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Prevalence, Clinico-Demographic Profile, and Antimicrobial Susceptibility of MRSA Infections in a Tertiary Hospital in Western India: A Retrospective Study

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ABSTRACT

Introduction: Methicillin-resistant *Staphylococcus aureus* (MRSA) has a high prevalence in hospital settings in India and imposes a serious economic burden on healthcare resources. Understanding the local prevalence and evolving antimicrobial resistance patterns of MRSA is crucial for guiding effective treatment strategies. This study aims to determine the prevalence, clinico-demographic profile, and antibiotic susceptibility patterns of MRSA and methicillin-susceptible *Staphylococcus aureus* (MSSA) isolates. **Methods:** This retrospective study analyzed *Staphylococcus aureus* isolates collected between June 2021 and May 2023 from blood, pus, sterile body fluids, respiratory, and urine samples at the Microbiology laboratory of Mahatma Gandhi Hospital. Isolates were identified as *S. aureus* and tested for methicillin resistance using the Vitek 2 Compact system, which employs an advanced colorimetry method for identification and determines the minimum inhibitory concentration (MIC) using a broth microdilution method for antimicrobial susceptibility testing. **Results:** Of the 481 *Staphylococcus aureus* isolates analyzed, 264 (55%) were identified as MRSA. Among the MRSA isolates, the most common source was pus/wound infections (59%), followed by bloodstream infections (22%). MRSA isolates showed a susceptibility rate of 56% to gentamicin and 45% to clindamycin, but only 14% to ciprofloxacin. However, 55% of MSSA isolates were resistant to ciprofloxacin. All MRSA isolates were susceptible to daptomycin, teicoplanin, vancomycin, and linezolid. **Conclusion:** Our findings underscore the need for continuous MRSA surveillance and emphasize tailoring local antibiotic guidelines based on resistance patterns. Targeted antimicrobial stewardship programs and reinforced infection control protocols, especially for pus/wound infections, are crucial to curb the spread of resistant strains.

INTRODUCTION

Staphylococcus aureus (*S. aureus*) is a versatile bacterium capable of acting both as a commensal organism and a formidable pathogen [1]. The introduction of methicillin as a treatment for *S. aureus* infections marked a significant advancement in combating this pathogen. However, this progress was soon challenged by the emergence of methicillin-resistant *S. aureus* (MRSA), with the first cases identified in 1960 [2]. The emergence of resistance underscored the persistent challenge posed by *S. aureus* and its remarkable ability to adapt to antimicrobial treatments. MRSA is a subtype of *S. aureus* characterized by resistance to β-lactam antibiotics, including penicillins, cephalosporins, and β-lactamase inhibitor combinations. This resistance is primarily mediated by the acquisition of the *mecA* gene, which encodes for an altered penicillin-binding protein (PBP2a) [3].

Methicillin resistance makes MRSA a particularly challenging pathogen, capable of causing a wide spectrum of infections, from minor skin and soft tissue infections to life-threatening conditions such as endocarditis and septic shock [4]. MRSA has rapidly become a leading cause of healthcare-associated infections worldwide, posing a significant challenge to healthcare systems due to its high morbidity, mortality, and associated healthcare costs [5]. The World Health Organization (WHO) has classified MRSA as a high-priority pathogen due to treatment failures, which can lead to an increased length of hospital

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stay, healthcare costs, and mortality compared to infections caused by MSSA strains [6, 7].

The global prevalence of MRSA among *S. aureus* isolates varies considerably, ranging from 13% to 74% across different healthcare settings. Similar variability is observed in Southeast Asian countries, where reported prevalence ranges from 2% to 69% depending on the specific country and study setting [8]. Studies investigating MRSA prevalence in India have reported considerable variation, with estimates ranging from 30% to 70% depending on the geographical location and study setting [7]. These regional variations underscore the need for continuous surveillance and localized data to inform effective infection control measures.

The Indian Council of Medical Research–Antimicrobial Resistance Surveillance Network (ICMR–AMRSN) reported a significant rise in MRSA rates, from 28.4% to 42.6% over a five-year period ending in 2021 [9]. In addition to its increasing prevalence, MRSA exhibits higher resistance to non-β-lactam antibiotics such as clindamycin, levofloxacin, and ciprofloxacin, compared to MSSA. This is a concerning as it restricts treatment options [7].

The rising incidence of MRSA and its evolving resistance patterns pose a significant challenge to public health, necessitating continuous surveillance to inform effective infection control measures and guide antimicrobial stewardship programs. Monitoring MRSA prevalence, particularly in high-risk settings like tertiary care hospitals, provides crucial data for developing local antibiograms, which are essential tools for guiding empirical antibiotic therapy [7]. Furthermore, understanding regional variations in MRSA epidemiology, including prevalent clones and resistance patterns, can help tailor infection control strategies and public health interventions. However, data regarding the prevalence and antimicrobial susceptibility of MRSA in Western India remain limited, hindering the development of targeted interventions.

This study aimed to: (1) determine the prevalence of MRSA among *S. aureus* isolates, (2) characterize the clinico-demographic profile of patients with MRSA and MSSA infections, and (3) evaluate the antimicrobial susceptibility profiles of MRSA and MSSA isolates.

MATERIAL AND METHODS

Study design, setting and data collection. This retrospective study was conducted at the microbiology laboratory of a tertiary hospital in Jaipur, India, between June 2021 and May 2023. The study included non-duplicate clinical samples from both inpatient and outpatient departments, including blood, pus/wound aspirates, sterile body fluids (pleural, ascitic, cerebrospinal, peritoneal, pericardial, and synovial), respiratory specimens (sputum, endotracheal aspirate, and bronchoalveolar lavage), and urine. Data on patient demographics (age and sex) and hospitalization status were retrieved from the hospital's electronic database and laboratory records.

Inclusion and exclusion criteria. This study included all *S. aureus* isolates recovered from non-duplicate clinical specimens processed at the microbiology laboratory during the study period. Isolates that were not identified as *S. aureus* were excluded.

Microbiological processing. Samples were processed using standard microbiological techniques for bacterial isolation and identification. Blood samples were collected in BD BACTEC aerobic blood culture bottles and incubated in a fully automated BD BACTEC™ FX blood culture system (BD, Franklin Lakes, NJ, USA). Subsequently, all samples, including positive blood cultures, were plated on 5% sheep blood agar and MacConkey agar, except for urine samples, which were inoculated on CLED agar. Chocolate agar was used for cerebrospinal fluid (CSF) samples. All isolates were incubated at 37°C for 24-48 h.

S. aureus was identified using standard microbiological techniques, including colony morphology on blood agar, Gram staining, catalase and coagulase testing. Species-level identification was confirmed using the Vitek 2 Compact system (bioMérieux SA, Marcy-l'Étoile, France) with the GP ID card.

Antimicrobial susceptibility testing. Antimicrobial susceptibility testing (AST) was performed using the Vitek 2 Compact system with the AST 628 card (bioMérieux SA), which utilizes the broth microdilution method. The AST panel included penicillin, gentamicin, ciprofloxacin, levofloxacin, erythromycin, clindamycin, linezolid, daptomycin, teicoplanin, vancomycin, and nitrofurantoin (for urinary tract isolates only). MRSA was defined as *S. aureus* exhibiting an oxacillin MIC > 2 µg/ml or a cefoxitin screen of positive, while MSSA was defined as *S. aureus* exhibiting an oxacillin MIC < 2 µg/ml or a cefoxitin screen of negative on the AST 628 card.

Quality control testing was performed weekly and with each new lot or shipment of identification and AST cards using *S. aureus* ATCC 29213 as the control strain. Antibiotic susceptibility results were interpreted according to the Clinical and Laboratory Standards Institute (CLSI) guidelines [10].

Statistical analysis. Data were entered into a Microsoft Excel (Microsoft, Redmond, WA, USA) spreadsheet and analyzed using MedCalc statistical software (MedCalc Software, Ostend, Belgium). Descriptive statistics, including percentages and frequencies, were used to summarize the data. Bivariate logistic regression models were used to investigate the association between MRSA infection and clinico-demographic characteristics such as age, sex, hospitalization status (inpatient or outpatient), and type of specimen (pus/wound aspirate, blood, respiratory specimen, urine or sterile body fluid) from

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which MRSA was isolated, calculating odds ratios (OR) and their corresponding 95% confidence intervals (CI). The chi-square test was used to compare antimicrobial susceptibility and resistance patterns between MSSA and MRSA isolates. A *P*-value of ≤ 0.05 was considered statistically significant.

Ethical considerations. Ethical approval was obtained from the Institutional Ethics Committee (IEC) of Mahatma Gandhi Medical College and Hospital (Reference number: MGMC&H/IEC/JPR/2023/1655). As this was a retrospective study using anonymized data, the requirement for informed consent was waived by the IEC.

RESULTS

A total of 32,060 samples were received for bacterial culture between June 2021 and May 2023, of which 7,213 (22.5%) were positive for bacterial growth. Among the positive cultures, 1,694 (23.5%) were identified as Gram-positive isolates, and 481 (28.4% of these) were *S. aureus*. The overall prevalence of MRSA was 54.9% (264/481) among *S. aureus* isolates. The prevalence of MRSA and MSSA among all positive cultures was 6.9% (264/32,060) and 6.0% (217/32,060), respectively.

Clinico-demographic profile. Table 1 presents the clinical and demographic characteristics of patients with S. aureus infections, including those with MRSA. The prevalence of MRSA was significantly higher among male patients compared to female patients (PR 1.82, 95% CI 1.39–2.43, $P < 0.0001$). There was no significant association observed between the prevalence of MRSA and age group ($P > 0.05$). *S. aureus* isolates were more frequently recovered from inpatient samples (77.5%, 373/481) compared to outpatient samples (22.5%, 108/481). However, there was no significant difference in the prevalence of MRSA between inpatient (56%, 207/373) and outpatient (53%, 57/108) groups (PR 1.05, 95% CI 0.78-1.43, $P = 0.74$).

The majority of *S. aureus* isolates (51%, 246/481) were recovered from pus/wound aspirate samples, followed by blood (23%, 109/481), tissue/wound aspirate (12%, 58/481), endotracheal aspirate (6%, 27/481), sterile body fluid (5%, 23/481), urine (2%, 10/481), and sputum (1%, 8/481) samples. Among MRSA isolates, the most common source was pus/wound aspirate (59%, 156/264), followed by blood (22%, 57/264) and tissue/wound aspirate specimens (10%, 26/264).

Table 1. Clinico-demographic characteristics of patients with *S. aureus* infections and the prevalence of MRSA at Mahatma Gandhi Hospital, a tertiary care hospital in Western India (study period: June 2021–May 2023)

Clinico-demographic characteristics	No. of patients with *S. aureus* (n = 481)	No. of patients with MRSA (%)	Prevalence ratio (95%CI)	*P*-value
Total	481	264 (54.9)	-	-
Sex				
Female*	230	69 (30.0)	Reference	<0.0001
Male	251	195 (77.7)	1.82 (1.39-2.43)	
Age groups (years)				
< 1	6	2 (33.3)	0.61 (0.07-2.28)	0.5
1-5	12	5 (41.7)	0.77 (0.24-1.86)	0.6
6-18	28	9 (32.1)	0.59 (0.26-1.17)	0.12
19-35*	189	102 (54.0)	Reference	
36 – 50	142	86 (60.6)	1.12 (0.83-1.51)	0.43
51 - 65	57	33 (57.9)	1.07 (0.70-1.60)	0.71
> 65	47	27 (57.4)	1.06 (0.66-1.64)	0.75
Hospitalization				
Inpatient*	373	207 (55.5)	Reference	0.74
Outpatient	108	57 (52.8)	1.05 (0.78-1.43)	
Specimen type				
Pus*	246	156 (63.4)	Reference	
Blood	109	57 (52.3)	0.82 (0.59-1.12)	0.211
Tissue	58	26 (44.8)	0.70 (0.44-1.07)	0.093
Endotracheal aspirate	27	13 (48.1)	0.75 (0.39-1.33)	0.34
Sterile body fluids				
Urine	23	7 (30.4)	0.47 (0.18-1.01)	0.03
Sputum	10	3 (30.0)	0.47 (0.09-1.43)	0.17
	8	2 (25.0)	0.39 (0.04-1.14)	0.161

*Reference group

Antibiotic susceptibility of MSSA and MRSA isolates. Table 2 shows the antimicrobial susceptibility and resistance patterns of MSSA and MRSA isolates to commonly tested antibiotics. MRSA isolates exhibited significantly higher resistance rates than MSSA isolates for gentamicin (44% vs. 10%, $P <0.0001$), ciprofloxacin (86% vs. 55%, $P <0.0001$), erythromycin (81% vs. 43%, $P <0.0001$), clindamycin (55% vs. 34%, $P <0.0001$), and trimethoprim-sulfamethoxazole (53% vs. 26%, $P <0.0001$).

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Table 2. Antibiotic susceptibility profiles of MSSA and MRSA isolates using chi-square test from clinical samples at Mahatma Gandhi Hospital, Western India (study period: June 2021–May 2023)

Antibiotic	Strain (N)	Sensitive N (%)	Resistant N (%)	*P*-value
Gentamicin	MRSA (264)	148 (56)	116 (44)	0.000
	MSSA (217)	195 (90)	22 (10)	
Ciprofloxacin	MRSA (264)	38 (14)	226 (86)	0.000
	MSSA (217)	97 (45)	120 (55)	
Erythromycin	MRSA (264)	51 (19)	213 (81)	0.000
	MSSA (217)	123 (57)	94 (43)	
Clindamycin	MRSA (264)	120 (45)	144 (55)	0.000
	MSSA (217)	144 (66)	73 (34)	
Trimethoprim-sulfamethoxazole	MRSA (264)	125 (47)	139 (53)	0.000
	MSSA (217)	161 (74)	56 (26)	
Benzylpenicillin	MRSA (264)	00	264 (100)	NE
	MSSA (217)	10 (5)	207 (95)	
Oxacillin	MRSA (264)	00	264 (100)	NE
	MSSA (217)	217 (100)	00	
Linezolid	MRSA (264)	264 (100)	00	NE
	MSSA (217)	217 (100)	00	
Teicoplanin	MRSA (264)	264 (100)	00	NE
	MSSA (217)	217 (100)	00	
Vancomycin	MRSA (264)	264 (100)	00	NE
	MSSA (217)	217 (100)	00	
Daptomycin*	MRSA (249)	249 (100)	00	NE
	MSSA (197)	197 (100)	00	
Nitrofurantoin#	MRSA (3)	3 (100)	0	NE
	MSSA (7)	7 (100)	0	

NE – Not estimated
*Respiratory isolates excluded
#Only for urine isolates

DISCUSSION

First reported in the late 1960s, MRSA infection rates rose dramatically worldwide between 1990 and 2000 [11, 12]. This rise has made MRSA a major public health concern globally, due to its significant antibiotic resistance, which can lead to increased morbidity and mortality among patients. This problem is especially pronounced in developing nations like India, where the burden of infectious diseases is already high. For example, a collaborative multicentric study by the Indian Network for Surveillance of Antimicrobial Resistance (INSAR) group, conducted across 15 tertiary care centers in India from January 2008 to December 2009, found a high MRSA prevalence of 41% [13].

Our study found a MRSA prevalence of 54.9%, which is consistent with several Indian studies conducted since 2010 that have reported a range from 33.6% to 52% [7, 14-16]. However, a recent meta-analysis documented a lower pooled prevalence of 33% in Western India [17]. This discrepancy could be attributed to variations in study methodology, patient populations, and antimicrobial susceptibility testing protocols. Our findings, along with a contemporary study from a tertiary care hospital in Jaipur that reported a comparable prevalence of 53.7% [18] highlight the persistently high rates of MRSA in India, particularly within tertiary care settings.

The high prevalence of MRSA observed in our study (54.9%) is consistent with other reports from tertiary care centers in India and may be attributed to several factors. Our hospital serves as a referral center for complex and high-risk cases, receiving patients with severe infections or those who have failed initial treatment elsewhere. This referral bias may contribute to a higher concentration of MRSA cases. Furthermore, the widespread prevalence of antimicrobial resistance, likely driven by the inappropriate use of antibiotics both within hospitals and the community, is a significant contributing factor.

These findings underscore the critical need for robust infection control measures and antimicrobial stewardship programs in hospitals to mitigate the transmission of MRSA. The high prevalence of MRSA in our hospital setting highlights the importance of regular surveillance for MRSA, particularly in high-risk departments. Strict adherence to contact precautions is crucial to prevent cross-contamination. Empiric antibiotic selection should be guided by local antibiograms, followed by de-escalation of therapy based on individual susceptibility results, adhering to antimicrobial stewardship principles.

Our finding of higher MRSA prevalence among male patients is consistent with observations from a previous study by Shrestha *et al*. (2021) [19]. However, in contrast to their findings, we did not observe a significant association between MRSA prevalence and age or hospitalization status. This discrepancy might be attributed to variations in study populations or local epidemiological factors.

Although our study did not differentiate between community-acquired MRSA (CA-MRSA) and hospital-acquired MRSA (HA-MRSA), the similar prevalence in outpatients (52.8%) and inpatients (55.5%), coupled with

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a substantial proportion of MRSA infections in young individuals (54%), raises the possibility of a significant CA-MRSA burden in our setting. However, this observation requires further investigation using molecular typing methods to characterize the genetic background of MRSA isolates and assess their potential for community transmission [20].

In our study, the most common source of MRSA isolation was pus/wound aspirate samples (59%). This finding aligns with other studies from India that have reported a predominance of MRSA in skin and soft tissue infections [16, 21, 22]. While MRSA was also isolated from blood and other clinical samples, the prevalence varied considerably by sample type, highlighting the diverse clinical manifestations of MRSA infection.

As expected, our study found significantly higher resistance rates in MRSA isolates compared to MSSA isolates for several commonly used antibiotics, a finding consistent with previous reports [16, 23, 24]. Specifically, resistance to ciprofloxacin (85.6% vs. 55.3%), erythromycin (80.7% vs. 43.3%), clindamycin (54.5% vs 33.6%), trimethoprim-sulfamethoxazole (52.7% vs. 25.8%), and gentamicin (43.9% vs. 10.0%) was significantly higher in MRSA isolates. The increasing resistance to oral antibiotics such as ciprofloxacin, clindamycin, and trimethoprim-sulfamethoxazole is concerning, as it limits treatment options, particularly for common infections like skin and soft tissue infections and urinary tract infections [7].

Encouragingly, our study found no resistance to vancomycin, teicoplanin, daptomycin, and linezolid. However, it is important to note that studies from other regions in India and neighboring countries have reported emerging resistance to vancomycin (0.71% - 6.25%) and linezolid (0.71% - 4.16%) [6, 8, 25]. This highlights the need for ongoing surveillance of antibiotic resistance patterns to guide treatment strategies and detect emerging resistance threats promptly.

While our study did not find resistance to these last-line antibiotics, our findings still underscore the importance of judicious antibiotic use in all clinical settings. This includes ensuring appropriate diagnosis of MRSA infections before initiating empiric therapy or de-escalating to targeted therapy based on susceptibility results. Such antimicrobial stewardship practices are essential to minimize the selective pressure that drives the development and spread of antibiotic resistance, even to these currently effective drugs [14].

This study provides valuable insights into the current epidemiology and antibiotic resistance patterns of MRSA within our tertiary care setting. Specifically, the high prevalence of MRSA, particularly among male patients, and the high rate of resistance to commonly used antibiotics underscore the need for tailored treatment guidelines and strengthened infection control practices. The inclusion of a diverse range of clinical samples, including pus/wound aspirate, blood, sterile body fluids, and respiratory specimens, enhances the generalizability of our findings to various clinical presentations of MRSA infections within our hospital.

Our study has several limitations inherent to its retrospective design. First, we did not perform molecular confirmation of MRSA using methods such as *mecA* gene PCR or assess for the presence of the *mecC* gene. Second, we did not conduct molecular typing to differentiate CA-MRSA from HA-MRSA, limiting our ability to fully characterize the epidemiology within our setting. Finally, we could not assess treatment outcomes due to the retrospective nature of the data. Future prospective studies incorporating molecular characterization of MRSA isolates and analysis of treatment outcomes are warranted to address these limitations and provide a more comprehensive understanding of MRSA in our region.

In conclusion, our study reveals a high prevalence of MRSA (54.9%) among *S. aureus* infections in our tertiary care hospital. This finding, coupled with high rates of resistance to several commonly used antibiotics, emphasizes the ongoing challenge of MRSA management. Although our study found no resistance to linezolid or vancomycin, suggesting their potential utility in treating MRSA infections, treatment decisions should always be individualized based on patient-specific factors, infection severity and site, and local susceptibility patterns.

These findings highlight the critical need for continued surveillance of MRSA, the development and regular updating of local antibiograms, and robust antimicrobial stewardship programs. By implementing targeted interventions, such as those informed by our findings on prevalent resistance patterns, healthcare providers can help optimize antibiotic use, which may potentially curb the emergence of resistance, and minimize the spread of MRSA within our hospital.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest associated with this manuscript.

REFERENCES

1. Batabyal B, Kundu GK, Biswas S. Methicillin-resistant *Staphylococcus aureus*: A brief review. Int Res J Biol Sci. 2012; 1 (7): 65-71.

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2. Jevons MP. "Celbenin" - resistant *Staphylococci*. Br Med J. 1961; 1 (5219): 124-5.

3. Kumar S, Budhani D, Sayal P, Sindwani P, Jain PK. Emphasis on antibiotic optimisation in difficult to treat methicillin resistant *staphylococcus aureus* infection. J Evolution Med Dent Sci. 2017; 6 (71): 5055-8.

4. Wielders CL, Fluit AC, Brisse S, Verhoef J, Schmitz FJ. *MecA* gene is widely disseminated in *Staphylococcus aureus* population. J Clin Microbiol. 2002; 40 (11): 3970-5.

5. Pappu RK, Ranjan PK, Poddar CK, Ahmad I, Sinha RN, Shahi SK. Prevalence and antimicrobial susceptibility of methicillin resistant staphylococcus in a tertiary care hospital in Koshi Region (Northern Bihar). IJCMR. 2019; 6 (6): 4-7.

6. Tacconelli E, Carrara E, Savoldi A, Harbarth S, Mendelson M, Monnet DL, et al. WHO Pathogens Priority List Working Group. Discovery, research, and development of new antibiotics: the WHO priority list of antibiotic-resistant bacteria and tuberculosis. Lancet Infect Dis. 2018; 18 (3): 318-27.

7. Shah S, Rampal R, Thakkar P, Poojary S, Ladi S. The Prevalence and Antimicrobial Susceptibility Pattern of Gram-Positive Pathogens: Three-Year Study at a Tertiary Care Hospital in Mumbai, India. J Lab Physicians. 2021; 14 (2): 109-14.

8. Pradhan P, Rajbhandari P, Nagaraja SB, Shrestha P, Grigoryan R, Satyanarayana S, et al. Prevalence of methicillin-resistant *Staphylococcus aureus* in a tertiary hospital in Nepal. Public Health Action. 2021; 11 (Suppl 1): 46-51.

9. Antimicrobial research surveillance network (AMRSN) Annual Report 2021 (Division of epidemiology and communicable diseases, ICMR) https://www.icmr.nic.in/sites/default/files/reports/AMRSN_Annual_Report_2021. Accessed on Dec 1, 2023.

10. Clinical and Laboratory Standards Institute. Performance Standards for Antimicrobial Susceptibility Testing: Twenty Second Informational Supplement M100-32. Wayne, Pennsylvania: Clinical and Laboratory Standards Institute; 2022.

11. Turner NA, Sharma-Kuinkel BK, Maskarinec SA, Eichenberger EM, Shah PP, Carugati M, et al. Methicillin-resistant *Staphylococcus aureus*: an overview of basic and clinical research. Nat Rev Microbiol. 2019; 17 (4): 203-18.

12. Ray P, Singh R. Methicillin-resistant *Staphylococcus aureus* carriage screening in intensive care. Indian J Crit Care Med. 2013; 17 (4): 205-6.

13. Indian Network for Surveillance of Antimicrobial Resistance (INSAR) group, India. Methicillin resistant *Staphylococcus aureus* (MRSA) in India: prevalence & susceptibility pattern. Indian J Med Res. 2013; 137 (2): 363-9.

14. Kaur K, Gill AK, Kaur M. Methicillin resistance, vancomycin intermediate and vancomycin resistance *Staphylococcus aureus* prevalence in a tertiary care hospital of Punjab, India. National J Lab Med. 2019; 8 (03): 1–3.

15. Mohanty S, Behera B, Sahu S, Praharaj AK. Recent pattern of antibiotic resistance in *Staphylococcus aureus* clinical isolates in Eastern India and the emergence of reduced susceptibility to vancomycin. J Lab Physicians. 2019; 11 (4): 340-5.

16. Choudhury D, Chakravarty P. Prevalence and antimicrobial susceptibility pattern of methicillin resistant *Staphylococcus aureus* in Silchar Medical College and Hospital, Assam, India. Int J Basic Clin Pharmacol. 2017; 5 (5): 2174-7.

17. Patil SS, Suresh KP, Shinduja R, Amachawadi RG, Chandrashekar S, Pradeep S, Kollur SP, Syed A, Sood R, Roy P, Shivamallu C. Prevalence of Methicillin-resistant *Staphylococcus Aureus* in India: A Systematic Review and Meta-analysis. Oman Med J. 2022; 37 (4): e440.

18. Kumar S, Bhadauria S. Increasing trend of methicillin-resistant *Staphylococcus aureus* in Jaipur, Rajasthan, India. Afr J Microbio Res. 2016; 10 (34): 1417-21.

19. Shrestha LB, Syangtan G, Basnet A, Acharya KP, Chand AB, Pokhrel K. Methicillin-resistant *Staphylococcus aureus* in Nepal. JNMA J Nepal Med Assoc. 2021 25; 59 (237): 518-22.

20. Preeja PP, Kumar SH, Shetty V. Prevalence and Characterization of Methicillin-Resistant *Staphylococcus aureus* from Community- and Hospital-Associated Infections: A Tertiary Care Center Study. Antibiotics (Basel). 2021; 10 (2): 197.

21. Anupurba S, Sen MR, Nath G, Sharma BM, Gulati AK, Mohapatra TM. Prevalence of methicillin resistant *Staphylococcus aureus* in a tertiary referral hospital in eastern Uttar Pradesh. Indian J Med Microbiol. 2003; 21 (1): 49-51.

22. Patel P, Khandelwal N, Raval P, Patel B, Soni S, Vegad M. Prevalence and antimicrobial susceptibility pattern of methicillin resistant *Staphylococcus aureus* in tertiary care teaching hospital, Western India. Int J Med Sci Public Health. 2014; 3 (1): 58-60.

23. Dar JA, Thoker MA, Khan JA, Ali A, Khan MA, Rizwan M, et al. Molecular epidemiology of clinical and carrier strains of methicillin resistant *Staphylococcus aureus* (MRSA) in the hospital settings of north India. Ann Clin Microbiol Antimicrob. 2006; 5: 22.

24. Prakash M, Rajasekar K and Karmegam N. Prevalence of Methicillin Resistant *Staphylococcus aureus* in Clinical Samples Collected from Kanchipuram Town, Tamil Nadu, South India. J Appl Sci Res. 2007; 3 (12): 1705-9.

25. Sowjanya G, Ark A, Swetha G, Kumar PV. Prevalence of MRSA and its antibiotic susceptibility pattern in a tertiary care center, karimnagar. IJPHRD. 2021; 12 (1): 159-63.

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