

Blood Culture Isolates and Antimicrobial Susceptibility Patterns in Patients with Suspected Sepsis: Association with Qsofa Score at a Tertiary Care Hospital in Jaipur

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Abstract

Background: Blood culture and antimicrobial susceptibility testing guide targeted antibiotic therapy in patients with suspected sepsis. The association of qSOFA score with blood culture positivity and multidrug resistance remains unclear, warranting evaluation alongside local bacterial susceptibility patterns.

Aim: To characterize blood culture isolates and their antimicrobial susceptibility patterns in patients with suspected sepsis and assess the association of qSOFA score with blood culture positivity and multidrug resistance.

Methods: A cross-sectional study of 100 adults with suspected sepsis at SMS Hospital, Jaipur, assessed qSOFA scores, blood cultures, and antimicrobial susceptibility. Associations with culture positivity and multidrug resistance were analyzed using chi-square or Fisher's exact tests ($p < 0.05$).

Results: Blood cultures were positive in 39 of 100 patients (39%). Gram-negative bacteria accounted for 84.6% of isolates, predominantly *Klebsiella pneumoniae* (33.3%) and *Acinetobacter baumannii* (23.1%). Multidrug resistance was reported in 22/39 isolates (56.4%). Culture positivity was significantly higher in patients with qSOFA ≥ 2 than in those with qSOFA 0–1 (52.7% vs 22.2%; $p = 0.004$). Among culture-positive patients, multidrug resistance did not differ significantly between these groups (58.6% vs 50.0%; $p = 0.721$).

Conclusion: Gram-negative isolates predominated, with frequent multidrug resistance. Higher qSOFA scores were associated with culture positivity but not significantly with multidrug resistance.

Keywords: Sepsis; Blood Culture; Antimicrobial Susceptibility; qSOFA; Multidrug resistance.

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Introduction

Sepsis is a life-threatening condition characterized by organ dysfunction resulting from a dysregulated host response to infection [1]. It remains a major cause of morbidity and mortality, particularly in low- and middle-income countries, where delayed presentation and limited diagnostic and critical care resources complicate management [2].

Global estimates indicate that approximately 48.9 million cases and 11 million sepsis-related deaths occurred in 2017 [1]. Early recognition, appropriate antimicrobial therapy, and identification of the infective source are therefore central to effective management [3]. Blood culture is essential for confirming bloodstream infection and identifying

the causative organism in patients with suspected sepsis [4]. Combined with antimicrobial susceptibility testing, it guides definitive treatment, facilitates de-escalation of empirical antibiotics, and supports antimicrobial stewardship [2]. However, culture yield depends on factors such as blood volume, collection technique, timing, and prior antibiotic exposure⁵. Consequently, a negative blood culture does not exclude sepsis, and microbiological findings require interpretation alongside the clinical presentation [6].

Antimicrobial resistance further complicates sepsis management by reducing the likelihood of effective initial therapy [4]. Gram-negative organisms,

including *Klebsiella pneumoniae*, *Escherichia coli*, *Acinetobacter baumannii*, and *Pseudomonas aeruginosa*, are important bloodstream pathogens in Indian tertiary care settings [7]. Resistance to commonly prescribed antibiotics, including cephalosporins and carbapenems, limits treatment options and increases the importance of susceptibility-guided therapy [1]. Because organism distribution and resistance patterns vary across institutions and patient populations, local microbiological surveillance is necessary to inform empirical antibiotic selection [5].

The quick Sequential Organ Failure Assessment (qSOFA) score provides a bedside assessment based on respiratory rate $\geq 22/\text{min}$, systolic blood pressure ≤ 100 mmHg, and altered mentation [3]. A score ≥ 2 identifies patients with suspected infection who may be at increased risk of adverse outcomes [4]. Although qSOFA has prognostic value, it does not independently establish a diagnosis of sepsis or replace clinical assessment and microbiological investigation [6]. Its association with blood culture positivity and antimicrobial resistance requires further evaluation to clarify whether bedside risk assessment also reflects the likelihood of bloodstream infection or resistant pathogens [7].

Integrating clinical risk assessment with microbiological findings may provide useful evidence for managing patients with suspected sepsis. At SMS Hospital, Jaipur, a tertiary referral institution serving a diverse population, locally relevant data are needed to describe bloodstream pathogens and their antimicrobial susceptibility patterns.

The present study therefore aimed to characterize blood culture isolates and their susceptibility patterns and assess the association of qSOFA score with blood culture positivity and multidrug resistance among culture-positive isolates.

Methodology

Study Design and Setting: This hospital-based cross-sectional observational study was conducted in the Department of Tropical Medicine, in collaboration with the Department of General Medicine, at SMS Medical College and Attached Hospitals, Jaipur. Recruitment commenced after institutional research and ethics approval and continued until 100 patients were enrolled.

Study Participants: Adults aged ≥ 18 years with clinically suspected or diagnosed sepsis who underwent blood culture testing and whose qSOFA score could be assessed at presentation were consecutively enrolled. Written informed consent was obtained from participants or their legally authorized representatives. Patients receiving prolonged antibiotic therapy before admission, those with incomplete clinical or laboratory

records, and those with contaminated or invalid blood culture samples were excluded.

Sample Size: The thesis reported a minimum sample size of 84 patients, calculated using a 95% confidence level, an anticipated proportion of 30%, and an absolute allowable error of 10%. The final sample size was increased to 100 patients.

Data Collection and qSOFA Assessment: Data were recorded using a predesigned, pretested structured proforma through patient interviews, clinical examination, and review of hospital and laboratory records. Information included demographic characteristics, presenting symptoms, comorbidities, prior antibiotic exposure, probable infection source, and laboratory findings. qSOFA was assessed at presentation by assigning one point each for respiratory rate $\geq 22/\text{min}$, systolic blood pressure ≤ 100 mmHg, and altered mentation or Glasgow Coma Scale < 15 . Patients were categorized as having low (0–1) or high (≥ 2) qSOFA scores.

Microbiological Assessment: Blood culture results, organism identification, and antimicrobial susceptibility findings were obtained from the microbiology laboratory. Isolates were classified by organism and Gram reaction, and available susceptibility and resistance results were recorded. The manuscript analyses focused on bacterial distribution, antimicrobial susceptibility patterns, and the associations of qSOFA with blood culture positivity and multidrug resistance among culture-positive isolates.

Statistical Analysis: Data were entered into Microsoft Excel and checked for accuracy. Categorical variables were summarized as frequencies and percentages, and continuous variables as mean and standard deviation. Associations between qSOFA categories and blood culture positivity or multidrug resistance were assessed using chi-square or Fisher's exact tests, as appropriate. A p-value < 0.05 was considered statistically significant.

Ethical Considerations: Approval was obtained from the Institutional Research Review Board and Institutional Ethics Committee of SMS Medical College, Jaipur. Participation was voluntary, and confidentiality was maintained through anonymized study records.

Result

The study included 100 patients with suspected sepsis, with a mean age of 49.35 ± 15.60 years; 53% were male. A qSOFA score ≥ 2 was recorded in 55 patients (55%), and blood cultures were positive in 39 patients (39%). Among the 39 isolates, Gram-negative bacteria predominated (33; 84.6%), while Gram-positive bacteria accounted

for six (15.4%). *Klebsiella pneumoniae* was the most common isolate (33.3%), followed by *Acinetobacter baumannii* (23.1%) and *Escherichia coli* (15.4%). Multidrug resistance was reported in

22 isolates (56.4%). Blood culture positivity was significantly higher among patients with qSOFA ≥ 2 than among those with qSOFA 0–1 (29/55 [52.7%] versus 10/45 [22.2%]; $p=0.004$).

Table 1: Baseline characteristics and qSOFA distribution of study participants (N=100)

Characteristic	(n)	(%)
Age		
≤ 30 years	12	12.0
31–40 years	20	20.0
41–50 years	15	15.0
>50 years	53	53.0
Sex		
Male	53	53.0
Female	47	47.0
Comorbidities		
Hypertension	29	29
Diabetes mellitus	24	24
Chronic kidney disease	8	8
COPD/asthma	7	7
Liver disease	6	6
Immunosuppression	4	4
QSOFA Score At Presentation		
0	20	20
1	25	25
2	34	34
3	21	21

The above Table 1 shows that most participants were aged >50 years (53%), followed by 31–40 years (20%), 41–50 years (15%), and ≤ 30 years (12%).

Males constituted 53% and females 47% of the study population. Hypertension (29%) and diabetes mellitus (24%) were the most common

comorbidities, followed by chronic kidney disease (8%), COPD/asthma (7%), liver disease (6%), and immunosuppression (4%).

At presentation, qSOFA score 2 was most frequent (34%), followed by scores 1 (25%), 3 (21%), and 0 (20%). Overall, 55% of participants had a qSOFA score ≥ 2 , while 45% had scores of 0–1.

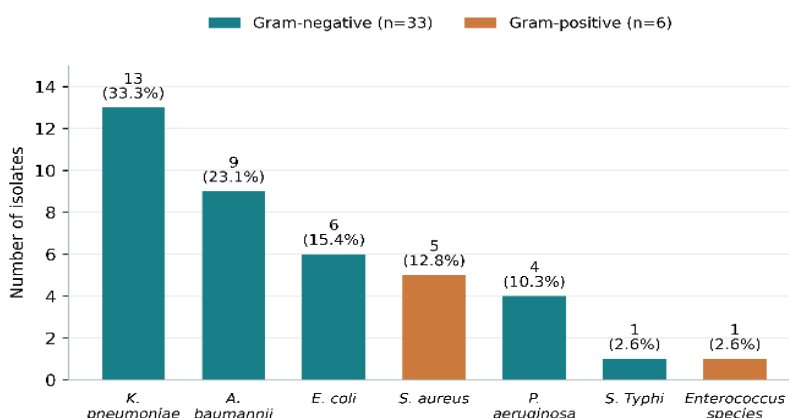


Figure 1: Distribution of bacterial isolates among positive blood cultures (n=39)

The above Figure 1 shows that Gram-negative bacteria predominated among the 39 blood culture isolates (84.6%). *Klebsiella pneumoniae* was the most common isolate (33.3%), followed by *Acinetobacter baumannii* (23.1%) and *Escherichia coli* (15.4%). Gram-positive bacteria accounted for 15.4% of isolates.

Table 2: Antimicrobial susceptibility and resistance patterns of blood culture isolates (A) Gram-negative isolates (n=33)

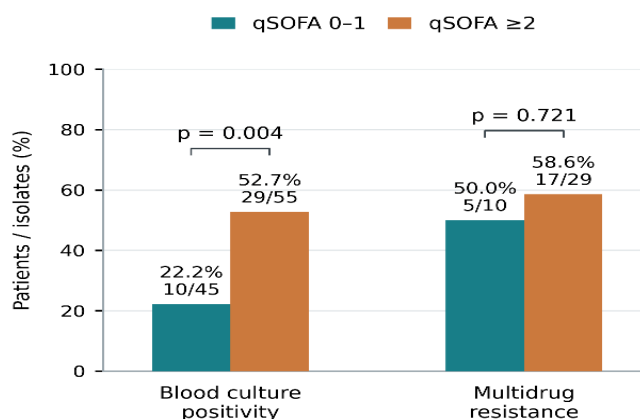
Antibiotic	Susceptible, n (%)	Resistant, n (%)
Ampicillin	5 (15.2)	25 (75.8)
Amoxicillin–clavulanic acid	9 (27.3)	23 (69.7)
Ceftriaxone	6 (18.2)	24 (72.7)
Cefepime	6 (18.2)	22 (66.7)
Piperacillin–tazobactam	18 (54.5)	13 (39.4)
Meropenem	18 (54.5)	15 (45.5)
Imipenem	19 (57.6)	12 (36.4)
Amikacin	20 (60.6)	11 (33.3)
Gentamicin	19 (57.6)	10 (30.3)
Ciprofloxacin	14 (42.4)	18 (54.5)
Levofloxacin	17 (51.5)	15 (45.5)
Colistin	29 (87.9)	1 (3.0)
Tigecycline	26 (78.8)	4 (12.1)

Table 2: (B) Gram-positive isolates (n=6)

Antibiotic	Susceptible, n (%)	Resistant, n (%)
Ampicillin	5 (15.2)	25 (75.8)
Amoxicillin–clavulanic acid	9 (27.3)	23 (69.7)
Ceftriaxone	6 (18.2)	24 (72.7)
Cefepime	6 (18.2)	22 (66.7)
Piperacillin–tazobactam	18 (54.5)	13 (39.4)
Meropenem	18 (54.5)	15 (45.5)
Imipenem	19 (57.6)	12 (36.4)
Amikacin	20 (60.6)	11 (33.3)
Gentamicin	19 (57.6)	10 (30.3)
Ciprofloxacin	14 (42.4)	18 (54.5)
Levofloxacin	17 (51.5)	15 (45.5)
Colistin	29 (87.9)	1 (3.0)
Tigecycline	26 (78.8)	4 (12.1)

Gram-negative Isolates: The above Table 2A shows that the highest reported susceptibility was to colistin (87.9%), followed by tigecycline (78.8%) and amikacin (60.6%). Susceptibility to imipenem and gentamicin was 57.6% each, while meropenem and piperacillin–tazobactam showed 54.5% susceptibility each. Resistance was highest to ampicillin (75.8%), followed by ceftriaxone (72.7%), amoxicillin–clavulanic acid (69.7%), and cefepime (66.7%).

Gram-positive Isolates: The above Table 2B shows that all six isolates were susceptible to linezolid (100%). Susceptibility to vancomycin and piperacillin–tazobactam was 83.3% each, followed by ampicillin and cefepime (66.7% each). Resistance was highest to amoxicillin–clavulanic acid (83.3%), while ceftriaxone, levofloxacin, and teicoplanin each showed 66.7% resistance.

**Figure 2: Association of qSOFA category with blood culture positivity and multidrug resistance.**

The above Figure 2 shows that blood culture positivity was significantly higher among patients with qSOFA ≥ 2 than among those with qSOFA 0–1 (52.7% versus 22.2%; $p=0.004$). Among culture-positive isolates, multidrug resistance was observed in 58.6% of the high-qSOFA group and 50.0% of the low-qSOFA group; this difference was not statistically significant ($p=0.721$).

Discussion

The present study demonstrated blood culture positivity in 39% of adults with suspected sepsis, with Gram-negative bacteria accounting for 84.6% of isolates. *Klebsiella pneumoniae* was the predominant pathogen, followed by *Acinetobacter baumannii* and *Escherichia coli*. The culture positivity rate was higher than the 21% reported by Gupta et al., although differences in patient selection and culture collection practices limit direct comparison. Gram-negative predominance was consistent with Choudhari et al., who reported 64% Gram-negative isolates among bloodstream infections in cancer patients. These variations across clinical populations emphasize the importance of local surveillance rather than applying organism distributions from other institutions directly to empirical treatment decisions.

Multidrug resistance was reported in 56.4% of isolates, alongside substantial Gram-negative resistance to ampicillin, ceftriaxone, amoxicillin–clavulanic acid, and cefepime. Susceptibility to meropenem and piperacillin–tazobactam was approximately 55%, highlighting the limitations of assuming adequate coverage with broad-spectrum agents. These observations broadly align with Gandra et al., who documented a considerable resistance burden among Gram-negative bloodstream pathogens in India. Although colistin and tigecycline showed comparatively higher reported susceptibility, laboratory activity alone does not establish their suitability for empirical therapy. The findings support susceptibility-guided treatment and antimicrobial stewardship; however, pooled susceptibility results and the small number of Gram-positive isolates limit organism-specific conclusions.

Blood culture positivity was significantly higher among patients with qSOFA ≥ 2 than among those with scores of 0–1 (52.7% versus 22.2%; $p=0.004$), suggesting an association between physiological derangement and documented bloodstream infection. Nevertheless, positive cultures in the low-qSOFA group demonstrate that a low score cannot exclude bacteremia. Multidrug resistance did not differ significantly between qSOFA categories (58.6% versus 50.0%; $p=0.721$), providing insufficient evidence to use qSOFA alone to anticipate resistance. This distinction

supports using clinical assessment and microbiological testing together, consistent with current guidelines that discourage qSOFA as a single sepsis screening tool. The single-centre design, limited culture-positive sample, and absence of adjusted analyses restrict generalizability and warrant confirmation in larger studies.

Conclusion

Gram-negative bacteria, predominantly *Klebsiella pneumoniae*, were the leading blood culture isolates, with multidrug resistance observed in more than half of isolates. A qSOFA score ≥ 2 was significantly associated with blood culture positivity, but its association with multidrug resistance was not statistically significant. These findings support using qSOFA alongside clinical assessment while retaining blood culture and antimicrobial susceptibility testing to guide targeted treatment and antimicrobial stewardship.

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