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From Pus to Plasma: A Comprehensive Assessment of MRSA Prevalence in a Tertiary Care Centre

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ABSTRACT

Introduction: Staphylococcus aureus remains one of the most important bacterial pathogens associated with both healthcare-associated and community-acquired infections across the globe. In the last three decades, methicillin-resistant S. aureus (MRSA) has gained prominence as a significant cause of infections in both hospital and community settings.(1) (2) (3) Antimicrobial resistance (AMR) has become a critical global healthcare challenge, and methicillin-resistant Staphylococcus aureus (MRSA) is one of its most important contributors

Materials And Methods: Clinical samples obtained from patients attending the hospital were collected under aseptic conditions and processed according to standard microbiological protocols. Specimens were inoculated onto 5% sheep blood agar, MacConkey agar, and chocolate agar (HiMedia Laboratories, India). Sterile body fluids, blood samples, and tissue specimens were additionally inoculated into conventional blood culture bottles for enrichment prior to subculture. Identification of Staphylococcus aureus isolates was performed using colony morphology, Gram staining, and standard biochemical tests, including catalase and coagulase (slide and tube) tests. Antimicrobial susceptibility testing was carried out on Mueller–Hinton agar (HiMedia Laboratories, India) using the Kirby–Bauer disk diffusion method. Interpretation of susceptibility results was performed in accordance with the Clinical and Laboratory Standards Institute (CLSI) guidelines.

Results: Among MRSA isolates from different clinical specimens, Penicillin resistance was uniformly 100% across all sample types. High resistance to Erythromycin was observed in pus (77.1%), urine (90.9%), tissue (75.0%), blood (71.4%), and sputum (100%). Resistance to Linezolid and Vancomycin remained low in most specimen types, indicating preserved activity against MRSA isolates. Pus samples, which constituted the majority of isolates, demonstrated moderate resistance to Clindamycin (31.4%) and Ciprofloxacin (31.4%).

Conclusion: In conclusion our study reveals a high prevalence of MRSA among the pus/wound aspirate samples, with majority of strains showing maximum sensitivity to vancomycin and linezolid drug which could be considered as an empirical antibiotic therapy for patients with invasive infection of MRSA in our study setting and high sensitivity to doxycycline which can be used for non-invasive skin and soft tissue infections.

Keywords: *Methicillin-resistant Staphylococcus aureus (MRSA), Antimicrobial Resistance (AMR), Antibiotic Susceptibility, Vancomycin, Linezolid.*

INTRODUCTION

Staphylococcus aureus remains one of the most important bacterial pathogens associated with both healthcare-associated and community-acquired infections across the globe. In the last three decades, methicillin-resistant *S. aureus* (MRSA) has gained prominence as a significant cause of infections in both hospital and community settings.(1) (2) (3) Antimicrobial

resistance (AMR) has become a critical global healthcare challenge, and methicillin-resistant *Staphylococcus aureus* (MRSA) is one of its most important contributors. Recognizing its clinical significance, the World Health Organization (WHO) has designated MRSA as a high-priority pathogen. MRSA is intrinsically resistant to almost all β-lactam antibiotics, including penicillins, cephalosporins, and carbapenems, except for the fifth-generation cephalosporin like ceftobiprole, ceftolozane and ceftaroline.[4] [5] [6] According to a comprehensive review and meta-analysis, MRSA prevalence in India was 37% from 2015 and 2019. A recent report by the Indian Council of Medical Research-Antimicrobial Resistance Surveillance Network (ICMR-AMRSN) revealed that MRSA prevalence in India increased from 32.9% in 2017 to 38.6% in 2018. North India had the highest prevalence at 52.8%, followed by West India at 48.1%.[7] [8]) The US Centers for Disease Control and Prevention (CDC) considers MRSA to be a significant threat to human life and health, regardless of factors such as treatment, mortality, healthcare infrastructure, antimicrobial resistance, and trends in prevention and transmission.[9] The difficulties involved with treating these infections typically result in prolonged high incidence rates and increased deaths ,presenting a serious challenge for managing S. aureus infections. This study investigated the distribution and antimicrobial resistance patterns of MRSA over three years to characterize regional susceptibility trends and resistance profiles, providing evidence to optimize empirical antibiotic therapy and strengthen antimicrobial stewardship programs.

MATERIALS AND METHODS

A retrospective observational study was conducted over a three-year period from January 2023 to December 2025 after getting IEC approval (IEC CODE NO- 036/3881/2026) at a tertiary care hospital in Tiruvannamalai, Tamil Nadu, India, to evaluate the prevalence and antimicrobial susceptibility profile of Methicillin-Resistant *Staphylococcus aureus* (MRSA) isolated from clinical specimens submitted for aerobic culture and sensitivity testing.

Clinical samples obtained from patients attending the hospital were collected under aseptic conditions and processed according to standard microbiological protocols. Specimens were inoculated onto 5% sheep blood agar, MacConkey agar, and chocolate agar (HiMedia Laboratories, India). Sterile body fluids, blood samples, and tissue specimens were additionally inoculated into conventional blood culture bottles for enrichment prior to subculture.

Identification of *Staphylococcus aureus* isolates was performed using colony morphology, Gram staining, and standard biochemical tests, including catalase and coagulase (slide and tube) tests. Antimicrobial susceptibility testing was carried out on Mueller–Hinton agar (HiMedia Laboratories, India) using the Kirby–Bauer disk diffusion method. Interpretation of susceptibility results was performed in accordance with the Clinical and Laboratory Standards Institute (CLSI) guidelines. All microbiological findings were correlated with the clinical details of the patients before reporting. To avoid duplication and ensure the accuracy of the analysis, only the first MRSA isolate recovered from a given clinical specimen was included in the study. Repeated isolates obtained from the same specimen were excluded from data analysis. This study was conducted using routinely collected laboratory data, and patient confidentiality was maintained throughout the study period.

RESULTS

Overall Specimen Types and Distribution characteristics of MRSA

The majority of MRSA isolates were recovered from pus/wound aspirate samples (67.3%), followed by urine (11.5%), tissue (7.7%), and blood (6.7%). Isolation from sputum, fluid, ET tube, and vaginal swab specimens was relatively infrequent.

Clinical Sample	Number of MRSA Isolates (n)	Percentage (%)
Pus/wound aspirate	70	67.3
Urine	12	11.5
Tissue	8	7.7
Blood	7	6.7
Sputum	4	3.8
Fluid	1	1.0
ET Tube	1	1.0
Vaginal Swab	1	1.0
Total	**104**	**100.0**

MRSA Antibiotic susceptibility pattern

MRSA isolates demonstrated the highest susceptibility to Linezolid (91.3%), Vancomycin (90.9%), and Doxycycline (90.4%). Moderate susceptibility was observed with Co-trimoxazole (75.0%), Ciprofloxacin (72.6%), and Clindamycin (68.3%). High resistance was noted against Erythromycin (79.0%) and Penicillin (100%).

Antibiotic	Sensitive n (%)	Resistant n (%)
Linezolid	95 (91.3)	9 (8.7)
Vancomycin	90 (90.9)	9 (9.1)

Doxycycline	94 (90.4)	10 (9.6)
Co-Trimoxazole	78 (75.0)	26 (25.0)
Ciprofloxacin	69 (72.6)	26 (27.4)
Clindamycin	71 (68.3)	33 (31.7)
Tetracycline	60 (65.2)	32 (34.8)
Nitrofurantoin*	5 (41.7)	7 (58.3)
Erythromycin	21 (21.0)	79 (79.0)
Penicillin	0 (0.0)	104 (100.0)

MRSA antibiotic resistance pattern in various clinical specimens

Among MRSA isolates from different clinical specimens, Penicillin resistance was uniformly 100% across all sample types. High resistance to Erythromycin was observed in pus (77.1%), urine (90.9%), tissue (75.0%), blood (71.4%), and sputum (100%). Resistance to Linezolid and Vancomycin remained low in most specimen types, indicating preserved activity against MRSA isolates. Pus samples, which constituted the majority of isolates, demonstrated moderate resistance to Clindamycin (31.4%) and Ciprofloxacin (31.4%).

Clinical Sample (n)	Penicillin R n (%)	Erythromycin R n (%)	Clindamycin R n (%)	Co-trimoxazole R n (%)	Ciprofloxacin R n (%)	Vancomycin R n (%)	Linezolid R n (%)
Pus (70)	70 (100.0)	54 (77.1)	22 (31.4)	16 (22.9)	22 (31.4)	10 (14.3)	7 (10.0)
Urine (12)	12 (100.0)	10 (90.9)*	2 (16.7)	3 (25.0)	3 (25.0)	1 (8.3)	1 (8.3)
Tissue (8)	8 (100.0)	6 (75.0)	5 (62.5)	2 (25.0)	3 (37.5)	1 (12.5)	0 (0.0)
Blood (7)	7 (100.0)	5 (71.4)	1 (14.3)	3 (42.9)	3 (42.9)	0 (0.0)	0 (0.0)
Sputum (4)	4 (100.0)	4 (100.0)	2 (50.0)	1 (25.0)	1 (25.0)	1 (25.0)	1 (25.0)
Fluid (1)	1 (100.0)	1 (100.0)	0 (0.0)	0 (0.0)	1 (100.0)	1 (100.0)	0 (0.0)
ET Tube (1)	1 (100.0)	1 (100.0)	1 (100.0)	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)
Vaginal Swab (1)	1 (100.0)	1 (100.0)	0 (0.0)	1 (100.0)	1 (100.0)	0 (0.0)	0 (0.0)

DISCUSSION

This is the first study on MRSA in a tertiary care hospital in Tiruvannamalai. This study analysed the antibiotic susceptibility pattern of 104 clinical isolates against a panel of non-beta-lactam antibiotics and found major development of antibiotic resistance over the past three years (2023-2025). The first increase in resistance to erythromycin (79%), clindamycin (33%), ciprofloxacin (26%), and co-trimoxazole (26%), as compared to the study conducted by Gupta et al. in Rajasthan. The growing resistance to oral antibiotics such as ciprofloxacin, erythromycin, clindamycin, and cotrimoxazole is alarming since it reduces treatment options, particularly for common infections such as skin and soft infections and urinary tract infections.[10] [11] Secondly, we found a slow increase in resistance to linezolid (9%) and vancomycin (9%), which is comparatively higher compared to other regions in India and neighbouring countries, which have reported emerging resistance to vancomycin (0.71%-6.25%) and linezolid (0.71%-4.16%).[10] [12] [13] [14] [15] Pus samples were the most frequent source of MRSA isolation in our investigation (67.3%). This finding aligns with other studies from India that have reported a predominance of MRSA in skin and soft tissue infections.[16] [17] [18] [19] [20] [21]

This study offers important new information about the antibiotic resistance trends and current MRSA prevalence in our tertiary care setting in Tiruvannamalai. In particular, the significant prevalence of antibiotic resistance highlights the necessity of customized treatment recommendations and improved infection control procedures.

Our findings are more broadly applicable to different clinical manifestations of MRSA infections in our hospital due to the inclusion of a wide variety of clinical samples, such as pus/wound aspirate, blood, sterile bodily fluids, and respiratory specimens.

Due to its retrospective methodology, our study has a number of inherent limitations. First, we did not check for the presence of the mecC gene or conduct a molecular confirmation of MRSA using techniques like mecA gene PCR. Second,

we were unable to completely define the epidemiology in our environment since we did not perform molecular typing to distinguish CA MRSA from HA-MRSA. Finally, because the data was retrospective, we were unable to evaluate treatment outcomes. To overcome these constraints and offer a more thorough understanding of MRSA in our area, future prospective studies that include molecular characterization of MRSA isolates and analysis of treatment results are necessary.

CONCLUSION

In conclusion our study reveals a high prevalence of MRSA among the pus/wound aspirate samples, with majority of strains showing maximum sensitivity to vancomycin and linezolid drug which could be considered as an empirical antibiotic therapy for patients with invasive infection of MRSA in our study setting and high sensitivity to doxycycline which can be used for non-invasive skin and soft tissue infections. This study highlights the changing pattern of antimicrobial resistance of MRSA strains in our epidemiology which were different from the findings of other studies conducted in different parts of our country which can be used in future for multicentric studies. So, one of the best ways to prevent MRSA infection is to constantly monitor the antibiotic resistance profile of local strains. Antibiotic stewardship needs to be strictly adhered to. To begin the therapeutic medication, a local antibiogram availability should be regularly updated and verified by the specialists. Regular surveillance is the final resort in a nation like India where the widespread usage of antibiotics is normal.

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CONFLICT OF INTEREST

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

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