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RESEARCH ARTICLE

Prevalence and Management of Suspected and Confirmed Bloodstream Infections Among Acute Leukaemia Patients Receiving Chemotherapy at Kenyatta National Hospital, Kenya

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ABSTRACT

Patients with acute leukaemia receiving chemotherapy are highly susceptible to infection because of disease-related immune dysfunction, chemotherapy-induced neutropenia, mucosal injury, and frequent use of invasive vascular devices. However, evidence on bloodstream infection and its management in this population in Kenya remains limited. This study aimed to determine the prevalence of suspected and confirmed bloodstream infection and to evaluate antibiotic utilisation and adherence to evidence-based treatment guidelines among patients with acute leukaemia receiving chemotherapy in adult wards at Kenyatta National Hospital. A retrospective cross-sectional study was conducted using medical records of patients aged ≥13 years with acute myeloid or acute lymphoblastic leukaemia who received chemotherapy in adult wards at Kenyatta National Hospital between January 2018 and December 2025. Of 332 eligible records identified after screening, 139 were selected using simple random sampling. Data were abstracted using a structured tool and analysed descriptively with IBM SPSS Statistics version 26. Of 139 patients, 58 (41.7%; 95% confidence interval: 33.4-50.4%, exact Clopper-Pearson method) met the composite definition of bloodstream infection. Of these, 12 (20.7% of cases; 8.6% of all patients) were microbiologically confirmed and 46 (79.3% of cases; 33.1% of all patients) were clinically suspected or documented. Of 15 isolates, 14 (93.3%) were bacterial and 1 (6.7%) was fungal (*Candida* spp.); Gram-negative organisms accounted for 71.4% of bacterial isolates (10 of 14). Cephalosporins were the most frequently used antibiotic class (53.4%), and two antibiotics per patient was the most common regimen size (41.4%). Among the 58 patients with bloodstream infection, 17 (29.3%) were adherent to all applicable guideline components, 37 (63.8%) were non-adherent to at least one, and 4 (6.9%) were not assessable. Bloodstream infection was common according to the study's composite clinical and microbiological definition, although microbiological confirmation was limited. Strengthening blood-culture investigation, antimicrobial susceptibility testing, clinical documentation, antimicrobial stewardship, and adherence to evidence-based treatment guidelines may improve infection management in this high-risk population.

Keywords: *antineoplastic agents; febrile neutropenia; antimicrobial stewardship; drug utilization; bloodstream infections; Kenya*

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INTRODUCTION

Bloodstream infections (BSIs) are important complications among patients with acute leukaemia receiving chemotherapy (Chen et al., 2021). Acute lymphoblastic and acute myeloid leukaemia, together with intensive chemotherapy, increase infection risk through prolonged neutropenia, impaired immunity, mucosal disruption, prolonged hospitalisation, and invasive devices such as central venous catheters (Kern & Rieg, 2020). BSIs can prolong hospitalisation, increase healthcare costs, and contribute to sepsis and death (Kern & Rieg, 2020; Chen et al., 2021).

Bloodstream infections (BSIs) may rapidly progress to sepsis, septic shock, organ dysfunction, and death in immune-compromised patients (Kara et al., 2019; Worku et al., 2022). Their frequency and distribution are influenced by malignancy, chemotherapy, neutropenia, central venous catheters, prior antimicrobial exposure, and local microbial ecology (Chen et al., 2021; Zimmer et al., 2022). Recent studies continue to demonstrate substantial BSI burdens among patients with haematological cancers and febrile neutropenia, although estimates vary by population and infection definitions (Choi et al., 2022; Cui et al., 2025).

The microbiological profile varies across institutions and regions. Gram-negative organisms and multidrug-resistant (MDR) bacteria remain important concerns. In Lebanon, Gram-negative organisms accounted for 65.0% of bacterial BSI episodes among patients with haematological malignancies (Haddad et al., 2021). Italian surveillance similarly identified MDR Gram-negative BSI as a continuing concern, particularly following MDR-organism colonisation or fluoroquinolone prophylaxis (Trecarichi et al., 2023). Among adults with acute leukaemia and Gram-negative BSI, antibiotic resistance was associated with poorer outcomes (J. Wang et al., 2024), highlighting the importance of institution-specific microbiological surveillance.

Antimicrobial resistance complicates management because empirical therapy is often initiated before microbiological results are available; inappropriate treatment may worsen outcomes, while unnecessary broad-spectrum exposure may promote resistance (Taplitz et al., 2018; Zimmer et al., 2022). Current guidelines emphasise prompt assessment, appropriate empirical therapy, microbiological investigation, and subsequent treatment modification or de-escalation based on clinical response, microbiological findings, individual risk factors, and local resistance patterns (Averbuch et al., 2026; Kim et al., 2022). Antimicrobial stewardship may improve antibiotic utilisation and reduce resistance among patients with acute leukaemia (Lee et al., 2024).

These challenges are amplified in low- and middle-income countries by limited diagnostic capacity, delayed access to blood cultures and susceptibility testing, and variable stewardship implementation (Mohammed Zain et al., 2022). Third generation cephalosporin resistant Enterobacteriaceae contribute substantially to resistant BSI and adverse outcomes in sub-Saharan Africa (Lester et al., 2020). In Sudan, Gram-negative bacilli accounted for 63.8% of bloodstream isolates among febrile neutropenic cancer patients, with substantial antibiotic resistance (Mohammed Zain et al., 2022). Microbiologically confirmed BSI has also been reported among febrile neutropenic cancer patients in Tanzania, while Ugandan research has described the aetiology, risk factors, and outcomes of bacteraemia among patients with haematological cancers and febrile neutropenia (Lubwama et al., 2024; Safari et al., 2023).

In Kenya, Kipchumba et al. (2024) described bacterial isolates among children with febrile neutropenia receiving cancer treatment, while Ghose et al. (2025) reported microbiological patterns and outcomes of bacteraemia among patients with chemotherapy-related febrile neutropenia at a Kenyan tertiary facility. However, these studies do not specifically address BSI prevalence and management among acute leukaemia patients receiving chemotherapy in adult wards (Ghose et al., 2025; Kipchumba et al., 2024).

Despite the clinical importance of BSI in acute leukaemia, Kenyan evidence remains limited regarding its prevalence, microbiological characteristics, antibiotic utilisation, and treatment-guideline adherence among adult chemotherapy patients. This gap is particularly relevant at Kenyatta National Hospital (KNH), a national referral facility providing intensive chemotherapy and specialised supportive care for patients with complex haematological malignancies.

Evidence-based clinical guidelines support standardised assessment and management of infection among patients with cancer, particularly those at high risk of severe infection because of chemotherapy-induced immunosuppression and neutropenia. The National Comprehensive Cancer Network (NCCN) Clinical Practice Guidelines in Oncology provide recommendations for the prevention, diagnosis, and treatment of cancer-related infections, including empirical antimicrobial

management in high-risk patients (National Comprehensive Cancer Network [NCCN], 2026).

This study aimed to determine the prevalence and clinical characteristics of BSI, describe microbiological findings and antibiotic utilisation, and assess adherence to applicable treatment guidelines among patients with acute leukaemia receiving chemotherapy in adult wards at KNH, Kenya.

METHODS

Study Design

A retrospective cross-sectional study was conducted using medical records of patients with acute leukaemia who received chemotherapy in the adult wards at KNH from 1st January 2018 to 31st December 2025. Each patient's observation window covered the documented treatment period, including relevant admissions and chemotherapy cycles. The patient was the primary unit of analysis, with each patient counted once for estimating BSI prevalence, consistent with cross-sectional study methodology (X. Wang & Cheng, 2020). Recurrent infections were counted once in patient-level analyses. Treatment-guideline adherence was assessed at the patient level.

Study Setting

The study was conducted at KNH, a Level 6 national teaching and tertiary referral hospital in Nairobi County, Kenya (Kenyatta National Hospital, n.d.). With approximately 1,800 beds (Kenyatta National Hospital, n.d.), KNH provides specialised haematology, oncology, chemotherapy, microbiology, laboratory, antimicrobial, and critical care services and manages complex haematological malignancies referred from Kenya and the wider region. The hospital was selected because its Haematology/Oncology Unit manages a substantial number of patients with acute leukaemia receiving chemotherapy and treatment of related complications, providing an appropriate setting to investigate BSI and antibiotic utilisation.

Study Population

The target population comprised patients with acute leukaemia receiving chemotherapy, while the accessible population comprised acute leukaemia patients treated in adult wards at KNH during the study period.

Inclusion criteria: (1) age ≥13 years; (2) documented diagnosis of acute myeloid leukaemia (AML) or acute lymphoblastic leukaemia (ALL); (3) receipt of chemotherapy at KNH during the study period; and (4) sufficient clinical, laboratory, and treatment information for determining BSI status.

Exclusion criteria: (1) records without a confirmed acute leukaemia diagnosis; (2) patients who had not received chemotherapy during the study period; and (3) records with insufficient information to determine the primary outcome. The age threshold reflected KNH practice of managing patients aged 13 years and above in adult wards.

Sampling Procedure

Records of patients with AML or ALL who received chemotherapy in the adult wards at KNH between 1st January 2018 and 31st December 2025 were identified from the KNH Hospital Management Information System (HMIS). Records available for detailed review were screened against the predefined eligibility criteria, and the eligible records constituted the sampling frame (record counts are reported in Results). These records were assigned unique study numbers, and the required sample was selected using simple random sampling in Microsoft Excel, giving each eligible record an equal probability of selection (Zrineh et al., 2026). Since eligibility was established before sampling, no replacement was required.

Sample Size Determination

Cochran's single population proportion formula was applied to generate the required sample size (Ahmed, 2024).

$$\mathbf{n = Z^2 p(1 - p) / d^2}$$

where n = required sample size, Z = 1.96 for 95% confidence, p = expected prevalence, and d = margin of error (0.05). Because sufficiently comparable local prevalence data were unavailable, p = 0.50 was used to obtain the maximum required sample size.

$$\mathbf{n = (1.96)^2 \times 0.50 \times 0.50 / (0.05)^2 = 384.16 \approx 384}$$

The finite population correction used the estimated annual number of patients with acute leukaemia receiving chemotherapy in the adult wards (N = 200), obtained from KNH Haematology/Oncology Unit records reviewed during the preliminary visit. An annual figure was used because the sample size was calculated before the sampling frame was established; the sample was subsequently drawn from the eligible records (see Sampling Procedure). The corrected sample size was

$$\mathbf{n_f = (n \times N)/(n + N) = (384 \times 200)/(384 + 200) = 131.5 \approx 132},$$

where n_f is the corrected sample size, n is the sample size from Cochran's formula, and N is the population size.

A 5% contingency was added for incomplete records:

$$132 \times 0.05 = 6.6 \approx 7$$

Thus, the final sample size was **139 records (132 + 7)**.

Data Collection Tools

A structured data abstraction form was developed based on the study objectives, operational definitions, the NCCN Clinical Practice Guidelines in Oncology for Prevention and Treatment of Cancer-Related Infections (Version 1.2026), and information available in KNH medical records. It captured demographic and clinical characteristics, leukaemia subtype, chemotherapy, laboratory and microbiological findings, BSI status and classification, antimicrobial susceptibility testing, antibiotic agents, dose, frequency, route, duration, and guideline adherence. Documented BSI episodes within each patient's observation window were reviewed to determine the patient's BSI status; analyses were conducted at the patient level, and episode-level data were not analysed.

Content validity was enhanced through review by the research supervisors and experts in oncology pharmacy and infectious diseases. The tool was pretested using 14 archived records (approximately 10% of the calculated sample) to assess clarity, completeness, and data availability.

Data Collection Procedure

Data were collected retrospectively by four trained research assistants with health-sciences backgrounds and clinical data-abstraction experience under the principal investigator's supervision. Training covered eligibility criteria, BSI definitions, interpretation of clinical and laboratory records, antibiotic classification, guideline adherence, confidentiality, and tool completion. Following ethical and institutional approvals, the KNH Health Information Department provided the eligible sampling frame. Data were abstracted from the selected records using the structured tool and a common abstraction guide to harmonise interpretation, over approximately six weeks during official working hours.

Data Quality Control

The principal investigator conducted weekly supervision, spot checks, and independent review of a subset of records, with discrepancies resolved by consensus. Completed forms were checked for completeness and consistency. Ten percent of records underwent double data entry, followed by checks for missing values, out-of-range observations, duplicates, and logical inconsistencies before analysis. Inter-rater agreement was not formally quantified.

Data Management and Analysis

Data were entered in Microsoft Excel and analysed using IBM SPSS Statistics version 26. Categorical variables were summarised as frequencies and proportions; continuous variables were presented as means ± standard deviations or medians with interquartile ranges, as appropriate. The primary outcome was BSI status (present/absent), defined using a composite study definition comprising microbiologically confirmed BSI and clinically suspected or documented BSI. Confirmed BSI required isolation of a relevant pathogen from blood culture, while clinically suspected or documented BSI required fever (≥38°C), chills/rigors, hypotension, or clinical deterioration, with documented suspected bloodstream or serious systemic infection and systemic antimicrobial therapy without microbiological confirmation.

Patients meeting either definition were classified as having BSI; those meeting neither had no documented BSI. BSI type (central line-associated BSI [CLABSI], primary BSI, secondary BSI, or unspecified BSI) was classified from documentation in the medical record and was not restricted to laboratory-confirmed infections; therefore, CLABSI and primary BSI do not necessarily meet formal Centers for Disease Control and Prevention/National Healthcare Safety Network (CDC/NHSN) surveillance criteria. Coagulase-negative staphylococci were reported as documented, without independently applying two-set blood culture criteria to distinguish contamination from true BSI. Confirmed and clinically suspected or documented cases were reported separately. BSI prevalence was calculated as the proportion of included patients meeting the composite definition, with corresponding 95% confidence intervals (CI) calculated using the exact Clopper-Pearson method. Microbiological findings, antibiotic utilisation, and guideline adherence were summarised descriptively.

Antimicrobial management was retrospectively assessed against the NCCN Clinical Practice Guidelines in Oncology for Prevention and Treatment of Cancer-Related Infections, Version 1.2026, used as a contemporary standardised benchmark for the 2018-2025 study period (NCCN, 2026). This did not imply that Version 1.2026 was the guideline in effect when treatment was provided.

Guideline adherence was assessed based on six components: empirical antibiotic selection, dose, frequency, route, duration, and culture-directed adjustment. Empirical selection was considered adherent when the antibiotic regimen was appropriate for the patient's clinical and infection-risk context;

dose and frequency when the prescribed dose and administration interval were appropriate; route when the route was appropriate for the clinical setting and risk; and duration when consistent with the infection, pathogen, clinical response, and microbiological findings. Culture-directed adjustment was applicable only to patients with a positive blood culture and was considered adherent when available culture results appropriately informed continuation, modification, de-escalation, or escalation of therapy.

Each applicable component was classified as adherent, non-adherent, or not assessable based on the documented medical record. Overall adherence required adherence to all applicable components. Any documented non-adherent component resulted in an overall classification of non-adherent regardless of whether other components were assessable, while cases with no documented non-adherent component but with an applicable component that could not be assessed were classified as not assessable.

Ethical Considerations

A waiver of informed consent was granted by the Kenyatta National Hospital-University of Nairobi Ethics and Research Committee (KNH-UoN ERC) because the study involved retrospective review of records without participant contact. The study complied with the Declaration of Helsinki and applicable ethical requirements. Ethical approval was granted by KNH-UoN ERC (Approval No. KNH-ERC/A/226; 14 May 2026), and National Commission for Science, Technology and Innovation (NACOSTI) authorisation was obtained (Licence No. NACOSTI/P/26/4193982). Direct identifiers were excluded from the database and replaced with unique study codes. Records remained at KNH and were accessed only by authorised personnel. Electronic data were password-protected with restricted access, and findings were reported in aggregate. No compensation was provided, and no incidental clinical findings arose from the retrospective review.

RESULTS

Record Selection and Participant Characteristics

Of the 711 patient records identified, 169 (23.8%) were unavailable for detailed review due to incomplete retrieval or non-availability of the corresponding records in the hospital records system. The remaining 542 records were available for detailed review and were screened against the eligibility criteria. A total of 210 records were excluded, leaving 332 eligible records that constituted the sampling frame. Simple random sampling was then used to select 139 eligible records for inclusion in the study.

Among the 139 patients included, 78 (56.1%) were male and 101 (72.7%) had AML. Age was analysed as a continuous variable, with a median age of 39.0 years (interquartile range [IQR]: 25.5-56.0 years; range: 13-78 years). Comorbidities were documented in 97 (69.8%) patients, central venous catheters in 124 (89.2%), and neutropenia in 75 (54.0%). The clinical and demographic characteristics of the study population are presented in Table 1.

Table 1: *Sociodemographic and Clinical Characteristics of Participants (N = 139)*

Characteristic	n	%
Age, years		
13-29	43	30.9
30-44	39	28.1
45-59	34	24.5
≥60	23	16.5
Sex		
Male	78	56.1
Female	61	43.9
Leukaemia subtype		
AML	101	72.7
ALL	38	27.3
Comorbidity		

Yes	97	69.8
No	36	25.9
Not documented	6	4.3
Central venous catheter		
Yes	124	89.2
No	11	7.9
Not documented	4	2.9
Neutropenia		
Yes	75	54.0
No	38	27.3
Not documented	26	18.7

Abbreviations: ALL, acute lymphoblastic leukaemia; AML, acute myeloid leukaemia.

Prevalence and Classification of Bloodstream Infection

Of the 139 patients included in the study, 58 met the composite definition of BSI, giving an overall prevalence of 41.7% (95% CI: 33.4-50.4%, exact Clopper-Pearson method). Twelve (20.7% of the 58 cases; 8.6% of all 139 patients) had microbiologically confirmed BSI, while 46 (79.3% of cases; 33.1% of all patients) had clinically suspected or documented BSI (Table 2).

Among the 58 patients meeting the composite BSI definition, CLABSI was the most frequently documented classification (21, 36.2%). Blood cultures were performed in 17 patients (29.3%), of whom 12 had positive results (patient-level data). The 12 positive cultures yielded 15 isolates, indicating that some cultures were polymicrobial; of these isolates, 14 (93.3%) were bacterial and 1 (6.7%) was fungal (*Candida* spp.). Organism frequencies were calculated separately within the bacterial and fungal groups. Clinical and microbiological characteristics are presented in Table 2.

Table 2: *Bloodstream Infection Classification, Clinical Characteristics and Microbiological Findings*

Characteristic	n	%
BSI status (N = 139)		
Microbiologically confirmed	12	8.6
Clinically suspected or documented	46	33.1
No documented BSI	81	58.3
BSI type among BSI cases (n = 58)		
CLABSI	21	36.2
Primary BSI	18	31.0
Secondary BSI	12	20.7
Unspecified	7	12.1
Clinical features among BSI cases (n = 58)		
Fever ≥38°C	45	77.6
Tachycardia	32	55.2
Chills/rigors	25	43.1
Hypotension	14	24.1
Altered mental status	6	10.3
Hypothermia	5	8.6

Blood culture among BSI cases (n = 58)		
Performed	17	29.3
Not performed/not documented	41	70.7
Blood culture result (n = 17)		
Positive	12	70.6
Negative	4	23.5
Result unavailable	1	5.9
AST among positive cultures (n = 12)		
Performed	5	41.7
Not performed/not documented	7	58.3
Isolates from positive cultures		
Bacterial Isolates (n = 14)		
Escherichia coli	4	28.6
Klebsiella spp.	3	21.4
Pseudomonas aeruginosa	2	14.3
Enterobacter cloacae complex	1	7.1
Staphylococcus aureus	2	14.3
Coagulase-negative *Staphylococcus*	2	14.3
Fungal Isolates (n = 1)		
Candida spp.	1	100.0

Abbreviations: AST, antimicrobial susceptibility testing; BSI, bloodstream infection; CLABSI, central line-associated bloodstream infection.

Antibiotic Utilisation Patterns

Among the 58 patients with BSI, cephalosporins were the most frequently used antibiotic class (31, 53.4%), followed by penicillin/β-lactamase inhibitor combinations (24, 41.4%). Empirical therapy was documented in 50 (86.2%) patients, and 27 (46.6%) had therapy subsequently modified or escalated based on clinical assessment and/or available microbiological findings. Modified or escalated therapy referred to any regimen change after initial treatment and was not limited to culture- or susceptibility-directed therapy. The most common number of antibiotics per patient was two (24, 41.4%). Intravenous administration was documented in 53 (91.4%), with a median treatment duration of 11.0 days (IQR: 7.0-15.0). Detailed utilisation patterns, including the distribution of treatment duration, are presented in Table 3.

Table 3: *Antibiotic Utilisation Patterns Among Patients with BSI (N = 58)*

Characteristic	n	%
Antibiotic class		
Cephalosporins	31	53.4
Penicillins/β-lactamase inhibitors	24	41.4
Glycopeptides	21	36.2
Carbapenems	19	32.8

Fluoroquinolones	16	27.6
Aminoglycosides	14	24.1
Individual antibiotics		
Ceftriaxone	27	46.6
Piperacillin/tazobactam	24	41.4
Vancomycin	21	36.2
Meropenem	19	32.8
Ciprofloxacin	16	27.6
Type of therapy		
Empirical only	23	39.7
Empirical followed by modified	27	46.6
Modified only	6	10.3
Not documented/other	2	3.4
Number of antibiotics		
1	14	24.1
2	24	41.4
3	14	24.1
≥4	6	10.3
Duration of antibiotic therapy, days		
≤7	18	31.0
8-14	25	43.1
15-21	10	17.2
>21	5	8.6

Adherence to Evidence-Based Treatment Guidelines

Guideline adherence was assessed across six components: empirical antibiotic selection, dose, frequency, route, duration, and culture-directed adjustment, classified per the rule described in Methods. Among the five components applicable to all 58 patients, adherence ranged from 62.1% (empirical antibiotic selection) to 93.1% (route), whereas culture-directed adjustment was applicable to 12 patients, of whom 4 (33.3%) were adherent (Table 4). Overall, 17 of 58 patients (29.3%) were adherent to all applicable components, 37 (63.8%) were non-adherent to at least one, and 4 (6.9%) were not assessable due to insufficient documentation. Component-specific findings are presented in Table 4.

Table 4: *Adherence to Evidence-Based Treatment Guidelines Among Patients with BSI (N = 58)*

Component	Adherent, n (%)	Non-adherent, n (%)	Not assessable, n (%)
Appropriate dose	51 (87.9)	5 (8.6)	2 (3.4)
Appropriate frequency	52 (89.7)	4 (6.9)	2 (3.4)
Appropriate route	54 (93.1)	3 (5.2)	1 (1.7)
Appropriate duration	42 (72.4)	14 (24.1)	2 (3.4)

Empirical antibiotic selection	36 (62.1)	18 (31.0)	4 (6.9)
Culture-directed adjustment (applicable n = 12)[a]	4 (33.3)	2 (16.7)	6 (50.0)
Overall adherence (n = 58)	17 (29.3)	37 (63.8)	4 (6.9)

DISCUSSION

Summary of Main Findings

This study examined BSI prevalence, microbiological characteristics, antibiotic utilisation, and guideline adherence among 139 patients with acute leukaemia receiving chemotherapy at KNH. Overall, 41.7% met the composite BSI definition, although only 8.6% had microbiologically confirmed infection. CLABSI was the most frequently documented classification, with Gram-negative organisms predominating among positive cultures. Broad-spectrum empirical antibiotics were commonly used. Although adherence to individual antibiotic-use components was high, only 29.3% of patients met all applicable guideline components simultaneously.

Interpretation and Comparison with Literature

The 41.7% composite BSI prevalence indicated a substantial burden of clinically suspected or documented infection. Rabagliati et al. (2024) reported microbiologically documented BSI in 38.7% of febrile neutropenia episodes among adults with acute leukaemia or lymphoma after chemotherapy in Chile, Ecuador, and Peru. The like-for-like figure from this study is the 8.6% of patients with microbiologically confirmed BSI, which is lower and probably underestimates culture-confirmed BSI because blood cultures were documented in only 29.3% of BSI cases; differing definitions and units of analysis also limit direct comparison. The higher composite estimate here may partly reflect the inclusion of clinically suspected or documented infections without culture confirmation, although this could not be tested because few patients had blood cultures. In Kenya, Ghose et al. (2025) reported positive blood cultures in 27.8% of febrile neutropenia episodes among adults with cancer, while Safari et al. (2023) reported 35.3% bacteraemia among febrile neutropenic cancer patients in Tanzania. Differences may reflect case definitions, populations, chemotherapy intensity, and microbiological testing access.

CLABSI was the most frequent documented category, consistent with the importance of catheter-related complications during intensive chemotherapy for acute leukaemia (Kern & Rieg, 2020; Picardi et al., 2023). Blood cultures were documented in only 29.3% of BSI cases. Gram-negative organisms, particularly *Escherichia coli*, *Klebsiella* spp., *Pseudomonas aeruginosa*, and *Enterobacter cloacae* complex, predominated, consistent with findings reported across sub-Saharan Africa and other international settings (Amanati et al., 2021; Lester et al., 2020; J. Wang et al., 2024). Ghose et al. (2025) similarly reported 68.0% Gram-negative organisms among positive cultures in chemotherapy-related febrile neutropenia, whereas Kipchumba et al. (2024) found predominantly Gram-positive organisms in a Western Kenyan paediatric population. Differences may reflect age, malignancy, chemotherapy intensity, central-line exposure, prior antibiotic use, hospital ecology, and infection-prevention practices. Limited culture testing also reduced opportunities for pathogen-directed therapy.

Antibiotic treatment relied mainly on empirical broad-spectrum therapy, particularly cephalosporins, penicillin/β-lactamase inhibitor combinations, glycopeptides, and carbapenems. Empirical therapy was documented in 86.2% of BSI cases, consistent with recommendations for early broad-spectrum treatment in acute leukaemia with suspected serious infection or febrile neutropenia (Kenyatta National Hospital, 2023; Zimmer et al., 2022). Carbapenem use (32.8%) was lower than the 85.6% of febrile neutropenia episodes in which Ghose et al. (2025) reported carbapenem-based empirical therapy in Kenya, potentially reflecting differences in resistance patterns, drug availability, severity, and prescribing practices. Limited culture and susceptibility data constrained assessment of culture-directed treatment modification, underscoring the need for timely empirical therapy followed by reassessment, de-escalation, or modification as information emerges. Stewardship interventions can improve antimicrobial use without worsening outcomes (Luu et al., 2024; Madran et al., 2024).

Adherence to individual antibiotic-use components was generally high (87.9% for dose, 89.7% for frequency, 93.1% for route, and 72.4% for duration) but only 29.3% of patients were adherent across all applicable components, reflecting the compounding effect of six independently assessed components and a substantial rate of non-adherence in empirical antibiotic selection (31.0%) and treatment duration (24.1%). Culture-directed adjustment was applicable to only 12 patients, of whom 2 (16.7%) were non-adherent and 6 (50.0%) were not assessable. This composite adherence rate was markedly lower than the 78.8% reported by Mizuno et al. (2025) for initial antibiotic selection alone in Japan, and the 87.4% of antimicrobial prescriptions for neutropenic fever judged appropriate by Singh et al. (2024) in Australia, though both used narrower, single-component adherence measures rather than a composite across dose, frequency, route, duration, selection, and culture-directed adjustment, which is expected to yield a lower rate by construction.

Practical Implications

The findings support a standardised BSI management pathway in the Haematology/Oncology Unit, emphasising early recognition, timely empirical therapy, blood culture collection before antibiotics where feasible, and reassessment within 48-72 hours. Improved access to and documentation of culture and susceptibility testing, alongside prospective antibiotic review, could strengthen antibiotic selection, duration, modification, and de-escalation in line with institutional guidelines and local resistance surveillance. Documentation of the infection source, treatment indication, culture results, and reasons for antibiotic modification or continuation should also be strengthened, and the hospital's Antimicrobial Stewardship Programme could conduct regular prospective or concurrent antibiotic reviews, monitoring selection, duration, modification, and guideline adherence.

Strengths

The study included 139 records over eight years at a national referral hospital. A structured, pretested tool, trained research assistants, standardised definitions, and data-quality procedures strengthened data consistency.

Future Research

Future studies should use prospective multicentre cohorts to assess BSI incidence and temporal determinants among acute leukaemia patients receiving chemotherapy in Kenya. Research should systematically capture cultures, susceptibility testing, neutropenia, chemotherapy intensity, central-line exposure, prior antibiotic use, and resistance patterns. Prospective studies should also evaluate whether standardised management pathways and stewardship interventions improve diagnostic practices, antibiotic use, and guideline adherence.

LIMITATIONS

This study had several limitations, each of which affects how the findings should be interpreted and applied.

First, the retrospective single-centre design depended on the completeness of existing records and limits causal inference. Because the study was conducted at one national referral hospital with a specialised haematology/oncology unit, the prevalence and adherence estimates may not be generalisable to lower-level facilities or other settings, although they may inform practice in comparable tertiary oncology units in the region.

Second, 169 of the 711 identified records (23.8%) were unavailable for review. If these records differed systematically from those reviewed, for example in documentation quality or infection burden, the prevalence and adherence estimates could be biased, and the direction of any bias cannot be determined from the available data.

Third, microbiological testing was limited, with blood cultures documented in only 29.3% of patients with BSI, so the study relied largely on clinically classified BSI. The composite definition may have increased prevalence estimates relative to studies restricting BSI to culture-confirmed infection, whereas the 8.6% microbiologically confirmed proportion probably underestimates culture-confirmed BSI. The 41.7% prevalence should therefore be interpreted as a composite clinical estimate and compared with other studies only where definitions match.

Fourth, BSI type was classified from documentation without applying formal CDC/NHSN criteria, which may have caused misclassification of CLABSI and primary BSI. Type-specific proportions should therefore be interpreted cautiously and not as surveillance rates. Similarly, coagulase-negative staphylococci were reported as documented without applying two-set culture criteria, so some isolates may represent contamination, although they accounted for only 2 of 14 bacterial isolates.

Fifth, the current NCCN guidelines (Version 1.2026) were used as a benchmark for care provided between

2018 and 2025. These guidelines may not reflect the recommendations or standards of care in place at the time of treatment, potentially overstating non-adherence for earlier treatment. The adherence findings should therefore be read as a comparison with a contemporary benchmark rather than a judgement of past practice.

Sixth, inter-rater agreement was not formally quantified, so variability in abstraction and classification may have affected the adherence estimates, although training, a common abstraction guide, and supervision were used to limit this. Finally, the small number of patients in some subgroups, such as the 12 patients with positive blood cultures, limits the precision of subgroup estimates, including those for culture-directed adjustment.

CONCLUSION

This study found a substantial burden of BSI among patients with acute leukaemia receiving chemotherapy in adult wards at KNH. Although 41.7% met the composite BSI definition, microbiological confirmation was limited. Gram-negative organisms predominated among isolates, and management relied largely on empirical broad-spectrum therapy. While adherence to individual antibiotic-use parameters was generally high, few patients were adherent across all applicable guideline components, with gaps particularly evident in empirical antibiotic selection and treatment duration, compounded by limited microbiological investigation and documentation. Strengthening blood culture and susceptibility testing, structured antibiotic review and reassessment, and antimicrobial stewardship could support more targeted and consistent BSI management within the Haematology/Oncology Unit.

RECOMMENDATIONS

Clinical practitioners and the Haematology/Oncology Unit: Implement a standardised BSI management pathway that requires blood cultures before the first antibiotic dose where feasible, since cultures were documented in only 29.3% of BSI cases. Establish a structured reassessment at 48-72 hours, documenting the infection source, culture results, and reasons for modifying or continuing therapy, to address the gaps in empirical selection (31.0% non-adherent) and duration (24.1% non-adherent).

Hospital administrators and the Antimicrobial Stewardship Programme: Strengthen laboratory access to blood culture and antimicrobial susceptibility testing, as only 5 of 12 positive cultures had susceptibility results. Conduct regular prospective antibiotic audits with feedback in the unit, and track culture-collection rates and overall guideline adherence (29.3% at baseline) as measurable indicators.

Researchers: Develop prospective multicentre studies that capture cultures, neutropenia, central-line exposure, and resistance patterns. Evaluate whether standardised pathways and stewardship interventions improve antibiotic use and adherence.

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Conflict of Interest

Authors declare no conflict of interest.

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Authors' Contributions

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