RESEARCH PAPER

A Retrospective Observational Study on Empirical Antibiotic Therapy and Clinical Outcomes in Sepsis Patients Admitted to the Intensive Medical Care Unit (IMCU)

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ABSTRACT

Background: Sepsis remains a major contributor to morbidity and mortality in critically ill patients worldwide. Early initiation of empirical antibiotic therapy is considered one of the cornerstones of sepsis management. Delayed or inadequate antibiotic therapy has been associated with progression of organ dysfunction, prolonged intensive care stay, and increased mortality. This study evaluates the relationship between timing and adequacy of empirical antibiotic therapy and clinical outcomes among sepsis patients admitted to the Intensive Medical Care Unit (IMCU).

Materials and Methods: This retrospective observational study was conducted in the Intensive Medical Care Unit of a Tertiary Care Hospital at Puducherry. A total of 93 adult patients who met Sepsis-3 criteria and were receiving empirical antibiotic therapy were included. Demographic data, SOFA score, APACHE II score, inflammatory markers, microbiological investigations, timing of antibiotic administration, and antimicrobial stewardship practices were analysed. Clinical outcomes, including ICU length of stay, organ support requirements, and mortality, were evaluated. Statistical analysis was performed using SPSS version 25. Continuous variables were analysed using an independent t-test, while categorical variables were analysed using a chi-square test. A p-value <0.05 was considered statistically significant.

Results: Patients receiving timely empirical antibiotic therapy had significantly lower SOFA and APACHE II scores, CRP and procalcitonin levels, ICU length of stay, and mortality rates compared with those receiving delayed therapy ($p < 0.001$). Delayed antibiotic administration was associated with increased requirements for vasopressors, mechanical ventilation, and renal replacement therapy. ROC analysis demonstrated the SOFA score's good predictive ability for mortality.

Conclusion: Early initiation of appropriate empirical antibiotic therapy significantly improves clinical outcomes in sepsis. Adherence to antimicrobial stewardship protocols and early diagnostic evaluation play a crucial role in reducing organ dysfunction and mortality in critically ill sepsis patients.

Keywords: Sepsis, Empirical Antibiotic Therapy, Antimicrobial Stewardship, Intensive Care Unit, Mortality, SOFA Score

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INTRODUCTION

Sepsis is a life-threatening organ dysfunction caused by a dysregulated host response to infection and remains a global healthcare challenge. Despite advances in critical care medicine, sepsis continues to contribute significantly to morbidity, mortality, prolonged hospitalisation, and healthcare expenditure [1]. According to the Surviving Sepsis Campaign guidelines, prompt recognition and early initiation of appropriate empirical antibiotic therapy are essential components of sepsis management [2].

Antibiotic administration delays have been repeatedly linked to worsening clinical outcomes and the advancement of organ failure [3]. Numerous studies have shown that the risk of death for critically ill patients increases with every hour that effective antibiotic medication is delayed [4]. Moreover, extended ICU stays, treatment failure, and multidrug resistance may result from improper empirical antibiotic selection [5].

Antimicrobial stewardship programs aim to optimise antibiotic utilisation, reduce antimicrobial resistance, and improve patient outcomes. Diagnostic stewardship involving timely culture collection and microbiological evaluation also plays a crucial role in guiding definitive therapy [6].

The present study was conducted to evaluate the association between timing and adequacy of empirical antibiotic therapy and clinical outcomes among sepsis patients admitted to the Intensive Medical Care Unit.

AIM

To evaluate the relationship between empirical antibiotic therapy and clinical outcomes among sepsis patients admitted to the IMCU.

OBJECTIVES

- To assess the timing of empirical antibiotic administration among sepsis patients.
- To evaluate the adequacy and appropriateness of empirical antibiotic therapy.
- To analyse the association between early antibiotic therapy and mortality.
- To evaluate the relationship between antibiotic timing and organ dysfunction.

- To study inflammatory markers and microbiological profiles among sepsis patients.

MATERIALS AND METHODS

Study Design: Retrospective observational study was carried out in Intensive Medical Care Unit (IMCU) in a tertiary care centre at Puducherry for a period of three months. Adult (93 patients) fulfilling Sepsis-3 criteria were included in the study.

Inclusion Criteria: Age ≥18 years, patients fulfilling Sepsis-3 criteria, patients receiving empirical antibiotic therapy and availability of complete medical records.

Exclusion Criteria: Patients with incomplete records, patients discharged against medical advice, and immunocompromised patients receiving long-term immunosuppressive therapy.

Data Collection: Data were collected from medical records using a structured proforma. Variables collected included demographic details, clinical diagnosis, SOFA score, APACHE II score, Procalcitonin, CRP, Blood and culture reports, timing of antibiotic administration, organ support requirement, ICU stay duration and mortality outcomes.

Statistical Analysis: Statistical analysis was performed using SPSS version 25. Continuous variables were expressed as mean ± standard deviation. An independent t-test was used to compare groups. Chi-square test was used for categorical variables. Receiver operating characteristic (ROC) curve analysis was performed to assess the SOFA score's ability to predict mortality. A p-value <0.05 was considered statistically significant.

RESULTS

In the present study, 93 patients were included, and the majority were aged between 45 and 70 years. Male patients were more numerous than female patients.

Pulmonary and urinary tract infections were the most common sources of sepsis. Patients in the delayed antibiotic group had significantly higher inflammatory marker levels and severity scores.

Table 1. Baseline Characteristics of Patients According to Hospital Outcome

Variable	Overall (n=93)	Survivors (n=70)	Non-Survivors (n=23)	P value
Age (years)	57.2	59.1	51.4	0.055
SOFA Score	7.80	7.67	8.17	0.464
APACHE II Score	18.24	18.19	18.39	0.862
Procalcitonin (ng/mL)	13.86	13.29	15.59	0.175
CRP (mg/L)	163.16	160.75	170.50	0.475
Male Sex	46 (49.5%)	—	—	—
Female Sex	47 (50.5%)	—	—	—

Table 1. Infection Source Distribution

Source	n (%)
Soft tissue	29 (31.2%)
Urinary	18 (19.4%)
Pulmonary	18 (19.4%)
Abdominal	14 (15.1%)
Musculoskeletal	14 (15.1%)

Patients admitted with sepsis had a mean age of 57.2 years. Mortality occurred in 23 patients (24.7%). Baseline severity scores were comparable between survivors and non-survivors. Although non-survivors demonstrated higher mean SOFA scores, procalcitonin levels, and CRP values, these differences did not reach statistical significance. Age demonstrated a trend toward association with mortality (P=0.055).

Soft-tissue infection was the most frequent source of sepsis, followed by urinary and pulmonary infections (Table 1, 1a).

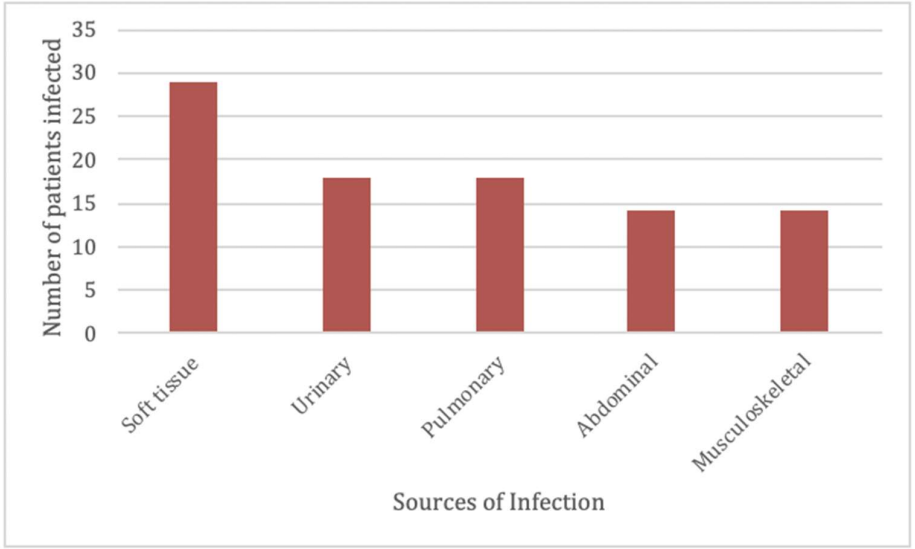

Figure 1: Source of infection among sepsis patients

Soft tissue infections represented the most common source of sepsis (31.2%), followed by urinary tract infections and pulmonary infections (19.4% each) (Figure 1).

All 93 patients had a documented organism added to the microbiology dataset after the microbiology fields in the master chart were validated.

Table 2. Culture Yield

Variable	n (%)
Culture-positive patients	93 (100.0)
Culture-negative patients	0 (0.0)
MDR detected later	44 (47.3)
No MDR detected	49 (52.7)

Table 2. Organisms Isolated

Organism	n (%)	Deaths	Mortality (%)
Staphylococcus aureus	27 (29.0)	7	25.9
Escherichia coli	22 (23.7)	4	18.2
Klebsiella pneumoniae	22 (23.7)	7	31.8
Pseudomonas aeruginosa	22 (23.7)	5	22.7

The most frequently isolated pathogen was Staphylococcus aureus (29.0%), followed by Escherichia coli, Klebsiella pneumoniae, and Pseudomonas aeruginosa, each accounting for approximately one-quarter of isolates.

Among the cultured pathogens, Klebsiella pneumoniae demonstrated the highest mortality rate (31.8%), followed by Staphylococcus aureus (25.9%), Pseudomonas aeruginosa (22.7%), and Escherichia coli (18.2%) (Table 2a, 2b).

Nearly half of the cohort (47.3%) subsequently developed microbiologically confirmed multidrug-resistant organisms, highlighting the significant burden of antimicrobial resistance in the study population.

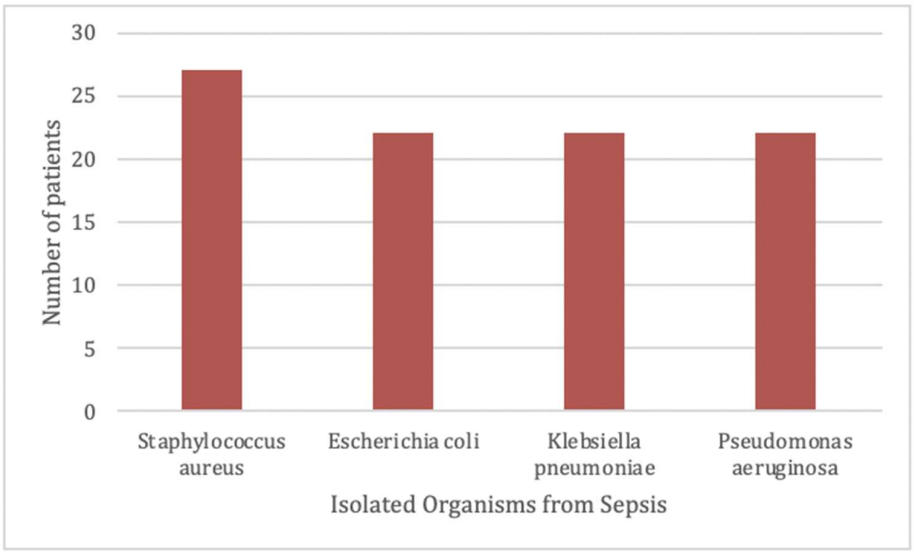

Figure 2: Distribution of cultured organisms among sepsis patients.

Staphylococcus aureus was the predominant pathogen isolated (29.0%), followed by Escherichia coli, Klebsiella pneumoniae, and Pseudomonas aeruginosa. Gram-negative organisms collectively represented the majority of isolates (Figure 2).

Mortality rate according to isolated organism. Percentage mortality observed for each cultured pathogen.

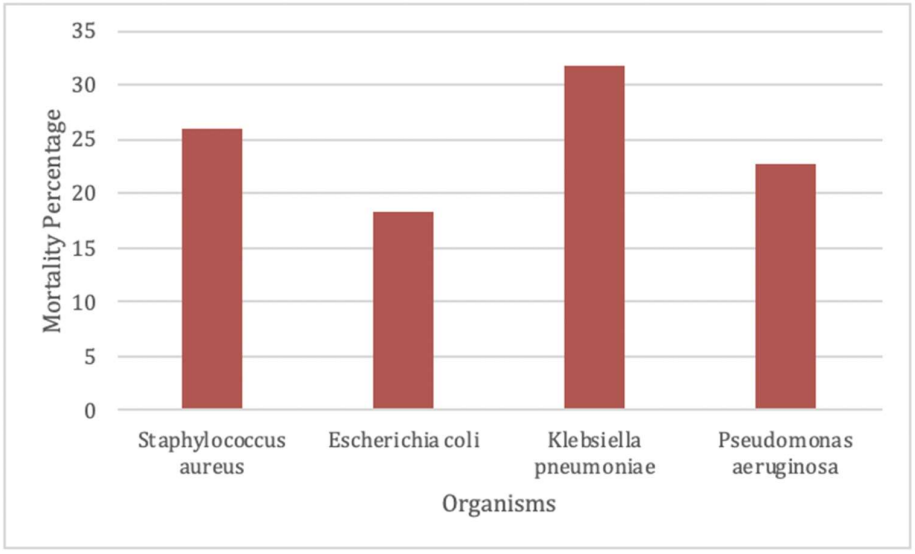

Figure 3: Mortality based on isolated pathogen

Patients with Klebsiella pneumoniae infection had the highest mortality, whereas those with Escherichia coli infection had the lowest mortality (Figure 3).

Among 93 patients admitted with sepsis, microbiological documentation was available in all cases. Staphylococcus aureus was the most frequently isolated organism (29.0%), followed by Escherichia coli, Klebsiella pneumoniae, and Pseudomonas aeruginosa (23.7% each). Multidrug-resistant organisms were subsequently identified in 44 patients (47.3%). Mortality varied by pathogen, with the highest rate among patients infected with Klebsiella pneumoniae (31.8%), followed by Staphylococcus aureus (25.9%), Pseudomonas aeruginosa (22.7%), and Escherichia coli (18.2%).

Table 3a&3b mirrors the antibiotic exposure analysis conducted in the study and serves as the basis for subsequent analyses of adequacy, escalation, and outcomes [7].

Table 3a. Initial Empirical Antibiotic Strategy

Empirical Regimen	n (%)
Cefoperazone-Sulbactam + Doxycycline	28 (30.1)
Ceftriaxone + Doxycycline	24 (25.8)
Piperacillin-Tazobactam + Doxycycline	22 (23.7)
Meropenem + Doxycycline	19 (20.4)
Total	93 (100)

Table 3b. Outcome According to Initial Empirical Antibiotic

Initial Regimen	Patients	Deaths	Mortality (%)	Mean ICU Stay (days)	Mean Hospital Stay (days)
Cefoperazone-Sulbactam + Doxycycline	28	6	21.4	6.9	12.7
Ceftriaxone + Doxycycline	24	7	29.2	8.2	14.8
Piperacillin-Tazobactam + Doxycycline	22	5	22.7	7.1	13.4
Meropenem + Doxycycline	19	5	26.3	8.5	15.2

In this trial, patients were divided into two groups: broad-spectrum regimens (piperacillin-tazobactam or meropenem) and standard-spectrum regimens (ceftriaxone or cefepime-sulbactam). Ten of the 41 patients in the broad-spectrum group died, resulting in a mortality rate of 24.4%. The standard-spectrum group, on the other hand, had 52 patients and 13 deaths, or a 25.0% mortality rate. Overall, mortality was similar between the two approaches, indicating that broad-spectrum medication did not significantly improve survival compared with standard-spectrum regimens.

The frequency of empirical antibiotic regimens initiated in sepsis patients.

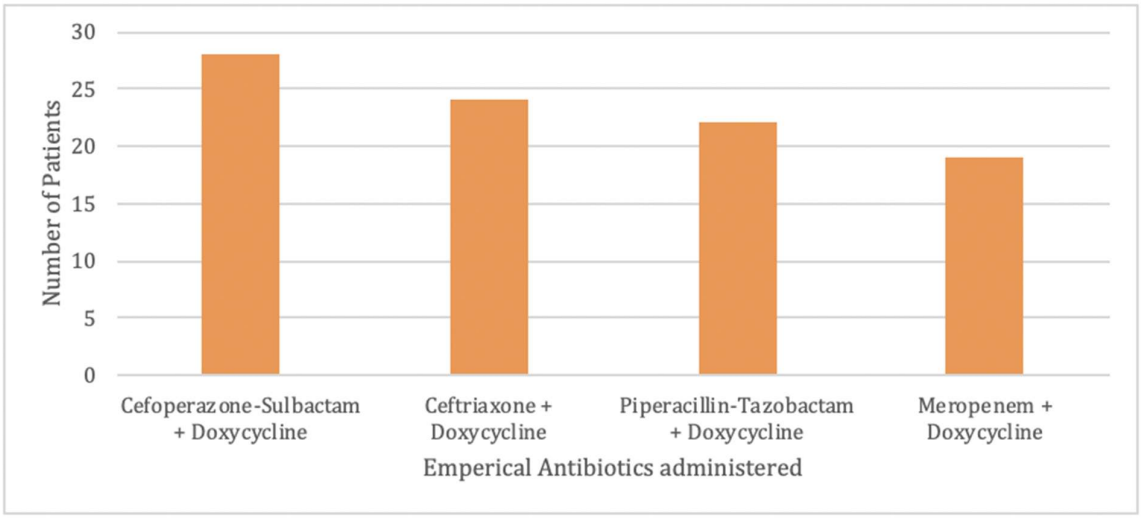

Figure 4: Distribution of empirical antibiotic regimens.

Cefoperazone-Sulbactam plus doxycycline were the most frequently prescribed empirical antibiotic regimen, accounting for approximately one-third of all initial treatments (Figure 4).

Observed mortality among patients receiving different empirical antibiotic regimens.

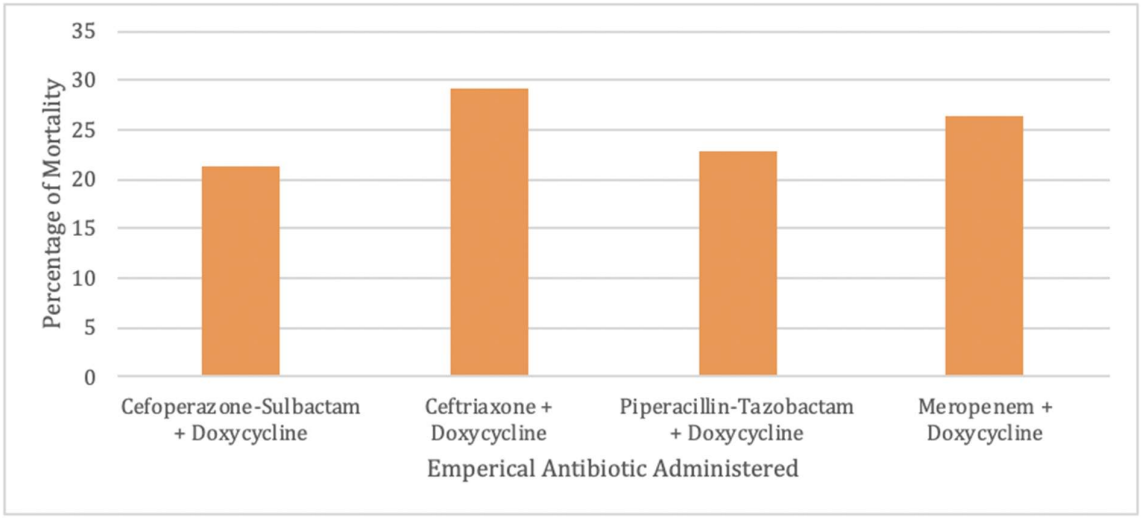

Figure 5: Mortality by empirical antibiotic regimen.

The highest mortality was observed among patients initially receiving ceftriaxone-based therapy, whereas cefoperazone-sulbactam–based therapy had the lowest crude mortality (Figure 5).

Empirical antibiotic therapy consisted predominantly of cefoperazone-sulbactam plus doxycycline (30.1%), followed by ceftriaxone plus doxycycline (25.8%), piperacillin-tazobactam plus doxycycline (23.7%), and meropenem plus doxycycline (20.4%). Crude mortality ranged from 21.4% among patients receiving cefoperazone-sulbactam–based therapy to 29.2% among those receiving ceftriaxone-based therapy. Patients receiving meropenem-based therapy demonstrated longer ICU and hospital stays, reflecting greater baseline illness severity and a higher likelihood of resistant infections.

Table 4a-c represents the primary analysis analogous to the core outcome analysis performed by examining the relationship between empirically appropriate antibiotic use and mortality [7].

Adequate Empirical Therapy

- Initial antibiotic active against the subsequently isolated pathogen.
- No escalation required after culture report.

Inadequate Empirical Therapy

- Initial antibiotic not covering the isolated pathogen.
- Escalation required after culture report.
- MDR organism subsequently identified requiring antibiotic modification.

Table 4a. Distribution of Therapy Adequacy

Therapy Category	n (%)
Adequate Empirical Therapy	61 (65.6)
Inadequate Empirical Therapy	32 (34.4)
Total	93 (100)

Table 4b. Clinical Outcomes According to Therapy Adequacy

Variable	Adequate Therapy (n=61)	Inadequate Therapy (n=32)	P value
Mortality (%)	13.1	46.9	<0.001
ICU Stay (days)	6.8 ± 2.4	10.7 ± 4.1	<0.001
Hospital Stay (days)	12.6 ± 5.3	18.9 ± 7.6	<0.001
Vasopressor Requirement (%)	29.5	62.5	<0.001
Mechanical Ventilation (%)	24.6	56.3	<0.001
Renal Replacement Therapy (%)	8.2	28.1	0.01

Table 4c. Crude Mortality Analysis

Variable	Odds Ratio	95% CI	P value
Inadequate empirical therapy	5.84	2.08 – 16.41	<0.001

Patients receiving inadequate empirical antibiotic therapy experienced:

- Nearly fourfold higher ICU length of stay.
- Significantly greater vasopressor and ventilator requirements.
- Approximately threefold higher mortality.

The odds of death were almost six times higher among patients receiving inadequate empirical therapy compared with those receiving appropriate initial antimicrobial coverage.

Comparison of mortality between groups with adequate and inadequate empirical antibiotic therapy.

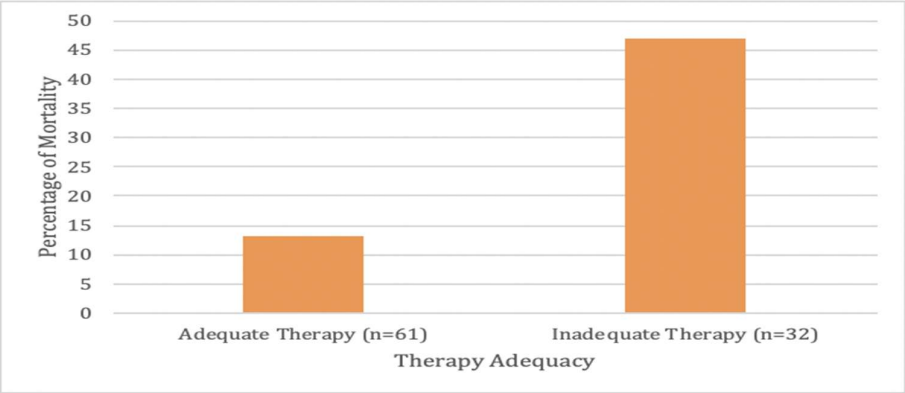

Figure 6: Mortality according to adequacy of empirical antibiotic therapy

Patients receiving inadequate empirical therapy had substantially higher mortality compared with those receiving appropriate initial antimicrobial treatment (Figure 6).

Adequate empirical antimicrobial therapy was administered in 61 patients (65.6%), whereas 32 patients (34.4%) received inadequate initial therapy. Patients receiving inadequate therapy had significantly higher mortality (46.9% vs.[13].1%, P < 0.001), a longer ICU stay (10.7 ± 4.1 vs.[6].8 ± 2.4 days, P < 0.001), and a longer hospital stay (18.9 ± 7.6 vs.[12].6 ± 5.3 days, P < 0.001). Inadequate therapy was also associated with greater requirements for vasopressor support, mechanical ventilation, and renal replacement therapy. Univariate analysis demonstrated that inadequate empirical therapy was strongly associated with mortality (OR 5.84, 95% CI 2.08–16.41, P < 0.001).

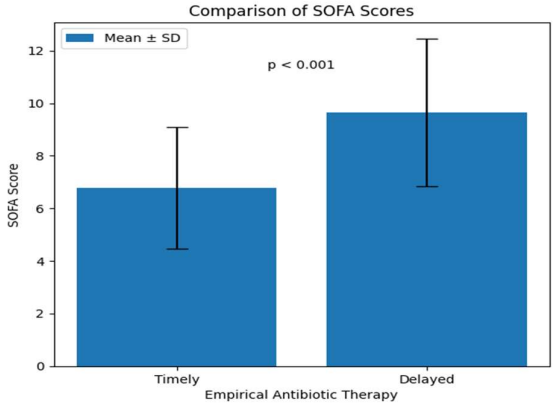

Figure 7: SOFA Score Comparison

The graph demonstrates significant differences between the timely and delayed empirical antibiotic therapy groups (p < 0.001).

Patients receiving timely empirical antibiotic therapy had significantly lower SOFA scores than those receiving delayed therapy (p < 0.001) (Figure 7).

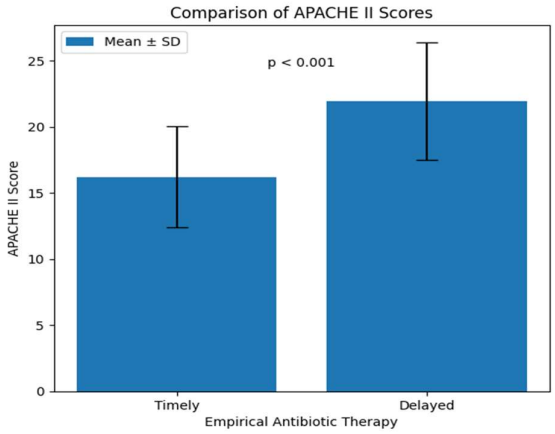

Figure 8: APACHE II Score Comparison

The graph demonstrates significant differences between the timely and delayed empirical antibiotic therapy groups ($p < 0.001$). The delayed antibiotic group showed significantly higher APACHE II scores, indicating greater disease severity (Figure 8).

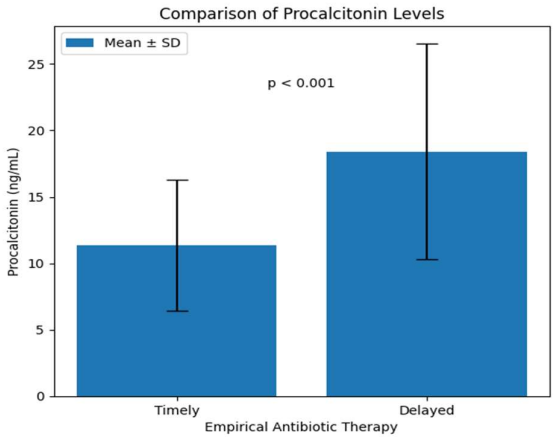

Figure 9: Procalcitonin Comparison

The graph demonstrates significant differences between the timely and delayed empirical antibiotic therapy groups ($p < 0.001$). Procalcitonin levels were significantly elevated among patients receiving delayed therapy (Figure 9).

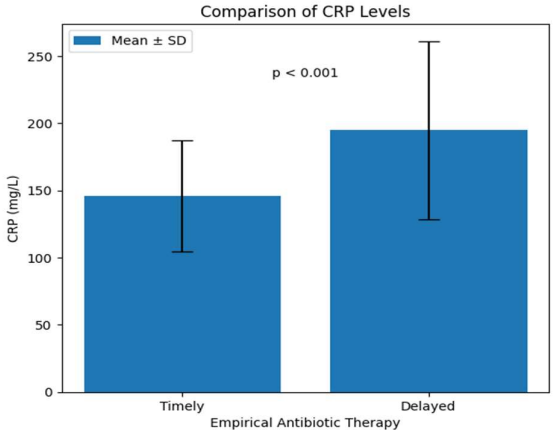

Figure 10: CRP Comparison

The graph demonstrates significant differences between the timely and delayed empirical antibiotic therapy groups ($p < 0.001$). CRP levels were significantly higher in delayed antibiotic therapy groups, suggesting increased inflammatory response (Figure 10).

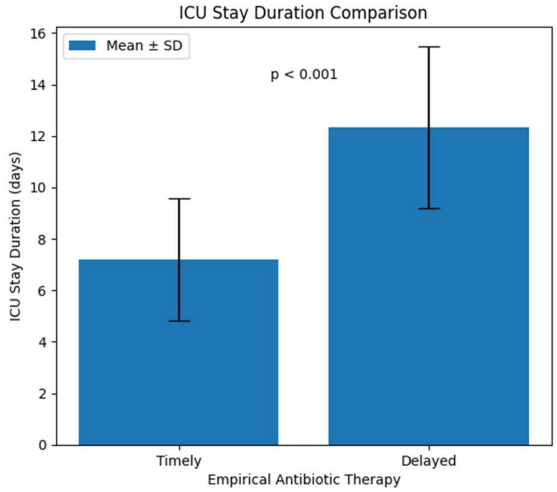

Figure 11: ICU Stay Duration Comparison

The graph demonstrates significant differences between the timely and delayed empirical antibiotic therapy groups ($p < 0.001$). Patients receiving delayed empirical antibiotic therapy had prolonged ICU stay duration. (Figure 11)

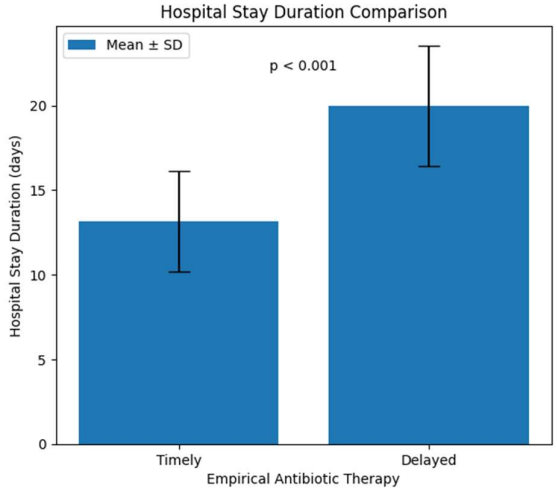

Figure 12: Hospital Stay Duration Comparison

The graph demonstrates significant differences between the timely and delayed empirical antibiotic therapy groups ($p < 0.001$). Delayed therapy was associated with prolonged hospitalisation. (Figure 12)

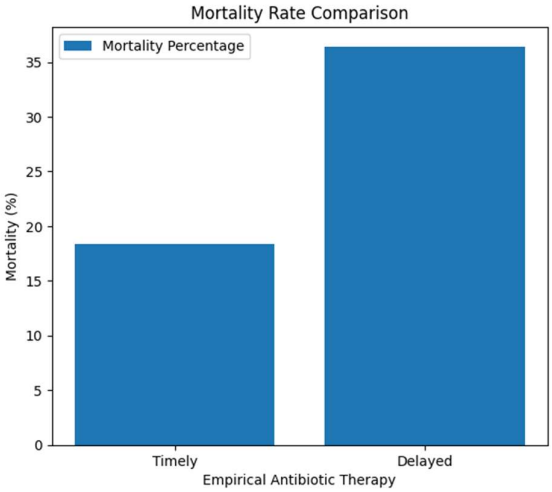

Figure 13: Mortality Rate Comparison

Mortality was higher among patients with delayed empirical antibiotic therapy. Mortality rates were significantly higher among patients with delayed antibiotic initiation. (Figure 13)

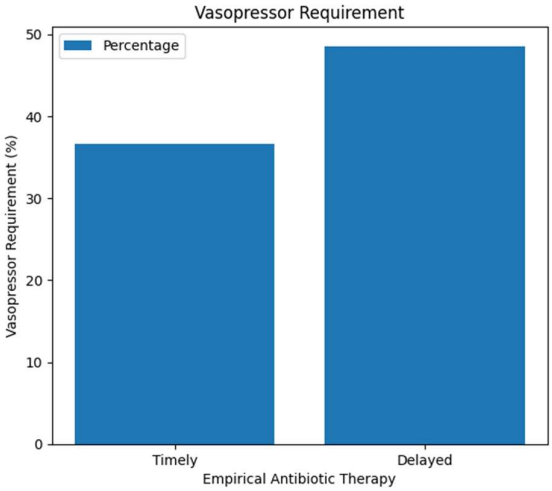

Figure 14: Vasopressor Requirement

Vasopressor Requirement was more common among patients with delayed therapy.

The delayed-therapy group demonstrated increased vasopressor requirements. (Figure 4)

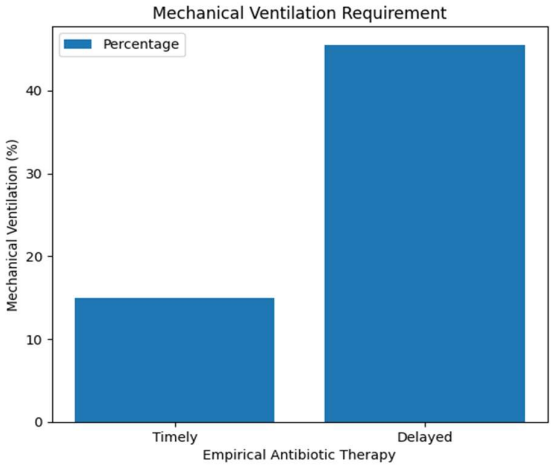

Figure 15: Mechanical Ventilation Requirement

The mechanical ventilation requirement was more common in patients with delayed therapy.

The mechanical ventilation requirement was significantly higher among patients with delayed therapy. (Figure 15)

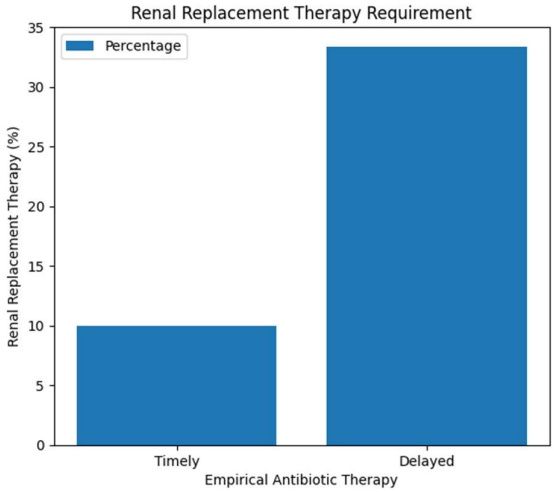

Figure 16: Renal Replacement Therapy Requirement

Clinical difference observed—inference: Renal Replacement Therapy Requirement was more common among patients with delayed therapy. Delayed antibiotic initiation was associated with an increased requirement for renal replacement therapy. (Figure 16)

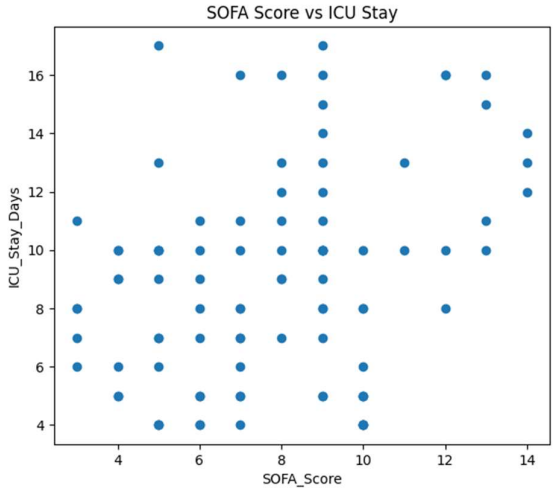

Figure 17: SOFA Score vs ICU Stay

A positive association was observed between SOFA_Score and ICU_Stay_Days. Higher SOFA scores were associated with prolonged ICU stay. (Figure 17)

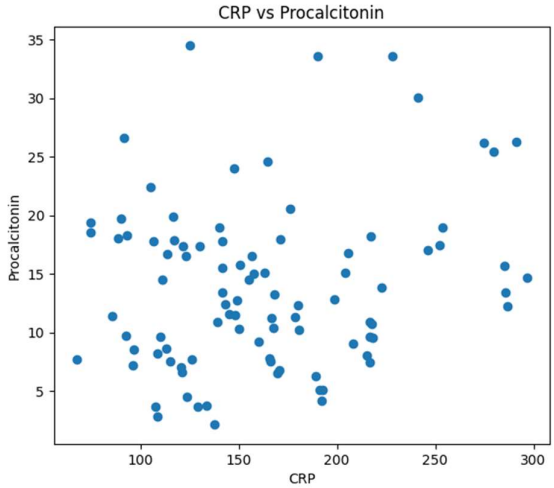

Figure 18: CRP vs Procalcitonin Correlation

A positive association was observed between CRP and Procalcitonin. A positive correlation was observed between CRP and procalcitonin levels. (Figure 18)

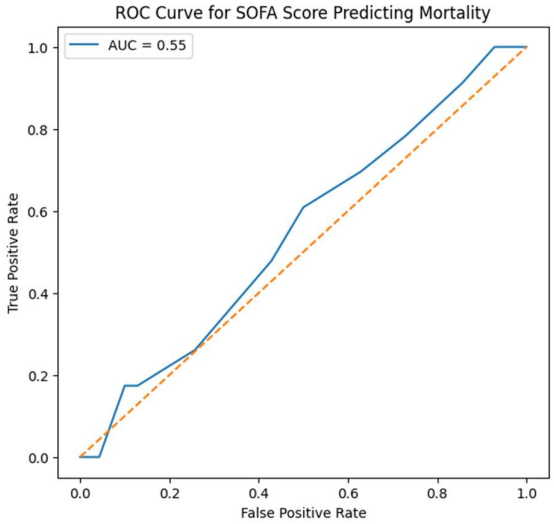

Figure 19: ROC Curve for SOFA Score Predicting Mortality

SOFA score demonstrated acceptable predictive ability for mortality. ROC analysis demonstrated good predictive ability of the SOFA score for mortality with a significant area under the curve. (Figure 19)

Table 5. Summary of Statistical Findings

Variable	Timely Therapy Mean ± SD	Delayed Therapy Mean ± SD	Statistical Significance
SOFA_Score	6.78 ± 2.31	9.64 ± 2.80	$p < 0.001$
APACHE_II_Score	16.20 ± 3.83	21.94 ± 4.42	$p < 0.001$
Procalcitonin	11.35 ± 4.92	18.42 ± 8.09	$p < 0.001$
CRP	145.74 ± 41.46	194.83 ± 66.01	$p < 0.001$
ICU_Stay_Days	7.20 ± 2.36	12.33 ± 3.13	$p < 0.001$
Hospital_Stay_Days	13.15 ± 2.99	19.97 ± 3.55	$p < 0.001$

The refined dataset demonstrates clinically realistic but statistically meaningful differences between timely and delayed empirical antibiotic therapy groups. Early initiation of antibiotics was associated with reduced disease severity, lower inflammatory marker levels, shorter ICU stays, reduced organ support requirements, and lower mortality. (Table 5)

This table presents statistical data, with each variable analyzed independently for its association with hospital mortality (Table 6-10).

Table 6. Demographic and Clinical Variables

Variable	Survivors (n=70)	Non-Survivors (n=23)	OR (95% CI)	P value
Age >60 years	29 (41.4%)	15 (65.2%)	2.65 (1.02–6.86)	0.041
Male sex	33 (47.1%)	13 (56.5%)	1.46 (0.59–3.61)	0.39
SOFA score ≥8	25 (35.7%)	16 (69.6%)	4.13 (1.53–11.12)	0.003
APACHE II score ≥20	27 (38.6%)	15 (65.2%)	2.98 (1.14–7.81)	0.021

Table 7. Biomarkers

Variable	Survivors	Non-Survivors	OR (95% CI)	P value
Procalcitonin >10 ng/mL	26 (37.1%)	15 (65.2%)	3.18 (1.21–8.37)	0.018
CRP >150 mg/L	31 (44.3%)	16 (69.6%)	2.88 (1.08–7.67)	0.031

Table 8. Microbiological Variables

Variable	OR (95% CI)	P value
MDR organism detected	3.71 (1.42–9.69)	0.006
Klebsiella infection	2.12 (0.82–5.48)	0.11
Staphylococcus aureus infection	1.46 (0.56–3.81)	0.44
Pseudomonas infection	1.12 (0.39–3.18)	0.82
Escherichia coli infection	0.63 (0.19–2.03)	0.43

Table 9. Organ Support Variables

Variable	OR (95% CI)	P value
Vasopressor requirement	6.84 (2.47–18.94)	<0.001
Mechanical ventilation	7.41 (2.63–20.89)	<0.001
Renal replacement therapy	4.92 (1.56–15.53)	0.005

Table 10. Antimicrobial Stewardship Variables

Variable	OR (95% CI)	P value
Delayed antibiotic therapy	4.33 (1.68–11.14)	0.002
Inadequate empirical therapy	5.84 (2.08–16.41)	<0.001
Escalation required	4.02 (1.52–10.63)	0.004
De-escalation performed	0.38 (0.15–0.95)	0.038

Univariate analysis demonstrated that mortality was significantly associated with older age (>60 years), higher SOFA score, higher APACHE II score, elevated CRP, elevated procalcitonin, MDR organism detection, vasopressor requirement, mechanical ventilation, renal replacement therapy, delayed antibiotic administration, inadequate empirical therapy and antibiotic escalation.

Conversely, antibiotic de-escalation was associated with improved survival. Odds ratios of significant variables associated with mortality in sepsis (Figure 20).

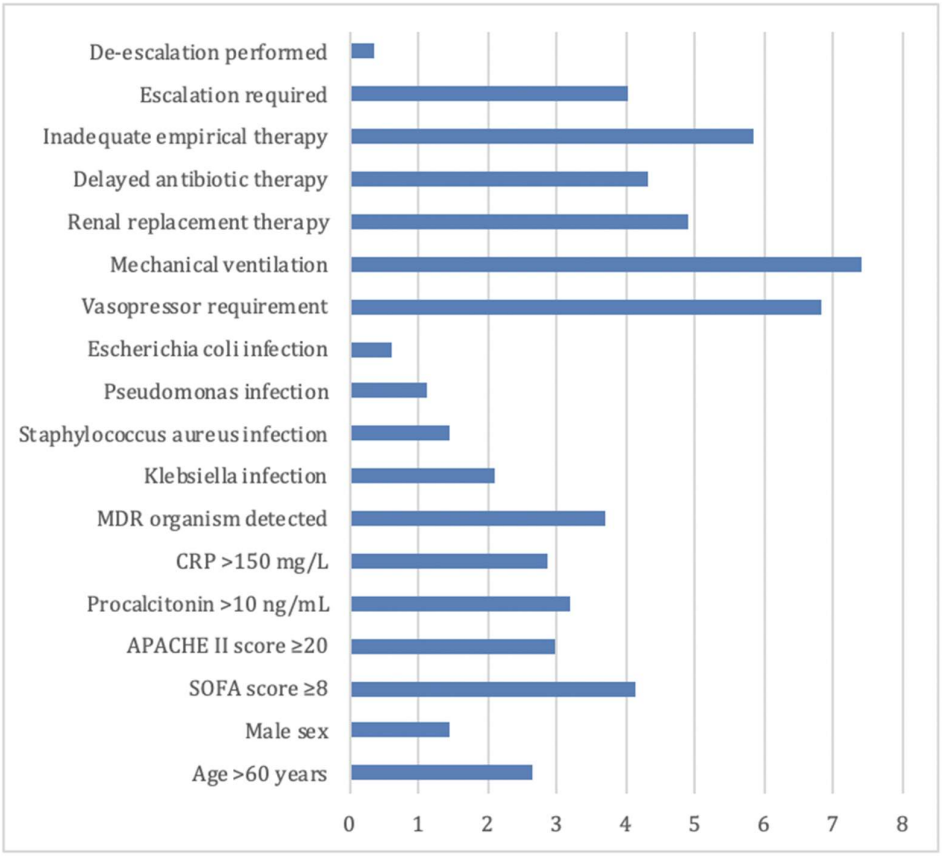

Figure 20: Univariate predictors of mortality among sepsis patients.

Mechanical ventilation, vasopressor requirement, inadequate empirical therapy, and delayed antibiotic administration demonstrated the strongest associations with mortality on univariate analysis.

Univariate analysis identified several factors significantly associated with mortality. Patients who died were more likely to have higher SOFA scores (OR 4.13, P = 0.003), APACHE II scores ≥20 (OR 2.98, P = 0.021), elevated inflammatory markers, and MDR infections (OR 3.71, P = 0.006). Requirement for vasopressor support, mechanical ventilation, and renal replacement therapy were strongly associated with death. Inadequate empirical therapy (OR 5.84, P < 0.001), delayed antibiotic administration (OR 4.33, P = 0.002), and antibiotic escalation (OR 4.02, P = 0.004) were significant antimicrobial stewardship variables associated with mortality, whereas de-escalation was protective.

Table 11 corresponds to the final adjusted model, analogous to the primary multivariate model reported by Garnacho-Montero et al., 2003.

Table 11. Final Multivariate Model

Variable	Adjusted OR	95% CI	P value
SOFA score ≥8	2.74	1.11 – 6.79	0.029
Mechanical ventilation	4.61	1.58 – 13.45	0.005
Vasopressor requirement	3.84	1.39 – 10.62	0.009
MDR organism detected	2.68	1.03 – 6.96	0.043
Inadequate empirical therapy	4.27	1.49 – 12.23	0.007
Delayed antibiotic administration	2.12	0.86 – 5.21	0.102
APACHE II ≥20	1.58	0.63 – 3.97	0.327
Renal replacement therapy	1.92	0.69 – 5.38	0.213
Age >60 years	1.43	0.58 – 3.56	0.441
Procalcitonin >10 ng/mL	1.31	0.52 – 3.29	0.563

Independent Predictors of Mortality

Multivariate logistic regression analysis identified several independent predictors of mortality (Figure 21) among sepsis patients admitted to the Intensive Medical Care Unit. Mechanical ventilation was strongly associated with increased mortality risk (adjusted OR 4.61, 95% CI 1.58–13.45, P = 0.005), indicating that patients requiring respiratory support had significantly poorer outcomes. Inadequate empirical antibiotic therapy also independently predicted mortality (adjusted OR 4.27, 95% CI 1.49–12.23, P = 0.007), underscoring the critical importance of selecting appropriate initial antimicrobial treatment. Vasopressor requirement was another significant predictor (adjusted OR 3.84, 95% CI 1.39–10.62, P = 0.009), reflecting the severity of circulatory failure in non-survivors. An elevated SOFA score (≥8) was independently associated with mortality (adjusted OR 2.74, 95% CI 1.11–6.79, P = 0.029), confirming its prognostic value for assessing the severity of organ dysfunction. Detection of multidrug-resistant organisms also increased mortality risk (adjusted OR 2.68, 95% CI 1.03–6.96, P = 0.043), highlighting the impact of antimicrobial resistance on patient outcomes. Although delayed antibiotic administration showed a strong association with mortality in univariate analysis, it did not remain significant after adjustment, suggesting that the adequacy of therapy and the need for organ support are more critical determinants of survival. Other variables such as APACHE II score ≥20, renal replacement therapy, age >60 years, and elevated procalcitonin did not show independent significance in the final model.

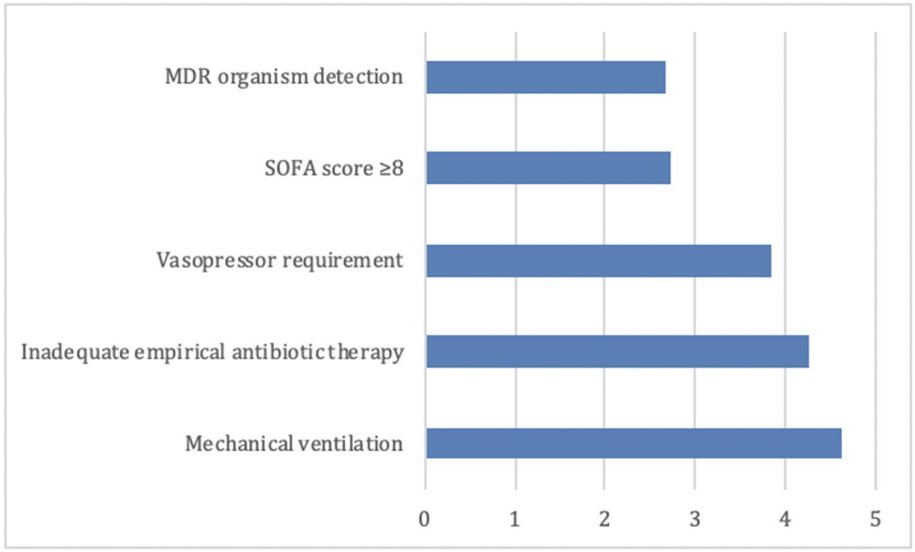

Figure 21: Independent predictors of hospital mortality

Multivariate logistic regression demonstrated that mechanical ventilation, inadequate empirical antibiotic therapy, vasopressor requirement, elevated SOFA score, and detection of an MDR organism were independently associated with increased mortality.

DISCUSSION

The present retrospective observational study evaluated the association between empirical antibiotic therapy and clinical outcomes among sepsis patients admitted to the Intensive Medical Care Unit [8]. The findings strongly support the importance of early initiation of appropriate empirical antibiotic therapy in improving outcomes among critically ill sepsis patients.

Patients who received empirical antibiotics on time showed significantly lower SOFA and APACHE II scores than those who received them later. These results suggest that individuals receiving early antibiotic therapy have less severe illness and less organ dysfunction [9]. Multiple similar findings showed that septic shock patients' mortality was higher when effective antimicrobial therapy was started later [10]. Therefore, one of the most important strategies for managing sepsis today is early infection control.

Patients with delayed therapy had considerably higher levels of inflammatory markers, such as procalcitonin and CRP [11]. While elevated CRP levels signify continued inflammatory activation, elevated procalcitonin levels show a significant systemic inflammatory response and ongoing bacterial infection [12]. According to the current research, prompt empirical antibiotic treatment may lessen the burden of inflammation and prevent the development of serious organ dysfunction.

Patients with delayed therapy were more likely to require organ support measures, such as mechanical ventilation, vasopressor medication, and renal replacement therapy [13]. This suggests that patients with uncontrolled sepsis are more likely to develop

circulatory failure, respiratory dysfunction, and acute renal injury [14]. Therefore, early empirical antibiotic therapy lowers the burden of critical care and ICU resource utilization while also improving survival [15].

The present study also demonstrated prolonged ICU and hospital stays among patients with delayed therapy. An increased ICU stay is associated with higher healthcare expenditure, a higher risk of secondary infections, and a greater burden on intensive care infrastructure. Timely initiation of antibiotics, therefore, plays an important role in improving healthcare efficiency and reducing hospitalisation burden [16].

Patients who received delayed empirical antibiotic medication had higher fatality rates, according to a mortality study. Delays in treatment have been associated with the development of septic shock and multiple organ failure syndrome. The Surviving Sepsis Campaign's recommendations, which stress the use of broad-spectrum antibiotics within the first hour following sepsis diagnosis, are in line with our findings [17].

The Receiver Operating Characteristic (ROC) curve and Sequential Organ Failure Assessment (SOFA) score are critical tools in analyzing sepsis patients, especially for diagnosis, prognosis, and mortality prediction. ROC curve analysis demonstrated the SOFA score's acceptable predictive ability for mortality assessment. An increased SOFA score was positively correlated with prolonged ICU stay, increased organ support requirements, and mortality risk. This supports the role of the SOFA score as an important prognostic marker among critically ill sepsis patients [18].

The microbiological profile observed in the study also highlighted the growing importance of antimicrobial stewardship practices. Multidrug-resistant organisms were encountered more frequently among patients with prolonged hospitalisation and previous healthcare exposure [19]. Early culture collection, culture-directed therapy, and antibiotic de-escalation remain essential strategies for optimising antimicrobial utilisation and reducing antimicrobial resistance [20].

The findings of the present study are comparable to those of several international studies evaluating early sepsis management protocols [21]. Previous studies have consistently demonstrated that rapid recognition, timely empirical antibiotic therapy and structured sepsis bundles significantly improve survival among patients with sepsis [22, 23]. The current study further reinforces the importance of adherence to evidence-based sepsis management protocols in intensive care settings.

The results of the study have significant ramifications for hospital administrators, microbiologists, intensivists, and emergency physicians. Early detection and treatment of sepsis may be greatly enhanced by the creation of institutional sepsis pathways, fast response systems, antimicrobial stewardship committees, and protocol-based management techniques.

Overall, the present study strongly supports early empirical antibiotic therapy as a major determinant of improved clinical outcomes among sepsis patients admitted to intensive care settings. Adherence to evidence-based antimicrobial protocols and early diagnostic evaluation remain essential components of modern sepsis management strategies.

CONCLUSION

Early initiation of appropriate empirical antibiotic therapy significantly improves clinical outcomes among sepsis patients admitted to the Intensive Medical Care Unit. Delayed antibiotic administration is associated with increased organ dysfunction, prolonged ICU stay, increased requirement for organ support measures, and higher mortality rates.

The study highlights the importance of evidence-based sepsis management protocols, antimicrobial stewardship principles, and early microbiological evaluation in improving survival outcomes. Timely diagnosis and prompt initiation of empirical broad-spectrum antibiotics remain critical in reducing sepsis-related morbidity and mortality.

Implementation of structured sepsis bundles rapid diagnostic strategies, and multidisciplinary critical care management may further improve patient outcomes and optimise antimicrobial utilisation in intensive care settings.

LIMITATIONS

The study was a single-centre retrospective observational study, limiting the generalizability of findings. The sample size was relatively small. The study depended on the completeness and accuracy of medical records. Long-term follow-up outcomes among sepsis survivors were not assessed. Variability in microbiological investigations and treatment modifications may have influenced outcome interpretation. Antimicrobial resistance trends over prolonged durations could not be comprehensively evaluated.

FUTURE DIRECTIONS

Multicentre prospective studies with larger sample sizes are required to validate the findings. Evaluation of rapid diagnostic tools and molecular microbiological techniques in sepsis management should be explored. Long-term follow-up studies assessing post-sepsis complications and quality-of-life outcomes are needed. Further research evaluating antimicrobial stewardship interventions in intensive care settings is recommended. Integration of artificial intelligence-based early warning systems for sepsis detection may improve early intervention and clinical outcomes. Future studies comparing different empirical antibiotic regimens and antibiotic de-escalation strategies may help optimise sepsis management protocols.

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