**SAS Journal of Medicine**
Abbreviated Key Title: SAS J Med
ISSN 2454-5112
Journal homepage: https://saspublishers.com

OPEN ACCESS

**Medicine**

# Antimicrobial Susceptibility Pattern of Bloodstream Isolates in Febrile Neutropenic Patients

Dr. Mizanur Rahman[1]*, Dr. Rebeka Sultana[2], Dr. Sumaiya Nousheen Pinki[3], Dr. Md. Abul Kalam Azad[4], Dr. Md. Kamrul Hassan[5], Dr. Shahnaz Sharmeen Lipi[6]

[1]Senior Consultant, Department of Medicine, Shaheed Sayed Nazrul Islam Medical College, Kishoreganj, Bangladesh
[2]Junior Consultant (CC), Directorate General Health Services (OSD), Bangladesh Medical University, Dhaka, Bangladesh
[3]Lecturer, Department of Pharmacology, Holy Family Medical College and Hospital, Dhaka, Bangladesh
[4]Pro Vice Chancellor (Administration), Bangladesh Medical University (BMU), Dhaka, Bangladesh
[5]Associate Consultant, Department of Hematology, Ahsania Mission Cancer and General Hospital, Dhaka, Bangladesh
[6]Assistant Professor, Department of Microbiology, Shaheed Syed Nazrul Islam Medical College, Kishorganj, Bangladesh

**DOI:** https://doi.org/10.36347/sasjm.2025.v11i12.009 | **Received:** 20.10.2025 | **Accepted:** 13.12.2025 | **Published:** 16.12.2025

***Corresponding author:** Dr. Mizanur Rahman
Senior Consultant, Department of Medicine, Shaheed Sayed Nazrul Islam Medical College, Kishoreganj, Bangladesh

**Abstract** **Original Research Article**

***Background:*** Bloodstream infections in febrile neutropenia represent a major clinical threat due to rapid progression and increasing antimicrobial resistance. Local susceptibility data are essential for optimizing empirical therapy. This study aimed to determine antimicrobial susceptibility patterns of bloodstream isolates recovered from febrile neutropenic patients in a tertiary care hospital. ***Methods:*** This cross-sectional observational study was conducted in the Department of Internal Medicine, Shaheed Syed Nazrul Islam Medical College Hospital, Kishoreganj, Bangladesh, from October 2022 to September 2023. A total of 50 adult febrile neutropenic patients with complete blood culture and susceptibility results were included. Blood cultures were obtained aseptically, processed on standard media and isolates identified via Gram stain and colony morphology. Susceptibility was tested by disc diffusion. Clinical and demographic data were recorded. ***Results:*** Among 50 patients, 15 (30%) had positive blood cultures. Gram-positive organisms accounted for 53.3% of isolates, predominantly *Staphylococcus epidermidis*, while Gram-negative organisms accounted for 46.7%, mainly Pseudomonas aeruginosa. Gram-positive isolates demonstrated uniform susceptibility to vancomycin and linezolid but variable susceptibility to β-lactams. Pseudomonas isolates showed 60% sensitivity to meropenem, imipenem, amikacin and piperacillin-tazobactam, with lower susceptibility to ceftazidime and ciprofloxacin. An ESBL-producing *E. coli* strain displayed sensitivity only to colistin. Prior antibiotic use showed a trend toward reduced culture positivity. ***Conclusion:*** Antimicrobial susceptibility patterns revealed significant resistance among Gram-negative isolates and preserved susceptibility of Gram-positive organisms to glycopeptides and linezolid. These findings support the need for updated local guidelines and ongoing microbiological surveillance.

**Keywords:** Febrile neutropenia, antimicrobial susceptibility, Gram-negative resistance, *Pseudomonas aeruginosa*, *Staphylococcus epidermidis*.



## INTRODUCTION

Febrile neutropenia is a critical complication in patients with hematologic malignancies and immunosuppression, as profound neutrophil depletion predisposes them to rapid bacterial invasion [1]. Neutrophils play a central role in innate immunity and an absolute neutrophil count (ANC) below protective levels allows even low-virulence organisms to cause severe infection. Fever is often the only sign of infection in neutropenic patients due to a blunted inflammatory response masking local symptoms and delaying diagnosis [2]. Bloodstream infections (BSIs) in this population are linked to high morbidity, septic shock and mortality, necessitating an understanding of antimicrobial susceptibility to optimize empirical therapy and improve outcomes [3].

The epidemiology of BSIs in neutropenic patients has changed substantially over the decades. Originally, Gram-negative organisms such as *Pseudomonas aeruginosa* were predominant, causing high mortality prior to the use of broad-spectrum empirical antibiotics [4]. The advent of prophylactic and

empirical therapies targeting gram-negative bacteria, along with increased central venous catheter use, shifted the epidemiology towards gram-positive bacteria starting in the late 1970s [1]. European surveillance demonstrated that gram-positive bacteria increased from 29% of BSIs in the 1970s to nearly 70% by the early 1990s and U.S. studies reported that gram-positive organisms accounted for 62–76% of bloodstream isolates by the late 1990s [4,5]. This shift has major implications for the choice of empirical antibiotics.

Despite the predominance of gram-positive organisms in many regions, gram-negative organisms remain a major concern in low- and middle-income countries, often dominating pathogen profiles and accounting for a significant proportion of infections, such as neonatal sepsis [6,7]. Resistance to carbapenems, third-generation cephalosporins and fluoroquinolones has sharply increased in these settings, fueled by extended-spectrum β-lactamase (ESBL)-producing Escherichia coli and multidrug-resistant Pseudomonas species, complicating treatment and increasing mortality risks [8,9]. These high resistance rates limit effective therapeutic options and present major challenges in the management of infections in resource-limited environments [10]. Therefore, regional antimicrobial susceptibility data are crucial for guiding empirical therapy, according to international guidelines emphasizing local epidemiology and resistance patterns [1,3].

Empiric antibiotic selection must balance comprehensive bactericidal coverage with antimicrobial stewardship principles to avoid the unnecessary use of broad-spectrum agents, such as carbapenems or colistin. This is especially critical in resource-limited environments, where options and resistance profiles vary widely among institutions. Studies from South Asia, the Middle East and Africa confirm gram-negative predominance and prevalent multidrug resistance, often deviating from Western susceptibility patterns and underscoring the need for center-specific antibiograms [11].

This study aimed to analyze the phenotypic antimicrobial susceptibility patterns of Gram-positive and Gram-negative bloodstream isolates from febrile neutropenic adults to inform local empirical therapy. Documenting resistance to agents, including carbapenems, piperacillin-tazobactam, glycopeptides, fluoroquinolones and last-resort antibiotics, will support stewardship programs and guide policy. This addresses the evidence gap in local susceptibility trends and highlights the critical need for continuous microbiological surveillance to optimize outcomes in this vulnerable population.

## MATERIALS & METHODS

This cross-sectional observational study was conducted in the Department of Internal Medicine at Shaheed Syed Nazrul Islam Medical College Hospital, Kishoreganj, Bangladesh. The study spanned October 2022 to September 2023. A total of 50 adult febrile neutropenic patients with complete blood culture and susceptibility results were included. The study population consisted of hospitalized adults presenting with documented febrile neutropenia requiring blood culture evaluation.

### Sample Selection

#### Inclusion Criteria

- Adults aged >18 years
- Documented febrile neutropenia (temperature ≥38.3°C once or ≥38.0°C for >1 hour; ANC <1500/µL)
- Availability of complete blood culture and antibiotic susceptibility reports
- Informed written consent provided

#### Exclusion Criteria

- Neutropenia due to confirmed viral infections
- Incomplete laboratory or clinical data

### Data Collection Procedure

Data collection followed a structured process using a pretested data sheet to ensure uniformity and reliability. After informed consent, patient history, physical examination findings and demographic data were recorded. Venous blood samples (10 mL) were taken using sterile technique and inoculated into aerobic culture bottles. Cultures were processed in designated microbiology laboratories using blood agar, chocolate agar and MacConkey agar. Plates were incubated at 37°C for 24–48 hours. Isolates were identified using standard microbiological techniques, including colony morphology and Gram staining. Antimicrobial susceptibility testing was performed using disc diffusion methods according to standard protocols. All laboratory procedures followed internal quality standards and data were cross-checked for consistency. Additional variables, including prior antibiotic use, hematologic parameters and chemotherapy status, were also documented.

### Ethical Considerations

Confidentiality and anonymity were ensured throughout data handling. Informed written consent was obtained before participation. Ethical principles of autonomy, beneficence and nonmaleficence were observed. The study followed local institutional guidelines for biomedical research involving human participants.

### Statistical Analysis

Data analysis was conducted using SPSS version 15. Descriptive statistics (mean ± SD; frequencies and percentages) were used to summarize clinical, demographic and microbiological findings. Comparisons between categorical variables were performed using chi-square tests, while continuous

variables were analyzed using Student's t-tests where applicable. A significance level of $p < 0.05$ was applied.

## RESULTS

**Table 1: Baseline Characteristics of Febrile Neutropenic Patients (n=50)**

| Variable | | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Mean age (years) | | 41.2 ± 18.9 | |
| Gender | Male | 28 | 56 |
| | Female | 22 | 44 |
| Blood culture result | Positive | 15 | 30 |
| | Negative | 35 | 70 |
| Prior antibiotic use | Yes | 20 | 40 |
| | No | 30 | 60 |
| Chemotherapy status | On chemotherapy | 43 | 86 |
| | Not on chemotherapy | 7 | 14 |

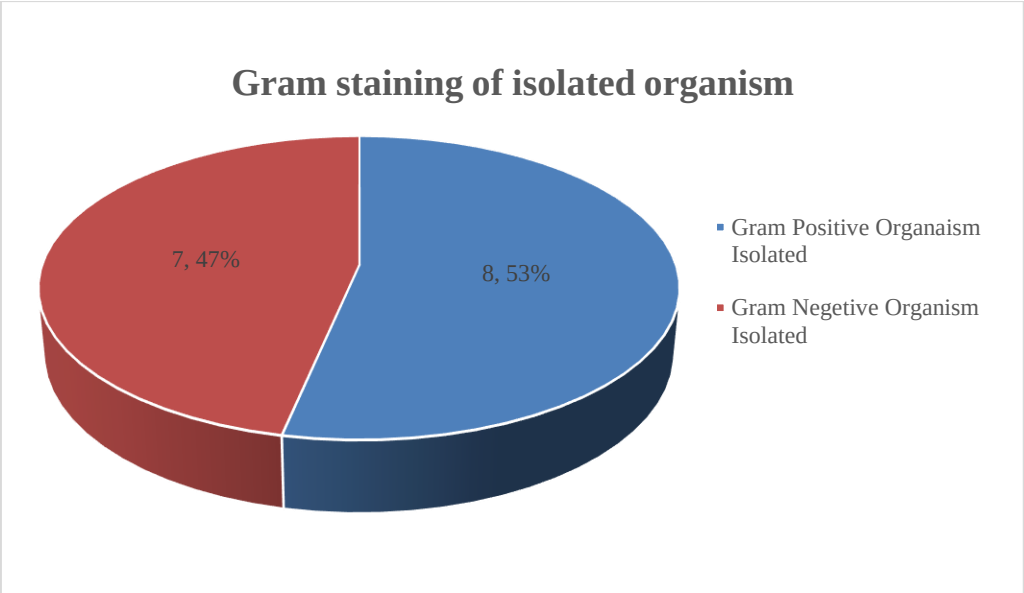


**Figure 1: Result of Gram staining of the isolated organism**

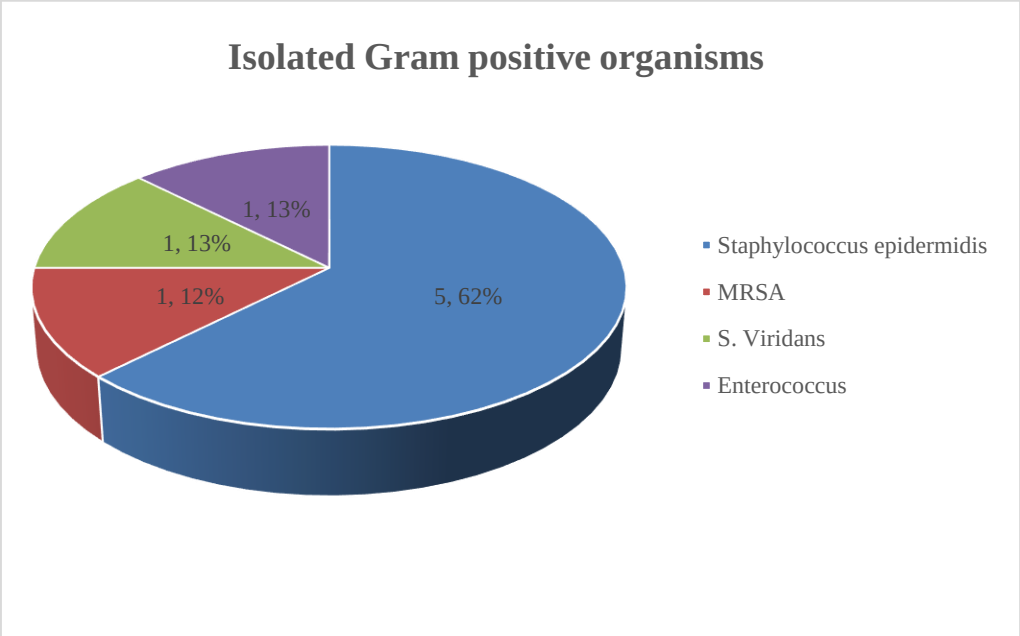


**Figure 2: Isolated Gram-positive organisms**

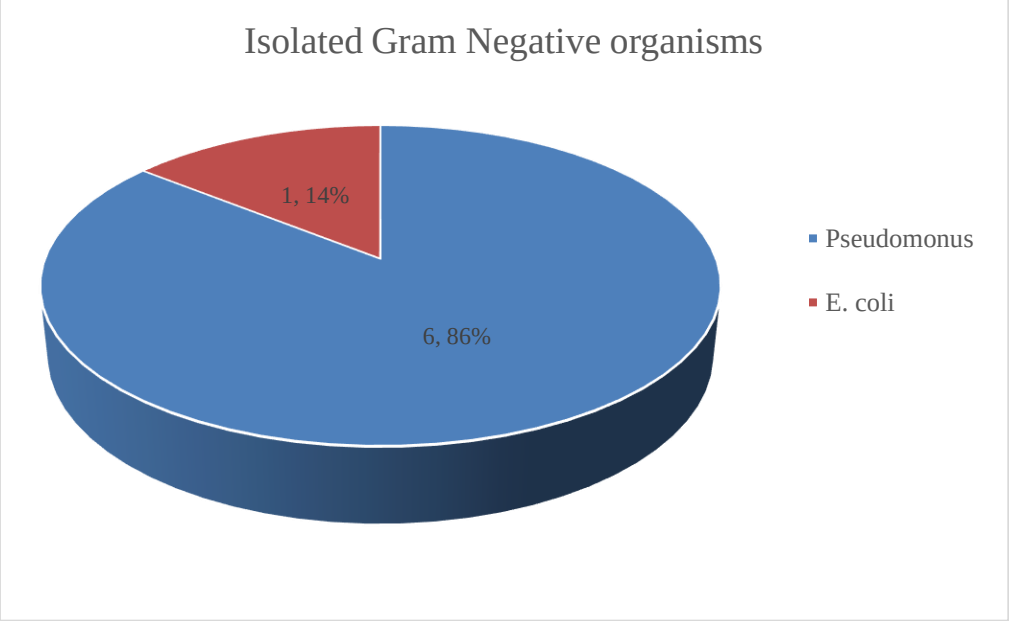


**Figure 3: Isolated Gram-Negative organisms**

**Table 2: Sensitivity and resistance pattern of commonly used antibiotics against isolated Gram-positive pathogens**

| Common Antibiotics, n (%) | | Staphylococcus epidermidis (5) | S. viridians (1) | MRSA (1) | Enterococcus (1) |
|---|---|---|---|---|---|
| | S | 1 (20%) | 0/1 (0%) | 0/1 (0%) | 0/1 (0%) |
| | R | 4 (80%) | 1/1 (1000%) | 1/1 (1000%) | 1/1 (1000%) |
| Cephradine | S | 1/5 (20%) | 0/1 (0%) | 0/1 (0%) | 0/1 (0%) |
| | R | 4/5 (80%) | 1/1 (1000%) | 1/1 (1000%) | 1/1 (1000%) |
| Cefuroxim | S | 1/5 (20%) | 0/1 (0%) | 0/1 (0%) | 0/1 (0%) |
| | R | 4/5 (80%) | 1/1 (1000%) | 1/1 (1000%) | 1/1 (1000%) |
| Ceftazidim | S | 2/5 (40%) | 0/1 (0%) | 0/1 (0%) | 0/1 (0%) |
| | R | 3/5 (60%) | 1/1 (1000%) | 1/1 (1000%) | 1/1 (1000%) |
| Ceftriaxone | S | 2/5 (40%) | 0/1 (0%) | 0/1 (0%) | 0/1 (0%) |
| | R | 3/5 (60%) | 1/1 (1000%) | 1/1 (1000%) | 1/1 (1000%) |
| Meropenem | S | - | 1/1 (100%) | 0/1 (0%) | 0/1 (0%) |
| | R | - | 0/1 (0%) | 1/1 (1000%) | 1/1 (1000%) |
| Piperacillin tazobactam | S | 3/5 (60%) | - | 0/1 (0%) | 0/1 (0%) |
| | R | 2/5 (40%) | - | 1/1 (1000%) | 1/1 (1000%) |
| Vancomycin | S | 5/5 (100%) | 1/1 (100%) | 1/1 (100%) | 1/1 (100%) |
| | R | 0/5 (0%) | 0/1 (0%) | 0/1 (0%) | 0/1 (0%) |
| Ciprofloxacin | S | 1/5 (20%) | 0/1 (0%) | - | |
| | R | 4/5 (80%) | 1/1 (1000%) | - | |
| Linezolid | S | 5/5 (100%) | - | 1/1 (100%) | 1/1 (100%) |
| | R | 0/5 (0%) | - | 0/1 (0%) | 0/1 (0%) |
| Tetracyclines | S | - | 0/1 (0%) | 1/1 (100%) | 0/1 (0%) |
| | R | - | 1/1 (1000%) | 0/1 (0%) | 1/1 (1000%) |

**Table 3: Sensitivity and resistance pattern of commonly used antibiotics against isolated Gram-Negative pathogens**

| Common Antibiotics, n (%) | | Pseudomonas (5) | E. coli (2) |
|---|---|---|---|
| Amoxycilin | S | 0/5 (0%) | 0/2 (0%) |
| | R | 5/5 (1000%) | 2/2 (100%) |
| Cephradine | S | 0/5 (0%) | 0/2 (0%) |
| | R | 5/5 (1000%) | 2/2 (100%) |
| Cefuroxim | S | 0/5 (0%) | 1/2 (50%) |
| | R | 5/5 (1000%) | 1/2 (50%) |
| Ceftazidim | S | 2/5 (40%) | 0/2 (0%) |
| | R | 3/5 (60%) | 2/2 (100%) |

| Common Antibiotics, n (%) | | Pseudomonas (5) | E. coli (2) |
|---|---|---|---|
| Ceftriaxone | S | 0/5 (0%) | 0/2 (0%) |
| | R | 5/5 (1000%) | 2/2 (100%) |
| Meropenem | S | 3/5 (60%) | 1/2 (50%) |
| | R | 2/5 (40%) | 1/2 (50%) |
| Piperacillin tazobactam | S | 3/5 (60%) | - |
| | R | 2/5 (40%) | - |
| Ciprofloxacin | S | 2/5 (40%) | 1/2 (50%) |
| | R | 3/5 (60%) | 1/2 (50%) |
| Amikacin | S | 3/5 (60%) | 0/2 (0%) |
| | R | 2/5 (40%) | 2/2 (100%) |
| Colistin | S | - | 2/2 (100%) |
| | R | - | 0/2 (0%) |

**Table 4: Comparison of previous antibiotic taken before doing blood culture in culture-positive versus culture-negative patients**

| Previous Antibiotic | Blood Culture | | Total |
|---|---|---|---|
| | Organism Isolated | No growth | |
| Yes | 3 | 17 | 20 |
| No | 12 | 18 | 30 |
| Total | 15 | 35 | 50 |

## DISCUSSION

The present study analyzed the antimicrobial susceptibility patterns of bloodstream isolates recovered from febrile neutropenic patients, providing institution-specific data essential for guiding empirical therapy. Among the 50 patients evaluated, bloodstream infection was confirmed in 15 cases, corresponding to a positivity rate of 30%. Although only a subset of patients demonstrated culture-confirmed bacteremia, the distribution of pathogens revealed a mixed microbial landscape, with both Gram-positive and Gram-negative organisms contributing substantially to the burden of infection. This pattern aligns with global trends over the past three decades, during which a shift toward Gram-positive predominance has been widely documented, particularly in centers where central venous catheters, mucositis-inducing chemotherapy and Gram-negative-targeted prophylaxis are common [12].

In the present cohort, Gram-positive organisms accounted for 53.3% of isolates, with *Staphylococcus epidermidis* emerging as the predominant pathogen. This finding reflects similar reports from large surveillance studies where coagulase-negative staphylococci constituted a major proportion of Gram-positive bloodstream isolates in neutropenic patients [13]. The role of these organisms is often linked to mucosal disruption and catheter-related infections, both of which frequently occur in the oncology setting. Additional Gram-positive isolates—Streptococcus viridans, MRSA and Enterococcus—though limited in number, highlight the variety of potential pathogens and the need for empiric regimens that ensure adequate Gram-positive coverage.

Despite the modest predominance of Gram-positive bacteria, Gram-negative organisms constituted 46.7% of isolates, underscoring their continued clinical relevance. *Pseudomonas aeruginosa* was the most frequent Gram-negative pathogen, followed by Escherichia coli. These findings mirror several reports from developing countries where Gram-negative bacilli remain prominent contributors to neutropenic sepsis [14]. Notably, the isolation of an extended-spectrum β-lactamase (ESBL)–producing *E. coli* sensitive only to colistin underscores the rising prevalence of multidrug-resistant Enterobacteriaceae, reflecting trends seen in studies from Turkey, India and Pakistan [15].

Evaluation of antimicrobial susceptibility patterns revealed important implications for empirical therapy. Among Gram-positive isolates, vancomycin and linezolid demonstrated uniform sensitivity, consistent with earlier studies reporting predictable susceptibility of coagulase-negative staphylococci and MRSA to glycopeptides and oxazolidinones [16]. Moderate susceptibility to piperacillin-tazobactam (60%) and limited susceptibility to ceftriaxone or ceftazidime (40%) indicate that β-lactam monotherapy may be insufficient in settings where Gram-positive cocci dominate and reinforces the importance of including agents active against resistant Gram-positive bacteria in selected clinical scenarios.

For Gram-negative organisms, susceptibility results were mixed. *Pseudomonas aeruginosa* demonstrated 60% sensitivity to meropenem, imipenem, piperacillin-tazobactam and amikacin. These rates, while reflecting preserved efficacy of key antipseudomonal agents, are lower than those reported in some earlier studies where carbapenem susceptibility approached 100% [16]. The reduced susceptibility observed here may be indicative of emerging carbapenem resistance, a phenomenon increasingly reported worldwide.

Susceptibility to ceftazidime and ciprofloxacin was lower (40%), echoing the global trend of declining fluoroquinolone and cephalosporin effectiveness against Pseudomonas. The presence of *E. coli* strains resistant to all tested β-lactams except colistin raises additional concerns regarding the spread of ESBL phenotypes, paralleling reports from high-burden regions [15].

An additional observation from this study is the relationship between prior antibiotic exposure and culture positivity. Although not statistically significant, culture results tended to be more frequently positive among patients who had not received antibiotics before sampling. This finding is consistent with established evidence that pre-culture antibiotic administration reduces bacterial recovery, potentially delaying pathogen-directed therapy [17]. This reinforces the importance of obtaining blood cultures before initiating antibiotics whenever feasible without compromising patient safety.

Overall, the results of this study highlight the importance of continuous microbiological surveillance to capture evolving resistance patterns and guide empirical therapy in febrile neutropenia. The coexistence of Gram-positive predominance with clinically significant Gram-negative infections necessitates empiric regimens capable of covering both groups effectively. Local patterns of resistance—such as reduced carbapenem sensitivity among Gram-negative organisms and complete susceptibility of Gram-positive isolates to vancomycin—must be considered when formulating institutional guidelines. The data further emphasize the need for stewardship strategies to preserve the effectiveness of broad-spectrum agents while preventing unnecessary escalation to last-resort antibiotics such as colistin.

### LIMITATIONS OF THE STUDY

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community. Only aerobic cultures were performed; thus, anaerobic, fungal, or viral pathogens were not assessed. Prior antibiotic exposure may have suppressed bacterial growth and influenced observed culture patterns.

## CONCLUSION

Bloodstream isolates recovered from febrile neutropenia demonstrated a mixed pattern of Gram-positive and Gram-negative pathogens, with *Staphylococcus epidermidis* and *Pseudomonas aeruginosa* emerging as the most frequent isolates. Gram-positive organisms showed consistent susceptibility to vancomycin and linezolid, while Gram-negative organisms demonstrated variable sensitivity to carbapenems, piperacillin-tazobactam and amikacin and notable resistance to cephalosporins and fluoroquinolones. The detection of ESBL-producing *E. coli* sensitive only to colistin highlights growing resistance challenges. These findings underscore the necessity of local susceptibility data to inform empirical antibiotic regimens and guide stewardship efforts in the management of febrile neutropenia.

**Acknowledgment:**

I would like to express my sincere gratitude for the invaluable support and cooperation provided by the staff, participants and my co-authors/colleagues who contributed to this study.

**Conflicts of interest:** There are no conflicts of interest.

**Ethical approval:** The study was approved by the Institutional Ethics Committee.

## REFERENCES

1. Rolston KVI. Challenges in the Treatment of Infections Caused by Gram-Positive and Gram-Negative Bacteria in Patients with Cancer and Neutropenia. Clin Infect Dis. 2005 Apr;40(Suppl 4): S246–52.
2. Rolston KVI. The Infectious Diseases Society of America 2002 guidelines for the use of antimicrobial agents in patients with cancer and neutropenia: salient features and comments. Clin Infect Dis. 2004 July;Suppl 39 1(s1): S44–8.
3. Averbuch D, Klyasova G, Viscoli C, Kern WV, Cordonnier C, Livermore DM, *et al.*,European guidelines for empirical antibacterial therapy for febrile neutropenic patients in the era of growing resistance: summary of the 2011 4th European Conference on Infections in Leukemia. Haematologica. 2013 Dec;98(12):1826–35.
4. Ramphal R. Is monotherapy for febrile neutropenia still a viable alternative? Clin Infect Dis Off Publ Infect Dis Soc Am. 1999 Sept;29(3):508–14.
5. Miedema KGE, Droz S, Spanjaard L, De Bont ESJM, Tissing WJE, Van De Wetering MD, *et al.*,Bacteria causing bacteremia in pediatric cancer patients presenting with febrile neutropenia—species distribution and susceptibility patterns. Support Care Cancer. 2013 Apr;21(9):2417–26.
6. Le Doare K, Bielicki J, Heath PT, Sharland M. Systematic review of antibiotic resistance rates among gram-negative bacteria in children with sepsis in resource-limited countries. Journal of the pediatric infectious disease's society. 2015 Mar 1;4(1):11-20.
7. Wen SC, Ezure Y, Rolley L, Spurling G, Lau CL, Riaz S, Paterson DL, Irwin AD. Gram-negative neonatal sepsis in low-and lower-middle-income countries and WHO empirical antibiotic recommendations: a systematic review and meta-analysis. PLoS medicine. 2021 Sep 28;18(9): e1003787.
8. Kakaraskoska Boceska B, Vilken T, Xavier BB, Kostyanev T, Lin Q, Lammens C, Ellis S, O'Brien S, da Costa RM, Cook A, Russell N. Assessment of three antibiotic combination regimens against

Gram-negative bacteria causing neonatal sepsis in low-and middle-income countries. Nature communications. 2024 May 10;15(1):3947.
9. Bediako-Bowan AA, Kurtzhals JA, Mølbak K, Labi AK, Owusu E, Newman MJ. High rates of multi-drug-resistant gram-negative organisms associated with surgical site infections in a teaching hospital in Ghana. BMC Infectious Diseases. 2020 Nov 25;20(1):890.
10. Sulis G, Sayood S, Gandra S. Antimicrobial resistance in low-and middle-income countries: current status and future directions. Expert review of anti-infective therapy. 2022 Feb 1;20(2):147-60.
11. Rabagliati R, Iturrieta MP, Flores J, Ojeda MJ, Salazar G, Pérez-Lazo G, *et al.*,An Emergent Change in Epidemiologic and Microbiological Characteristics of Bloodstream Infections in Adults with Febrile Neutropenia Resulting from Chemotherapy for Acute Leukemia and Lymphoma at Reference Centers in Chile, Ecuador and Peru. Open Forum Infect Dis. 2024 Feb;11(3).
12. Wisplinghoff H, Seifert H, Wenzel RP, Edmond MB. Current trends in the epidemiology of nosocomial bloodstream infections in patients with hematological malignancies and solid neoplasms in hospitals in the United States. Clinical Infectious Diseases. 2003 May 1;36(9):1103-10.
13. Klastersky J. Science and pragmatism in the treatment and prevention of neutropenic infection. The Journal of antimicrobial chemotherapy. 1998 Jun 1;41(suppl_4):13-24.
14. Kumar L, Kochupillai V, Bhujwala RA. Infections in acute myeloid leukemia. Study of 184 febrile episodes. The Journal of the Association of Physicians of India. 1992 Jan 1;40(1):18-20.
15. Sacar S, Hacioglu SK, Keskin A, Turgut H. Evaluation of febrile neutropenic attacks in a tertiary care medical center in Turkey. The Journal of Infection in Developing Countries. 2008 Oct 1;2(05):359-63.
16. Meidani M, Bagheri A, Khorvash F. A population-based study of bacterial spectrum in febrile neutropenic patients; 2013;6(2):150.
17. Gonzalez-Barca E, Fernandez-Sevilla A, Carratala J, Granena A, Gudiol F. Prospective study of 288 episodes of bacteremia in neutropenic cancer patients in a single institution. European Journal of Clinical Microbiology and Infectious Diseases. 1996 Apr;15(4):291-6.