcare setting.

Keywords: Drug-resistant *Staphylococcus aureus*; Health care workers; Screening; decolonization

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Introduction

Gram-positive cocci that resemble grape bunches are known as *Staphylococcus aureus* (*S. aureus*). Skin is frequently contaminated with *Staphylococcus aureus* which is aerobic and facultative anaerobic in nature. On medium containing nutrients, they form colonies that are yellow and white in hue. A deep infection can be caused by *Staphylococcus aureus*. It is detected prior that blood borne infection and bacteraemia are majorly caused by *Staphylococcus aureus* and also a common cause of nosocomial infection i.e. surgical site infection.¹

A significant pathogen that poses challenges for medical professionals treating infections brought on by a rise in penicillin and now oxacillin resistance or MRSA (Methicillin Resistant *Staphylococcus aureus*) to other antibiotic classes such as Linezolid and Vancomycin.²

MRSA is divided into two groups.

- HA MRSA (Hospital Acquired MRSA)-generally caused during prolonged or recurrent hospitalization.
- CA MRSA (Community Acquired MRSA) -Mostly affects healthy persons.^{3,4}

Penicillin was the first choice of antibiotics for treatment of *Staphylococcal* infections. 90% *Staphylococcus aureus* strains are resistant to penicillin. Penicillin destroyed by the penicillinase enzyme that resistant for *Staphylococcus aureus*.⁵ Penicillin resistance is caused by the bacterial enzyme beta lactamase, which mediates antibiotic hydrolysis.⁶ MecA gene is responsible for methicillin resistance.⁷ One of the mechanisms explained for MRSA is the MecA gene that produces a penicillin-binding protein with a low affinity for medicines that block beta lactamases.⁸ Vancomycin is mostly used for the treatment of MRSA. Treatment of Vancomycin is not uncommon because when the MRSA strains are more susceptible to Vancomycin according to CLSI.⁹

Health care providers are exposed to patients who have MRSA infections or colonization over the course of their employment, and the spread of MRSA has been more widely acknowledged in recent years in various health care settings, including primary care. (10,11) Health care workers (HCWs) act as an

association between the community and institutions such as nursing homes, long-term care homes, and hospitals. They could act as MRSA cross-transmission victims, vectors, or reservoirs. (12) .

Material and Methods

STUDY DESIGN: Cross-Sectional Study.

PLACE OF STUDY: This study was conducted in Teerthanker Mahaveer University hospital, Moradabad (U.P)

DURATION OF STUDY: November 2023 to August 2024

SELECTION OF SAMPLES: A total of 198 sample of hand impression and nasal swab were collected for our study. Selection of the sample of all health workers were collected & divided into categories i.e.

Table 1: Shows category wise distribution of Health care workers.

CATEGORIES	HEALTHCAREWORKERS
CAT-I	DOCTORS
CAT-II	INTERNS
CAT-III	NURSES
CAT-IV	TECHNICIANS
CAT-V	PHARMACIST
CAT-VI	HOUSE KEEPING STAFF

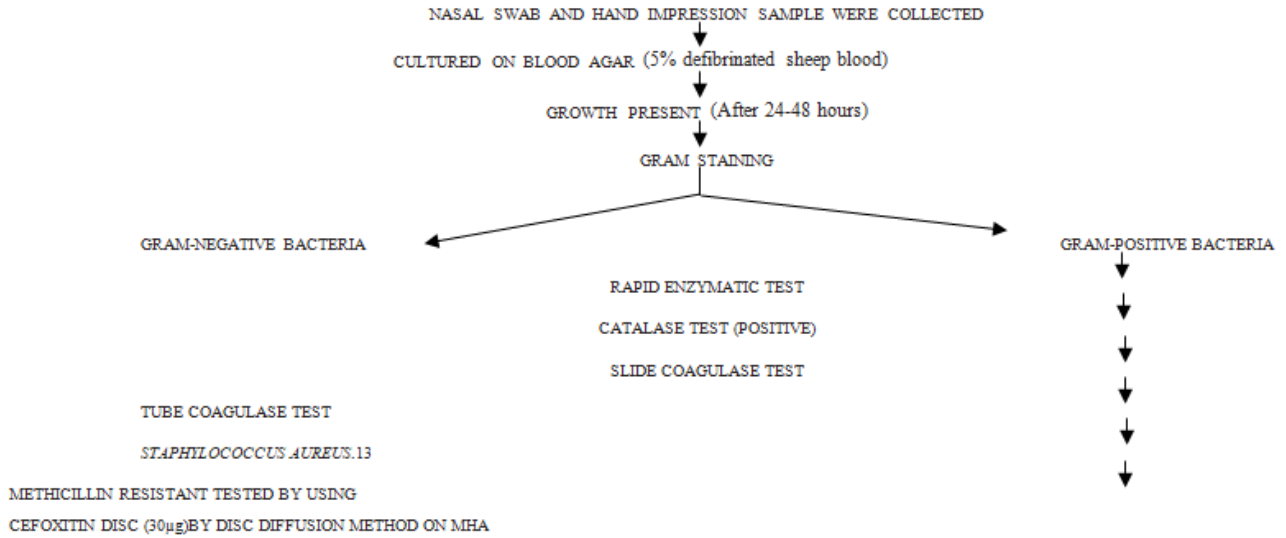
TYPE OF SAMPLE: Nasal swab and hand impression

SAMPLE COLLECTION: Samples from recruited subjects were collected and processed in bacteriology section of microbiology laboratory. Nasal swab and hand impression were collected.

SAMPLE PROCESSING:

Materials Required:

1. Swab Stick
2. Gloves
3. Mask
4. Culture Media (Nutrient agar and 5% sheep blood agar and Muller Hinton Agar)
5. Gram stain kit
6. Antibiotic (Cefoxitin Disc)



Catalase positive, Coagulase positive = *Staphylococcus aureus*

Catalase positive, Coagulase negative = Coagulase negative *Staphylococcus* (CONS)

Control strain:

Positive Control- *Staphylococcus aureus*

Negative Control- *Streptococcus* spp. (14)

- **Screening for Methicillin Resistance:** Using Mueller Hinton Agar and the Kirby-Bauer disk diffusion method, methicillin resistance was investigated using 30µg of cefoxitin disc.
- Antibiotic sensitivity testing was done for identification of MRSA and was reported. As per the CLSI standards, an isolated organism was classified as MRSA if it showed an inhibitory zone of less than 22 mm. (15)

Table 2: Cefoxitin 30mcg parameters of AST

S.NO	ANTIBIOTIC	DISC CONTENT	INTERPRETATIVE CRITERIA
1.	CEFOXITIN	30mcg	RESISTANCE- ≤21 SENSITIVE- ≥22

Result

The study was carried out in the microbiology department of medical college TMMC&RC, Moradabad. This study determines the resistance pattern of *Staphylococcus aureus* in nasal swab and hand impressions. The samples were obtained from different categories of health care workers (doctors,

interns, technicians, pharmacists, nursing staff and housekeeping staff) in TMU hospital. In this study among 198 health care workers, 62(31.1%) were positive for nasal carriers and hand impression of *Staphylococci* including *coagulase negative Staphylococcus* (CONS), which were processed for MRSA detection.

Table 3: Shows the positive carriage of *Staphylococci* isolates from nasal swab and hand impression.

CARRIAGE	RESULT (%)
Positive	62 (31.3%)
Negative	136 (68.6%)
Total	198 (100%)

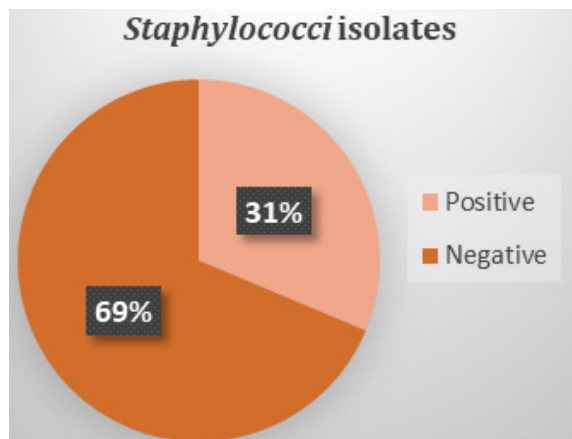


Figure 1: Shows the positive carriage of *Staphylococci* isolates from nasalswaband hand impressions.

Out of 58 samples, there was 40 (20.2%) *Staphylococcus aureus* in nasal swabs and 18(9.09%) *Staphylococcus aureus* in hand impression as shown below in the table.

Table 4: Shows the *Staphylococcus aureus* isolates from nasal swabs and hand impressions.

SAMPLE	RESULT (%)
Nasal swab	40 (20.2%)
Hand impression	18 (9.09%)

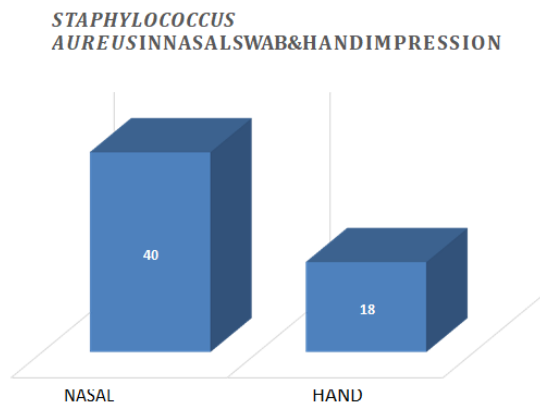


Figure 2: Shows the *Staphylococcus aureus* isolates in nasal swabs and hand impressions.

Out of 58 *Staphylococcus aureus* isolates 20 (34.4%) were Methicillin resistance *Staphylococcus aureus* (MRSA) and 38 (65.5%) were the methicillin sensitive *Staphylococcus aureus* (MSSA) as shown below in the table.

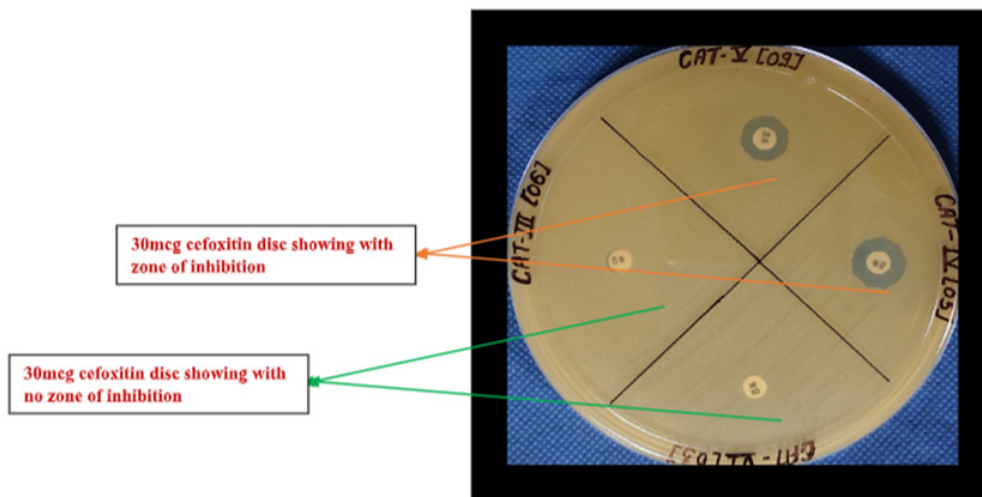


Figure showing cefoxitin disc diffusion method with zone of inhibition on Mueller Hinton agar plate.

S.NO	CATEGORY	CEFOXITIN DISC CONTENT	INTERPRETATIVE CRITERIA
1.	CAT V (09)	30mcg	<p>Zone of inhibition = 13</p> <p>RESISTANT-<21</p> <p>SENSITIVE - >=22</p>

Continue.....

2.	CAT IV (05)	30mcg	Zone of inhibition = 15 RESISTANT-<21 SENSITIVE - ≥22
3.	CAT VI (03)	30mcg	Zone of inhibition = No zone RESISTANT-<21 SENSITIVE - ≥22
4.	CAT III (06)	30mcg	Zone of inhibition = No zone RESISTANT-<21 SENSITIVE - ≥22

Table 6: Shows the isolated Methicillin Resistant and sensitive organisms.

ISOLATES	RESULT (%)
MRSA	20 (34.4%)
MSSA	38 (65.5%)
Total	58 (29.2%)

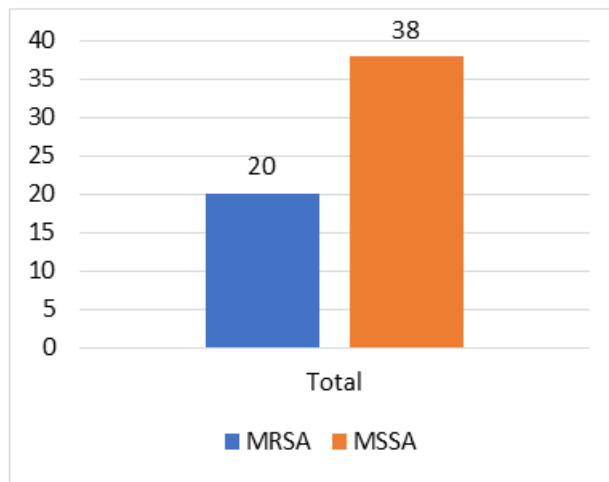


Figure 4: Shows the isolated Methicillin resistant and sensitive organisms

Out of 58 *Staphylococcus aureus* from different health care workers, the maximum no. of *Staphylococcus aureus* was obtaining from doctors 17 (30.3%), Nurses 15(26.7%), Lab technicians 13(23.2%)

least in Interns 3 (5.17%). Maximum MRSA in nurses 9 (47.3%), not in interns and pharmacists as shown below in the table.

Table 7: Shows categories wise isolated MRSA from HCW's.

Health workers	No of sample (n=198)	<i>Staphylococcus aureus</i> (n=58)	MRSA (n=20)
Doctors	33	17(29.3%)	5 (25%)
Nurses	33	15(25.86%)	10 (50%)
Lab technicians	33	13(22.4%)	4 (20%)
Housekeeping staff	33	6 (10.7%)	1 (5%)
Pharmacist	33	4(6.8%)	0
Interns	33	3 (5.17%)	0

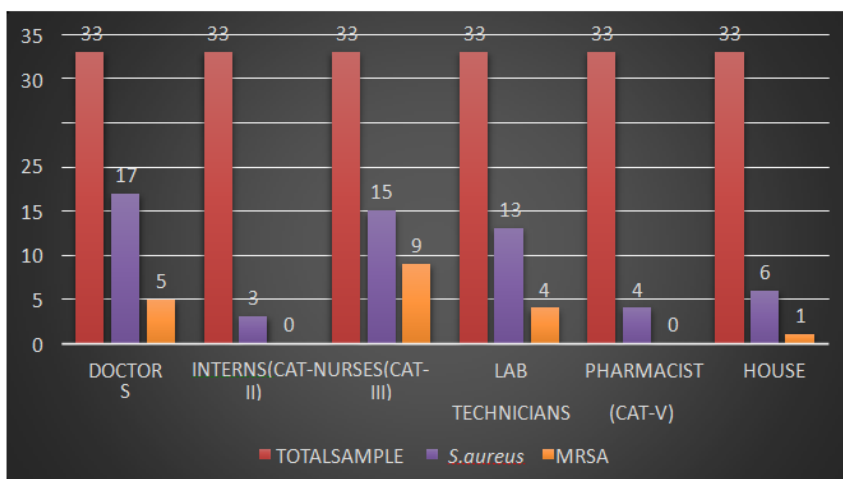


Figure 5: Shows categories wise isolated MRSA from HCW's.

Out of 58 *Staphylococcus aureus* from different wards, the maximum no of *Staphylococcus aureus* was obtaining from general surgery 16 (28.5%), general

medicine 13 (23.21%), Gynecology 7 (12.5%), Central LAB 6 (10.7%) as shown below in the table.

Table 8: Shows wards wise isolated MRSA from the hospital.

WARDS	<i>Staphylococcus aureus</i>	MRSA
NICU	2 (3.5%)	0
PICU	2 (3.5%)	0
MEDICAL STORE	4 (7.14%)	0
GENERAL SURGERY	16 (28.5%)	5 (25%)
GENERAL MEDICINE	13 (23.21%)	4 (20%)
Gynecology	7 (12.5%)	5 (25%)
Orthopedics	4 (7.14%)	1 (5%)
Pediatrics	2 (3.5%)	2 (10%)
OT	2 (3.5%)	3 (15%)
Central LAB	6 (10.7%)	0

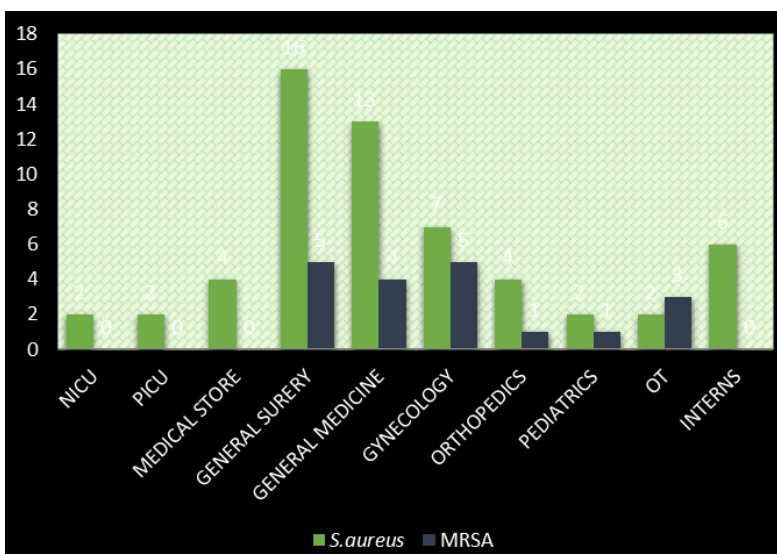


Figure 6: Shows wards wise isolated MRSA from the hospital.

Out of 58 *Staphylococcus aureus* from different age groups, the maximum number of *Staphylococcus aureus* were obtained from the age group of 21-40 (67.8%), followed by 41-60 (28.5%). Minimum age group were 18-20 (1.78%).

Table 9: Showing age group wise carriers of *Staphylococcus aureus* from HCW's.

Age group (Years)	Total number	Percentage
18-20	1	1.72%
21-40	38	65.5%
41-60	16	27.5%
61-80	3	5.17%
81-100	0	0%
Total	58	100%

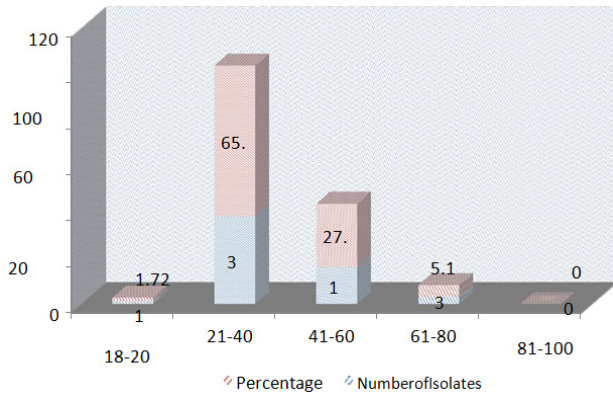


Figure 7: Showing age group wise carriers of *Staphylococcus aureus* from HCW's.

In this study for detection of MRSA we used Cefoxitin antibiotic disk 30 µg for antibiotic sensitivity test. We do AST for all isolates of 58 samples where we find that only 20(34.4%) samples were resistant for drug used and remaining 38(65.5%) samples were sensitive to the particular drug as shown below in the table.

Table 10: Showing Cefoxitin Screen Test from the total isolates.

Antibiotics	No. of samples	Interpretation
Cefoxitin (30 µg)	20 (34.4%)	Resistant
Cefoxitin (30 µg)	38 (65.5%)	Sensitive

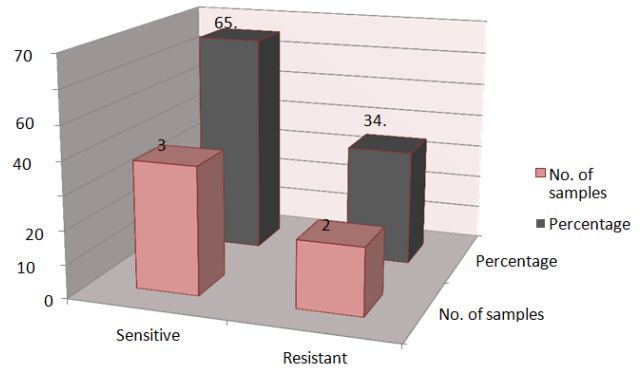


Figure 8: Showing Cefoxitin disc diffusion test from total isolates.

Discussion

Gram-positive cocci bacteria are called *Staphylococcus aureus*. One of the infections that are frequently found in both community and hospitals is *S. aureus*. A particular strain of *Staphylococcus aureus* that is resistant to methicillin is known as methicillin-resistant *S. aureus* or MRSA. The MRSA outbreak is a serious new issue that many hospitals are dealing with the current investigation found a steady rise in MRSA isolates in the nasal swab and hand impression between 2021 and 2024. Methicillin-resistant *Staphylococcus aureus* is becoming more common. This can be linked to a number of risk factors including healthcare workers (HCWs) MRSA carriage, inadequate hand hygiene compliance, a lack of active MRSA surveillance programme, improper and abusive use of antibiotics extended hospital stays and a lack of a bundle approach. The nasal carriage rate of *S. aureus* was found to be 20.2% in this investigation. **Yazgi et al.** obtained similar results (27.5%).⁽¹⁶⁾ The current result was also in line with earlier Nepali publications by **Mukhiya et al.** (20.9%), **Khanal et al.** (15.7%), and **Sah et al.** (20.4%).⁽¹⁷⁾ Conversely, a considerably greater frequency of 51.9% for the HCWs from the same hospital was observed by **Pant, Rai et al.** ⁽¹⁸⁾ in 2007. This decline in prevalence may be the result of recent improvements in infection control strategies and awareness. Compared to reports from Nepal (27.3% to 92.0%) and India (22.2% to 48.0%), the current finding was lower. ⁽¹⁹⁾ Conversely, **L. Agarwal et al.** reported low carriage rates of *S. aureus* (14%).⁽²⁰⁾ Our investigation revealed that the MRSA nasal carriage rate among healthcare workers was 34.4% (20/198),

which is more than the results of studies conducted in a tertiary care hospital in Western Nepal by **Nadia et al.** (21.4%).⁽²¹⁾ that **Shibabaw et al.** reported globally (12.7%).⁽²²⁾ and also higher than **Khanal R et al.** 3.43% (7/204).⁽²³⁾ **S.R. Rongharpi et al.** studies revealed similar results (11.43%).⁽²⁴⁾ and **B.Shakya et al.** (7.1%).⁽²⁵⁾

S. aureus rate was high in doctors 29.3% whereas MRSA rate was high in nurses 47.3 % in our study. Similar results were detected by **Giri N, Maharjan S et al.**⁽⁷⁴⁾ where *S. aureus* carriage rate was maximum in doctors 28.57% whereas MRSA rate was highest in nurses 10.41% **Shibabaw et al.**⁽²⁵⁾ (12.7%).

In our present study, age group of 41-60 years is the most common age to isolate the *Staphylococcus aureus* in nasal swab and hand impression. Maximum *Staphylococcus aureus* was isolated from the 21-40 (65.5%) age group in our study. A study done by **Bankar N et al.**⁽¹⁾ maximum *Staphylococcus aureus* was isolated from the 21-40 (57.4%) age group.

Present study shows 58 isolates of *Staphylococcus aureus* 20(34.4%) were MRSA. By utilizing Cefoxitin/Oxacillin sensitivity, MRSA were identified in accordance with CLSI recommendations.⁽²⁶⁾ MRSA prevalence in a prior study conducted by Harshan K H et al.⁽²²⁾ Devi U et al.⁽¹⁾, Banker N et al.⁽¹⁾ was isolated 29.7%, 28.8% and 26.9%. Only a few Indian studies such **Kumar A et al.** (60.9%) have reported resistance rates that are marginally greater than those in our research report.⁽²⁷⁾ in Jamshedpur in 2018 and (52%) by **Khanal R et al.**⁽²³⁾ from Gujarat in 2016.

The high resistance against the most commonly used antibiotics have been found because of the overuse of antibiotics without any bacterial infections which may cause drug resistance. There are many mechanisms that cause bacteria to start resistance Capsule formation, genes mutations, enzyme production. In this study resistance of cefoxitin were 34.4% which is lower than **Harshan HK et al.**⁽²⁸⁾ in a study stated high level resistance to Cefoxitin (41.7%).⁽²⁸⁾

In this study the highest number of isolates comes from general surgery ward 16 (28.5%), whereas 13 (23.21%) in general medicine, 7(12.5%) in gynecology, 6(10.7%) central laboratory, 4(7.14%) ICU and 4 (7.14%) from orthopedics. **Rao R et al.**⁽²⁹⁾ reported

that the general surgery has the highest cases of *S. aureus* 36 (35.29%), whereas 30 (29.42%) were found in Orthopedics, 10 (9.80%) were from Medicine ward. Another study conducted by **Banker N et al.**⁽¹⁾ stated that the highest number of *Staphylococcus aureus* were from General Surgery 207(68.09%) and Medicine 19(6.25%).

Conclusion

In order to identify MRSA colonization and take the necessary action, this study emphasizes the necessity of active surveillance of HCWs.

- Since nursing staff members have the greatest rates of MRSA colonization, more focus should be placed on preventing MRSA colonization in this professional group.
- Ability to transmit MRSA infections among hospital staff members can be restricted by following infection control and prevention procedures.
- Frequent training on infection control procedures can improve HCWs' knowledge.
- *Staphylococcus aureus* and MRSA are frequently carried by HCWs. They run the risk of this MDR bacteria colonizing them because of their ongoing exposure to the hospital environment.
- If healthcare workers completed routine screening and decontamination before dealing with high-risk, vulnerable patients there would be a decreased likelihood of MRSA transmission to patients.
- It is imperative that healthcare workers prioritize hand hygiene. If put into practice, these control methods can aid in preventing the infection of this feared bacterium in both the community and the hospitals.
- To break the infection of MRSA from healthcare workers to the patients, there is a need of developing the awareness campaigns, hand hygiene practices & regular screening programs.

Ethical clearance: Taken from institutional ethical committee TMU Moradabad Ref no. TMU/IEC Nov. 23/57 dated:24.11.23

Source of funding: Self

Conflict of interest: Nil

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