Antibiotic Resistance Pattern of Pathogens (Gram-positive cocci) among Adult Patients Admitted at a Tertiary Level Hospital of Dhaka City in Bangladesh

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Abstract

Background: Resistance pattern of the organism varies from one country to another and within the country. Regular monitoring and surveillance are necessary for curbing the emergence of resistant organisms and effective infection control in the hospital settings of Bangladesh. **Objective:** The purpose of the present study was to assess the sensitivity pattern of bacterial gram-positive cocci isolated from the clinical specimens. **Methodology:** This was a descriptive type of cross-sectional study. Sampling technique was purposive sampling technique was applied and data were collected by pretested semi-structured questionnaires and face to face interview. A total of 384 urine & blood samples were collected in sterile containers from suspected infected cases. A specimen was considered positive if an organism was cultured at a concentration of ≥ 105 CFU/ml or when an organism was cultured at a concentration of 104 CFU/ml and >5 pus cells per high power field. Antimicrobial susceptibility testing of the isolated bacterial species was performed by the disc diffusion method following the National Committee for Clinical Laboratory Standards (NCCLS) guidelines. **Results:** Sample size was 384 adult patients of Dhaka Medical College Hospital. Enterococci were found highly resistant to cefixime 50.00%, cloxacillin 75.00%, and erythromycin 90.00%. Due to widespread resistance of the drugs used to treat infection, the choice of drugs in the treatment of infection is quite narrow. In our country, awareness for prevention of infection should be encouraged at the community level as it affects all adult age groups. *Staphylococcus aureus* was 83.33% resistant to amoxycillin, 100.0% to cefradine, 66.66% to cefuroxime, 100.0% to cephalexin, 50.0% to cefixime, 66.66% to cloxacillin and erythromycin, and 100.0% to methicillin. **Conclusion:** A high prevalence of resistance to most antibiotics was detected, along with major gaps in surveillance and information gaps in the methodological data of the studies. [*Bangladesh Journal of Infectious Diseases, June 2025;12(1):62-68*]

Keywords: Antibiotic resistance pattern; pathogens; Gram-positive cocci; adult patients

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Introduction

Infections are one of the most common bacterial causes seen in clinical practice particularly in developing countries with a high rate of morbidity and financial cost[1]. These are the most common infections in community practice with approximately 150 million diagnosed cases each year (European Centre for Disease Prevention and Control[2]. The resistance pattern of pathogens is changing drastically, specifically in developing countries, such as Bangladesh because of uncontrolled and widespread use of antibiotics. Antibiotics are usually given empirically before the laboratory results of urine & blood culture are available. To ensure appropriate therapy, current knowledge of the organisms that cause infections and their antibiotic susceptibility is mandatory[3].

Due to rising antibiotic resistance among pathogens, it is important to have local hospital-based knowledge of the organisms' causing infections and their antibiotic sensitivity patterns[4]. The spectrums of etiologic agents causing infections and their antibiotic resistance pattern have been continuously changing over the years both in hospital[5]. Antibiotic resistance has emerged as one of the most critical public health challenges of the 21st century.

It threatens to undermine decades of medical advancement by rendering common bacterial infections increasingly difficult to treat. Among the various microbial agents, Gram-positive cocci, notably *Staphylococcus aureus*, *Enterococcus spp.*, and *Streptococcus pneumoniae*, are responsible for a significant proportion of hospital-acquired and community-acquired infections[6]. These pathogens are especially concerning due to their growing resistance to multiple classes of antibiotics, including beta-lactams, macrolides, and glycopeptides.

In resource-limited settings such as Bangladesh, the burden of antibiotic-resistant infections is particularly severe. Factors such as overuse and misuse of antibiotics, lack of stringent prescription practices, inadequate infection control measures, and limited diagnostic facilities have accelerated the emergence and spread of resistant strains[7]. Tertiary care hospitals in urban centers like Dhaka often serve as referral centers for critically ill patients, and they witness a high influx of individuals with complex infections. This increases the likelihood of encountering multidrug-resistant organisms, particularly among Gram-positive cocci[8].

Staphylococcus aureus, including methicillin-resistant *Staphylococcus aureus* (MRSA), is a leading cause of bloodstream infections, pneumonia, surgical site infections, and skin and soft tissue infections in hospitalized adults[9]. The emergence of vancomycin-intermediate and vancomycin-resistant *S. aureus* has further complicated treatment options. Similarly, *Enterococcus faecalis* and *Enterococcus faecium* have become increasingly resistant to vancomycin and aminoglycosides, posing challenges in treating intra-abdominal and urinary tract infections[10]. *Streptococcus pneumoniae*, although primarily associated with respiratory infections, has also demonstrated rising resistance to penicillin and macrolides in several parts of the world, including South Asia. Understanding local antibiotic resistance patterns is essential for effective empirical therapy, infection control, and antibiotic stewardship. Data specific to Dhaka City, particularly from tertiary-level hospitals that manage a broad spectrum of critical adult cases, are necessary to guide clinicians in making informed decisions[11]. However, there is a paucity of up-to-date, hospital-based surveillance studies that focus specifically on Gram-positive cocci in adult populations in this setting.

This study was aimed to investigate the antibiotic resistance patterns of Gram-positive cocci isolated from adult patients admitted to a tertiary level hospital in Dhaka City. By identifying prevailing resistance trends, this research seeks to contribute to the development of more targeted treatment protocols and assist in formulating policy recommendations for infection control and antimicrobial stewardship programs in similar healthcare settings.

Methodology

Study Settings and Population: This was a descriptive type of cross-sectional study conducted in the Department of Community Medicine at Sir Salimullah Medical College, Dhaka, Bangladesh from 2021 to 2023 for a period of 2 years. The adult patients who were admitted in Dhaka Medical College hospital of Dhaka City were enrolled as study population. In brief, the study population was considered as adult population with the age group of 20 to 65 years which was comprised of both male and female adult people and were admitted at Dhaka Medical College Hospital, Dhaka, Bangladesh.

Study Procedure: For the collected relevant data from the individual sample unit, comprising of total

384 sample size. Purposive sampling technique was applied for selection of respondents to collect information incorporated with the use of a pretested semi-structured questionnaires list. The purpose of the study was explained to the individual patients (respondents) and after having interviewed face to face.

Sample Collection and Isolation of Pathogens: Pus/swab samples were streaked on nutrient agar, blood agar, and MacConkey agar plates. Sputum samples (2 to 5 mL) were collected in a sterile plastic container (50 mL capacity) and streaked on chocolate agar, blood agar, nutrient agar, and MacConkey agar plates. The samples except blood were processed the same day; streaked plates were incubated at 35°C for 24 to 72 h and sub-cultured on nutrient agar plates. Bacterial identification was done based on colony morphology, biochemical tests, and the Gram reaction.

Antibiotic Susceptibility Test of Bacterial Isolates: Gram-positive bacterial isolates were evaluated for antibiotic susceptibility employing Kirby-Bauer disk-diffusion method (CLSI, 2018). A single colony was picked and suspended in sterile normal saline (0.85% NaCl) to generate the equivalent of 0.5 McFarland standard solution. About 1 mL of bacterial suspension was mixed with 19 mL of sterile Muller-Hinton soft agar (45°C) and poured in Petri plates, incubated at 35°C for 24 h after the transfer of antibiotics disks by disk dispenser. Gram Positive isolates were classified as resistant, intermediate, and sensitive to antibiotics on the basis of the size of the zone of inhibition according to the Clinical Laboratory Standard Institute (CLSI) guidelines.

Statistical Analysis: Collected data both in questionnaire were verified, edited coded and processed and finalized then finalized data were used for analysis as per selected key variables of the study to justify the objectives of the study. Statistical analysis was performed by Windows based software named as Statistical Package for Social Science (SPSS), versions 22.0 (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.). Continuous data were expressed as mean, standard deviation, minimum and maximum. Categorical data were summarized in terms of frequency counts and percentages. Every efforts were made to obtain missing data.

Ethical Clearance: All procedures of the present study were carried out in accordance with the principles for human investigations (i.e., Helsinki Declaration 2013) and also with the ethical guidelines of the Institutional Research Ethics. Formal ethics approval was granted by the local ethics committee. Participants in the study were informed about the procedure and purpose of the study and the confidentiality of information provided. All participants consented willingly to be a part of the study during the data collection periods. All data were collected anonymously and were analyzed using the coding system.

Results

The present study was conducted to study on situation analysis of antibiotic resistance of adult patients admitted in a tertiary level hospital of Dhaka City. Data were collected from 384 adult patients admitted in tertiary level hospital of Dhaka city by interviewer administered pretested semi-structured questionnaire.
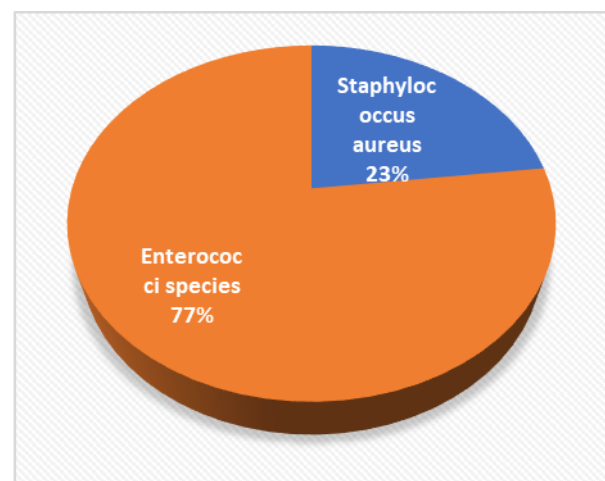

Figure I: Showing the distribution of isolated Gram-positive bacteria

The overall results of the study had been presented in tabular, graphical and narrative form thereby interpreting the results to describe the various aspects of respondents.

Enterococci showed 50% resistance to cefixime, 75% to cloxacillin, 90% to erythromycin, 75% to ciprofloxacin, 85% to cotrimoxazole, 70% to cephalexin, 55% to cefradine; cefuroxime and methicillin, 25% to amoxicillin and vancomycin. *Staphylococcus aureus* was 83.33% resistant to amoxycillin, 100% to cefradine, 66.66% to cefuroxime, 100% to cephalexin, 50% to cefixime, 66.66% to cloxacillin and erythromycin and 100.0% to methicillin (Table 1).

Table 1: Antibiotic Resistance Pattern of Pathogens (Gram positive cocci)

Antibiotics	*Enterococci* (n=20)	*Staphylococcus aureus(n=6)*
Amoxycillin	5 (25.0%)	5 (83.3%)
Cefradine	11(55.0%)	6 (100.0%)
Cefuroxime	10 (50.0%)	4 (66.7%)
Cephalexin	14 (70.0%)	6 (100.0%)
Cefexime	10 (50.0%)	3 (50.0%)
Cloxacillin	16(75.0%)	4(66.7%)

Antibiotics	*Enterococci* (n=20)	*Staphylococcus aureus(n=6)*
Ciprofloxacin	15 (75.0%)	0(0.0%)
Cotrimoxazole	17 (85.0%)	0(0.0%)
Imipenem	0(0.0%)	0(0.0%)
Meropenem	0(0.0%)	0(0.0%)
Erythromycin	18(90.0%)	4 (66.7%)
Methicillin	10(50.0%)	6(100.0%)
Vancomycin	5 (25.0%)	0(0.0%)
Linezolid	0(0.0%)	0(0.0%)
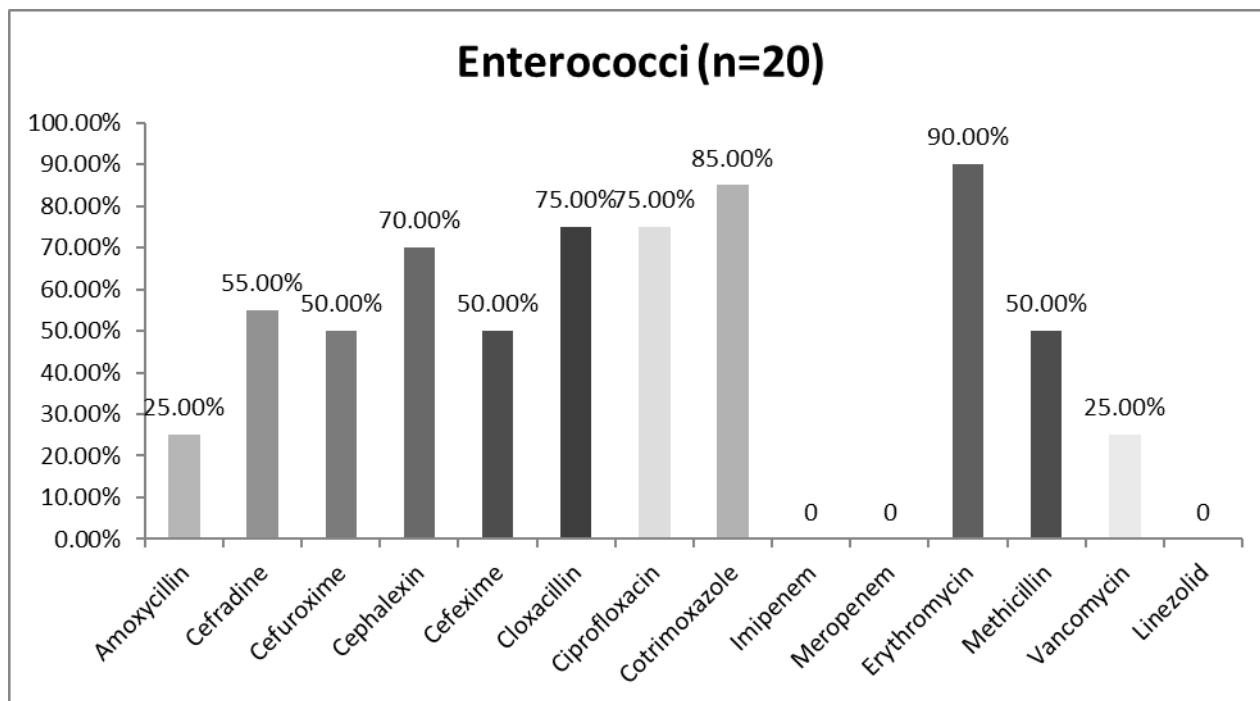
Figure I: Showing the Antimicrobial sensitivity pattern of *Enterococci* species
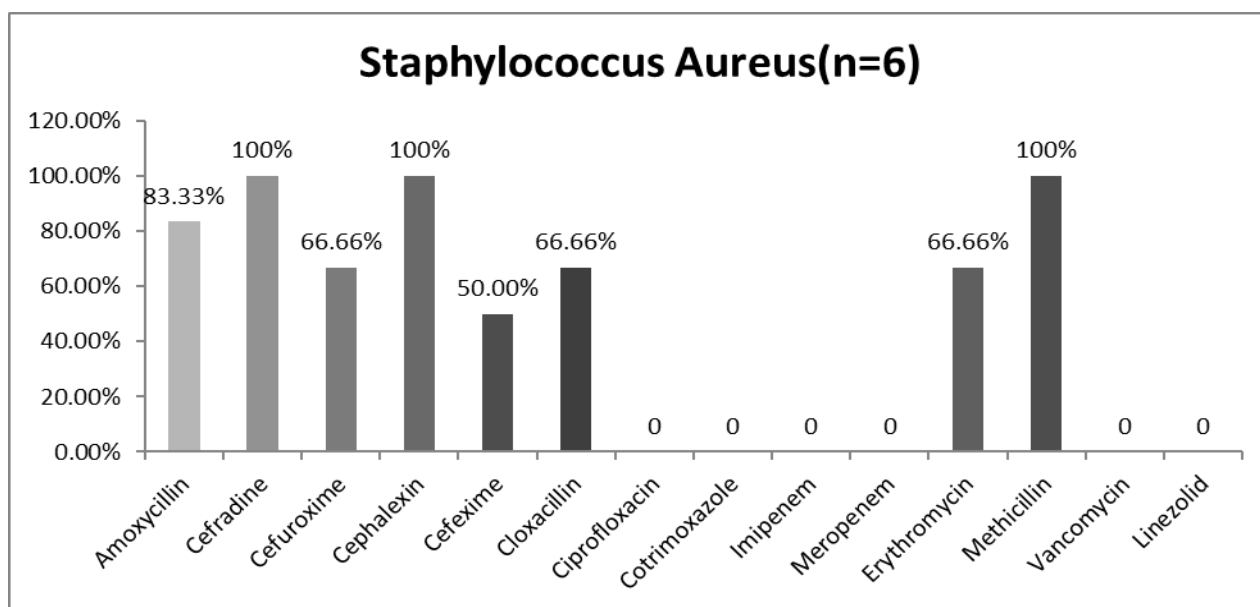
Figure II: Showing the Antimicrobial Sensitivity Pattern of *Staphylococcus aureus*

Discussion

Emergence of multidrug-resistant organisms (MDR) is a global concern[6]. One of the greatest discoveries of the 20th century is undoubtedly the finding of antibiotics. This fact is evident, but the genuine speculation is that the rise of antibiotic resistance in hospitals, communities and the environment are associated with their use. The surprising yet alarming new genetic capacities of microorganisms have resulted from man's overuse of antibiotics to exploit every source of their resistance genes and every means of horizontal gene transmission to develop multi-resistant strains. Such has been seen in this study that the clinical strain of *Staphylococcus aureus* was significantly vulnerable to the antibiotics. Antibiotic resistance pattern monitoring will help us to review the current status of antimicrobial resistance locally, nationally and globally and helpful in minimizing the consequence of drug resistance, limit the emergence and spread of drug-resistant pathogens. This has been a major endeavor of this study.

Resistance to antibiotic is increasing and significant community health problems are at risk[8]. An accelerated startup of developing new antibiotics and taking measures to conserve the existing antibiotic agents can be our way to alleviate the current problem. Also, the widespread usage of antibiotics should be brought to a controlled manner along with the measures to help control the bacterial spread to slow the emergence and spread of resistant organisms[9-10]. Over the last decade there has been a substantial increase in resistance of pathogens to antibiotics. Resistance rates among *Staphylococcus aureus* strains are increasing and a major part of this species has become resistant to beta-lactamase resistant penicillin for such resistant species, vancomycin is the effective choice of drug[11-12].

This study investigated the antibiotic resistance pattern of Gram-positive cocci isolated from adult inpatients in a tertiary-level hospital in Dhaka. The findings highlight a concerning level of antimicrobial resistance, particularly among *Staphylococcus aureus* and *Enterococcus* species, consistent with global and regional trends. *Staphylococcus aureus* and *Enterococcus* both were resistant to amoxicillin, cloxacillin, cephalosporins, erythromycin in a variable percentage in this study. Resistance to vancomycin is reported among Enterococci but this resistance has also begun to develop among *Staphylococci*. We concentrated on resistance to vancomycin and resistant strains to vancomycin were observed in case of Enterococci

25.0%. *Staphylococcus aureus* was 100.0% sensitive to ciprofloxacin and cotrimoxazole but *Enterococcus* was 75.0% and 85.0% resistant to these drugs in this study. Jahan et al[13] found similar findings like us in case of *Enterococcus*. Another study in India was found *Staphylococcus aureus* was sensitive to gentamicin 80.0%, levofloxacin 73.3%, netilmicin 93.33% and ceftriaxone 93.3%. In Bangladesh[14], *Staphylococcus aureus* was found 100.0% sensitive to amikacin, ceftriaxone and ciprofloxacin.

Staphylococcus aureus and *Enterococci* were both 100.0% sensitive to imipenem, meropenem and linezolid in study. Another study in Square Hospital, Dhaka Bangladesh found 93.3% resistant to imipenem and meropenem which does not correlate with our study. Therefore, infections caused by Gram-positive cocci may be treated by linezolid, vancomycin, imipenem and meropenem according to the finding of this study[15]. *Staphylococcus aureus* was the most frequently isolated pathogen, with a significant proportion identified as Methicillin-Resistant *Staphylococcus aureus* (MRSA). This aligns with previous studies conducted in Bangladesh and other South Asian countries, where MRSA prevalence has remained high due to widespread misuse of antibiotics and inadequate infection control measures[16]. Resistance to commonly used antibiotics such as penicillin, erythromycin, and ciprofloxacin was alarmingly high, limiting the effectiveness of first-line treatments.

On the other hand, linezolid and vancomycin remained effective against the majority of MRSA and other resistant Gram-positive isolates. This is consistent with both national and international literature, where these antibiotics are still regarded as reliable options for treating resistant infections[15]. However, emerging reports of vancomycin-intermediate and -resistant *Staphylococcus aureus* (VISA/VRSA) and Vancomycin-Resistant *Enterococcus* (VRE) in some settings underline the need for ongoing vigilance. The study also found that *Enterococcus* spp. displayed multidrug resistance, particularly to ampicillin and high-level gentamicin, which are commonly used in empirical therapy. The detection of even a small percentage of VRE is worrisome, as treatment options for such infections are limited and costly, often requiring newer, more toxic, or less accessible antibiotics[11].

Compared to similar studies in other hospitals in Bangladesh[12], the resistance rates observed in this hospital were slightly higher, likely reflecting differences in antibiotic prescription practices,

patient demographics, and infection control policies. The concentration of severely ill patients in tertiary hospitals may also contribute to higher rates of antimicrobial resistance due to prolonged hospital stays and invasive procedures.

Overall, the findings underscore the urgent need for robust antimicrobial stewardship programs, regular surveillance of resistance patterns, and strict adherence to infection prevention protocols. Clinicians must be guided by local antibiograms to ensure appropriate antibiotic use. Further research involving molecular typing and resistance gene profiling would be valuable to understand the mechanisms driving resistance in this setting.

Conclusion

This study reveals a high prevalence of antibiotic resistance among Gram-positive cocci isolated from adult patients admitted to a tertiary-level hospital in Dhaka City. *Staphylococcus aureus*, particularly Methicillin-Resistant *Staphylococcus aureus* (MRSA), and *Enterococcus* species were the most commonly isolated pathogens, demonstrating significant resistance to commonly used antibiotics such as penicillin, erythromycin, and ciprofloxacin. The persistence of susceptibility to vancomycin and linezolid offers some reassurance; however, emerging resistance trends pose a serious threat to effective treatment options.

The findings highlight the urgent need for continuous surveillance of antimicrobial resistance, rational antibiotic prescribing, and stringent infection control measures within hospital settings. Implementation of antimicrobial stewardship programs and use of hospital-specific antibiograms can help guide empirical therapy and reduce the selection pressure contributing to resistance. Further research, including molecular analysis of resistance mechanisms, is essential to inform targeted interventions and preserve the efficacy of remaining treatment options. Without coordinated action, the rising burden of antimicrobial resistance among Gram-positive cocci will continue to challenge patient outcomes and healthcare systems in Bangladesh and beyond.

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