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A Cross-Sectional Observational Study on the Bacteriological Profile and Antibiotic Sensitivity Pattern of Surgical and Medical Infections in Patients Admitted to a Tertiary Care Hospital

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Abstract
Background: Hospital-based infections remain a major cause of morbidity, prolonged hospitalization, and inappropriate antibiotic exposure, especially in settings where local bacteriological surveillance is limited. ***Objectives:*** To determine the bacteriological profile and antibiotic sensitivity pattern of surgical and medical infections among patients admitted to a tertiary care hospital. ***Methods:*** This cross-sectional observational study included 100 consecutively admitted patients with clinically suspected infections at a tertiary care hospital in Kerala, India, from February 2025 to July 2025. Relevant clinical specimens were processed by standard bacteriological methods, and antimicrobial susceptibility testing was performed using the Kirby-Bauer disc diffusion method with interpretation according to contemporary CLSI principles. ***Results:*** The largest age group was 41-60 years (38%), and 62% were male. Surgical site infection was the commonest clinical presentation (36%), followed by urinary tract infection (22%) and respiratory tract infection (18%). Culture positivity was observed in 82% of samples. Escherichia coli was the predominant isolate (24.4%), followed by Staphylococcus aureus (19.5%) and Klebsiella pneumoniae (17.1%). Imipenem showed the highest overall sensitivity (86.6%), followed by amikacin (80.5%) and piperacillin-tazobactam (74.4%), whereas sensitivity to ceftriaxone and cefotaxime was substantially lower. ***Conclusion:*** Gram-negative bacteria predominated across medical and surgical infections, and broad-spectrum agents retained better activity than third-generation cephalosporins. Periodic hospital antibiogram surveillance is essential to guide empirical therapy, improve antimicrobial stewardship, and strengthen infection-control practices.

Keywords: bacteriological profile; antibiotic sensitivity; surgical site infection; hospital-acquired infection; antibiogram; tertiary care hospital

INTRODUCTION
Infections occurring in hospitalized patients remain an important cause of clinical deterioration, longer hospital stay, increased cost of treatment, and excess antimicrobial use across health systems. Surgical and medical infections together constitute a substantial proportion of the inpatient infectious burden, particularly in tertiary care institutions where referral of complicated cases, invasive procedures, and prior antibiotic exposure are common [1-5]. The spectrum of infection in such settings often includes surgical site infections, urinary tract infections, respiratory tract infections, bloodstream infections, and skin and soft tissue infections, each with varying microbiological characteristics and therapeutic implications [2-5].

The bacteriological profile of hospital-treated infections has undergone a marked shift in recent years because of selective antibiotic pressure, widespread device use, and the emergence of multidrug-resistant organisms. Gram-negative bacilli such as Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, and Acinetobacter species continue to pose major therapeutic challenges, while Staphylococcus aureus remains an important Gram-positive pathogen in both postoperative and nonsurgical infections [4,6,7]. These organisms are frequently implicated in the broader ESKAPE pathogen group, which is recognized for antimicrobial resistance, persistence in healthcare environments, and clinically significant treatment failure [6,7].

Local microbiological surveillance is therefore indispensable. Empirical antibiotic therapy is often initiated before culture reports are available, especially in patients presenting with severe or clinically progressive infection. In the absence of updated institutional data, empirical regimens tend to rely on generalized prescribing patterns that do not always reflect current susceptibility trends. Standardized antimicrobial susceptibility testing and interpretation using accepted CLSI-based approaches improve the reliability of organism-specific treatment decisions and hospital antibiogram development [8-12]. Such evidence is also central to antimicrobial stewardship, rational escalation and de-escalation, and containment of cephalosporin and broad-spectrum resistance [7,10-12].

Although several reports have described healthcare-associated infection patterns in different settings, institution-specific data remain essential because pathogen prevalence and susceptibility profiles vary considerably across regions, patient populations, and hospital services [2-5,13,14]. A tertiary care hospital that manages both surgical and medical infections requires a unified understanding of its bacteriological burden to support early diagnosis, targeted therapy, and infection-control planning. The present study was therefore undertaken to determine the bacteriological profile of surgical and medical infections among admitted patients and to assess the prevailing antibiotic sensitivity pattern of isolated organisms at Azeezia Institute of Medical Sciences and Research, Adichanalloor, Kerala, India.

MATERIALS AND METHODS

Study design and setting. This hospital-based cross-sectional observational study was conducted in the Department of Microbiology in collaboration with the concerned clinical units at Azeezia Institute of Medical Sciences and Research, Adichanalloor, Kerala, India. The study period extended from February 2025 to July 2025. The institution is a tertiary care teaching hospital receiving both medical and surgical admissions, including patients requiring inpatient antimicrobial therapy, postoperative monitoring, and microbiological workup for suspected infection.

Study population and sample size. The study included 100 admitted patients with clinically suspected medical or surgical infections during the study period. Patients were enrolled consecutively after fulfillment of eligibility criteria. Both male and female patients aged 18 years and above were considered. Surgical infections included postoperative wound and soft tissue infections, while medical infections included urinary, respiratory, bloodstream, and related inpatient infectious syndromes. Patients with inadequate samples, duplicate specimens from the same untreated infectious episode, or records lacking essential microbiological details were not included in the final analysis.

Clinical specimens and microbiological processing. Relevant specimens were collected under aseptic precautions according to the site of infection and clinical indication. These included pus or wound swabs, urine, blood, sputum, and other appropriate samples. Specimens were transported promptly to the microbiology laboratory and processed using standard bacteriological methods. Direct smear examination was performed wherever indicated. Samples were inoculated onto routine culture media such as blood agar, MacConkey agar, and other media required for isolation. Plates were incubated under standard conditions, and isolates were identified by colony morphology, Gram staining characteristics, and conventional biochemical reactions in accordance with established laboratory practice [8-12]. Growth showing clinically significant bacterial pathogens was recorded as culture positive.

Antimicrobial susceptibility testing. Antibiotic sensitivity testing was carried out for all clinically significant bacterial isolates by the Kirby-Bauer disc diffusion method on Mueller-Hinton agar. Zone diameters were interpreted using contemporary CLSI-based principles and accepted susceptibility breakpoints [10-12]. Antibiotics tested included commonly used agents relevant to hospital practice, such as imipenem, amikacin, piperacillin-tazobactam, cefoperazone-sulbactam, ceftriaxone, and cefotaxime. The susceptibility profile of each isolate was entered into the study proforma and later consolidated to describe the overall sensitivity pattern of isolates recovered during the study period.

Data collection and statistical analysis. Demographic details, clinical diagnosis, specimen type, culture result, organism isolated, and susceptibility findings were recorded in a predesigned data sheet. The analysis was descriptive in nature. Categorical variables were summarized as frequency and percentage. Culture positivity rate was calculated from the total number of processed samples. The distribution of infection types and bacterial isolates was presented in tabular form. The final analysis focused on describing the burden of common infections, identifying the predominant pathogens, and outlining the antibiotic sensitivity pattern most relevant for empirical hospital prescribing and microbiological surveillance.

Ethical considerations. Institutional ethical clearance was obtained before commencement of the study as per hospital policy for observational research on patient samples and records. Confidentiality of patient information was maintained throughout the study, and data were analyzed in aggregate form without disclosure of personal identifiers.

RESULTS

A total of 100 patients admitted with clinically suspected infections were included in this cross-sectional observational study conducted in a tertiary care hospital. Clinical samples were collected from all patients and subjected to bacteriological culture and antibiotic susceptibility testing. The study evaluated demographic characteristics, type of infection, bacteriological isolates, and antimicrobial sensitivity patterns.

The majority of patients were aged 41-60 years (38%), followed by those aged 21-40 years (34%). Male patients constituted 62% of the study population, while female patients accounted for 38%, indicating a male predominance among admitted patients with documented infectious conditions (Table 1).

Table 1. Demographic characteristics of study participants (N = 100)

Variable	Category	n	%
Age group (years)	18-20	12	12.0
	21-40	34	34.0
	41-60	38	38.0
	>60	16	16.0
Sex	Male	62	62.0
	Female	38	38.0

With regard to the clinical spectrum, surgical site infection was the most frequently encountered category, accounting for 36% of all cases. Urinary tract infection constituted 22% of cases, followed by respiratory tract infection in 18%. Bloodstream infection represented 12%, whereas skin and soft tissue infection and other infections accounted for 8% and 4%, respectively. This distribution indicates that surgically related infections formed the largest single burden in the admitted cohort (Table 2).

Table 2. Distribution of clinical infections among patients (N = 100)

Type of infection	n	%
Surgical site infection	36	36.0
Urinary tract infection	22	22.0
Respiratory tract infection	18	18.0
Bloodstream infection	12	12.0
Skin and soft tissue infection	8	8.0
Other infections	4	4.0

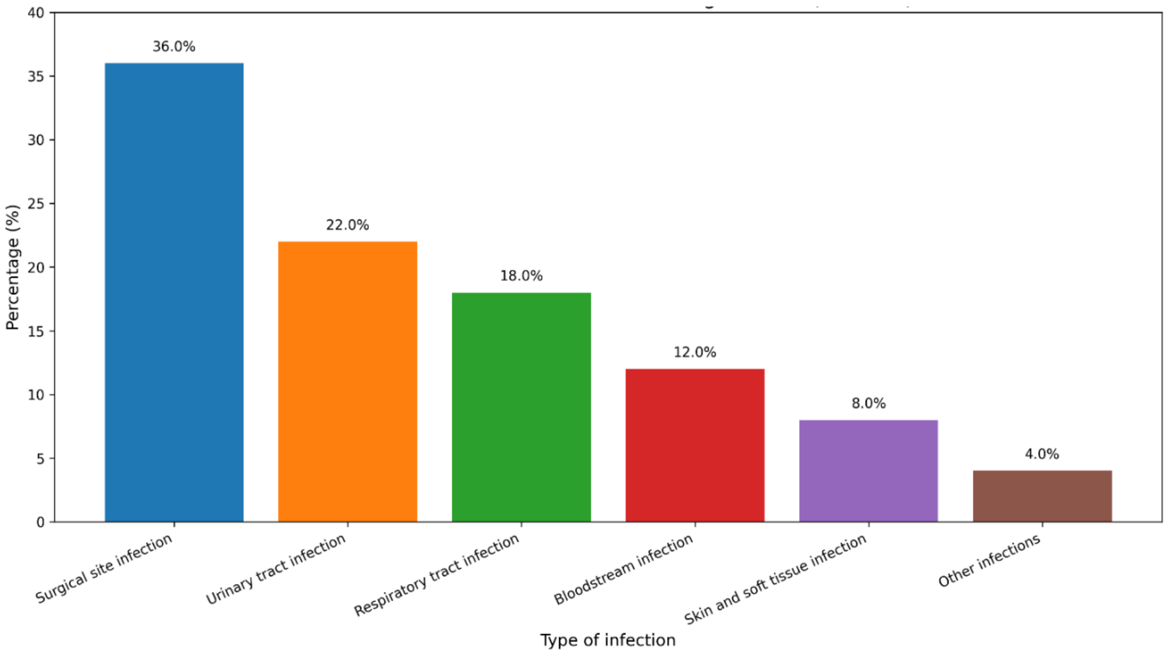

Figure 1: Distribution of Clinical Infections Among Patients

Out of the 100 specimens processed, 82 showed significant bacterial growth, giving a culture positivity rate of 82%. Among the culture-positive samples, Gram-negative organisms predominated. Escherichia coli was the most frequently isolated pathogen, accounting for 24.4% of isolates, followed by Staphylococcus aureus (19.5%) and Klebsiella pneumoniae (17.1%). Pseudomonas aeruginosa and Acinetobacter spp. together accounted for nearly one-fourth of isolates, further highlighting the importance of nosocomial Gram-negative pathogens in both medical and surgical infections (Table 3).

Table 3. Bacteriological isolates identified in culture-positive samples (n = 82)

Bacterial isolate	n	%
Escherichia coli	20	24.4
Staphylococcus aureus	16	19.5
Klebsiella pneumoniae	14	17.1
Pseudomonas aeruginosa	11	13.4
Acinetobacter spp.	8	9.8
Coagulase-negative Staphylococcus	6	7.3
Proteus spp.	4	4.9
Enterococcus spp.	3	3.6

Antibiotic susceptibility analysis demonstrated greater activity of carbapenem and aminoglycoside-based therapy against the overall pool of isolates. Imipenem exhibited the highest sensitivity (86.6%), followed by amikacin (80.5%) and piperacillin-tazobactam (74.4%). Cefoperazone-sulbactam retained moderate activity, whereas third-generation cephalosporins showed distinctly lower sensitivity, with ceftriaxone and cefotaxime active against only 42.7% and 37.8% of isolates, respectively (Table 4). These findings indicate a narrowing utility of cephalosporin-based empirical regimens in the studied setting.

Table 4. Antibiotic sensitivity pattern of bacterial isolates (n = 82)

Antibiotic	Sensitive isolates (n)	%
Imipenem	71	86.6
Amikacin	66	80.5
Piperacillin-tazobactam	61	74.4
Cefoperazone-sulbactam	56	68.3
Ceftriaxone	35	42.7
Cefotaxime	31	37.8

Overall, the results show that Gram-negative bacteria constituted the predominant etiological agents in admitted patients with surgical and medical infections, while imipenem, amikacin, and piperacillin-tazobactam were the most active agents against the majority of isolates recovered during the study period.

DISCUSSION

The present study provides a concise institution-level picture of the bacteriological profile and antibiotic sensitivity pattern of admitted patients with medical and surgical infections in a tertiary care setting. The largest age group in the present series was 41-60 years, and males constituted nearly two-thirds of the cohort. This pattern is broadly compatible with hospital infection surveillance studies showing greater inpatient infectious burden among adult male patients and among populations with higher procedural exposure, comorbidity load, and prolonged admission [1,3,5].

Surgical site infection was the most common clinical category in the present study, followed by urinary tract and respiratory tract infections. This distribution is consistent with multicentre and systematic survey data in which surgical site infection remains one of the leading healthcare-associated infection categories, particularly in tertiary hospitals and mixed surgical-medical populations [2-5,8,9]. The prominence of surgical site infection in the present study is clinically important because postoperative infections increase antibiotic consumption, delay wound healing, and prolong inpatient stay. The observed contribution of urinary and respiratory infections also indicates that inpatient surveillance should not remain restricted to postoperative wards alone.

Culture positivity in the present study was 82%, and Gram-negative bacilli predominated among isolates. Escherichia coli emerged as the leading pathogen, followed by Staphylococcus aureus and Klebsiella pneumoniae. Similar trends have been documented in prevalence studies and tertiary-care microbiology reports, where Enterobacterales and Staphylococcus aureus consistently account for a large proportion of wound, urinary, and bloodstream isolates [2-7,13,14]. The presence of Pseudomonas aeruginosa and Acinetobacter spp. in a meaningful proportion of isolates further reflects the selective pressure created by hospitalization, prior antibiotic exposure, and healthcareenvironment persistence of resistant opportunistic pathogens [6,7].

The antibiotic sensitivity pattern observed in this study is equally noteworthy. Imipenem showed the highest overall sensitivity, followed by amikacin and piperacillin-tazobactam, whereas ceftriaxone and cefotaxime demonstrated considerably lower activity. This pattern aligns with contemporary reports describing higher resistance to third-generation cephalosporins among hospital-associated Gram-negative pathogens and relatively better retained activity of carbapenems and selected reserve agents [7,10-13]. Such findings underscore the risk of relying on cephalosporin-heavy empirical therapy in institutions where Gram-negative resistance is expanding. At the same time, the higher activity of imipenem should not encourage indiscriminate carbapenem use, since stewardship principles demand preservation of these agents for appropriately selected patients [8-12].

The clinical value of the present study lies in its local applicability. Hospital antibiograms are most useful when based on recent institutional isolates rather than extrapolated regional trends. The present data support periodic bacteriological surveillance, stronger infection-prevention practices, and more rational empirical therapy in both medical and surgical units. In particular, the predominance of Gram-negative organisms and the reduced susceptibility to third-generation cephalosporins indicate that prescribing policies should be reviewed in tandem with laboratory reporting and infection-control interventions. Continued surveillance with larger samples and organism-specific resistance analysis would further strengthen institutional stewardship efforts.

Limitations

The study was conducted at a single tertiary care center with a sample size of 100 patients, which limits wider generalization. Organism-wise stratified susceptibility analysis and resistance phenotyping were not performed. The study design was descriptive and did not evaluate risk factors, clinical outcomes, prior antibiotic exposure, or duration of hospital stay. Anaerobic, fungal, and molecular diagnostic profiling were outside the study scope.

CONCLUSION

This study demonstrates that surgical site infection constituted the largest clinical category among admitted patients with medical and surgical infections, while Gram-negative bacteria formed the dominant microbiological group. Escherichia coli, Staphylococcus aureus, and Klebsiella pneumoniae were the principal isolates. Imipenem, amikacin, and piperacillin-tazobactam showed better overall activity than ceftriaxone and cefotaxime, indicating reduced usefulness of third-generation cephalosporins for uninformed empirical therapy in the local setting. Regular hospital-based bacteriological surveillance, timely culture-guided treatment, and robust antimicrobial stewardship are necessary to optimize empirical antibiotic policy, reduce resistance pressure, and improve inpatient infection management in tertiary care hospitals.

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