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PREVALENCE AND ANTIMICROBIAL RESISTANCE PATTERN OF METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS (MRSA) IN A TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Methicillin-Resistant Staphylococcus aureus (MRSA) is a major health challenge due to rapidly evolving antimicrobial resistance.

Aim and Objective: This study examined the prevalence, demographic distribution, clinical sample types, and antibiotic resistance profiles of MRSA among 500 clinical isolates in North India.

Materials and Methods: This was a prospective study conducted over six months in a tertiary care setting in the Department of Microbiology. All *Staphylococcus aureus* isolates from a variety of clinical specimens were tested via standard biochemical and disc diffusion techniques. Inclusion criteria comprised all S. aureus isolates; exclusion criteria included any specimen yielding bacteria other than S. aureus. Results were analyzed using SPSS-23.0.

Results: The MRSA prevalence was 29.6% (148/500). MRSA was more common in males and in the productive age group (20–50 years). Most MRSA isolates were from pus, followed by urine and blood. High resistance rates were observed to erythromycin and clotrimazole, with linezolid and teicoplanin remaining most effective.

Conclusion: Regular monitoring and tailored antibiotic policies are vital. The MRSA burden remains high, and strict infection control with routine surveillance is indispensable.

Keywords: MRSA, MSSA, Prevalence, India, Antimicrobial resistance, Cefoxitin, Oxacillin, Tertiary care

INTRODUCTION

Staphylococcus aureus has long been identified as a formidable pathogen responsible for a broad spectrum of diseases—ranging from minor skin and soft tissue infections to severe, life-threatening systemic illnesses such as pneumonia, endocarditis, and osteomyelitis. Its significant disease burden is notable not only in immunocompetent individuals but also among the most vulnerable populations worldwide, including newborns, the elderly, and the immunocompromised [1–4]. A key driver of S. aureus' clinical importance is its remarkable ability to acquire resistance to a multitude of antibiotics, notably methicillin [5–7].

The emergence of Methicillin-Resistant Staphylococcus aureus (MRSA) in the twentieth century fundamentally altered the management of S. aureus infections, leading to substantial increases in morbidity, mortality, economic burden, and hospital stay durations globally. India, like many developing countries, faces a complex MRSA scenario, with prevalence reports varying from 30% to 70% in tertiary-care settings [10–13]. This heterogeneity reflects not only geographical and institutional differences but also diverse patient populations and variations in detection methods. MRSA is particularly challenging to treat owing to its resistance determinants, especially the mecA and mecC genes encoding penicillin-binding protein 2A (PBP2A), which lowers affinity for β-lactam antibiotics.

Additionally, MRSA often co-exists with resistance to other antibiotic classes, further narrowing therapeutic options to costly agents such as vancomycin and linezolid. The last decade has also witnessed an alarming increase in livestock-associated MRSA and community-associated strains, marking MRSA's relevance beyond hospital settings. Rapid and sensitive laboratory identification of MRSA, effective infection control, and robust antimicrobial steward policy are key to curbing its spread [22–25]. Despite global advances, resource-constrained environments face considerable diagnostic lag, compounding the MRSA challenge.

No single detection technique has emerged as universally optimal, thus constant evaluation of epidemiological trends and resistance patterns remains essential [28–31].

This study aims to comprehensively document the prevalence of MRSA, sample-wise distribution, demographic associations, and detailed antibiotic susceptibility patterns among 500 consecutive clinical isolates in a tertiary care hospital of North India. The present work also synthesizes the most recent literature and underscores the dire need for sustainable policy interventions in the face of rising resistance.

MATERIALS AND METHODS

Study Design and Setting

This prospective, observational study was undertaken in the Department of Microbiology, with a sample size augmented to 500 clinical isolates for robust statistical inference.

Inclusion Criteria

All S. aureus isolates obtained from clinical specimens (pus, wound/vaginal swabs, blood, pleural fluid, urine, throat swab, etc.) from various hospital wards, including surgery, obstetrics and gynaecology, medicine, orthopedics, and ICU.

Exclusion Criteria

Specimens yielding organisms other than S. aureus (Gram-positive cocci other than S. aureus, Gram-negative bacteria).Repeat isolates from the same patient during the study period.

Microbiological Methods

Specimens were inoculated onto 5% sheep blood agar, MacConkey agar, and CLED agar (for urine). Following incubation at 37°C for 24 hours, isolates were identified through standard phenotypic methods: colony morphology, Gram stain, catalase, coagulase, and mannitol fermentation tests. MRSA screening and confirmation followed Clinical and Laboratory Standards Institute (CLSI) recommendations, using oxacillin and cefoxitin disc diffusion on Mueller-Hinton

agar. Resistance to oxacillin (≤10mm) and cefoxitin (≤19mm) indicated MRSA. Additional antibiotic susceptibility was assessed for linezolid, teicoplanin, gentamycin, tetracycline, erythromycin, clindamycin, ciprofloxacin, vancomycin, cotrimoxazole, amoxyclave, and rifampicin. Statistical Analysis Data was recorded in MS Excel and analyzed via chi-square tests using SPSS (v23.0). A p-value <0.05 was considered significant.

RESULTS

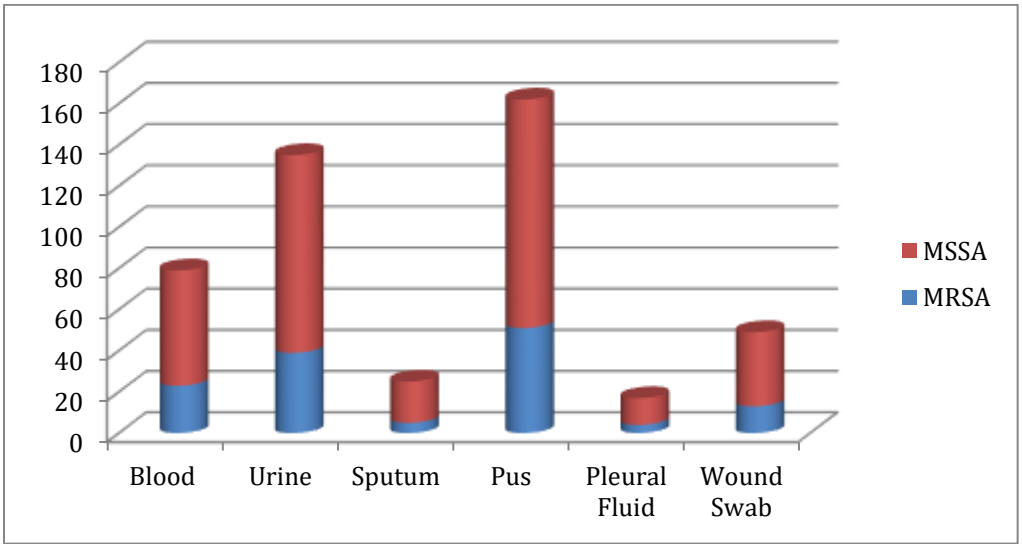
Among 500 S. aureus isolates, MRSA constituted 29.6% (148/500), while 70.4% (352/500) were MSSA. Males outnumbered females across both MRSA and MSSA categories. Most infections were concentrated between ages 21–50 years, reflecting high exposure environments and/or predisposing health conditions.

Table 1: Age- and Sex-wise Distribution

Age Group	MRSA Male	MRSA Female	MSSA Male	MSSA Female
0-10 years	8	5	17	9
11-20 years	3	3	23	22
21-30 years	22	17	35	31
31-40 years	16	13	42	40
41-50 years	18	14	38	22
51-60 years	10	8	27	12
61 +	8	3	23	10

Table 2: Sample-wise Distribution MRSA was most prevalent in pus samples, followed by urine, blood, and wound swabs. Full breakdown:

Sample Type	MRSA	MSSA
Blood	23	56
Urine	39	96
Sputum	5	20
Pus	51	111
Pleural Fluid	4	13
Wound Swab	13	36
Vaginal Swab	5	13
CSF	1	0
Throat Swab	5	8



Graph No. 1: Sample-wise Distribution MRSA was most prevalent in pus samples, followed by urine, blood, and wound swabs.

Table 3: Antibiotic Resistance Pattern Resistance was highest to erythromycin and clotrimazole. Linezolid, teicoplanin, and amoxy-clave showed greatest efficacy.

Antibiotic	MRSA	MSSA
Linezolid	39	461
Teicoplanin	77	423
Gentamycin	146	354
Tetracycline	188	312
Erythromycin	345	155
Clindamycin	176	324
Ciprofloxacin	184	316
Cefoxitin	147	353
Oxacillin	129	371
Co-trimoxazole	297	203
Amoxyclave	134	366
Vancomycin	133	367
Rafampicin	133	367

DISCUSSION

MRSA continues to pose a formidable threat in India, with prevalence hovering around 30% in tertiary centers, in alignment with studies from Mumbai, Haryana, and Greater Noida [20–22]. Internationally, findings from Jordan and other South Asian regions underscore similar challenges. Younger and middle-aged adults, particularly males, dominate epidemiological statistics, likely due to occupational exposures and metabolic vulnerabilities. Sample-wise, pus specimens accounted for the largest MRSA burden—echoing findings from Agra and elsewhere. Alarmingly, high resistance rates to erythromycin and tetracycline reinforce the notion that empiric therapies must be cautiously chosen, with linezolid and teicoplanin emerging as drugs of last resort. As with other studies, multi-drug resistance reinforces the urgent need for rigorous stewardship protocols.

The present study demonstrated that linezolid, vancomycin, and amoxyclave were most effective against MRSA isolates, while linezolid, teicoplanin, and oxacillin displayed high efficacy against MSSA. These results are in close agreement with Kumar et al., who reported a 95% sensitivity of MRSA isolates to linezolid and vancomycin [23]. Similarly, Sharma et al. also found vancomycin and linezolid to have retained their effectiveness, with over 90% sensitivity in MRSA cases [24] .Erythromycin and co-trimoxazole resistance among MRSA was notably high in our cohort, which aligns with findings from Bhatta et al.,[25] where macrolide resistance rates exceeded 80%. For MSSA, the preserved sensitivity to oxacillin and cefoxitin is congruent with the work by Patel et al., [26] who observed greater than 90% susceptibility rates for these antibiotics in MSSA isolates. The comparatively lower resistance to tetracyclines in both MRSA and MSSA, as seen in our study, is also reported by Gupta and Sinha [27]. Demographic distribution indicated the highest incidence of MRSA among males in the 21–30 year age group. This mirrors patterns described by Nair et al., [28] where young adults, particularly males, were predominantly affected. Higher prevalence in young males may relate to greater occupational exposure and increased physical activity, leading to higher risk of colonization or infection. Sample-wise analysis confirmed that pus specimens yielded the highest number of MRSA isolates, followed by urine and blood samples. This distribution is consistent with findings from Mehta et al. [29] and Sengupta et al.,[30] both of whom reported pus and wound swabs as the leading source of MRSA isolates due to the organism's propensity for skin and soft tissue infection.

In conclusion, our antibiotic susceptibility pattern closely matches existing national and international evidence, highlighting the continued effectiveness of linezolid and vancomycin for

MRSA, and oxacillin and cefoxitin for MSSA. Regional variations in resistance rates underscore the importance of local antimicrobial stewardship and periodic surveillance.

CONCLUSION

The rising prevalence and multidrug resistance of MRSA highlight an urgent need for continuous surveillance, strict infection control, and evidence-based antibiotic usage in Indian hospitals. Results support regular susceptibility monitoring and tailored therapeutic strategies.

Limitations

Single institution, limiting generalizability. Lack of molecular confirmation of MRSA. Comparative analysis of hospital- versus community-associated MRSA not performed.

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