STM JOURNALS

Research & Reviews: A Journal of
Microbiology & Virology

https://journals.stmjournals.com/rrjomv

ISSN: 2230-9853 (Online)
ISSN: 2349-4360 (Print)
Volume 14, Issue 2, 2024
May–August
DOI (Journal): 10.37591/RRJoMV

Research RRJoMV

Patient Profile and Antimicrobial Susceptibility Testing in Clinical Isolates of *Staphylococcus aureus*

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Abstract

Introduction: *Staphylococcus aureus is a gram-positive bacterium capable of causing various infections, ranging from minor skin infections to serious bloodstream infections. The rise of methicillin-resistant S. aureus (MRSA) strains has made treating these infections more challenging, as MRSA is frequently resistant to several types of antibiotics.* ***Objective:*** *The aim of this study was to investigate the patient profile and antimicrobial susceptibility patterns of clinical isolates of S. aureus in a tertiary care hospital.* ***Materials and Methods:*** *A retrospective analysis of total no. of 40 isolates was done for a period of 6 months from January 2023 to June 2023 sample of S. aureus were collected from patients with suspected S. aureus infections, and were identified using standard laboratory methods. Patient data, including age, gender, site of infection, type of specimen (OPD, IPD, ICU, NICU, emergency) and antibiotic use history, were recorded. The Kirby–Bauer disk diffusion method was used for antimicrobial susceptibility testing, and the results were interpreted following the guidelines set by the Clinical and Laboratory Standards Institute (CLSI).* ***Results:*** *The majority of patients with S. aureus infections were adults (60%), older (7.5%), adolescent (15%), neonatal (12.5%), infant (2.5%) children (2.5%), male (45%), female (65%), and the most common type of specimen was blood (50%). MRSA was identified in (50%), MSSA (5%), S. Aureus (37.5%), the isolates which is consistent with previous reports of MRSA prevalence in hospital settings. The highest rates of resistance were observed for penicillin (87.5%), erythromycin (75%), and clindamycin (40%), linezolid (40%), vancomycin (20%).* ***Conclusion:*** *Our findings highlight the importance of judicious use of antibiotics in the management of S. aureus infections, as well as the need for continued surveillance of antimicrobial resistance patterns to guide empirical therapy. The high rates of resistance to penicillin and macrolides suggest that these antibiotics should not be used as first-line therapy for S. aureus infections, and that alternative agents, such as vancomycin or linezolid, should be considered. The data collected on patient demographics and antibiotic use history can also help to guide empirical therapy and improve outcomes for patients with S. aureus infections.*

Keywords: *Staphylococcus aureus*, patient profile, multidrug-resistant, antimicrobial susceptibility

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Received Date: July 05, 2024
Accepted Date: July 19, 2024
Published Date: Jul 25, 2024

Citation: Asmat Mushtaq, Jasmina Javaid, Pankaj Kaul. Patient Profile and Antimicrobial Susceptibility Testing in Clinical Isolates of *Staphylococcus aureus*. Research & Reviews: A Journal of Microbiology & Virology. 2024; 14(2): 31–37p.

INTRODUCTION

Staphylococcus aureus is a gram-positive bacterium that can cause various infections, from mild skin infections to severe, life-threatening conditions such as sepsis and endocarditis. Furthermore, the development of methicillin-resistant *S. aureus* (MRSA) strains has made treating these infections more challenging because MRSA is often resistant to multiple classes of antibiotics [1]. The increasing prevalence of MRSA infection has led to an urgent need for effective antibiotics and improved infection control measures. *Staphylococcus aureus* colonizes the skin and mucous membranes of humans. It is a major human pathogen that can cause a broad spectrum of

infections, ranging from mild skin and soft tissue infections to severe life-threatening systemic diseases [2]. The emergence of antibiotic-resistant strains, particularly methicillin-resistant *Staphylococcus aureus* (MRSA), has become a global concern, posing challenges for the effective treatment of these infections. Understanding patient profiles and conducting antimicrobial susceptibility testing are crucial steps in combating *Staphylococcus aureus* infections and optimizing patient care [3].

1. *Structure: Staphylococcus aureus* appears as spherical cells (cocci) organized in grape-like clusters. It is non-motile, non-spore-forming, and facultatively anaerobic, meaning that it can grow with or without oxygen [4].
2. *Virulence factors: Staphylococcus aureus* generates numerous virulence factors that enhance its ability to cause diseases. These include enzymes (such as coagulase, which helps the bacterium evade the immune system), toxins (such as hemolysins and exfoliative toxins that damage host cells), and cell surface proteins (such as protein A, which inhibits phagocytosis) [5].
3. *Infections: Staphylococcus aureus* can cause a wide range of infections, including skin and soft tissue infections (such as boils, impetigo, and cellulitis), respiratory tract infections (such as pneumonia), bloodstream infections (such as sepsis), bone and joint infections, and surgical site infections. It is a leading cause of hospital-acquired infections and is becoming increasingly resistant to antibiotics [6].
4. *Methicillin-resistant Staphylococcus aureus:* MRSA is a strain of *Staphylococcus aureus* that has become resistant to various antibiotics, including methicillin and other beta-lactam antibiotics. Treating MRSA infections is challenging, and often necessitates the use of alternative antibiotics [7].
5. *Transmission: Staphylococcus aureus* can spread from person to person through direct contact with infected individuals or contaminated surfaces. Additionally, it can be asymptomatically carried in the nasal passages of healthy individuals, thereby acting as a reservoir for infection [8].
6. *Prevention and treatment:* Preventive measures include maintaining good hygiene such as frequent handwashing, covering wounds, and avoiding close contact with infected individuals. Treatment usually involves antibiotic therapy, but the choice of antibiotics may depend on the susceptibility profile of the specific strain that causes the infection [9].

MATERIAL AND METHODS

1. *Study design:* Retrospective cross-sectional design was used.
2. *Study area:* This study was conducted in a district hospital 6 phase Mohali Punjab, for a period of 6 months.
3. *Study population:* Patients with clinical isolates of *S. aureus* from a district hospital 6 phase Mohali Punjab.
4. *Type of study:* A descriptive, cross-sectional study was done for research purposes.
5. *Duration of study time:* study was conducted from January 2023 to June 2023.
6. *Sample size:* the study population of 40 patients was taken.
7. *Sample collection: S. aureus* isolates were collected from different clinical specimens, including blood, urine, wound swabs, and respiratory specimens.
8. *Patient profile data:* Demographic data of the patients, including age, sex, and underlying medical conditions, such as diabetes and immune suppression, were collected.
9. *Antimicrobial susceptibility testing:* Antimicrobial susceptibility testing was performed using standard methods, such as the Kirby–Bauer disk diffusion method, and the results were interpreted using the Clinical & Laboratory Standards Institute (CLSI) guidelines.
10. *Data analysis:* Demographic profile data analysis was performed in order of age group, gender ratio, and type of specimen.
11. *Age group:* Distribution was divided into (n=6) theses including neonatal, infant, adolescent, adult, older, and children [10, 11].

DATA ANALYSIS

Sex Ratio

The samples were collected from patients at the District Hospital Mohali, Punjab. In this study, the maximum number of patients was (65%) and 45% (men) (Table 1). Figure 1 shows a pie chart that

Table 1. Distribution of sex ratio.

Gender	Frequency	Percentage
Male	14	45%
Female	26	65%
Total	40	100%

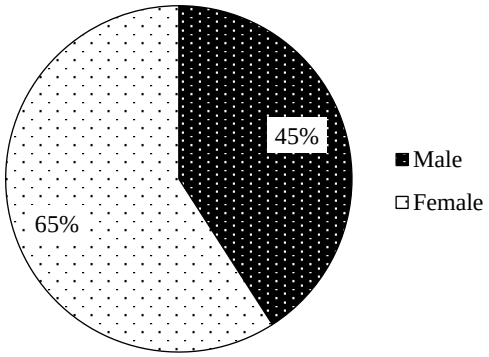

Figure 1. Pie chart show the graphical representation of gender ratio.

graphically represents the sex ratio of *S. aureus* patients. In this chart, the green color represents the female gender (maximum), and the blue color represents the male gender (minimum) [12].

Age Group

Table 2 shows the demographic representation of the age groups, divided into six categories: infants (1 month to 1 year), children (1–12 years), adolescents (13–17 years), adults (18–60 years), and older adults (60–90 years). Figure 2 illustrates that the age group with the highest number of patients was adults (60%), followed by adolescents (15%), neonates (12.5%), older adults (7.5%), and both infants and children (2.5% [13].

Table 2. Age group distribution.

Age group	Frequency	Percentage
Children	1	2.5%
Adolescent	6	15%
Adults	24	60%
Older	3	7.5%
Neonatal	5	12.5%
Infants	1	2.5%

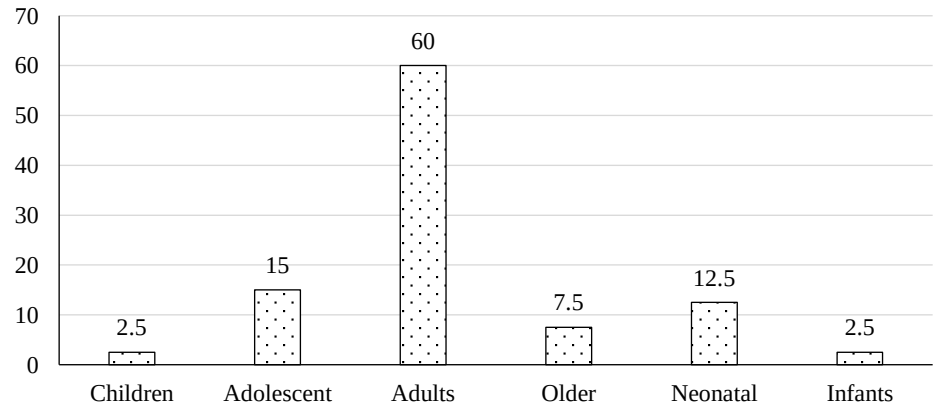

Figure 2. Graphical representation of age distribution.

Types of Specimens

Table 3 shows the distribution of the collected specimens into five groups: blood (21), pus (12), urine (3), swab (3), and wound (1). Figure 3 is a graph representing the types of specimens collected, with the highest being blood (52.5%), followed by pus (12%), swabs (7.5%), urine (7.5%), and wounds (2.5%) [14].

Distribution of Wards

Table 4 shows the distribution of wards into 12 groups: ICU (2), medicine ward (11%), medicine OPD (3), postnatal ward (2), orthopedic ward (4), gynecology ward (1), surgery OPD (4), NICU ward (4), emergency OPD (3), Skin OPD (1), pediatric ward (1), and ENT OPD (4). Figure 4 graphically represents the wards in which patients were admitted, with the highest being the medicine ward (27.5%). The remaining patients were classified as medicine OPD (7.5%), ICU (5%), NICU (10%), emergency OPD (7.5%), pediatric ward (2.5%), postnatal ward (5%), surgery OPD (10%), gynecology ward (2.5%), skin OPD (2.5%), ENT OPD (7.5%), and orthopedic ward (10%) [15].

Table 3. Type of specimen collected.

Specimen	No. of cases	Percentage
Blood	21	52.5%
Pus	12	30%
Urine	03	7.5%
Swab	03	7.5%
Wound	01	2.5%

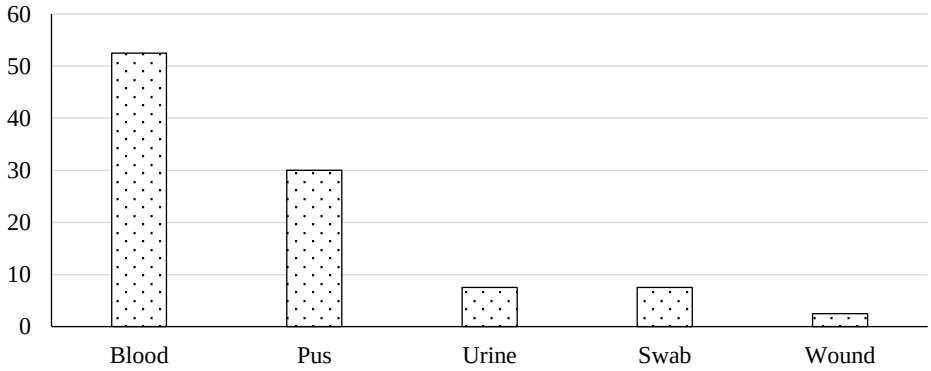

Figure 3. Graphical representation showing type of specimen.

Table 4. Distribution of ward.

Wards	No. of cases	Percentage
Medicine ward	11	27.5%
Medicine OPD	03	7.5%
ICU	02	5%
NICU	04	10%
Emergency OPD	03	7.5%
Pediatric ward	01	2.5%
Postnatal ward	02	5%
Surgery OPD	04	10%
Gynecology ward	01	2.5%
Skin OPD	01	2.5%
ENT OPD	04	10%
Orthopedic ward	04	10%

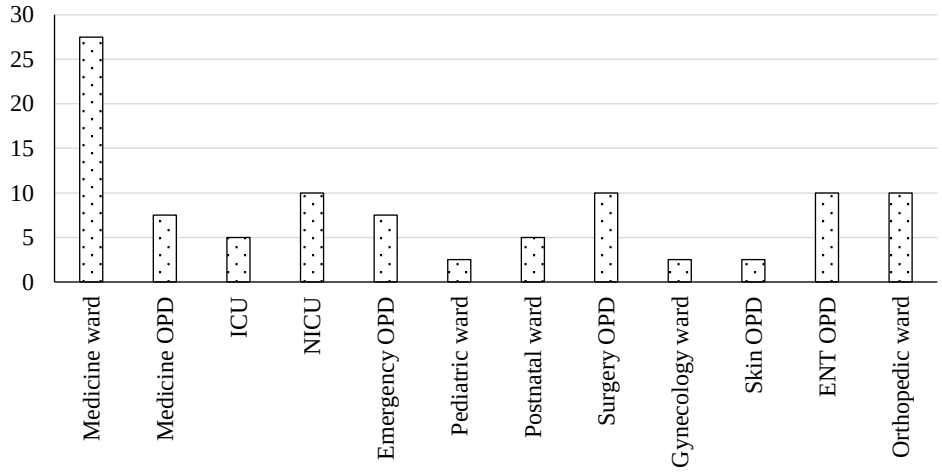

Figure 4. Graphical representation of wards.

AST (Antimicrobial Susceptibility Pattern of Clinical Isolates of *Staphylococcus aureus*)

Table 5 shows that the most resistant antibiotic is methicillin (35), followed by erythromycin (30), ciprofloxacin (24), clindamycin (16), and cotrimoxazole (8). Figure 5 graphically represents the resistance of antibiotics against *Staphylococcus aureus*, with methicillin being the most resistant (87.5%), followed by erythromycin (75%), ciprofloxacin (60%), chloramphenicol, clindamycin, and tetracycline (40%), linezolid (25%), and gentamicin, cotrimoxazole, and vancomycin (20%) [16].

Table 5. Shows antibiotic resistance against S aureus.

Serial No.	Antibiotic used	Sensitive (s)	Resistant (r)	Intermediate (i)
01	Gentamycin	30	08	02
02	Erythromycin	08	30	02
03	Clindamycin	24	16	0
04	Chloramphenicol	24	16	0
05	Linezolid	30	10	0
06	Ciprofloxacin	15	24	01
07	Tetracycline	23	16	01
08	Methicillin/oxacillin	04	35	01
09	Vancomycin	30	08	02
10	Cotrimoxazole	31	08	01

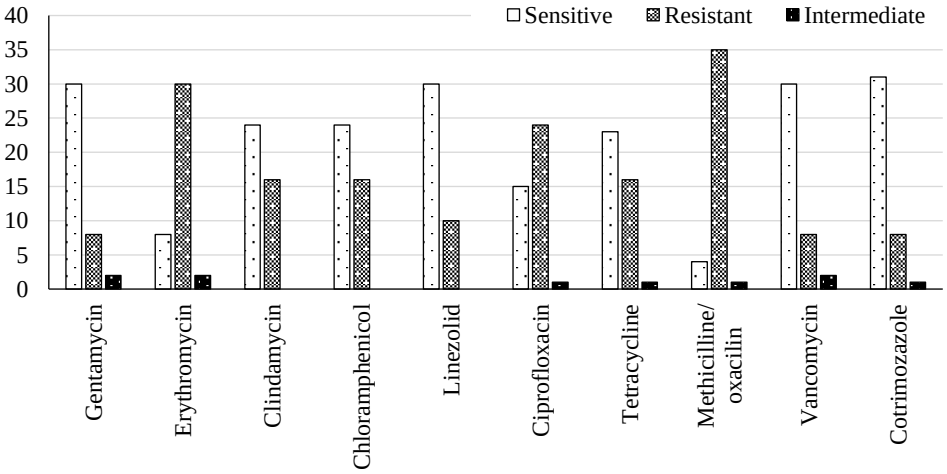

Figure 5. Graphical representation of antibiotics.

RESULT

A total of 40 isolates were collected from the district hospital 6 phase Mohali, Punjab. The study period was 6 months (January 2023 to June 2023). AST was performed using the Kirby–Bauer dics diffusion method. The highest number of pathogens was isolated from the blood (52.5%), and the maximum number of patients was admitted to the medical ward (27.5%).

Observation

In this study, the sex ratio was not equal among females (65%), who were more vulnerable to *S. aureus* infection than males (35%). The maximum age group infected was adults (60%), and the minimum age group infected was infants and children (2.5%). The most resistant antibiotic against the isolates was methicillin (87.5%), erythromycin (75%), ciprofloxacin (60%), chloramphenicol, clindamycin and tetracycline (40%), linezolid (25%), gentamycin, cotrimoxazole and vancomycin (20%) [17–19].

CONCLUSION

In conclusion, our study on antimicrobial susceptibility testing of clinical isolates of *Staphylococcus aureus* underscores the significance of ongoing surveillance, appropriate treatment selection, and infection control measures in the face of increasing antimicrobial resistance. The high prevalence of MRSA and multidrug-resistant strains highlights the need for proactive strategies to combat these challenges. Continued research and collaborative efforts are crucial in addressing antimicrobial resistance and ensuring effective treatment outcomes in patients with *Staphylococcus aureus* infections.

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