ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCES

SCHOOL OF MEDICINE

DEPARTMENT OF EMERGENCY AND CRITICAL CARE MEDICINE

MAGNITUDE OF MORTALITY FROM SEPSIS AND SEPTIC SHOCK AND ASSOCIATED FACTORS AMONG PATIENTS ADMITTED TO ADULT EMERGENCY DEPARTMENTS OF TIKUR ANBESSA SPECIALIZED HOSPITAL AND ST. PAUL HOSPITAL MILLENNIUM MEDICAL COLLEGE, ADDIS ABABA, ETHIOPIA, 2025.

Dr. Assefa Petros, MD

A research thesis is to be submitted to the Department of Emergency and Critical Care Medicine, College of Health Sciences, presented in partial fulfillment of the requirements for a specialty certificate in Emergency and Critical Care Medicine.

December 2025

Addis Ababa, Ethiopia

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Name of investigator	Dr. Assefa Petros MD
Full title of the project	*Assessment of the magnitude of mortality from sepsis and septic shock and associated factors among patients admitted to adult Emergency departments of Tikur Anbessa Specialized Hospital and St. Paul Hospital Millennium medical College, Addis Ababa, Ethiopia, 2025.*
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December 2025

Addis Ababa, Ethiopia

DECLARATION

Assessment of the magnitude of mortality from sepsis and septic shock and associated factors among patients admitted to adult Emergency departments of Tikur Anbessa Specialized Hospital and St. Paul Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2025. This multicenter institutional based cross-sectional study was conducted by the principal investigator, Dr. Assefa Petros in the Department of Emergency and Critical Care Medicine, under the supervision of Dr. Temesgen Beyene (MD, MPH, Associate professor of Emergency Medicine and Critical care) and Dr. Tigist Zewde (MD, MPH, Emergency Medicine and Critical Care consultant at Tikur Anbessa Specialized Hospital). The information derived from the literature has been duly acknowledged in the reference list and will be recognized accordingly. The assistance and support received during this work will also be appropriately acknowledged. Otherwise, this is the original work of Dr. Assefa Petros.

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ABBREVIATIONS AND ACRONYMS

AAU: Addis Ababa University

AMR: Antimicrobial Resistance

CDC: Center for Disease Control

COPD: chronic obstructive pulmonary disease

COVID-19: Coronavirus disease 2019

ED-LOS: Emergency department length of stay

EDs: Emergency Departments

EU: European Union

FMOH: Federal Ministry of Health

GDP: Gross domestic product

HIV: Human Immunodeficiency Virus

ICON: Intensive Care Over Nations

ICU: Intensive care unit

IHME: Institute for Health Metrics and Evaluation

LMICs: Low- and middle-income countries

OPDS: outpatient departments

POCUS: point of care ultrasound

qSOFA: quick sepsis related organ failure assessment

SPHMMC- St. Paul millennium medical college

SSA: Sub-Saharan Africa

SSC: Surviving Sepsis Campaign

TASH: Tikur Anbessa Specialized hospital

WHO: World Health Organization

ABSTRACT

Introduction: Sepsis and septic shock remain major causes of morbidity and mortality worldwide, with disproportionately high burden in low and middle-income countries. Evidence on early mortality and its determinants in Ethiopian Emergency departments is limited. This study aimed to determine the magnitude of mortality from sepsis and septic shock and associated factors among adult patients admitted to the emergency departments of Addis Ababa teaching tertiary hospitals.

Methods: An institutional based retrospective chart review was conducted between October 2023 to October 2025 among the total of 141 eligible medical records of patients with sepsis or septic shock that admitted to the EDs at Tikur Anbessa Specialized Hospital and St. Paul Hospital Millenium Medical College. Multivariable logistic regression was conducted and adjusted odds ratios (AOR) with a 95% confidence interval (CI) were reported, and statistical significance was set at a *p* value of less than 0.05.

Results: Among 141 patients, majority 57% were females and 42.6% were males, with median age range was 40-59years and about half, 47.5% of the had qSOFA score ≥ 2. The 24-hour emergency departments' mortality among patients with sepsis and septic shock was 31.9% (95% CI: 24.2%–40.3%). Respiratory infections accounted for 49.6% of admissions, followed by gastrointestinal (38.3%) and central nervous system infection (4.3%). Mortality was significantly associated with multiorgan failure 2.9(1.1_7.4), length of EDs stay 12 hours 4.99(2.046_12.21), malignancy 2.6(1.1_6.2), qSOFA score ≥2 3.49(1.5_7.8) and comorbidities 3.3(1.125_ 9.84).

Conclusion: Overall, the magnitude of ED mortality rate among patients with sepsis or septic shock admitted to EDs of Addis Ababa teaching hospitals was high. Respiratory and gastrointestinal infections were leading causes of death, emphasizing the need for targeted interventions. Clinical indicators such as altered mentation, hypotension, multiorgan failure, comorbidity, and prolonged ED significantly increased the risk of mortality. Enhancing early identification, optimizing resuscitation within the golden hours, and improving timely interventions are critical to reducing sepsis related mortality.

Keywords: Sepsis/Septic shock, Early mortality, Emergency department, Addis Ababa, Ethiopia.

1.Introduction

1.1 Background

Sepsis and septic shock remain critical global health concern, characterized by a dysregulated host response to infection leading to life threatening organ dysfunction. The definition has evolved significantly over time. The 2001 sepsis-2 criteria described sepsis as life threatening dysfunction caused by an abnormal host response to infection, while septic shock was considered a severe subset marked by profound circulatory and metabolic disturbances **(**1). In 2026, the Sepsis -3 consensus further refined these definitions, emphasizing sepsis as a life- threatening organ dysfunction resulting from dysregulated host responses and septic shock as a subset associated with markedly increased mortality due to circulatory and metabolic abnormalities (2).

Globally, the burden of sepsis remains substantial. Estimates from the Institute of Health Metrics and Evaluation (IHME) indicated that the number of global sepsis cases declined from 60.2million in 1990 to 48.9 million in 2017, reflecting a reduction across most regions of world (3). However, findings from a systemic review contradicted on this trend, suggesting that while global estimates may appear an increasing tractor rather than a true decline (4).

Understanding the risk profile of sepsis is essential. According to the World Health Organization (WHO) and the Mayo Clinic, major risk groups include young infants, older adults, pregnant women, hospitalized patients and individuals with chronic diseases such as diabetes, chronic kidney disease, chronic obstructive lung disease (COPD), and those with compromised immunity due to corticosteroid therapy, HIV/AIDS, cirrhosis, cancer or asplenia. These risk factors increase susceptibility to infection and accelerate progression to sepsis or septic shock (5).

Globally, sepsis and septic shock account for significant morbidity and mortality with estimates suggesting that one in six to one in three affected individuals dies depending on the severity of illness and access to care (5).The WHO reports that severe sepsis and septic shock occur at annual prevalence of 13-300 cases and 11 cases per 100,00 population, respectively, with the highest burden observed in Sub-Saharan Africa due to limited healthcare resources(6).

In Ethiopia, the burden of sepsis mirrors the global challenge. A study conducted in intensive care units reported respiratory infections as the leading source of sepsis (53.1%), followed by urinary tract (19.3%) and intra-abdominal infections (18.9%). Comorbidities such as HIV (19.3%), diabetes mellitus (15.3%) and malignancies (12.4%) were frequently identified with overall mortality reaching 50.9% within 28days among patients diagnosed with sepsis or septic shock (7).

Given the high global burden, evolving definitions, and substantial mortality in low resource settings such as Ethiopia, assessing the magnitude of mortality and identifying associated factors among emergency department patients is critical. This study addresses these gaps by generating local evidence to guide early detection, timely intervention, and improved outcomes among adults presenting with sepsis and septic shock.

1.2 Statement of the problem

Sepsis and septic shock are life threatening medical emergencies due to a dysregulated host response to infection, which leads to organ dysfunction and profound circulatory and metabolic abnormalities with high mortality (1). Despite advances in critical care, sepsis remains a major global health burden due to its rapid progression, diagnostic complexity, and high mortality rate, particularly when early recognition and treatment are delayed.

Globally, sepsis and septic shock affect millions each year. In 2017alone an estimated 49 million cases and 11 million reported, accounting for nearly 20% of all global mortality (8). Mortality rates vary widely, ranging from 15% to over 50%, depending on disease severity, healthcare access, and timeliness of intervention (8). Sepsis is also a common cause of EDS admissions and prolonged hospital stays.

The burden of sepsis and septic shock is disproportionately higher in low and middle-income countries (LMICs), where delayed presentation, limited diagnostic capacity, inadequate early resuscitation and constrained critical care resources contribute to poor outcomes. Continued use of older definitions in this setting further limits early recognition and accurate risk stratifications (9).

Sepsis is complex syndrome influenced by immune dysregulation, multiorgan dysfunction, patient comorbidities and infection characteristics. Evidence shows early intervention during the golden hours including timely antibiotics and resuscitations significantly reduced mortality (10). However, context-specific evidence from Ethiopian EDS, remains limited. This study aims to address this gap through the assessment of mortality and associated factors among adults with sepsis and septic shock in EDs.

1.3 Significance of the study

This study is significant for multiple stakeholders involved in the care and management of sepsis and septic shock patients. Patients benefit through improved early recognition and timely management of sepsis in EDs, which can lead to reduced mortality and better clinical outcomes. Healthcare providers, including emergency physicians, nurses and critical care teams, benefit by gaining context specific evidence on key predictors of mortality, enabling more informed clinical decision making, risk stratification and periodization of early interventions. Hospital administrators and policymakers can benefit from data that highlight system level gaps such as prolonged ED stays and delays in care, supporting resource allocations, protocol development and quality improvement initiatives. Finally, researchers and academic institutions benefit by using the findings as baseline evidence for future interventional studies and for strengthening locally relevant sepsis management guidelines in resource limited settings.

2.LITERATURE REVIEW

2.1 Epidemiology of sepsis and septic shock

Sepsis and septic shock represent major global health challenges, affecting millions of individuals annually across diverse healthcare settings. Advances in case definitions, particularly the introduction of the Sepsis-3 criteria, have refined epidemiological estimates by improving identification of patients at highest risk of adverse outcomes (1). According to global estimates, approximately 49 million cases of sepsis occurred worldwide in 2017, with the highest incidence reported in LMICs (8). This disproportionate burden is attributed to higher prevalence of infectious diseases, delayed access to healthcare, limited diagnostic capacity, and shortages of trained healthcare professionals (14,22).

Hospital based studies consistently identify emergency departments and intensive care units as key points of sepsis presentation. Epidemiological data show that while septic shock constitutes a smaller proportion of sepsis cases, it is associated with substantially higher mortality and resource utilization (1,9). Variability in reported incidence across regions is influenced by differences in diagnostic criteria, surveillance systems, and healthcare infrastructure (2,3).

2.2 Mortality rates of sepsis and septic shock

Despite improvements in supportive care, sepsis remains a leading cause of death worldwide. Globally, sepsis accounted for an estimated 11 million deaths in 2017, representing nearly 20% of all global mortality (8). Mortality rates for sepsis generally range from 15% to 30%, while septic shock is associated with mortality exceeding 40% in many studies. The risk of death increases significantly with delayed diagnosis, progression to multiorgan failure, and inadequate early resuscitation (1,9,17). From study conducted, in Atlanta, over all hospital mortality was 20.6% and death secondary to septic shock with in 24hrs was 5.5% (10).

Mortality rates are consistently higher in LMICs compared to high-income countries. Studies from Sub-Saharan Africa report hospital mortality rates ranging from 30% to above 50%, particularly among patients presenting with septic shock (7).

In Ethiopia, available studies demonstrate similarly high mortality, reflecting challenges related to delayed presentation, limited critical care resources, and prolonged EDs stays (7,12). From

two years ED review, in TASH sepsis was immediate cause of death in 16.8%, and more than half of the primary causes of death had comorbidities with secondary causes of mortality majorly includes, cancer, cardiac disease, hypertension, hematologic malignancy, diabetes, and asthma (20). From prospective study conducted in this EDs, mortality of sepsis accounts for 18.8% among the most common causes of death (21). Similar study in SPHMMC, EDS revealed that septic shock causes 19.7% of overall EDs mortality followed by multiorgan failure that accounts for about 11.8% of ED deaths (23). Another study from this set up revealed that about 16.8% total deaths are due to sepsis or septic shock (2).

2.3 Burden of sepsis and septic shock

The burden of sepsis extends beyond mortality to include significant morbidity, long-term disability, and economic costs. Sepsis is a leading cause of ICU admission, prolonged hospitalization, and increased healthcare expenditure (8,13). Survivors frequently experience persistent physical weakness, cognitive impairment, psychological distress, and reduced quality of life, contributing to long term disability adjusted life years (14).

In LMICs, the burden amplified by systemic healthcare constraints, including limited access to diagnostic tools, antimicrobial shortages, and inadequate critical care capacity (10,17). These factors contribute to delayed diagnosis and treatment, resulting in higher mortality and increased complications. The economic impact on patients, families, and healthcare systems is substantial, particularly in settings where out of pocket expenditure is common (13,15). Acute complications include respiratory distress syndrome (ARDS), acute kidney injury, hepatic dysfunction, disseminated intravascular coagulation, myocardial dysfunction, and septic shock with cardiovascular collapse. Neurological complications, such as sepsis-associated encephalopathy are also associated with poor prognosis and increased mortality (23). From a study conducted in TASH the common sepsis complication identified was ARF 37(61.7%) followed by ARDS 9(15.7%) and combination of both ARF and ARDS (3,3%) (19).

2.4 Factors associated with sepsis and septic shock.

Multiple factors influence the development of sepsis and progression to septic shock. Patient related factors include advanced age, male sex, and the presence of comorbid conditions such as diabetes mellitus, chronic kidney disease, chronic liver disease, HIV/AIDS, malignancy, and other immunosuppressive states (5,16).

Respiratory tract infections consistently reported as the most common source of sepsis, followed by intra-abdominal, urinary tract, and bloodstream infections (7,17). Gram-negative bacterial infections are frequently implicated and are often associated with more severe disease and septic shock. Hospital-acquired infections and antimicrobial resistance further increase the risk of severe sepsis and poor outcomes (18,19).

Healthcare system-related factors, including delayed presentation, prolonged emergency department stays, delayed administration of antibiotics, inadequate fluid resuscitation, and limited access to source control, are strongly associated with progression to septic shock (20).

2.4.1 Factors associated with mortality in sepsis and septic shock.

Mortality in sepsis is influenced by a combination of clinical, laboratory, and system level factors. Clinical indicators such as altered mental status, persistent hypotension, tachypnea, and signs of tissue hypoperfusion are consistently associated with increased risk of death (9,21). Laboratory abnormalities including elevated lactate levels, anemia, thrombocytopenia, and renal dysfunction are also strong predictors of severity as well as mortality (22).

The development of multiorgan failure is one of the strongest determinants of mortality in sepsis and septic shock. Patients requiring vasopressor support, mechanical ventilation, or renal replacement therapy have markedly higher mortality rates (1,23). From multicenter study conducted in Atlanta different EDs, following factors were independently associated with early septic shock mortality: age (OR, 1.04; 95% CI, 1.03–1.05), malignancy (OR, 1.53; 95% CI, 1.11–2.11), pneumonia (OR, 1.39; 95% CI, 1.02–1.88), early vasopressor use (OR, 2.16; 95% CI, 1.60–2.92) were commonest predictors(10).

From study conducted in TASH, the sole predictor of early ED mortality identified was a co-morbid disease, HIV AIDS. Those clients with known seropositive status for HIV AIDS were three times more likely to be dead early in ED than their counterparts (p-value 0.04 AOR = 2.72, 95% CI: 1.01–7.30) (20). Another study in the same Ed revealed overall hospital mortality, the most common comorbidity was malignancy (22.25%) and (13.25%) patients had >2 comorbidities (11). From the study conducted at SPHMMC ED, triage category, shock index, type of shock, vasopressor use, and organ failure were found to be significant predictors of mortality in shock patients (23). As per another study finding from the same ED, orange triage category, duration of chief complaint within the range of less than 24 hours and 3–4 days, and respiratory disease, liver disease, DM and its complications, severe anemia are predictive for less likely deaths to happen within 24 hours of length of stay (2).

2.6 Conceptual framework

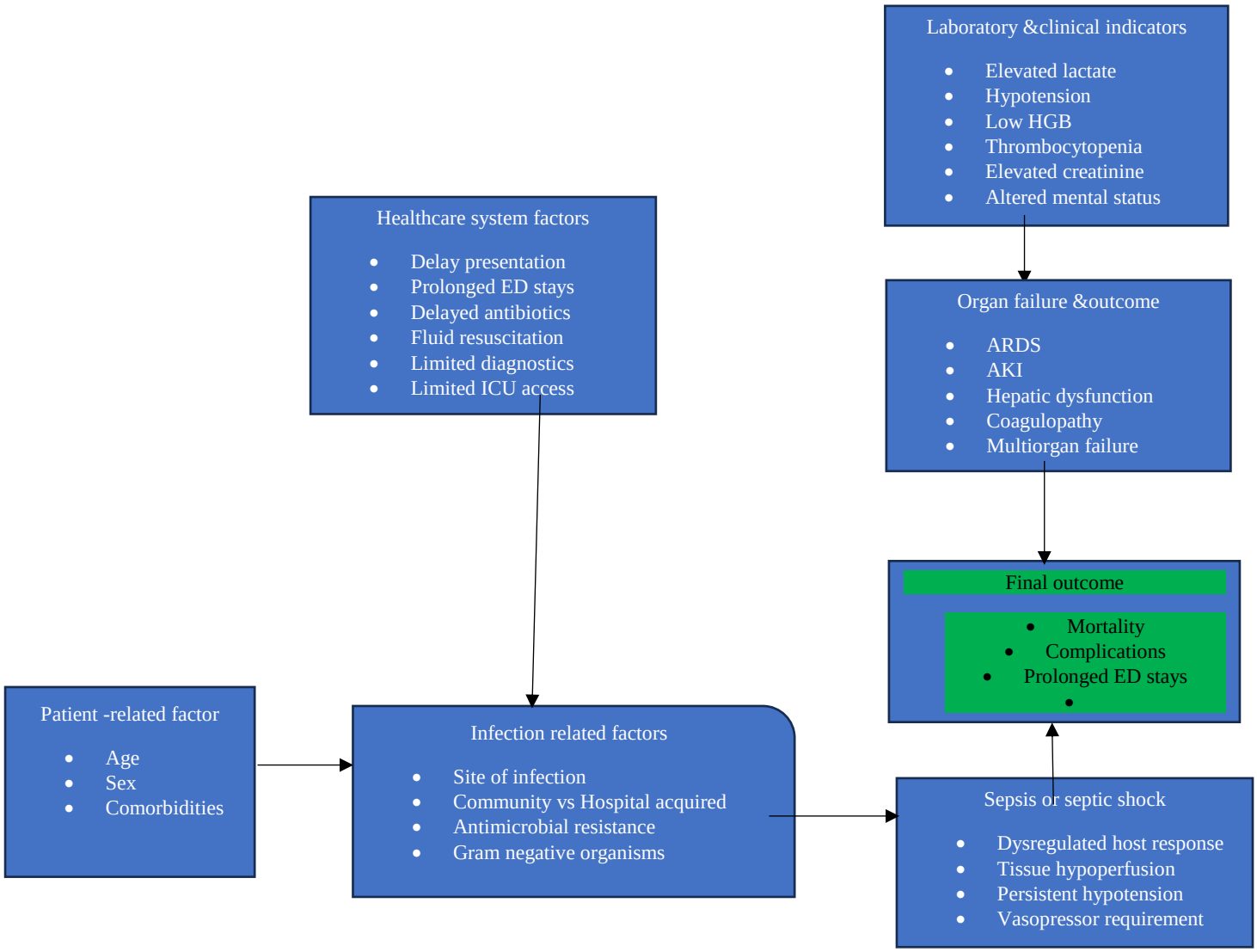


Figure 1. Conceptual framework for the study of magnitude and mortality of sepsis and septic shock and associated factors in Adult EDs, in Addis Ababa, Ethiopia, 2025 developed from literature review (3, 5)

3.OBJECTIVES

3.1 General objectives

- To assess the magnitude of mortality from sepsis and septic shock and associated factors among patients admitted to adult EDs of Tikur Anbessa Specialized Hospital and St. Paul Hospital Millennium medical College, Addis Ababa, Ethiopia, 2025.

3.2 Specific objectives

1. To estimate the magnitude of mortality of adult patients with sepsis and septic shock in the EDs of TASH and SPHMMC.

2. To identify factors associated with mortality among sepsis or septic shock patients in the EDs TASH and SPHMMC.

4.METHODS

4.1 Study setting

An institution-based cross-sectional retrospective study was conducted from 2023 to 2025 among adults diagnosed with sepsis or septic shock and admitted to the emergency departments of Tikur Anbessa Specialized Hospital (TASH) and St. Paul Hospital Millennium Medical College (SPHMMC) in Addis Ababa, Ethiopia. TASH is a tertiary academic referral hospital affiliated with Addis Ababa University, with an annual EDs census exceeding 25,000 visits. SPHMMC is one of the largest national referral centers, serving a catchment population of approximately 7 million people and providing care to about 1500 emergency and outpatient cases daily (2).

4.2 Study period: Data was collected retrospectively from electronic medical records of patients who were diagnosed with sepsis and septic shock in the EDs between October 1, 2023, and October 1, 2025.

4.3 Study design: Retrospective review of patient's medical records who had diagnosed sepsis or septic shock in the EDs of selected hospital between October 2023-October 2025.

4.4 Population

4.4.1 Target population: all adult patients with sepsis and septic shock and died with in EDs in public tertiary hospitals.

4.4.2 Source population

All adult patients of age ≥14 years and who were admitted to the adult EDs with sepsis or septic shock at the selected public hospitals during the study period.

4.4.3 Study population: All eligible patients with sepsis or septic shock and admitted to EDs of TASH and SPHMMC during the study period.

4.4.4 Sample population: All eligible adult patients with sepsis or septic shock and admitted to EDs of TASH and SPHMMC whose medical records were reviewed and included in the analysis.

4.5. Inclusion and Exclusion Criteria

4.5.1 Inclusion criteria: All adult patients with age above ≥14 years, admitted to EDs during the study period with sepsis and septic shock.

4.5.2 Exclusion criteria: Patients who are dead upon arrival and died bodies were excluded.

Deaths after 24hrs of admission were excluded, and readmissions are excluded.

4.6 Sample size determination and Sampling technique

Card numbers of all patients fulfilling inclusion criteria were recorded from both emergency departments logbooks, online registry, patient charts, monthly performance reports, emergency mortality registry, and card number of sepsis or septic shock patients admitted to adult ED from October 2023 to October 2025 were used.

We calculated the required sample size using a single population formula. Assuming the observational study conducted in TASH early ED mortality rate due to sepsis or septic shock was (26.5%) calculated from total mortality of 56.7% (19) and mortality due to sepsis or septic shock with in 24hrs was 14.5% in St. Paul Hospital (2).

We used pooled proportion ($\bar{p}$) since the proportions are similar.

$\bar{p}=p1+p2/2=0.205$, then using single population formula-

$$n = (Z\alpha/2)2\ P\ (1 - P)\ /d2$$

n = minimum sample size required

Z = is the standard score corresponding to a 95% confidence interval level = 1.96

d = is the proportion of sampling error between the sample and the population = 5% (0.05)

P = is the estimated mortality of sepsis and septic shock, 20.5% = 0.205

The sample size calculated using the Epi Info 7.2.7 calculator was 250.

Since the sampling frame is < 10000, i.e., 264, (in TASH_ED about 144pts/2yrs death is due to sepsis and septic shock and about 120 patients died in St. Paul in 2yrs from monthly audit report of Each Hospital and previous studies (23,24).

$$n\_adj = n / (1 +((n/N))$$

where n_{adj} = Adjusted sample size

n = calculated sample size (250)

N = study population (264)

n_{adj}= 250/ (1+(250/264)) = 128**.**

By considering a 10% non-response rate, final sample size was 128/ (1-nonresponse rate) =128/0.9=**142** participants included.

Table 1. Sample size determination for the second objective.

variables	95%CI	Power	Ratio	AOR	%Cases with exposure	%Cases with control	Total
Age>60	95%	80%	1:2	2.8	55.94	31.2	138
Organ failure	95%	80%	1:1	5.77	44.03	12	72
Malignancy	95%	80%	1:2	5.54	61.32	22.25	59

The sample size for the second objective was calculated using a double population proportion formula using Epi Info, based on factors previously reported to be associated with mortality among adult patients with sepsis and septic shock presenting to the EDs (Table 1) (11). The assumptions included a 95% confidence level, 80% statistical power, and exposure-to-non-exposure ratios of 1:1 or 1:2, depending on the predictor variable. Effect sizes were estimated using adjusted odds ratios from prior sepsis literature, and the expected proportions of mortality among exposed and unexposed groups were incorporated into the calculation.

The calculated sample sizes were 138 for age >60 years**,** 72 for organ failure**,** and 59 for malignancy. To ensure adequate power across all candidate predictors, the largest estimated sample size (N = 138) was considered. When sample sizes for both study objectives were compared, the first objective yielded the largest sample size (N = 142); therefore, this value was taken as the final sample size.

The final sample was proportionally allocated between the EDs based on sepsis and septic shock related mortality using the formula: $T(TASH) = (n_1/N) \times n$ and $S(SPHMMC) = (n_2/N) \times n$, where n_1 and n_2 represent total mortalities at TASH and SPHMMC EDs, respectively, and N is the combined total mortality. A systematic random sampling technique was applied using admission dates as the sampling frame, with participants selected at every fourth admission day interval until the required sample size was achieved. Accordingly, 78 patients were included from TASH-ED and 64 patients from SPHMMC-ED**.**

4.7 Study Variables

3.7.1 Dependent variables: The primary outcome variable of this study was mortality among sepsis and septic shock diagnosed patients, and secondary outcome variables were length of ED stay and complications.

4.7.2 Independent Variables

- **Patient factors:** age, sex, residence, referral source, triage categories
- **Clinical factors:** vital signs, comorbidities, focus of infection, GCS, creatinine level, qSOFA score, MAP, baseline hemoglobin, bedside POCUS findings,
- **Treatment factors:** fluid resuscitation, antibiotic initiation time, blood transfusion, vasopressor use, intubation, length of stay, organ failure.
- **Infection-related factors:** Site of infection, community vs hospital acquired, gram negative organisms.

4.8 Data Collection Methods and Materials

4.8.1 Data Collection method

Data were extracted from medical records, EDs logbooks, HIMS registries, triage records, and death certificates of eligible adult patients using a structured, pretested abstraction checklist adapted from prior studies and international sepsis tools.

4.8.2 Materials and Tools

A structured data abstraction checklist was used to collect sociodemographic characteristics, comorbidities, vital signs, laboratory parameters, treatment interventions, and outcomes. Patients' medical records and ED logbooks served as the primary data sources, while the HIMS registry was used to verify admission status and mortality outcomes, triage registers and death certificates were reviewed to confirm diagnoses, admission timing, and outcomes.

4.9 Data quality control

A structured data collection checklist was developed based on relevant literature and previously published sepsis or septic shock studies. Data collectors and supervisors received prior training on study objectives, eligibility criteria, operational definitions, and proper chart abstraction procedures, with emphasis on accurate identification of sepsis and septic shock using documented clinical findings and qSOFA criteria. The tool was pretested on 10% of the sample at TASH ED, and necessary modifications were made to improve clarity and consistency. During data collection, patient charts and electronic records were cross checked using multiple sources**,** with daily supervision by the principal investigator to ensure completeness and consistency.

Data was reviewed for accuracy before entry, followed by data cleaning in Microsoft Excel, including range and consistency checks and outlier verification; missing values were rechecked against source documents to maintain data integrity.

4.10 Data management and analysis

Data was entered, cleaned and analyzed using SPSS version 27. Descriptive statistics were analyzed to summarize sociodemographic characteristics, clinical features, and outcomes. Categorical variables were described using frequencies and percentages, while continuous variables were summarized using means and standard deviations or medians with interquartile ranges, based on data distribution type.

Bivariable logistic regression was conducted to assess the association between each independent variable and EDs mortality. Variables with a p-value less than 0.25 in the bivariable analysis were candidates for the multivariable logistic regression. A multivariable regression model was fitted to identify independent predictors of ED mortality. Adjusted odds ratios (AORs) with 95%CI were used to measure the strength of associations.

Multiclonality was checked using Variance Inflation Factor (VIF) and all values were below 5. Model fitness was assessed using the Omnibus test, pseudo R^2 statistics, Hosmer_Lemshow test and classification accuracy. The model was statistically significant (Omnibus test, P<0.001) and explained a substantiality proportion of variability in mortality (Nagelkerke R^2 =0.393) and Hosmer–Lemeshow's test was insignificant (p-value =0.1). Variables with p-value <0.05 from multivariate analysis were declared as statistically significant.

4.11 Operational definitions

Sepsis - those patients admitted to the EDs with the diagnosis of sepsis by physician decisions that were with suspected or confirmed infections.

Septic shock- those patients admitted to the EDs with the diagnosis of septic shock by physician decisions.

Quick SOFA criteria- patients with altered mental status (GCS < 15), RR >22, and systolic blood pressure <90mmHg.

Incomplete data- a medical record that does not include a clinical assessment tool as per the qSOFA criteria and when immediate cause of death is not clearly mentioned on the death report and when patient transferred or left against medical advice before 1st 24hrs.

Organ failure- rapid or progressive deterioration of an organ like liver, kidney, lung, or heart.

mSOFA: a scoring of organ dysfunction which includes five parameters (icteric sclera, cardiovascular, Spo2/fio2, CNS and serum creatinine).

ED Mortality due to septic shock- death occurring within the emergency department among patients diagnosed with sepsis or septic shock, where death is attributable to complications of sepsis.

Immediate cause of death- Death primarily attributable to sepsis related organ failure, refractory shock, or complications of septic shock, as documented by treating physician.

Comorbidity: the cooccurrence of one or more diseases or medical conditions in patients according to the Charlson Comorbidity Index (CCI)(4).

Altered body temperature: temperature hyperthermia (>38◦C) or hypothermia (<36◦C).

Altered white blood cell: white blood cell count >12,000/mm3 or <4,000/mm3.

Organ dysfunction: organ failure related to septic shock documented or diagnosed by a physician during admission or treatment.

Prolonged ED stay: Patient who stayed for more than 12hrs with the diagnosis of sepsis or septic shock.

4.12 Ethical Considerations and review process

Ethical clearance to access medical records was obtained from the Department of Emergency and Critical Care Medicine, College of Medicine and Health Sciences, Addis Ababa University, with a waiver of informed consent due to the retrospective nature of the study. Additional ethical approval Sgranted by the Saint Paul's Hospital Millennium Medical College (SPHMMC) Ethical Review Board (Ref: Pm23/334; Protocol: SPHMMC-ERC_461/25). Permission to access patient data was secured from the head of the hospital's Emergency Department. Strict confidentiality was maintained throughout the study, with no disclosure of medical records to unauthorized third parties. All data were anonymized prior to analysis, and all study procedures were conducted in accordance with relevant ethical guidelines and regulations.

5. RESULTS

5.1. Sociodemographic characteristics of study participants

Among the total of 142 patients with sepsis whose medical registration cards were reviewed, 141 (99.3%) were included in this study after meeting the eligibility criteria. One chart did not clearly report on the outcome of treatment. Age was categorized into three groups (14–39, 40–59, and ≥60 years). The median age was 49 years with IQR (35_64). In terms of gender distribution, more than half 80(57.4%) of the patients admitted to EDs were females and 61(42.6%) were males (Table 2). Additionally, higher proportions (61.7%) of the patients were urban residents and 68 (48.2%) were from clinics and hospitals that include regular OPDS and 42 (29.8%) were from health centers in the city and most of patients, 66 (46.8%) were triaged to the red zone on admission (Table 2).

Table 2. Sociodemographic characteristics of patients with sepsis or septic shock admitted to adult EDs of Addis Ababa tertiary teaching hospitals, Ethiopia, 2025(N=141)

Variables	Category	Frequency	Percent
Age at diagnosis(years)	14- 39	45	31.9
	40-59	49	34.8
	≥60	47	33.3
Sex of the patient	Male	61	42.6
	Female	80	57.4
Residency	Urban	87	61.7
	Rural	54	38.3
Referred from	Health center	42	29.8
	Clinics and Hospitals	68	48.2
	Self	31	22.0
Triage zone	Red	66	46.8
	Orange	55	39.0
	Yellow	20	14.2

5.2. Clinical Characteristics of the study participants

In this study, 49(34.8%) of the patients had altered body temperature and 127 (90.1%) of them had a GCS score of 13_15(Table2). Among patients about 42 (29.8%) of the patients had non hematologic cancer followed by COPD 37(26.2%) and hematologic malignancy 12(8.5%) as comorbidity during admission (Figure2). Besides, the primary focus of patients with sepsis was chest focus 70 (49.6%), followed by gastrointestinal 54 (38.3%), and 5(3.5%) had more than one focus (Table 4). Among patients who died from sepsis or septic shock from EDs 24(53.3%) had qSOFA score of ≥ 2, while 21(46.7%) had qSOFA score of < 2. But among the total admitted patients more than half, (52.5%) had scores of less than 2 (Table 3). Majority, 107 (76%) had MAP< 65, almost half 58(48%) of patients had serum creatine level above 1.2mg/dl, and about 23% of total patients required dialysis. Most patients,44(31.2%) and 31(23%) presented to the ED with the respiratory and gastrointestinal system compliant (Table 3).

Table 3. Clinical characteristics of patients with sepsis or septic shock admitted to EDs of Addis Ababa, tertiary teaching hospitals, Ethiopia, 2025(N=141).

Variables	Category	Frequency	Percent
Systolic BP (mmhg)	<90/60	96	68.1
	>90/60	45	31.9
Respiratory Rate	<22	80	56.7
	>22	61	43.3
Altered mentation	Yes	81	57.4
qSOFA score	<2	74	52.5
	≥2	67	47.5
Serum creatinine	<0.6	21	14.9
	0.6-1.2	58	41.1
	>1.2	62	44.0
Length of stay	<12hrs	68	48.2
	≥12hrs	73	51.8
Comorbidities	yes	39	86.6
Duration of illness	<7days	97	68.8
	≥7days	44	31.2
MAP (mmhg)	<65	107	76
	≥65	34	24
Sepsis/septic shock immediate cause of death	yes	39	86.6
Chief complaints manifestation	Respiratory manifestation	44	31.21
	GI complaints	31	21.9
	CVS	22	15.60
	CNS compliant	11	7.80

Table 4. Treatment given for the patients with sepsis or septic shock admitted to EDs of Addis Ababa tertiary teaching hospitals, Ethiopia, 2025(N=141).

Variables	Category	Frequency	Percent
Fluid resuscitation	Yes	124	87.9
Antibiotics given	Yes	137	**98.6**
Number of antibiotics	Monotherapy	4	2.8
	Combination	130	**92.2**
	Unknown	3	2.1
Types of antibiotics	Cefepime and vancomycin	60	**42.6**
	Meropenem	16	11.3
	Ceftriaxone and vancomycin	33	12.8
Blood transfusion	Yes	25	17.7
Vasopressors given	Yes	125	**88.7**
Steroids given	Yes	72	51.1
Vasopressors	Started at ED	95	67.4
	Before ED	30	21.3
	Not started	16	11.3
Number of vasopressors	Single	75	**53.2**
	Double or more	50	35.5
	Not started	16	11.3
Types of vasopressors	Noradrenaline	50	**35.5**
	Adrenaline	24	17.7
	Dopamine	1	0.7
	Adrenaline and Noradrenaline	35	**24.8**
	EP, NEP +others	15	10.6
	Unknown/not started	16	11.3
Intubated	Yes	57	40.4
DVT prophylaxis	Yes	23	16.3
Ulcer prophylaxis	Yes	63	44.7
Dialysis	Yes	33	23.4
Antibiotics initiation time(hours)	<1	40	28.3
	1_3	74	**54.01**
	>3	23	16.7
Types of infections	hospital acquired	28	19.6
	Community acquired	113	**80.1**
Source of infection	Chest	70	**49.3**
	Intrabdominal/GI	54	38.3
	CNS	6	4.3
	Others	11	7.8

5.3 Prevalence of infection, sepsis and septic shock

Among patients admitted with septic shock in the EDs, 70 (49.6%) had a suspected or confirmed infectious focus. The most common source was pulmonary infection, while 113 patients (80.0%) had community-acquired infections. Intra-abdominal infections accounted for 54 cases (38.3%), making them the second most frequent source. Skin and soft tissue infections and central nervous system infections ranked third, each comprising 4.3% of cases; skin and soft tissue infections were predominantly surgical site infections, diabetic foot ulcers, and necrotizing fasciitis. Overall, 47.5% of patients fulfilled the criteria for septic shock based on the SOFA score.

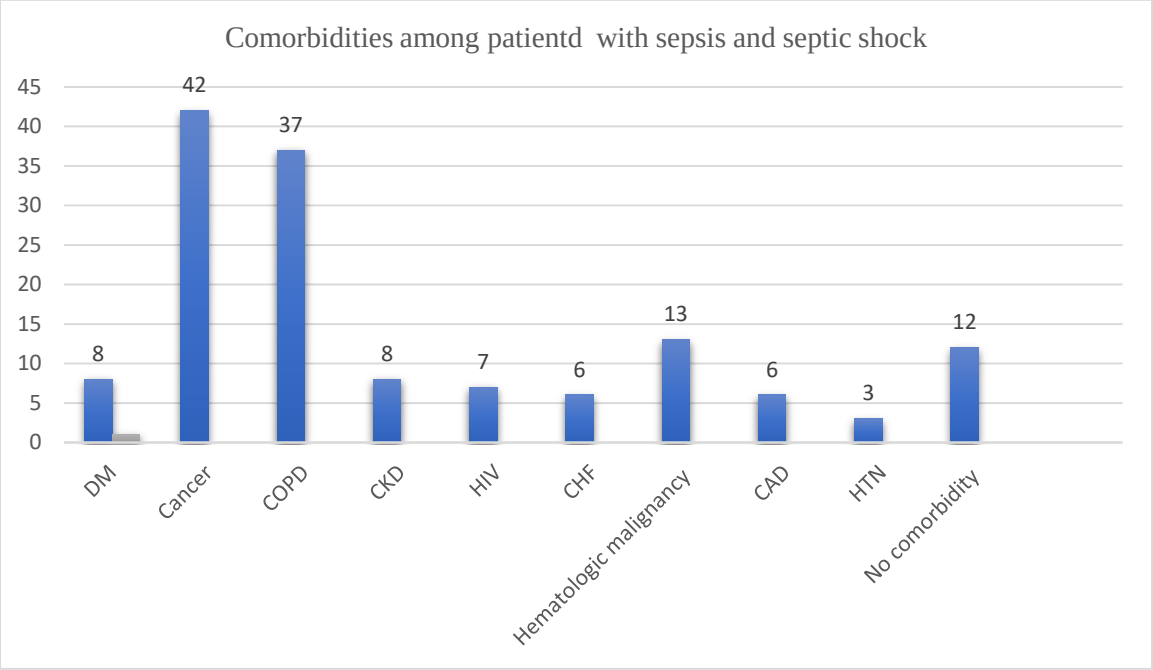


Figure 2. Comorbidities among patients with sepsis or septic shock admitted to adult EDs of Addis Ababa tertiary teaching hospitals, Ethiopia, 2025.

In this study, the magnitude of ED mortality with in the first 24hours among patients with sepsis and septic shock admitted to EDs of Addis Ababa teaching hospitals was 45 (31.9%; 95% CI: 24.2%–40.3%). Among the total 141 patients included in the detailed chart review, 67 patients (47.5%) had a qSOFA score ≥2 at presentation.

Notably, 65% of patients with a high qSOFA score ≥2 were females, suggesting a potential sex related vulnerability and most patients about 97(68.8%), has recent illness period of less than 7days and 44(31.2%), had duration of more than a week or delayed presentation that may warrant further investigation (Table 3).

5.4 Treatment provided and duration of stay at the emergency department

Among patients with sepsis or septic shock, 57 (40.4%) required mechanical ventilation during their ED stay. Of those included, 137 (97.2%) received at least one antibiotic. The most prescribed regimen was cefepime plus vancomycin in 60 patients (42.6%), followed by ceftriaxone plus vancomycin in 33 (12.8%). Patients diagnosed with sepsis accounted for 130 (92.6%) of all antibiotic prescriptions (Table 4).

Intravenous fluids were administered to 124 patients (87.9%), and 125 (88.0%) required vasopressor support. Noradrenaline was the most frequently used single vasopressor for 50 patients, (35.5%), followed by 24 patients, (17.0%). Combined noradrenaline and adrenaline therapy was initiated in 35 patients (24.8%), while 10.6% required more than two vasopressors. ED length of stay was <12 hours for 68 patients (48.2%) and ≥12 hours for 73 (51.8%). Prolonged ED stay (>12 hours) was significantly associated with mortality among patients with sepsis and septic shock ($p < 0.05$; Table 5).

5.5. Factors associated with mortality of sepsis and septic shock.

In the bivariable logistic regression analysis, several variables showed an association with mortality at a significance level of $p < 0.25$. These variables were, age and sex, body temperature at admission, GCS, altered mentation, multiorgan failure, MAP, qSOFA score, primary focus of infection, blood transfusion, vasopressor support, comorbidity status, and length of hospitalization and malignancy were selected as candidate variables for inclusion in the multivariable logistic regression model (Table 5).

In the multivariable logistic regression altered mentation, qSOFA score, length of ED stay, malignancy, comorbidity, qSOFA score, length of EDs stay and MOF were found to be significantly associated with mortality, with a p value less than 0.05. Specifically, the odds of mortality of patients presenting with qSOFA score ≥2 had 4 times higher odds 3.55

(95%CI:1.64_767.139) of dying due to sepsis or septic shock compared to those with qSOFA score <2.

Patients who were presented with alter mentation had 2.8times odds of the mortality compared with those without altered mentation (AOR=2.8;95%:1-1-72; p=0.032) (Table 5).

Furthermore, patients with multiorgan failure at diagnosis 2.9(1.1_7.4, P=0031), times higher odds of dying from sepsis or septic shock compared to those without multiorgan failure. Malignancy was independently associated with the outcome. Thus, patients with malignancy had about 2.6 times higher odds of outcome compared to those without malignancy 2.6(1.1-6.2, P=0.028). And comorbidities were independently associated with mortality, that patients with comorbidity had approximately 3.3 times higher mortality when compared with those without comorbidities (AOR=3.327;95%:1.125-9.844; p=0.030). Length of ED stay more than 12hrs was linked to 5 times higher odds**,** 4.99(2.046_12.21) of sepsis or septic shock related death when compared to those who stayed below 12hrs (Table 5).

5.6. Complications associated with sepsis and septic shock

From this study, hemodynamic instability was common with many patients presenting with hypotension and requiring vasopressor support. Respiratory failure was also prominent, that about 40.4% required intubation during their ED course (Table 4). Renal involvement was frequent, with elevated serum creatinine levels (>1.2mg/dl) in 44.0% of patients and 23.4% required dialysis and MOF was documented in 86% of mortalities among deaths in septic shock diagnosed patients. Neurological complications were notable, as more than half of patients presented with altered mental status at admission (Table3).

Hematologic complications like abnormal white blood counts were documented in over half of study population. Hypoglycemia in 14% of cases, and abnormalities in body temperature were reported in one third of patients. Multiorgan failure, and prolonged ED stay were independently associated with increased mortality, as demonstrated in the multivariable logistic regression analysis (Table 5).

Table 5. Multivariable and Bivariable logistic regression analysis of factors associated with mortality due to sepsis and septic shock among patients admitted to EDs of Addis Ababa tertiary teaching hospitals, Ethiopia, 2025(N=141).

Variable	Category	Outcome		COR (95%CI)	AOR (95%CI)	P-value
		Death	Censored			
Age (years)	14_39	18	27	1	1	
	40_59	16	33	1.38(.59_3.20)	2.8(.008_95.35)	.567
	>60	11	33	2.18(.89_5.37)	2.12(.204_22.1)	.530
Gender	Male	14	46	1	1	
	Female	31	50	.491(.232_1.037)	2.7(.479_15.272)	.260
Triage Zone	Red	23	43	.393(.064_2.416)	2.704(.479_15.27)	.149
	Orange	17	38	.514(.076_3.488)	.348(.026_4.750)	.43
	Yellow/green	5	15	1	1	
Blood transfusion	No	6	19			
	Yes	39	77	4.30(1.75_10.59)	.044(.001_1.605)	.089
Vasopressors given	No	3	13	1	1	
	Yes	42	83	2.37(0.83–6.83)	.463(.103_2.074)	.314
Steroids Given	No	19	50	1	1	
	Yes	26	46	1.69(0.83–3.45)	.178(.041_.780)	.641
Multiorgan failure	No	26	77	1	1	
	Yes	28	23	2.962(1.36–6.43)	2.9(1.1_7.4)	**.0031**
Malignancy	No	23	73	1	1	
	Yes	22	23	3.04(1.435–6.42)	2.6(1.1_6.2)	**.028***
qSOFA score	<2	21	19	1	1	
	>2	24	77	3.55(1.64–7.67)	3.492(1.562_7.808)	**.004****
Altered Mentation	No	12	49	1	1	
	Yes	33	47	2.86(1.324–6.21)	2.422(.9_6.374)	.073
Length of ED stay(hours)	<12hrs	9	55	1	1	
	>12hrs	36	41	5.37(2.33–12.37)	4.99(2.046_12.21)	**<.001****
Comorbidity	No	7	31	1	1	
	Yes	38	65	2.58(1.039-6.45)	3.327(1.125-9.844)	**.030***

** for P-value <0.01, * for P-value < 0.05

6. DISCUSSION

This study highlights that sepsis mortality is the result of an interaction between host vulnerability, infection characteristics, and healthcare system performance**.** Importantly several of the identified risk factors, particularly ED delay and early management practices, are modified**,** offering practical targets for quality improvement initiatives.

The study revealed that magnitude of ED mortality due to sepsis or septic shock was nearly 31.9%. Factors like high qSOFA score, MOF, malignancy, comorbidities and the LOS were identified as significantly associated factors with death due to sepsis and septic shock from the selected EDS. The mortality from this study is in the global range that estimated mortality rate was up to 30% for sepsis, 50% for severe sepsis and as high as 80% for septic shock (13).

The meta-analysis from Europe, North America and Australia have reported ED mortality was at 37.3%, while in-hospital mortality reached 39.0% and mortality rates ranged from 15 to 56% (12). These small variations reflect differences in patient populations, healthcare infrastructure, and early recognition and management strategies.

This study also exhibits similarity with the septic survival guideline of 2024 that pneumonia was responsible for about half of all cases of sepsis (24). Other common causes of sepsis include intraabdominal and urinary tract infections. In 40% of patients with sepsis, hypotension is the presenting abnormality (1,5). But in contrary to study conducted in Egypt, reveled cardiovascular dysfunction was prevalent in 75% of septic patients, contributing to a mortality rate of 54.5% (22). From global burden of sepsis reports, chronic health conditions, such as DM, cardiovascular disease, COPD, and cancer, are major risk factors for sepsis (14).

From the Caribbean, mortality rate was almost similar that of EDs mortality for sepsis or septic shock exceeds 20% (16). This study also reveals similarly higher rate of mortality when used sepsis -3 criteria as a study from Türkiye, when Sepsis-3 criteria were applied, has with a higher observed mortality rate of 75.9% VS 70.4% using Sepsis-1 definitions (8).

Studies from Africa, in hospitals mortality for sepsis and severe sepsis was 23.7% and 28.1%, respectively (15). These findings are almost comparable to the early EDs mortality of 31.9% that

observed on current study. But the differences in study design, outcome definitions, and healthcare system capacity may explain observed variations (9).

Studies from northern part of Ethiopia, mortality rates were 46.2% for sepsis and 58.3% for septic shock respectively (18). These rates exceed that observed results of current study, that assessed early ED mortality within 1st 24hrs. This likely reflects differences in outcomes, care setting and access to ICU level interventions and infrastructure. Similarly, findings of our study were lower than a 60.5% septic shock mortality reported at TASH, which mainly evaluated overall hospital mortality rather than early ED outcomes (4).

Sepsis or septic shock accounted for 16.8% of total ED deaths, from study conducted at SPHMMC ED (2). And an 8-month prospective study at TASH ED reported sepsis as the cause of 18.8% of deaths (21). The higher mortality observed in this study may reflect differences in patient severity, referral patterns, and the specific focus on early ED mortality and its multicenter study. Another study at TASH ED reported an overall hospital sepsis mortality rate of 56.7%, with higher mortality observed in severe sepsis (40.9%) and septic shock (60.5%) and early mortality from this study was estimated to be lower than the present study (19). When compared to another 2years study from TASH ED, mortality of current study was higher than the previous one, that was 16.8% for sepsis (20). This variation is noted as the above studies asses the overall hospital mortality of sepsis and septic shock separately.

This study also revealed that, half of patients who admitted with sepsis or septic shock had 70(49.6%) of patients had suspected or confirmed infection of which chest focus, followed by intra-abdominal infections which account for 54(38.3 %) of all. This is consistent with the study conducted at Adama which found that, (64.8%) had suspected or confirmed infections (5).

Like the current study, malignancy was the most common comorbid condition among early ED mortalities (34.8%) (21). A multicenter study conducted across EDs in Atlanta identified age, malignancy, pneumonia, and early vasopressor use, as impendent predictors of early septic shock mortality (10). In contrast, the present study found no significant association between vasopressor support and mortality. These differences may be explained by variations in patient demographics, clinical characteristics disease severity at presentation and underlying epidemiological patterns.

Another study in Ethiopian concludes the most common comorbidity was (HIV) infection, followed by diabetes mellitus and malignancies, most frequently reported and about 14.5% of patients had more than one comorbidity (7). This goes in line with the current study, cancer and COPD were commonest comorbidities associated with mortality in sepsis and septic shock.

The current study shows significant association illustrated that the odds of death among patients presenting with MOF, high qSOFA score, comorbidities and malignancies were higher. Regarding the qSOFA score, above the half of the patients who died had score ≥ 2, while majority of total admitted patients had score < 2, this reflects there is higher mortality among patients presenting with higher qSOFA score. This is like the study conducted in USA that sociodemographic characteristics are significant, with the highest prevalence and mortality occurring with, MOF, low MAP at presentation and baseline HGB level, and length of stay at ED (6).

Comorbidities, timing of antimicrobial therapy, and timing of renal replacement therapy initiation have been linked to increased mortality according to the study conducted in Adama (5). But the present study did not show any significant association with early initiation of antibiotics. This variation may be due to differences in study design, or the focus on early emergency department mortality rather than overall hospital outcomes.

However, the study as per SPHMMC ED, triage category, duration of chief complaint with in the range of less than 24hours and 3–4 days, and respiratory disease, liver disease, DM and its complications, severe anemia are predictive for less likely deaths to happen within 24 hours of length of stay in ED(2,5), but in the present study length of stay, comorbidities and MOF on admission had association with early septic shock mortality.

This study included patients from two tertiary teaching referral hospitals to increase their representativeness in similar settings. However, several limitations should be taken into consideration. First, this study could not determine the exact cause of death of the patients, as several factors, such as delays in presentation to the EDs, which we might not have included, could contribute to it. Also, these two tertiary referral hospitals, which manage more severe and complicated cases, may limit the findings to primary or district hospitals and to patients with less severe sepsis.

Reliance on medical records as the primary data source may result in the omission of crucial variables, such as facility related and behavioral factors, potentially weakening the model's predictive power. Retrospective study and rely on records, locating data for all variables is challenging, and those with insufficient information are omitted from the analysis.

Outcomes were assessed only during the emergency department stay; therefore, long term patient outcomes were not evaluated. In addition, complete sepsis diagnostic work up including serum lactate, albumin, coagulation profiles, and culture results were often unavailable. Assessment of key clinical interventions, such as timing of antibiotic and vasopressor administration following septic shock diagnosis, was limited due to incomplete documentation. Furthermore, accurate evaluation of patients' fluid status, including the type and volume of resuscitation fluids administered, was challenging.

7. CONCLUSION AND RECOMMENDATIONS

7.1 CONCLUSIONSION

This study demonstrated a high magnitude of early emergency department mortality among adult patients with sepsis and septic shock in Addis Ababa public tertiary hospitals. Respiratory and gastrointestinal infections were identified as leading causes of sepsis, emphasizing the need for focused interventions. Altered mentation, those with deteriorated clinical conditions at admission, hypotensive, patients with Multi organ failure, patients with comorbidity, patients with high qSOFA and prolonged EDs stays were identified to be associated with the death of patients diagnosed with sepsis or septic shock in the ED. Strengthening early identification, rapid resuscitation, and timely disposition of septic patients is essential to reducing sepsis-related mortality in Ethiopian emergency departments.

7.2 *RECOMMENDATIONS*

- **Clinical practice recommendation**s

Early hemodynamic resuscitation with close monitoring of MAP and initiation of vasopressors when indicated.

- **Emergency department and hospital level recommendations**

Develop and enforce ED specific sepsis management bundles aligned with surviving sepsis surviving sepsis campaign guidelines

Reduce prolonged EDS stays by improving patient care, ICU capacity and strengthening interdepartmental coordination.

Laboratory facility for rapid assessment of key sepsis markers

- **Policy and health system recommendations**

Incorporate sepsis care pathway into national emergencies and critical care guidelines

Improve referral systems and pre-hospital recognition to reduce late presentations

Training for emergency care providers on early sepsis renomination and treatment.

- **Research recommendations**

Conduct prospective cohort studies to evaluate long-term outcomes

Assess impact of EDs based on sepsis bundles on mortality and length of stay

Explore pre-hospital and community factors contributing to delayed presentations

8.REFERENCES

1.Singer M, Deutschman CS, Seymour CW, et al. *The Third International Consensus Definitions for Sepsis and Septic Shock* (Sepsis-3). JAMA. 2016;315(8):801-810. doi:10.1001/jama.2016.0287

2.Dode W, Alemayehu G, Tebebe B, et al. *Pattern and predictors of mortality in the emergency department of Saint Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia:* a retrospective study. Res Sq [Preprint]. 2022. doi:10.21203/rs.3.rs-1920924/v1

3.Amogne DW, Kempker DR. *The magnitude and determinants of sepsis and septic shock among adult patients admitted to Tikur Anbessa Specialized Hospital, Addis Ababa*, Ethiopia Addis Ababa University; 2024. http://etd.aau.edu.et/handle/123456789/5162

4.Ayenew Mekuria T, Liyew Wudu B, Zegeye AF, et al. *Incidence of mortality and its predictors among septic shock patients in intensive care units of hospitals in Northwest Amhara, Ethiopi*a. Front Disaster Emerg Med. 2024; 2:1405753. doi:10.3389/femer.2024.1405753

5.Habtamu T. *Magnitude of sepsis and septic shock and associated factors in patients admitted to the central intensive care unit of Adama Hospital Medical College, Adama, Ethiopia [*unpublished manuscript]. 20XX.

6. Jawad I, Lukšić I, Rafnsson SB. *Assessing available information on the burden of sepsis: global estimates of incidence, prevalence, and mortality*. J Glob Health. 2012;2(1):010404. doi:10.7189/jogh.02.010404

7.Mulatu HA, Bayisa T, Worku Y, et al. *Prevalence and outcomes of sepsis and septic shock in intensive care units in Addis Ababa, Ethiopia*. Afr J Emerg Med. 2021;11(1):188-195. doi: 10.1016/j.afjem.2021.02.006

8.Rudd KE, Johnson SC, Agesa KM, et al. *Global, regional, and national sepsis incidence and mortality,* 1990–2017: Lancet. 2020;395(10219):200-211. doi:10.1016/S0140-6736(19)32989-7

9.Shankar-Hari M, Harrison DA, Rubenfeld GD, Rowan K. *Epidemiology of sepsis and septic shock in critical care units: comparison between sepsis-2 and sepsis-3 populations.* Br J Anaesth. 2017;119(4):626-636. doi:10.1093

10. Matthew S. Reaven,et al Incidence and risk factors associated with early death in patients with emergency department septic shock, Acute and Critical Care 2022 May 37(2):193-201

11. Hikma Fekadu, The Magnitude and determinants of sepsis and septic shock among adult patients admitted to Tikur Anbesa Specialized Hospital, Addis Ababa, Ethiopia.2024.

12.Moore JX, Donnelly JP, Griffin R, et al. *Defining sepsis mortality clusters in the United States. Crit Care Med*. 2016;44(7):1380-1387. doi:10.1097/CCM.0000000000001665

13. Fleischmann C, Scherag A, Adhikari NKJ, et al. *Assessment of global incidence and mortality of hospital-treated sepsis.* Am J Respir Crit Care Med. 2016;193(3):259-272. doi:10.1164/rccm.201504-0781OC

14. La Via L, Sangiorgio G, Stefani S, et al. *The global burden of sepsis and septic shock. Epidemiology*. 2024;5(3):456-478. doi:10.3390/epidemiologia5030032

15. Size M, Borgstein E, Haisma H. *One-year audit of admissions to the Intensive Care Unit of Queen Elizabeth Central Hospital, Blantyre.* Malawi Med J. 2005;17(1):12-13.

16. Singh K, Hariharan S, Ventour D, et al. *Epidemiology and management trends of sepsis and septic shock in the Caribbean. Cureus*. 2020;12(10): e10952. doi:10.7759/cureus.10952

17. World Health Organization. *World Health Statistics 2020: Monitoring Health for the SDGs. WHO*; 2021.

18. Getu SA, Legese GL, Gashu KD, et al. *Mortality due to sepsis in intensive care units of Southern Amhara, Ethiopi*a. BioMed Res Int. 2024; 2024:4378635. doi:10.1155/2024/4378635

19. Zewdu T. *Sepsis in the emergency department of Tikur Anbessa Specialized Hospital, Add*is Ababa, Ethiopia Addis Ababa University; 2013. http://etd.aau.edu.et/handle/123456789/1918

20. Yosha HD, Tadele A, Teklu S, Melese KG. *A two-year review of adult emergency department mortality at Tikur Anbessa Hospital, Ethiopia.* BMC Emerg Med. 2021;21(1):33. doi:10.1186/s12873-0

21. Hunchak C, Teklu S, Meshkat N, et al. P*redictors of early mortality in emergency department patients in Addis Ababa, Ethiopia*. BMC Res Notes. 2015; 8:605. doi:10.1186/s13104-015-1584-z

22. Mohammed Mostafa1, Lamiaa Hamed1, Sherif Mokhtar1 and Moamen Arafa1. Analysis of mortality factors in ICU patients with sepsis and septic shock: a retrospective study

23. Kalsidan Girma Asfaw (MD), Abel Getachew Adugna (MD), et al Incidence of Mortality and Predictors Among Patients with Shock Managed in the Emergency Room of a Large Tertiary Referral Hospital in Ethiopia

24. Arnold, Michael J, Surviving Sepsis: Updated Guidelines From the Society of Critical Care Medicine, pages, 589-590, American Family Physician, 2022-11

ANNEXES

ANNEX A. Information sheet and consent.

This study utilized secondary data obtained retrospectively from hospital patients medical records. No direct contact was made with patients, and no identifiable personal information was collected. All data were anonymized during extraction and handled with strict confidentiality. Due to the retrospective nature of the study and the use of existing clinical records, the requirement for individual informed consent was waved by the Department of Emergency and Critical Care Medicine, College of Medicine and Health Sciences, Addis Ababa University, and the Saint Paul's Hospital Millennium Medical College Ethical Review Board. The study posed no additional risk to patients, and all procedures were conducted in accordance with national and institutional ethical guidelines.

Annex B. Data collection checklist for the study.

Table 1. Sociodemographic characteristics of patients dead of sepsis and septic shock at ED of TASH and SPHMMC, 2025.

Variable	Category	Frequency
Age	14-39	
	40-59	
	>60	
Sex	Male	
	Female	
Residence	Urban	
	Rural	
Source of referral	Self	
	Clinics and Hospitals	
	Health centers	
Triage category	RED	
	Orange	
	Yellow Green	
Triage Time	Less than 5mins	
	Above 5mins	

Table 2. qSOFA criteria during the first 24 hours of ED admission

Systolic BP, <90MMHG	YES	NO
RR >=22	YES	NO
GCS<15	YES	NO
Score	>=2	<2

Table 3. Management provided among adult patients with sepsis and septic shock at ED of SPHMMC and TASH, 2025.

Variables	**Category**	**Frequency**	**%**
Fluid resuscitation	Yes/No		
Antibiotics	Yes/No		
Blood transfusion	Yes/No		
Vasopressors	Yes/No		
Steroids	Yes/No		
Started vasopressors before ED	Yes/No		
Started vasopressors at ED	Yes/No		
Type of vasopressors used			
Noradrenaline			
Adrenaline			
Dopamine			
Dobutamine			
No. of vasopressors	single		
	>=2		
Mechanical ventilation	Yes/No		
	No		
DVT prophylaxis	Yes		
	No		
Ulcer prophylaxis	Yes		
	No		
Dialysis	Yes		
	No		
Antibiotics	Monotherapy		
	Combination		
Types of antibiotics	Cefepime and vancomycin		
	Ceftazidime and vancomycin		
	Ceftriaxone		

	and +		
	Meropenem		
	Others, specify		
Pathogen identification	Yes		
	No		
Types of infection	Hospital acquired		
	Community acquired		

Table 4. Comorbidities of patients, source of infection before sepsis and septic shock development at TASH and SPHMMC Eds, 2025.

Comorbidities	yes	No	Site of infection	yes	No	Organ failure	yes	No
DM			Lung			Neurologic failure		
COPD			Intraabdominal infections			Cardiovascular failure		
CHF			CNS			Renal failure		
CAD			Blood stream infections			Respiratory failure		
Cancer			CNS			Hematologic failure		
HTN			Skin/soft tissue infections			Metabolic failure		
Renal failure			Sepsis of unknown focus			Liver failure		
Liver failure			others					
HIV								
Electrolyte imbalance								

Table 5. laboratory abnormalities or findings

variables	Category	Variables	Category
Hgb	Normal	IVC status	Full
	Mild to moderate anemia		Dilated
	Severe anemia		plethoric
WBC	Normal	Cardiac contractility	Good
	Leukopenia		poor
	Leukocytosis		Hyperdynamic
PLT	Normal	Fluid collections	No
	Mild -moderate thrombocytopenia		plural
	Severe thrombocytopenia		Ascites
Na	Normal		Pericardial collections
	Hyponatremia		Plural & pericardial
	Hypernatremia		
K	Normal		
	Hypokalemia		
	Hyperkalemia		
Cr	<0.6	Multiple B-lines and Consolidation	Yes
	06_1.2		No
	>1.2		

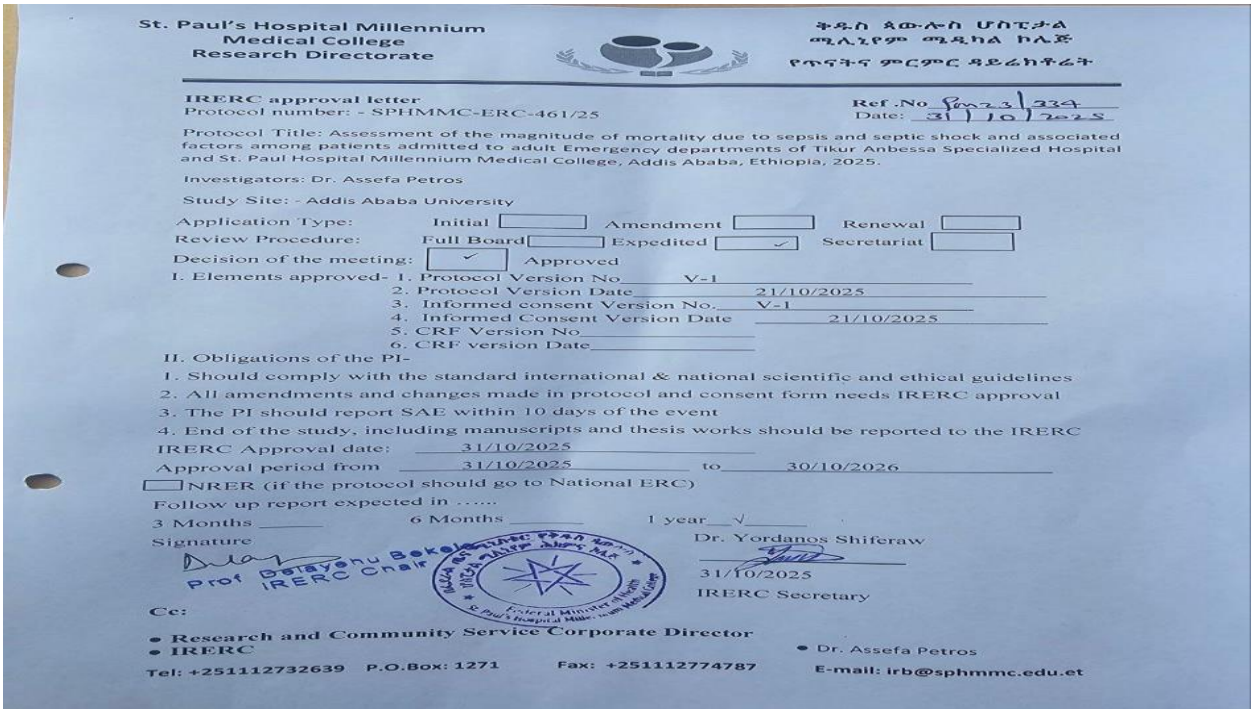
Table 6. Clinical characteristics related to septic shock patients admitted to the ED of TASH and SPHMMMC, 2025.

Variables	category	Frequency (%)
MAP	<65	
	>65	
Tachypnea at admission	Yes/No	
Tachycardia	Yes/No	
Altered Body T	Yes/No	
Low oxygen saturation at admission	Yes/No	
GCs at admission	<9	
	9-13	
	13-15	
Altered WBC	Yes/No	
Hypoglycemic	Yes/No	
Thrombocytopenic	Yes/No	
MOF	Yes/NO	
Malignancy	Yes/NO	

***Annex C**, Ethical approval and Univariate logistic regression*

Univariate logistic regression analysis of factors associated with mortality due to sepsis and septic shock among patients admitted to EDs of Addis Ababa tertiary teaching hospitals, Ethiopia, 2025(N=141).

Variable	Category	COR	95%CI	p-value
Age in years	14-39			
	40-59	1.38	.59_3.20	.460
	≥60	2.18	0.89_5.37	**<.001**
RR≥22	Yes	0.67	.31_1.28	.199
Blood transfusion	Yes	4.30	1.75_10.59	.002
Vasopressors given	yes	2.37	.83_6.83	.107
Steroids given	yes	1.69	.83_3.45	.152
Tachypnea	yes	2.70	1.24_5.89	.012
Alerted WBC	Yes	.42	.20_.88	.021
Source of referral	Health centers			
	Hospitals and clinics	.16	.02_1.31	.088
	Self	.33	.03_4.1	.405
MOF	yes	.34	.16_.73	.006
MAP	<65	24.71	8.88_68/70	**<.001**
Malignancy	Yes	.33	.16_.70	.004
Low base line HGB	Yes	.46	.22_.94	.034
qSOFA score	≥2	3.55	1.64_7.67	.001
Altered mentation	yes	.35	.16_.76	.008
Length of ED stay	>12hrs	5.37	2.33-12.37	**<.001**
Comorbidities	Yes	.387	.155_962	.041



St. Paul's Hospital Millennium Medical College
Research Directorate

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IRERC approval letter
Protocol number: - SPHMMC-ERC-461/25
Ref .No ፩መጋ3/334
Date: 31/10/2025

Protocol Title: Assessment of the magnitude of mortality due to sepsis and septic shock and associated factors among patients admitted to adult Emergency departments of Tikur Anbessa Specialized Hospital and St. Paul Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2025.

Investigators: Dr. Assefa Petros

Study Site: - Addis Ababa University

Application Type: Initial [ ] Amendment [ ] Renewal [ ]
Review Procedure: Full Board [ ] Expedited [✓] Secretariat [ ]
Decision of the meeting: [✓] Approved

I. Elements approved- 1. Protocol Version No V-1
2. Protocol Version Date 21/10/2025
3. Informed consent Version No. V-1
4. Informed Consent Version Date 21/10/2025
5. CRF Version No
6. CRF version Date

II. Obligations of the PI-
1. Should comply with the standard international & national scientific and ethical guidelines
2. All amendments and changes made in protocol and consent form needs IRERC approval
3. The PI should report SAE within 10 days of the event
4. End of the study, including manuscripts and thesis works should be reported to the IRERC

IRERC Approval date: 31/10/2025
Approval period from 31/10/2025 to 30/10/2026
[ ] NRER (if the protocol should go to National ERC)
Follow up report expected in .....
3 Months ____ 6 Months ____ 1 year __√__

Signature
Prof Belayenu Bekele
IRERC Chair
Dr. Yordanos Shiferaw
31/10/2025
IRERC Secretary

Cc:
- Research and Community Service Corporate Director
- IRERC
- Dr. Assefa Petros

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