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Original Article

Microbiology Section

Microbial Spectrum, Resistance Patterns, and Outcomes in Febrile Neutropenic Cancer Patients: A Retrospective Observational Study

GODSON SHAJI[1], SREERAJ VASUDEVAN[2], GEETHALAKSHMI VELAYUDHAN[3], MARIYA JOHNSON[4], ALGA THOMAS[5], VIDHU JOSHY[6], REENA JOHN[7], ANIL JOSE THAZATH[8]

ABSTRACT

Introduction: Febrile Neutropenia (FN) represents a critical medical emergency in the field of oncology, necessitated by the profound state of immunosuppression that follows cytotoxic chemotherapy. In regions like India, the management of FN is increasingly complicated by an escalating prevalence of Multidrug-Resistant (MDR) pathogens, which threatens to render traditional empirical antibiotic regimens obsolete.

Aim: To analyse short-term outcomes, including 30-day mortality and reinfection, in oncology patients with FN.

Materials and Methods: This retrospective observational study was conducted at Amala Institute of Medical Sciences, Thrissur, in Central Kerala, India, from January to December 2024. A total of 340 FN episodes were analysed. Blood cultures were processed using the BACT/ALERT automated system. Organism identification and Antimicrobial Susceptibility Testing (AST) were performed via the VITEK 2 Compact using specific identification cards. Interpretation of resistance followed the Clinical and Laboratory Standards Institute (CLSI) M100 34th edition (2024) guidelines. Descriptive statistics, including means with standard deviations and frequencies, were used to summarise baseline data. Predictors of 30-day mortality were identified using univariate and penalised multivariable (ridge) logistic regression analysis with a p-value <0.05 considered statistically significant.

Results: Among the 340 FN episodes, 149 (43.8%) were culture-positive. Gram-Negative Bacilli (GNB) predominated (53.7%), led by *Klebsiella* spp. (25.0%) and *Acinetobacter baumannii* (17.5%). High resistance was noted among Enterobacterales, with 71.1% ESBL production and 35.56% phenotypic Carbapenem-resistant Enterobacterales (CRE). The 30-day all-cause mortality rate was 21.5% (32/149), primarily driven by GNB infections (56.2%). MDR organism positivity was the only significant independent predictor of mortality (aOR: 3.64; 95% CI: 1.67-7.91; p-value=0.0011). Reinfection within 30 days occurred in 38.5% of survivors.

Conclusion: There is a high burden of ESBL and Carbapenem resistance GNB among FN in the study, which demands the use of aggressive antimicrobial therapy. These findings underscore the necessity for active microbiological surveillance and the early initiation of aggressive empirical antimicrobial therapy to improve clinical outcomes and mitigate the high burden of reinfection in FN oncology patients.

Keywords: Antimicrobial stewardship, Carbapenem resistance, Haematologic malignancy, Sepsis

INTRODUCTION

Cancer remains a leading global cause of mortality, accounting for approximately 13% of all worldwide deaths, with a disproportionately high burden residing in Low- and Middle-Income Countries (LMICs) such as India [1]. Chemotherapy-induced neutropenia is a common and dangerous adverse effect of systemic anti-cancer treatments, predisposing patients to severe, rapidly progressing infections [2]. FN is historically regarded as an oncological emergency because it represents the only clinical sign of underlying life-threatening infection in an immunocompromised host [3]. Immediate initiation of broad-spectrum antimicrobial therapy is the standard of care to prevent sepsis, organ failure, and death [4]. However, the global rise of Antimicrobial Resistance (AMR) has complicated the empirical management of these patients, particularly in India, which has been identified as a significant contributor to the global AMR crisis due to widespread antibiotic misuse, inadequate regulation of over-the-counter sales, and hospital infection-control challenges [5].

Recent epidemiological data from across India indicate a significant shift in the microbial spectrum causing FN [3]. While landmark studies from the United States and Europe in the 1990s, notably by Wood AJJ and Pizzo PA and Zinner SH, reported a predominance of Gram-positive organisms often linked to the increased use of indwelling Central Venous Catheters (CVC) and increased use of indwelling CVCs and fluroquniolone prophylaxis [6,7]. Indian data consistently show a resurgence of GNB, such as *Escherichia coli*, *Klebsiella pneumoniae*, and *Acinetobacter baumannii* [2,4,8]. This pattern is clinically concerning because GNB bacteraemia is associated with more rapid clinical deterioration, a higher incidence of septic shock, and greater 30-day mortality compared to Gram-positive infections in FN patients [9,10]. The 2024 Indian Council of Medical Research (ICMR) surveillance report revealed alarming trends in carbapenem resistance, with imipenem susceptibility for *Klebsiella pneumoniae* dropping to 31.2% (indicating 68.8% resistance) and explicit carbapenem resistance reaching 43% for *Pseudomonas aeruginosa* isolates in India [11].

Kerala has been at the forefront of Antimicrobial Stewardship (AMS) in India, launching the Kerala Antimicrobial Resistance Strategic Action Plan (KARSAP) in 2018 [12] and the “AMRITH” (Antimicrobial Resistance Intervention for Total Health) initiative in 2024 [13]. Despite these efforts, robust surveillance data from specialised oncology centres in South India remain limited [14,15]. There is a critical need to understand how local resistance patterns influence short-term clinical outcomes such as mortality and reinfection, particularly given the high selective pressure of broad-spectrum antibiotics used in oncology units [16]. Existing gaps in the literature involve the lack of longitudinal data correlating specific resistance with clinical failure and the high reinfection rates observed after the initial FN episode [10,16].

This study aimed to evaluate the microbial spectrum, resistance patterns, and clinical outcomes specifically 30-day reinfection rates and all-cause mortality among FN cancer patients at a tertiary cancer centre in Central Kerala, India.

MATERIALS AND METHODS

This retrospective observational study was conducted at Amala Institute of Medical Sciences, Thrissur, in Central Kerala, India. The clinical data were collected from January 2024 to December 2024. Data extraction, collation, and statistical analysis were subsequently conducted from January 2025 to March 2025. Institutional ethical approval was obtained from the Amala Institute of Medical Sciences Ethics Committee (Ref. 04.EC/24/AIMS-05). Due to the retrospective nature of the study and the use of de-identified medical records, the requirement for individual informed consent was waived by the committee.

The FN was defined as a single oral temperature of ≥38.3°C (≥101°F) or a temperature of ≥38.0°C (≥100.4°F) sustained over a 1-hour period, in conjunction with an Absolute Neutrophil Count (ANC) of <500 cells/μL or an ANC expected to decrease to <500 cells/μL within the next 48 hours [17]. The ANC was derived using standard laboratory parameters. Neutropenia and profound neutropenia were defined as an ANC of <500 cells/μL and <100 cells/μL, respectively, in accordance with the Infectious Diseases Society of America (IDSA) 2011 guidelines [17].

Sample size: A formal sample size calculation was not performed due to the retrospective design. The study included 340 consecutive FN episodes occurring in 258 unique patients who met the inclusion criteria during the one-year study period (January 2024 - December 2024).

Inclusion criteria: Patients undergoing chemotherapy for malignancy who met international criteria for FN, adult patients (age >18 years) who presented with a formal diagnosis of FN were included in the study.

Exclusion criteria: Patients with fever episodes that did not meet the strict FN definition (e.g., non neutropenic fever), FN episodes where blood cultures were not obtained prior to the administration of new antibiotic regimens, patients with incomplete medical records regarding 30-day clinical outcomes; and patients under 18 years of age were excluded from the study.

Study Procedure

Blood cultures were obtained following standard guidelines, at least two sets were collected, including one set via peripheral venipuncture and a second set either from a different peripheral site or, if a CVC or chemoport was present, from each catheter lumen [17]. Each set comprised one aerobic and one anaerobic bottle. A target volume of 8 to 10 mL of blood was inoculated into each bottle to ensure optimal sensitivity for low-level bacteraemia.

Blood samples were transported to the clinical microbiology laboratory within one hour and loaded into the BACT/ALERT (bioMérieux) automated microbial detection system. This system continuously monitors for growth every 10 minutes via colorimetric sensors that detect carbon dioxide production [18]. Cultures were incubated for a minimum of five days at 37°C before being reported as negative, a duration established as sufficient for the recovery of the majority of clinically significant pathogens in automated systems [19].

Upon a positive growth signal, Gram staining and subculturing on to blood agar and Mac-Conkey agar were performed. Organism identification and AST were conducted using the VITEK 2 Compact automated system (bioMérieux). Specifically, ID-GN cards and AST-N406, 407 cards were used for Gram-negative organisms, while ID-GP and AST cards were used for Gram-positives. Minimum Inhibitory Concentrations (MICs) were determined, and susceptibility was interpreted using the CLSI M100 34th edition (2024) breakpoints [20]. Coagulase-Negative Staphylococci (CONS) were considered contaminants unless they were isolated from at least two separate culture sets or were associated with clinical signs of sepsis (haemodynamic instability) and a clear source such as a catheter-related infection [17,19]. Extended-spectrum beta-lactamases (ESBLs) and CRE were identified in accordance with the CLSI M100 guidelines [20]. ESBL production in *Escherichia coli* and *Klebsiella* spp. was initially screened using third-generation cephalosporins (ceftriaxone and cefotaxime) and confirmed via the phenotypic combined disk method, demonstrating a more than 5 mm increase in the zone diameter for either antimicrobial tested in combination with clavulanate versus the antimicrobial tested alone. CRE isolates were identified based on in-vitro resistance to meropenem, imipenem, or ertapenem, defined by MIC breakpoints or disk diffusion zone diameters as specified by the CLSI [20].

The primary outcome was 30-day all-cause mortality, defined as death from any cause occurring within 30 days of the index FN diagnosis. The index episode was defined as the first chronological FN event meeting the inclusion criteria for each patient during the one-year study period. The secondary outcome was 30-day reinfection. Reinfection was defined as a new microbiologically confirmed infection (isolation of a different organism from blood or another sterile site) or a recurrent febrile episode requiring new intravenous antibiotics, occurring after the initial episode had resolved and the patient had remained afebrile for >48 hours, in accordance with European Organisation for Research and Treatment of Cancer (EORTC) International Antimicrobial Therapy Group criteria [21]. Outcomes were assessed through in-hospital records or post-discharge follow-up telephone calls with the patient or their primary caregiver after 30 days of index FN diagnosis.

STATISTICAL ANALYSIS

Statistical analysis was performed using IBM Statistical Package for the Social Sciences (SPSS) Statistics (version 27.0) and R (version 4.4.2). Data normality was assessed using the Shapiro-Wilk test. Group comparisons were conducted using the Pearson Chi-square test or Fisher's exact test for categorical variables, and the independent t-test or Mann-Whitney U test for continuous variables. Univariate and multivariate logistic regression analyses were performed to identify predictors of outcomes. All tests were two-tailed, with a p-value <0.05 considered statistically significant.

RESULTS

A total of 340 FN events in 258 patients happened during the study period. Of the 340 episodes, 149 (43.8%) were blood culture-positive, while 191 (56.2%) yielded no microbial growth after five days of incubation [Table/Fig-1].

Characteristics	Total FN episode (N=340) No. (%) or Mean±SD
Age (years)	55.6±17.2
Sex	
Male	214 (63.0)
Female	126 (37.0)
Primary cancer type	
Haematologic malignancy	197 (58.0)
Solid tumour	143 (42.0)
Specific diagnoses	
Leukaemia	101 (29.7)
Multiple myeloma	49 (14.4)
Lymphoma	47 (13.8)

Carcinoma (Solid)	143 (42)
Neutropenia severity	
ANC <100	82 (24.1)

[Table/Fig-1]: Baseline demographic and clinical characteristics of Febrile Neutropenia (FN) episodes (N=340).
Abbreviations: SD: Standard deviation
Note: Percentages may not total 100 because of rounding.

Among the 149 episodes with positive blood cultures, Gram-negative organisms formed the largest group accounting for 80 isolates (53.7%), while Gram-positive organisms accounted for 69 isolates (46.3%). The distribution of GNB isolates revealed a high diversity of pathogens. The four most common species were *Klebsiella* spp., *Acinetobacter baumannii, Escherichia coli, Pseudomonas aeruginosa* accounted for 56 isolates (70% of GNB). The distribution of GNB and GPC are given in [Table/Fig-2].

Organism	n (%)[a]
Gram-negative bacteria (Total n=80)	
Klebsiella spp.	20 (25.0)
Acinetobacter baumannii	14 (17.5)
Escherichia coli	13 (16.25)
Pseudomonas aeruginosa	9 (11.25)
Burkholderia spp.	7 (8.75)
Enterobacter spp.	6 (7.5)
Proteus spp.	4 (5.0)
Sphingomonas paucimobilis	2 (2.5)
Stenotrophomonas maltophilia	2 (2.5)
Non typhoidal *Salmonella*	1 (1.2)
Ralstonia spp.	1 (1.2)
Citrobacter koseri	1 (1.2)
Gram-positive bacteria (Total n=69)	
Coagulase-negative Staphylococci (CoNS)	45 (65.2)
Enterococcus spp.	10 (14.5)
Corynebacterium spp.	8 (11.6)
Streptococcus spp.	4 (5.8)
Staphylococcus aureus	1 (1.4)
Kocuria kristinae	1 (1.4)

[Table/Fig-2]: Distribution of bacterial isolates in Febrile Neutropenia (FN) episodes.
Abbreviations: CoNS: Coagulase-negative staphylococci
Note: [a]Data reconciled based on the total culture-positive cohort. CoNS were considered contaminants unless meeting specific clinical criteria. Percentages may not total 100 due to rounding. Percentages were calculated based on the total number of isolates within their respective subgroup (Gram-negative n=80; Gram-positive n=69)

The 69 (46.3%) Gram-positive isolates were dominated by CONS. However, after applying the predefined criteria for pathogenicity, only 13% (n=9/69) of CONS were considered genuine pathogens. True Gram-positive pathogens 33 out of 69 (47.8%) were led by *Enterococcus (n=10), CoNS (n=9)* and *Corynebacterium (n=8)* species, *Streptococcus* (n=4), *S. aureus* (n=1), and *Kocuria kristinae* (n=1).

A 25% of all deaths occurred in leukaemia patients (n=8/32). Acute Myeloid Leukaemia (AML) and breast carcinoma were the most common malignancies among haematological cancers and solid organ tumours, respectively.

Analysis of the 80 (53.7%) Gram-negative isolates demonstrated extremely high levels of resistance to traditional agents. The prevalence of ESBL production among Enterobacterales was 72.7% (n=32/44). Phenotypic CRE prevalence was 36.36% of Enterobacterales isolates (n-16/44) [Table/Fig-3]. Colistin sensitivity remained 100% across all Gram-negative isolates.

[Table/Fig-4] shows the distribution of CRE isolates in the study cohort. Among the 16 isolates identified, *Klebsiella* spp. was the predominant organism, comprising 56.2% (n=9) of all isolates. *Escherichia coli* and *Enterobacter* spp. each accounted for 18.8% (n=3), while *Proteus* spp. was least frequent at 6.2% (n=1). These findings indicate that the CRE isolate profile in this cohort was largely driven by *Klebsiella* spp, with a smaller contribution from *Escherichia coli*, *Enterobacter* spp., and *Proteus* sp.

Among the predominant CRE isolates, *Escherichia coli* showed relatively higher susceptibility to amikacin 9/12 (75%), gentamicin 8/10 (80%), imipenem 10/13 (77%), and meropenem 10/13 (77%), whereas susceptibility to ampicillin 1/13 (7.7%) and most cephalosporins remained low. *Klebsiella* spp. demonstrated better susceptibility to fosfomycin 3/3 (100%), tigecycline 4/6 (67%), and ertapenem 2/3 (67%), with moderate activity of amikacin 11/20 (55%), gentamicin 10/19 (53%), imipenem 11/20 (55%), and meropenem 11/20 (55%), but similarly low susceptibility to ampicillin 1/20 (5%) and several cephalosporins. Overall, both organisms exhibited limited susceptibility to commonly used antibiotics, with comparatively better activity retained for selected reserve agents and aminoglycosides. [Table/Fig-5] present the susceptibility pattern of *E. coli* spp and *Klebsiella* spp.

Meropenem was the most frequently utilised initial empirical antibiotic, used in 108 (72.5%) of the culture-positive episodes. Patients with CRE bacteraemia required escalation to colistin or ceftazidime-avibactam in 100% of cases, with a median time to escalation of 48 hours. Zero mortality was observed among CRE bacteraemia patients treated with colistin and ceftazidime-avibactam compared to other antibiotic regimes.

The 30-day all-cause mortality rate among culture-positive FN cases was 21.5% (n=32/149) deaths. Gram-negative pathogens were associated with 18 of these deaths (56.2%). Gram positive pathogens were associated with 14 deaths (43.8%). [Table/Fig-6] lists common gram-negative organisms causing death.

Of the 104 patients who survived the initial febrile episode and were evaluable for secondary outcomes, 40 (38.5%) experienced a microbiologically confirmed reinfection within 30 days.

Among the evaluated predictors, MDR organism positivity showed the strongest association with 30-day mortality in both univariate and multivariable analyses. In univariate analysis, MDR positivity was associated with higher odds of death at 30 days with an OR of 4.55 (95% CI 2.11-9.79, p-value=0.0001). After adjustment in the multivariable ridge logistic regression model, this association remained significant with an adjusted OR of 3.64 (95% CI 1.67-7.91, p-value=0.0011). Severe neutropenia defined as ANC <100 was associated with mortality in univariate analysis, OR 2.57 (95% CI 1.14-5.78, p-value=0.0225), but this association attenuated in multivariable analysis, adjusted OR 2.09 (95% CI 0.89-4.90, p-value=0.0907). Male sex, leukaemia, and age greater than 60 years were not independently associated with 30-day mortality in the final model. Univariate and multivariate data represented in [Table/Fig-7].

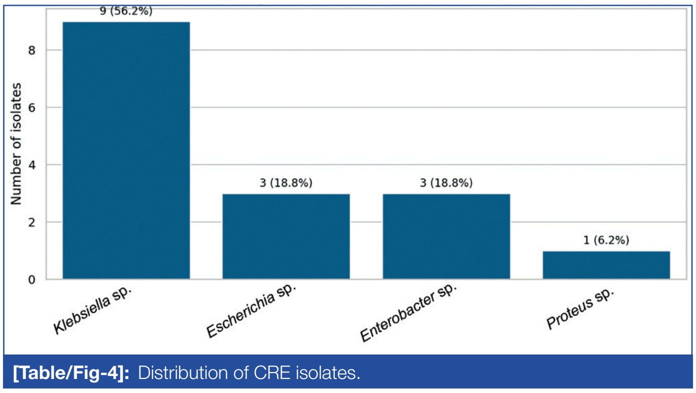
DISCUSSION

This retrospective study provides a critical snapshot of the evolving microbiological landscape and AMR trends within a tertiary cancer centre in Kerala, India. The findings reinforce a clear predominance of GNB in FN, accounting for 80 (53.7%) of culture-positive isolates. This mirrors broader epidemiological shifts across India, where GNB rates of 57.6% are reported [8]. The clinical implications of this shift are profound; GNB sepsis in neutropenic patients is associated with faster progression to multiorgan failure and a higher risk of 30-day mortality.

This analysis suggests that MDR positivity is the most important independent predictor of 30-day mortality in this cohort, even after adjustment for age, sex, leukaemia, and profound neutropenia. This finding was consistent with Tamma PD et al., who emphasise that multidrug resistance in Gram-negative pathogens significantly limits therapeutic options and worsens outcomes in high-risk

No	Age (years)	Sex	Type of cancer	Organism	Ertapenem	Imipenem	Meropenem	Day 30 reinfection	Death
1	58	F	Leukaemia	*Escherichia coli*	NA	R	R	Yes	No
2	62	F	Carcinoma	*Escherichia coli*	R	R	R	No	No
3	60	F	Myeloma	*Escherichia coli*	R	R	R	No	Death
4	68	F	Leukaemia	*Klebsiella* sp.	NA	R	R	No	Death
5	40	F	Leukaemia	*Klebsiella* sp.	NA	R	R	Yes	No
6	79	M	Myeloma	*Klebsiella* sp.	NA	R	R	No	No
7	45	F	Carcinoma	*Klebsiella* sp.	R	R	R	No	Death
8	67	M	Carcinoma	*Klebsiella* sp.	NA	R	R	Yes	No
9	39	F	Leukaemia	*Klebsiella* sp.	NA	R	R	Yes	No
10	72	F	Leukaemia	*Klebsiella* sp.	NA	R	R	No	No
11	35	M	Leukaemia	*Klebsiella* sp.	NA	R	R	No	No
12	60	F	Carcinoma	*Klebsiella* sp.	NA	R	R	No	No
13	69	M	Leukaemia	*Proteus* sp.	NA	R	R	Yes	No
14	69	F	Carcinoma	*Enterobacter* spp.	NA	R	R	No	No
15	39	F	Leukaemia	*Enterobacter* spp.	NA	R	R	Yes	No
16	19	F	Leukaemia	*Enterobacter* spp.	R	R	R	No	No

[Table/Fig-3]: Clinical Characteristics of CRE isolates.
Abbreviations: M: Male; F: Female; NA: Not tested; R: Resistant



[Table/Fig-4]: Distribution of CRE isolates.

Antibiotic	*Escherichia coli* (S,%)	*Klebsiella* spp. (S,%)
Amikacin	75% (9/12)	55% (11/20)
Ampicillin	7.7% (1/13)	5% (1/20)
Cefazolin	15% (2/13)	15% (3/20)
Cefepime	100% (1/1)	50% (1/2)
Cefoperazone-sulbactum	62% (8/13)	40% (8/20)
Cefotaxime	15% (2/13)	25% (5/20)
Ceftazidime-avibactam	50% (1/2)	27.2% (3/11)
Ceftriaxone	15% (2/13)	25% (5/20)
Cefuroxime	15% (2/13)	20% (4/20)
Chloramphenicol	NA	50% (1/2)
Ciprofloxacin	25% (3/12)	37% (7/19)
Ertapenem	33% (1/3)	67% (2/3)
Fosfomycin	67% (2/3)	100% (3/3)
Gentamicin	80% (8/10)	53% (10/19)
Imipenem	77% (10/13)	55% (11/20)
Meropenem	77% (10/13)	55% (11/20)
Minocycline	NA	100% (1/1)
Ofloxacin	0% (0/1)	NA
Piperacillin-tazobactum	46% (6/13)	40% (8/20)
Tigecycline	100% (3/3)	67% (4/6)
Trimethoprim-sulfamethoxazole	27% (3/11)	45% (9/20)

[Table/Fig-5]: Susceptibility pattern of *E. coli* and *Klebsiella sp.*
Note: Resistance was determined by CLSI M100-34th Edition (2024) breakpoints, Percentages are calculated based on the total number of isolates for each specific organism. As the total count for each species is <30, these data do not constitute a formal cumulative antibiogram as defined by CLSI M39-A4 guidelines and should be interpreted with caution regarding statistical representation

Organism	n (%)[a]
Escherichia coli	6 (33.3)
Acinetobacter baumannii	4 (22.2)
Klebsiella spp.	4 (22.2)
Burkholderia sp.	2 (11.1)
Pseudomonas aeruginosa	1 (5.6)
Proteus spp.	1 (5.6)

[Table/Fig-6]: GNB organisms most frequently associated with 30-day mortality.
[a] Calculated based on a total of N=18 deaths.
Note: All organisms listed were Gram-negative bacteria

Predictor	Univariate OR (95% CI)	Univariate p-value	Multivariable OR (95% CI)	Multivariable p-value
MDR positive	4.55 (2.11-9.79)	0.0001	3.64 (1.67-7.91)	0.0011
ANC <100	2.57 (1.14-5.78)	0.0225	2.09 (0.89-4.9)	0.0907
Male sex	0.55 (0.26-1.16)	0.1154	0.63 (0.29-1.33)	0.223
Leukaemia	1.3 (0.6-2.8)	0.5074	1.01 (0.45-2.28)	0.9762
Age >60 years	-	-	1	-

[Table/Fig-7]: Univariate and multivariate analysis of predictors of mortality.
Footnote: Age >60 years was included in the penalised multivariable ridge logistic regression model; however, its coefficient was shrunk to approximately zero, yielding an adjusted OR of 1.00, and conventional 95% confidence intervals and p values were not reliably estimable from the penalised model output. Multivariable ridge logistic regression was performed after imputation; total analytic cohort = 340. Multivariable analysis was retained as an exploratory model to estimate adjusted effects of clinically relevant covariates despite non-significant univariate associations; findings should be interpreted cautiously given the limited sample size and event count

patients [22]. Furthermore, the present study results mirror the rising burden of carbapenem-resistant isolates in the Indian context as documented by the Indian Council of Medical Research (ICMR) [11]. The association between ANC <100 cells/µL and mortality remained clinically relevant but lost conventional statistical significance after multivariable adjustment. Nevertheless, this remains a cornerstone of risk stratification according to Freifeld AG et al., in the IDSA guidelines, which identify profound neutropenia as a primary driver of infectious complications [17].

The exceptionally high burden of resistance among GNB is alarming. The observed ESBL prevalence of 72.7% (n=32/44) and phenotypic CRE prevalence of 36.6% (n=16/44) are similar to that of other reported national Indian studies [2,4,8,23]. For instance, the 2024 ICMR AMRSN annual report cited carbapenem resistance at 34% for *Escherichia coli* and 58% for *Klebsiella pneumoniae* in hospital-acquired infections [11]. The diminishing reliability of carbapenems is a particular concern; meropenem faced a resistance rate 36.6% (n=26/71) among GNB. This trend aligns with the WHO GLASS

2025 report, which indicates that resistance to last-resort antibiotics is widespread and increasing in India [24].

The patient was initially started on empirical meropenem therapy, which was later switched to linezolid. The patient survived the infection. A similar prevalence of VRE (5.3%) was reported in a study conducted by Bajpai V et al., [10].

For patients with CRE bacteraemia, therapeutic options are limited to newer agents such as ceftazidime-avibactam or colistin. While ceftazidime–avibactam demonstrated 80% susceptibility, it lacks activity against New Delhi metallo-beta-lactamase (NDM) producers, which are highly prevalent in India [23]. Colistin remains the salvage therapy with 100% susceptibility preserved in our isolates.

The all-cause mortality rate of 21.5% (n=32/149) aligns with previous studies conducted by Jacob L et al., Bajpai V et al., and Horasan ES et al., where mortality rates in febrile neutropenic patients are 13.3%, 33% and 32.6%, respectively [10,14,25].

A 25% of all deaths occurred in leukaemia patients. AML was the most common malignancy among haematological cancers, and carcinoma breast was the most common malignancy among solid organ tumours. The high mortality among AML patients was also observed in a recent study conducted by Jacob L et al., [14].

The 30-day reinfection rate of 40 (38.5%) among culture-positive patients was exceptionally high. This was likely due to the recurrent nature of neutropenia and mucositis in patients receiving multi-cycle chemotherapy (e.g., AML induction), providing a constant portal for translocation of resistant gut flora. Implementation of routine rectal screening for ESBL and CRE colonisation could help identify high-risk patients [3].

Limitation(s)

This study had several limitations. First, its retrospective design introduced selection bias regarding dynamic clinical data. Second, classification of CONS as contaminants is subjective and may underestimate the Gram-positive burden. Third, as a single-centre study, findings may not be generalisable to community-based units. Finally, univariate analyses are limited by confounding and multiple comparison, and several predictors had sparse categories, raising concern for unstable estimates or separation. The multivariable model is constrained by the small number of events (32 deaths) relative to candidate covariates, increasing risk of overfitting and wide/unstable adjusted effects; residual confounding from unmeasured severity and treatment factors may remain.

CONCLUSION(S)

This study demonstrated that MDR-GNB, particularly ESBL-producing and CRE, are the primary drivers of 30-day mortality in patients with FN. Analysis of the cohort identified MDR status as the sole significant independent predictor of mortality. The concentration of deaths within the GNB bacteraemia group highlights a critical window where current empirical therapies may be failing due to rising resistance levels. Consequently, local clinical guidelines must be updated to recommend the early initiation of targeted “high-end” antibiotics for patients identified as high-risk for CRE. Furthermore, the high 30-day reinfection rate of 38.5% suggests a persistent clinical challenge likely rooted in the gut translocation of resistant flora during prolonged neutropenia. Ultimately, improving survival in this vulnerable population requires a shift toward rapid MDR risk stratification and more aggressive frontline AMS.

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PARTICULARS OF CONTRIBUTORS:
1. Student, Department of Clinical Haematology, Amala Institute of Medical Sciences, Thrissur, Kerala, India.
2. Associate Professor and Head, Department of Clinical Haematology, Amala Institute of Medical Sciences, Thrissur, Kerala, India.
3. Assistant Professor, Department of Microbiology, Amala Institute of Medical Sciences, Thrissur, Kerala, India.
4. Lecturer, Department of Antimicrobial Stewardship, Amala Institute of Medical Sciences, Thrissur, Kerala, India.
5. Lecturer, Department of Antimicrobial Stewardship, Amala Institute of Medical Sciences, Thrissur, Kerala, India.
6. Lecturer, Department of Community Medicine, Amala Institute of Medical Sciences, Thrissur, Kerala, India.
7. Professor and Head, Department of Microbiology, Amala Institute of Medical Sciences, Thrissur, Kerala, India.
8. Professor and Head, Department of Medical Oncology, Amala Institute of Medical Sciences, Thrissur, Kerala, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Sreeraj Vasudevan,
Associate Professor and Head, Department of Clinical Haematology, Amala Institute of Medical Sciences, Amala Nagar, Thrissur-680555, Kerala, India.
E-mail: sreerajfleming@gmail.com

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