



PREVALENCE AND ANTIMICROBIAL SUSCEPTIBILITY PATTERN OF METHICILLIN-RESISTANT *STAPHYLOCOCCUS AUREUS* (MRSA) ISOLATED FROM CLINICAL SAMPLES AT A TERTIARY CARE HOSPITAL IN BANGLADESH

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Methicillin resistant *Staphylococcus aureus* (MRSA), Methicillin sensitive *Staphylococcus aureus* (MSSA), *Staphylococcus aureus*, Antibiotic susceptibility.

Abstract:

Background: *Staphylococcus aureus*, including Methicillin-resistant *Staphylococcus aureus* (MRSA) strain, can become resistant to several classes of clinically available antibiotics and cause skin infections and severe infections in the lungs, heart, and bloodstream. MRSA pathogens are considered a serious global health threat, leading to increased mortality and antimicrobial resistance. Rates of MRSA in Bangladesh remain high, necessitating continuous surveillance. This study determines the prevalence and antimicrobial susceptibility pattern of MRSA isolated from the clinical samples in East West Medical College and Hospital (EWMCH), Dhaka, Bangladesh.

Methods: This retrospective study was conducted from January 2024 to December 2024 in EWMCH, Dhaka, Bangladesh. 4026 clinical samples from inpatients and outpatients were examined. *Staphylococcus aureus* isolates were identified by standard microbiological methods (Gram staining, catalase test, coagulase test). *S. aureus* strains were tested for Methicillin resistance by using cefoxitin disc diffusion method. The antibiotic susceptibility pattern of all MRSA strains was determined by Kirby-Bauer disc diffusion method recommended by Clinical and laboratory standards institute (CLSI) 2024.

Results: Out of 4026 clinical samples analysed, *S. aureus* was recovered from 206 (5%) samples. Out of 206 *S. aureus* isolates, MRSA accounted for 106 cases (51.45%). Highest percentage of MRSA cases were from respiratory samples (83.33%), followed by pus / wound swab (56.52%), urine (52.47%) and blood (34.21%). MRSA isolates were more common in indoor patients (58.16%) than in outdoor patients (45.37%). Regarding antibiotic sensitivity, the most sensitive antibiotic for MRSA isolates was linezolid (76.41%) followed by doxycycline (74.52%) and tetracycline (51.88%). For Urine samples the most sensitive antibiotic was nitrofurantoin (86.79%) for MRSA.

Conclusion: The data in this study represents a snapshot of the alarming prevalence of MRSA in Bangladesh. The drug susceptibility pattern is sufficient to warn the clinicians to choose empiric therapy in case of MRSA isolates. To combat the situation strengthening of infection control programme including practice of standard and isolation based precautions, surveillance of infections, rational use of antibiotics, periodic review of empiric therapy and monitoring of disinfection and sterilization of equipment are urgent needs.

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Introduction

Staphylococcus aureus continues to be one of the most common bacterial pathogens encountered worldwide, both in healthcare facilities and the community settings. It can cause a wide spectrum of

illnesses, ranging from mild skin infections to life threatening conditions such as pneumonia, bloodstream infections, endocarditis, osteomyelitis, and sepsis.^{1,2} Its ability to colonize healthy individuals (particularly in the nose, on the skin, and across

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mucosal surfaces) makes it a persistent carrier organism and facilitates its spread in healthcare facilities and beyond.

Management of *S. aureus* infections has become increasingly challenging due to the global rise of methicillin resistant *Staphylococcus aureus* (MRSA). The *mecA* gene of the staphylococcal cassette chromosome *mec* (SCC*mec*) is responsible for this resistance. This gene produces PBP2a, a penicillin binding protein that interacts poorly with β lactam antibiotics. Nearly all drugs in this class become ineffective. As a result, MRSA infections are harder to treat and are associated with higher rates of illness, death, and healthcare costs.³ Although MRSA was once largely confined to hospitals, it is now widespread in the community. Which is affecting individuals without healthcare related risk factors. Moreover, livestock associated MRSA has been detected in animals and people working with them, expanding the ecological reach of this pathogen. The prevalence of MRSA varies considerably across regions, driven by antibiotic prescribing habits, infection control measures, population density, and the strength of surveillance systems.⁴

Lower middle-income countries (LMICs) like Bangladesh face a particularly heavy burden of MRSA. Unregulated antibiotic use, limited laboratory capacity, and gaps in infection control contribute to ongoing transmission and resistance. Hospital based studies in Bangladesh consistently report high MRSA prevalence among clinical isolates. Though the isolation rates differ depending on specimen type and patient population.^{5,6}

MRSA is frequently isolated from respiratory secretions, wound and pus samples, urine, and blood, underscoring its ability to cause both localized and invasive disease.⁵⁻⁷ Resistance profiles often show reduced effectiveness of multiple antibiotic classes, though drugs such as linezolid, tetracyclines, and glycopeptides generally retain activity. Surveillance of MRSA prevalence and resistance trends is critical for guiding empiric therapy, supporting stewardship programs, and informing infection control strategies.

In this context, the present study was designed to assess the prevalence of MRSA among clinical *S. aureus* isolates in a tertiary care hospital in Bangladesh. Our study also tries to examine MRSA distribution by infection site and patient setting and to compare the resistance patterns of MRSA with

methicillin sensitive *S. aureus* (MSSA). These findings are intended to provide updated epidemiological insights that can support rational antibiotic use and strengthen infection control practices.

Materials and Methods

This retrospective cross sectional study was conducted at the Department of Microbiology, East West Medical College, Dhaka, Bangladesh from January 2024 to December 2024 included all patients both outpatient and inpatient.

In this study 4026 different clinical specimens (urine, blood, pus/wound swab, sputum /respiratory samples, body fluids) were collected for routine culture and antibiotic susceptibility testing and were processed according to the standard microbiology laboratory techniques. The sample collected was evaluated in terms of its acceptability, proper labelling (full name, age, sex, serial number of the patient, date of collection). The specimens were cultured on blood agar, chocolate agar, MacConkey agar and urochrome media plates and incubated aerobically at 37°C for 24 to 48 hours.

Identification of *S. aureus* isolates:

A total of 206 isolates of *S. aureus* from different clinical specimens were identified in the laboratory of Microbiology of East West Medical college. These 206 isolates of *S. aureus* were identified by colony morphology, haemolytic property, pigment production, Gram staining, catalase test, coagulase test (slide and tube method) as per standard methods.⁸

Detection of MRSA:

In this study, MRSA was detected by using discs containing 30 μ g of Cefoxitin were placed on the Plates, which were incubated at 37°C for 24 hours. *S. aureus* strains were screened for MRSA by detection of resistance to cefoxitin disc (zone of inhibition \leq 22 mm) following the CLSI guidelines (CLSI, 2024). Cefoxitin resistant isolates were considered as MRSA and cefoxitin susceptible isolates were considered as MSSA.⁹

Antimicrobial susceptibility test:

Disc diffusion method was used for antimicrobial susceptibility testing of MRSA and MSSA isolates by "Kirby-Bauer method" and as per recommendation by the Clinical Laboratory Standards Institute.^{9,10}

Antibiotic susceptibility testing of MRSA and MSSA was performed by Kirby-Bauer disk diffusion method using

Muller Hinton agar plates using a bacterial suspension with the turbidity adjusted to a 0.5 McFarland standard and zone of inhibition were interpreted according to CLSI guideline (CLSI, 2024). Penicillin G (10 µg), Ciprofloxacin (05 µg), Cotrimoxazole (25 µg), Clindamycin (2 µg), Azithromycin (15 µg), Gentamicin (10 µg), linezolid (30 µg), doxycycline (30 µg), tetracycline (10 µg), nitrofurantoin (300 µg) antibiotic discs were used as recommended by CLSI guideline for *S. aureus*. Clindamycin and Azithromycin discs were not used for urine samples. Nitrofurantoin was used only in urine samples.^{9,10}

Data were analyzed by using Microsoft Excel presented by tables and Figures.

Results:

Figure 1 showed Out of 4026 clinical specimens, 206 (5.12%) *S. aureus* were isolated. Table I showed the prevalence rate of MRSA isolates. Out of 206 *S. aureus* isolates, MRSA accounted for 106 cases (51.45%). Prevalence of *S. aureus* and MRSA from different clinical specimens are presented in Table: II. The rate of isolation for *S. aureus* was highest from pus/wound swab samples (27.5%) followed by body fluids (20%), sputum and other respiratory samples (8.8%), urine (4.7%) and blood (2.45%). Highest percentage of MRSA cases were from respiratory samples (83.33%), followed by pus /wound swab (56.52%), urine (52.47%), blood (34.21%) and body fluid (33.33%).

Demographic characteristics of the study population are presented in table III. Among these 206 *S. aureus* isolates, 68 (33%) were from men and 138 (67%) were from women, with a sex ratio of 1:2. Relatively a higher number of MRSA was isolated in women (76, 55.07%) compared with men (30, 44.12%) and the highest percentage of MRSA was detected in the age of below one year (60%), followed by age groups 1–20 years (59.46%) and 21–40 years (52.56%).

Table IV showed the prevalence of MRSA isolates among indoor and outdoor patients. MRSA were more common in indoor patients (58.16%) than in outdoor patients (45.37%).

Antimicrobial susceptibility pattern of MRSA and MSSA strains are shown in Table V. Regarding antibiotic sensitivity, the most sensitive antibiotic for MRSA isolates was linezolid (76.41%) followed by doxycycline (74.52%) and tetracycline (51.88%). For Urine sample the most sensitive antibiotic was nitrofurantoin (86.79%) for MRSA. MRSA isolates show low sensitivity to

azithromycin (11.32%) followed by ciprofloxacin (22.64%), gentamycin (49.05%), clindamycin (49.05%) and cotrimoxazole (49.05%). On the other hand the most sensitive antibiotic for MSSA isolates were gentamycin (93%) and doxycycline (93%) followed by linezolid (88%), cotrimoxazole (87%) and tetracycline (84%). For Urine sample the most sensitive antibiotic was nitrofurantoin (93.75%) for MSSA. MSSA isolates show low sensitivity to azithromycin (21.15%) followed by penicillin (36%).

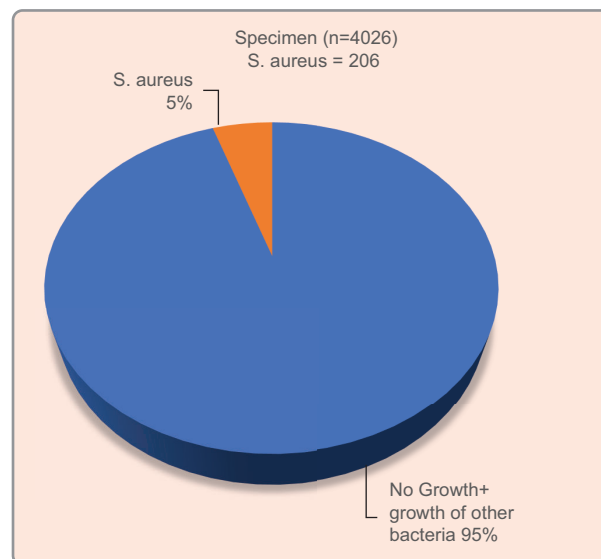


Figure 1: Prevalence of *Staphylococcus aureus* in clinical specimens.

Table-I

Prevalence of MRSA and MSSA strains in isolated *Staphylococcus aureus*

| Strains | No. of positive isolates | Percentage |
|---------|--------------------------|------------|
| MRSA | 106 | 51.45% |
| MSSA | 100 | 48.55% |
| Total | 206 | 100% |

Table-II

Prevalence of *S. aureus* and MRSA from different clinical specimens

| Type of specimen | Total number of specimens | <i>S. aureus</i> | MRSA |
|--------------------------------------|---------------------------|------------------|-------------|
| Pus/wound swabs | 178 | 49 (27.5%) | 28 (57.14%) |
| Sputum and other respiratory samples | 136 | 12 (8.8%) | 10 (83.33%) |
| Blood | 1548 | 38 (2.45%) | 13 (34.21%) |
| Urine | 2134 | 101 (4.7%) | 53 (52.47%) |
| Body fluids | 30 | 06 (20%) | 02 (33.33%) |

Table-III*Distribution of Staphylococcus aureus and MRSA according to age and sex*

| Categories | Sub categories | No. of <i>S. aureus</i> Isolated (n=206) | No. of MRSA Isolated |
|------------|----------------|--|----------------------|
| Age | <01 yr | 5 (2.43%) | 03 (60%) |
| | 1yr to 20yrs | 37 (17.96%) | 22 (59.46%) |
| | 21yrs to 40yrs | 78 (37.86%) | 41 (52.56%) |
| | 41yrs to 60yrs | 54 (26.21%) | 24 (44.44%) |
| | >60yrs | 32 (15.53%) | 16 (50%) |
| Sex | Male | 68 (33%) | 30 (44.12%) |
| | Female | 138 (67%) | 76 (55.07%) |

Table-IV*Prevalence of MRSA and MSSA strains in indoor and outdoor patients*

| Patient type | MRSA | MSSA |
|-----------------|-------------|-------------|
| Indoor (n=98) | 57 (58.16%) | 41 (41.84%) |
| Outdoor (n=108) | 49 (45.37%) | 59 (54.63%) |
| Total, (n=206) | 106 | 100 |

Table-V*Antimicrobial susceptibility pattern of MRSA and MSSA strains.*

| Antimicrobial agents | MRSA Sensitive (%) (n=106) | MSSA Sensitive (%) (n=100) | Total sensitive (%) (n=206) |
|---|----------------------------|----------------------------|-----------------------------|
| Penicillin G | 00 | 36 (36%) | 36 (17.47%) |
| Gentamycin | 52 (49.05) | 93 (93%) | 145 (70.38%) |
| Ciprofloxacin | 24 (22.64) | 58 (58%) | 82 (39.80%) |
| Azithromycin (samples other than urine) | 06 (11.32) | 11 (21.15%) | 17 (16.19%) |
| Clindamycin (samples other than urine) | 26 (49.05) | 35 (67.30%) | 61 (58.09%) |
| Cotrimoxazole | 52 (49.05) | 87 (87%) | 139 (67.47%) |
| Linezolid | 81 (76.41) | 88 (88%) | 169 (82.03%) |
| Doxycycline | 79 (74.52) | 93 (93%) | 172 (83.49%) |
| Tetracycline | 55 (51.88) | 84 (84%) | 139 (67.47%) |
| Nitrofurantoin (only for urine) | 46 (86.79) | 45 (93.75%) | 91 (90.09%) |

Discussion

Our study confirms that methicillin resistant *Staphylococcus aureus* (MRSA) remains a major healthcare challenge in Bangladesh. More than half of the *S. aureus* isolates tested (51.45%) were identified as MRSA, underscoring the difficulties clinicians face when selecting effective antibiotics and treatment strategies.

These results are consistent with earlier Bangladeshi studies. Parvez et al. (2018) and Suma et al. (2023) also reported high MRSA prevalence, while Alam et

al. (2021) found MRSA in roughly one third of wound infections in Dhaka.^{5,11,12} Roy et al. (2024) documented a 36% prevalence in Mymensingh, and broader reviews by Ahmed et al. (2019) and Yusuf et al. (2014) revealed rates ranging from 4.8% to 77% across the country.^{6,13,14} Such variation likely reflects differences in study populations, specimen types, and hospital practices. Despite these differences. Nevertheless, the consistent finding is that MRSA has become deeply embedded in Bangladesh's healthcare environment. Our findings also align with reports from

other LMICs in South and Southeast Asia. Gandra et al. (2020) described a median MRSA prevalence of 46.7% in blood cultures, closely matching our data.⁴ In contrast, high income countries have achieved notable reductions in MRSA through long term surveillance, strict infection control, and antimicrobial stewardship programs. For example, Japan saw declines between 2011 and 2019, and England reduced MRSA bloodstream infections substantially over a decade.^{15,16} These differences highlight the challenges LMICs face in curbing MRSA transmission.

MRSA prevalence varied by specimen type. Respiratory samples showed the highest rate (83.33%), followed by pus or wound specimens (57.14%) and urine (52.47%). Blood and other body fluids had lower rates, around one third. Similar distributions have been reported elsewhere.⁷ Skin and soft tissue infections accounted for a large portion of MRSA cases, consistent with earlier Bangladeshi studies.^{5,6} Bloodstream infections deserve special attention, as one of the Sustainable Development Goal (SDG) indicators and MRSA bacteremia is often linked to invasive devices and hospital procedures, echoing findings from another study.¹⁶

Our data revealed higher MRSA rates among inpatients compared to outpatients, consistent with established associations between MRSA and healthcare facility exposure. Hospitalization, invasive interventions, and broad-spectrum antibiotic therapy all elevate risk. However, the notable MRSA prevalence among outpatients indicates that transmission extends beyond hospital settings. Community-acquired MRSA is rising globally, including throughout South Asia, emphasizing the necessity for comprehensive stewardship programs.³

Our MRSA isolates showed complete resistance to penicillin and poor susceptibility to azithromycin and ciprofloxacin. In contrast, nitrofurantoin (for urinary isolates), linezolid, doxycycline, and tetracycline retained better activity. These findings mirror resistance trends reported in Bangladesh and across the Asia Pacific region.^{15,17} The widespread multidrug resistance is concerning, particularly given similar reports from Japan.¹⁵

Methicillin susceptible *S. aureus* (MSSA) isolates were generally more responsive to antibiotics, but resistance to reserve agents remains a growing issue. While Parvez et al. (2018) found MRSA isolates susceptible to vancomycin, Alam et al. (2021) reported

occasional vancomycin resistance.^{5,12} More recent studies highlight rising resistance rates and transmissible resistance genes. Our observation of reduced linezolid susceptibility underscores the urgent need for routine MIC testing and molecular surveillance.^{6,11}

MRSA was detected across all age groups. Infants and younger patients showed higher proportional frequencies, while adults aged 21–40 years accounted for the largest number of cases overall. Female patients had higher MRSA proportions than males. These demographic patterns likely reflect differences in healthcare exposure and infection types rather than inherent biological susceptibility, consistent with earlier findings.^{5,6}

This study demonstrates the high prevalence of MRSA across diverse infections in a tertiary care hospital in Bangladesh. The extensive resistance to commonly prescribed antibiotics, coupled with reliance on a limited set of effective agents, highlights the urgent need for stronger infection control and stewardship measures. Systematic antibiogram reporting, enhanced prevention strategies, and surveillance, including timely culture and susceptibility testing are essential to reduce resistance and improve patient outcomes.^{3,4}

Conclusions

The data in this study represents a snapshot of the alarming prevalence of MRSA in Bangladesh. The drug susceptibility pattern is sufficient to warn the clinicians to choose empiric therapy in case of these infections as MRSA isolates are not only resistant to beta lactams but also to other groups of antibiotics. To combat the situation strengthening of infection control programme including practice of standard and isolation based precautions, surveillance of infections, rational use of antibiotics, periodic review of empiric therapy and monitoring of disinfection and sterilization of equipment are urgent needs.

Recommendation

The study duration encompasses only a year. A longer study duration could have been helpful to determine the trend of MRSA over the years. This study can serve as a pilot to much larger research involving multiple centers that can provide a nationwide picture, validate regression models proposed in this study for future use and emphasize points to ensure better management and adherence.

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Conflict of interest: None to disclose

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