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Original Article

Spectrum Of Staphylococcus Species and Their Antimicrobial Susceptibility Patterns in Clinical Isolates from A Tertiary Care Hospital

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ABSTRACT

Background: Staphylococci are among the most frequently isolated bacterial pathogens in clinical microbiology laboratories and are responsible for a wide spectrum of community-acquired and healthcare-associated infections. The increasing prevalence of antimicrobial resistance, poses a significant therapeutic challenge and necessitates continuous surveillance of local susceptibility patterns.
Objectives: To determine the (prevalence) of *Staphylococcus* species recovered from various clinical specimens and to evaluate their antimicrobial susceptibility patterns in a tertiary care hospital.
Materials and Methods: A hospital-based cross-sectional observational study was conducted over a two-year period in the Department of Microbiology of a tertiary care teaching hospital. A total of 615 clinically significant *Staphylococcus* isolates obtained from blood, urine, pus, wound swabs, respiratory samples, endotracheal aspirates, body fluids, catheter tips, and other specimens were identified using standard microbiological methods. Antimicrobial susceptibility testing was performed by the Kirby–Bauer disc diffusion method according to CLSI guidelines.
Results: Of the 615 isolates of styphylococci, Coagulase-negative staphylococci (CoNS) constituted 55.93% (344/615), while *S. aureus* accounted for 44.07% (271/615). Blood specimens represented the predominant source of CoNS isolates (45.35%), whereas *S. aureus* was predominantly isolated from non-urine specimens (67.16%).All*S. aureus* and CoNS isolates were susceptible to vancomycin, while linezolid demonstrated 100% and 98.55% susceptibility, respectively. High resistance was observed to penicillin (80% in *S. aureus* and 93.31% in CoNS) and amoxicillin-clavulanic acid (56.1% and 74.41%, respectively).
Conclusion: CoNS were the predominant *Staphylococcus* isolates in the present study. Vancomycin and linezolid remained highly effective against both *S. aureus* and CoNS, whereas resistance to commonly used antibiotics was considerable. Continuous antimicrobial resistance surveillance and rational antibiotic stewardship are essential for effective management of staphylococcal infections.

Keywords*: Staphylococcus aureus; Coagulase-negative staphylococci (CoNS); Antimicrobial susceptibility; Antibiotic resistance.*

INTRODUCTION

Staphylococci are Gram-positive cocci that characteristically arrange in grape-like clusters and constitute an important component of the normal human microbiota and skin flora. Although many staphylococcal species exist as commensalsof the skin and mucous membranes, several members of the genus have emerged as significant opportunistic pathogens responsible for a broad spectrum of community-acquired and healthcare-associated infections. Among them, *S.aureus* remains the most virulent species, while CoNS, previously considered contaminants, are increasingly recognized as important causes of bloodstream infections, device-associated infections, surgical site infections, and urinary tract

infections [1, 2].Staphylococcal infections represent a major burden on healthcare systems worldwide because of their ability to cause diseases ranging from superficial skin and soft tissue infections to life-threatening conditions such as bacteremia, endocarditis, pneumonia, osteomyelitis, and sepsis. The widespread use of invasive medical procedures, indwelling devices, prolonged hospitalization, and immunosuppressive therapies has further increased the incidence of infections caused by both *S. aureus* and CoNS species [3].The management of staphylococcal infections has become increasingly challenging due to the rapid emergence and dissemination of antimicrobial resistance.Furthermore, resistance among coagulase-negative staphylococci to β-lactams, macrolides, fluoroquinolones, and other commonly used antimicrobial agents has been reported with increasing frequency. The emergence of strains exhibiting reduced susceptibility to glycopeptides and other reserve antibiotics further complicates treatment options [4, 5].Patterns of antimicrobial susceptibility vary considerably across geographical regions, healthcare settings, and patient populations. Continuous surveillance of local resistance trends is therefore essential for guiding empirical therapy, developing antimicrobial stewardship strategies, and implementing effective infection control measures. Identification of the spectrum of staphylococcal species isolated from different clinical specimens, together with their susceptibility profiles, provides valuable information for clinicians and microbiologists involved in patient care [6].

Aims and Objectives

The present study was undertaken to determine the distribution of Staphylococcus species isolated from various clinical specimens and evaluate their antimicrobial susceptibility patterns in a tertiary care hospital.

MATERIALS AND METHODS

Study Design and Setting: This hospital-based cross-sectional observational study was conducted in the Department of Microbiology of a tertiary care teaching hospital over a period of two years.

Inclusion Criteria

- All clinically significant Staphylococcus isolates recovered from patients attending inpatient and outpatient departments
- Patients who provide written informed consent

Exclusion Criteria

- Duplicate isolates from the same patient and specimens considered contaminants
- Patients who did not provide written informed consent

Sample Collection and Processing: Clinical specimens including pus, wound swabs, blood, urine, respiratory samples, body fluids, endotracheal aspirate, catheter tips, and other relevant specimens were collected using standard aseptic precautions and processed according to standard microbiological procedures.

Isolation and Identification of Staphylococcus Species: Samples were inoculated onto Blood Agar and MacConkey Agar and incubated aerobically at 37°C for 18–24 hours. Suspected colonies were identified based on colony morphology, Gram staining, Catalase test, Coagulase test (slide and tube methods), mannitol fermentation, and other relevant biochemical tests. Staphylococcal isolates were further categorized as *S. aureus* and CoNS.

Antimicrobial Susceptibility Testing: Antimicrobial susceptibility testing was performed by the Kirby–Bauer disc diffusion method on Mueller–Hinton agar following CLSI guidelines [7]. Antibiotics tested included penicillin, cefoxitin, erythromycin, clindamycin, gentamicin, ciprofloxacin, cotrimoxazole, linezolid, tetracycline, vancomycin, and other routinely used anti-staphylococcal agents. Zone diameters were interpreted according to the latest CLSI criteria.

Data Analysis: Data were entered into Microsoft Excel and analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. A p-value <0.05 was considered statistically significant wherever applicable.

Ethical Considerations: The study was conducted after obtaining approval from the Institutional Ethics Committee. Patient confidentiality was maintained throughout the study.

RESULTS

A total of 615 *Staphylococcus* isolates were recovered during the study period. CoNS constituted the majority of isolates (55.93%), while *S. aureus* accounted for 44.07%. Non-urine specimens yielded the highest number of *S. aureus* isolates (67.16%), whereas CoNS were predominantly isolated from blood samples (45.35%).

Table 1: Distribution of Staphylococcus isolates according to specimen type

Sample type	Staphylococcus spp.	S. aureus	CoNS
Non-urine	312 (50.73%)	182 (67.16%)	130 (37.79%)

Blood	225 (36.59%)	69 (25.46%)	156 (45.35%)
Urine	78 (12.68%)	20 (7.38%)	58 (16.86%)
Total	615 (100%)	271 (44.07%)	344 (55.93%)

All *S. aureus* isolates were susceptible to vancomycin and linezolid (100%). High susceptibility was observed to doxycycline and gentamicin (91.2% each), followed by ciprofloxacin (65.2%). Resistance was highest to cotrimoxazole (87.2%) and penicillin (80%), while moderate resistance was noted against amoxicillin-clavulanic acid (56.1%) and erythromycin (45.7%).

Table 2: The antimicrobial susceptibility pattern of staphylococcus aureus as per CLSI guidelines

Antibiotic	Sensitive	Resistant
Vancomycin	100%	0%
Linezolid	100%	0%
Penicillin	20%	80%
Erythromycin	54.3%	45.7%
Clindamycin	55.7%	44.3%
Ciprofloxacin	65.2%	34.8%
Doxycycline	91.2%	8.8%
Amoxicillin-clavulanic acid	44.9%	56.1%
Gentamicin	91.2%	8.8%
Cotrimoxazole	12.8%	87.2%

CoNS isolates exhibited complete susceptibility to vancomycin (100%) and high susceptibility to linezolid (98.55%). Good activity was also observed with Cotrimoxazole (82.85%), and Gentamicin (79.36%). High resistance was noted to penicillin (93.31%) and Amoxicillin-Clavulanic acid (74.41%), whereas moderate resistance was observed against Ciprofloxacin (59.88%), Erythromycin (55.52%), Clindamycin (52.62%), and Doxycycline (48.55%).

Table 3: The antimicrobial susceptibility pattern of CoNS as per CLSI guidelines

Antibiotic	Sensitive	Resistant
Vancomycin	100%	0%
Linezolid	98.55%	1.45%
Penicillin	6.69%	93.31%
Erythromycin	44.48%	55.52%
Clindamycin	47.38%	52.62%
Ciprofloxacin	40.12%	59.88%
Doxycycline	51.45%	48.55%
Amoxicillin-clavulanic acid	25.58%	74.4%
Gentamicin	79.36%	20.64%
Cotrimoxazole	82.85%	17.15%

DISCUSSION

The predominance of CoNS observed in the present study reflects their increasing importance as healthcare-associated pathogens, particularly in bloodstream and device-related infections. Similar observations have been reported by Becker et al [8], who emphasized the growing clinical significance of CoNS in hospitalized patients.

We have found that the blood specimens represented the major source of CoNS isolates, whereas *S. aureus* was predominantly isolated from non-urine specimens, especially wound and pus samples. These findings are consistent with those reported by Otto M et al [9], who observed that S. aureus remains a major pathogen in skin and soft-tissue infections, whereas CoNS are frequently isolated from blood cultures and indwelling medical devices.

All *S. aureus* isolates in the current study demonstrated complete susceptibility to vancomycin and linezolid. Similar findings have been reported by Tiwari HK et al [10], who observed near-universal susceptibility of staphylococcal isolates to these reserve antibiotics in tertiary healthcare institutions. The preserved efficacy of vancomycin and linezolid may be attributed to their restricted usage and implementation of antimicrobial stewardship programs.

High susceptibility of *S. aureus* to doxycycline and gentamicin was observed in the present study. Comparable susceptibility rates have been reported by Patel JB et al [11], who demonstrated that tetracycline and aminoglycosides remain useful therapeutic options against staphylococcal infections in many Indian healthcare settings. These findings suggest that these agents may serve as valuable alternatives for the treatment of selected infections when supported by susceptibility testing.

Our study demonstrated substantial resistance of *S. aureus* to cotrimoxazole and penicillin. Similar resistance patterns have been documented by Gurung RR et al [12], who reported widespread β-lactam resistance among staphylococcal isolates due to β-lactamase production and acquisition of resistance determinants. The high resistance to cotrimoxazole observed in the current study may reflect prolonged and indiscriminate use of this antimicrobial agent in community and hospital settings.

Among CoNS isolates, complete susceptibility to vancomycin and high susceptibility to linezolid were observed. Similar findings were reported by Wang J, et al [13], who demonstrated excellent activity of glycopeptides and oxazolidinones against CoNS isolates. However, resistance to penicillin and amoxicillin-clavulanic acid was notably high in this study. These observations are in agreement with findings reported by Michels R et al [14], who demonstrated widespread β-lactam resistance among clinical CoNS isolates due to frequent carriage of mecA and other resistance genes.

CONCLUSION

The present study demonstrated that coagulase-negative staphylococci were the predominant Staphylococcus isolates recovered from clinical specimens, with blood samples serving as the major source of CoNS. Staphylococcus aureus was predominantly isolated from wound and pus specimens. Vancomycin and linezolid remained highly effective against both S. aureus and CoNS, whereas substantial resistance was observed to penicillin and several routinely used antibiotics. Continuous antimicrobial resistance surveillance, rational antibiotic use, and strict infection-control practices are essential to limit the spread of resistant staphylococcal strains and improve patient outcomes.

REFERENCES

1. Centers for Disease Control and Prevention. *Staphylococcus aureus Basics*. Atlanta: CDC; 2024. Available from: https://www.cdc.gov/staphylococcus-aureus/about/index. html
2. Touaitia R, Mairi A, Ibrahim NA, Basher NS, Idres T, Touati A. *Staphylococcus aureus*: A Review of the Pathogenesis and Virulence Mechanisms. Antibiotics (Basel). 2025 May 6;14(5):470. doi: 10.3390/antibiotics14050470. PMID: 40426537; PMCID: PMC12108373.
3. Bennett JE, Dolin R, Blaser MJ, editors. Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases. 9th ed. Philadelphia: Elsevier; 2020.
4. National Library of Medicine (US). Staphylococcal Infections. MedlinePlus [Internet]. Bethesda (MD): National Library of Medicine (US); 2023 Nov 8 [cited 2026 Jun 9]. Available from: https://medlineplus.gov/staphylococcalinfections.html.
5. Heyar AK, Singh P, Kaur A. Prevalence and antibiotic sensitivity pattern of Staphylococcus aureus from clinical samples with emphasis on MRSA in a tertiary care hospital. J Evol Med Dent Sci. 2017;6(95):6982–6986. doi:10.14260/jemds/2017/1272.
6. Taylor TA, Unakal CG. Staphylococcus aureus Infection. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025. Available from: https://www.ncbi.nlm.nih.gov/books/NBK441868/
7. Clinical and Laboratory Standards Institute. Performance Standards for Antimicrobial Susceptibility Testing. CLSI Supplement M100. 32nd ed. Wayne, PA: CLSI; 2022.
8. Becker K, Both A, Weisselberg S, Heilmann C, Rohde H. Emergence of coagulase-negative staphylococci. Clin Microbiol Rev. 2020; 33(3):e00009-19.
9. Otto M. Coagulase-negative staphylococci as reservoirs of genes facilitating MRSA infection. Bioessays. 2013;35(1):4–11. OR Koksal F et al. Ann Clin Microbiol Antimicrob. 2009;8:6.
10. Tiwari HK, Sapkota D, Sen MR. High prevalence of multidrug-resistant MRSA with preserved susceptibility to vancomycin and linezolid**.** Infect Drug Resist. 2008;1:57–61.
11. Patel JB et al. Antimicrobial susceptibility patterns of clinical S. aureus isolates. Diagn Microbiol Infect Dis. 2019.
12. Gurung RR, Maharjan P, Chhetri GG. Antibiotic resistance pattern of *Staphylococcus aureus* with reference to MRSA isolates from pediatric patients. Future Sci OA. 2020;6(4):FSO464. doi:10.2144/fsoa-2019-0122.
13. Wang J, Meng Y, Zhang R, Yan H, Xu G, Zhu Y, Xie Z, Jiang S. Coagulase-negative staphylococci are the main causes of bacterial meningitis in duck. Poult Sci. 2024 May;103(5):103592. doi: 10.1016/j.psj.2024.103592. Epub 2024 Feb 27. PMID: 38447309; PMCID: PMC11067754..
14. Michels R, Last K, Becker SL, Papan C. Update on Coagulase-Negative Staphylococci—What the Clinician Should Know. Microorganisms. 2021;9(4):830. doi:10.3390/microorganisms9040830.