



Seek Wisdom, Elevate your Intellect and Serve Humanity

Addis Ababa University
አዲስ አበባ ዩኒቨርሲቲ



ADDIS ABABA UNIVERSITY
COLLEGE OF HEALTH SCIENCES
DEPARTMENT OF EMERGENCY MEDICINE AND CRITICAL CARE

THE PROGNOSTIC VALUE OF NEUTROPHIL TO LYMPHOCYTE RATIO IN SESPSIS AMONG ADULT EMERGENCY PATIENTS AT TIKUR ANBESSA SPECIALIZED HOSPITAL (TASH) AND ZEWDITU MEMORIAL HOSPITAL(ZMH) , ADDIS ABABA, ETHIOPIA

Principal investigator: Dr Awetahegn Ephrem , MD

Advisors: - Dr Birhanu Tesfaye(MD , MPH , Emergency Medicine and critical care consultant at Tikur Anbessa Specialized Hospital)

Dr Gedefaw Tigabu (MD, Emergency Medicine and critical care consultant at Tikur Anbessa Specialized Hospital)

A thesis submitted to the Department of Emergency Medicine and Critical Care, College of Health Sciences for the partial fulfillment of the requirements for a specialty certificate in emergency and critical care

Dec, 2025

Addis Ababa, Ethiopia

Declaration

DRPC FORM III: RESEARCH PROPOSAL APPROVAL BY ADVISORS

ADDIS ABABA UNIVERSITY COLLEGE OF HEALTH SCIENCES, SCHOOL OF MEDICINE, DEPARTMENT OF EMERGENCY AND CRITICAL CARE MEDICINE, POSTGRADUATE PROGRAM

I, Dr. Awetahegn Ephrem, hereby declare that this thesis entitled “ **The prognostic value of neutrophil to lymphocyte ratio in sepsis among adult emergency patients at Tikur Anbessa specialized hospital (TASH) and Zewditu Memorial Hospital (ZMH) Addis Ababa, Ethiopia multi-centered prospective cross-sectional study** ” in line with the requirement of graduate studies was fully undertaken by me under the guidance of my advisors and that I have, to the best of my knowledge and effort, avoided plagiarism or duplication of materials unless and otherwise cited and/or acknowledged and that it has not been so far submitted for any form of proposal application or consideration.

Investigator Dr. Awetahegn Ephrem

We hereby certify that we have read and evaluated this thesis relating to “Diagnostic and prognostic value of Neutrophil to lymphocyte ratio in sepsis among adult emergency patients at Tikur Anbessa specialized hospital (TASH) and ZMH ,Addis Ababa, Ethiopia ” under our guidance from its inception up to in its current format including ethical issues and that it can be submitted to the DRPC for further administrative processing & documentation of the proposal by the Department as part of the resident’s research undertaking for his partial fulfillment to the Degree of Specialty in emergency and critical care medicine.

Advisors Dr. Berhanu Tesfaye

 Dr. Gedefaw Tigabu

Acknowledgement

I would like to thank my advisors Dr Birhanu Tesfsaye and Dr Gedefaw Tigabu for their constructive advice and committed guidance throughout the research proposal process. I would also like to thank the department of Emergency and Critical Care Medicine at AAU College of health Sciences for allowing me to do this research proposal

I would like to thank the department of emergency medicine and critical care at Addis Ababa University for giving me this educational opportunity to conduct this study

Table of Contents

Acknowledgement	3
List of tables.....	6
List of figures	6
Abbreviation and acronym.....	1
Abstract	2
1.Introduction.....	3
1.1 Background.....	3
1.2 Statement of the Problem	4
1.3 Significance of the study.....	5
2. Literature review	6
3. Objective	8
3.1 General objective	8
4. Method and materials.....	9
4.1 Study area.....	9
4.2 Study design and period.....	9
4.3.1 Target population	9
4.3.2 Source population	10
4.3.3 Study population	10
4.4 Eligibility criteria.....	10
4.4.1 Inclusion criteria	10
4.4.2 Exclusion criteria	10
4.5 Sample size determination and Sampling technique	10
4.5.1 Sample size determination	10
4.5.2 Sampling method	11
4.6 Study variable	11
4.6.1 Dependent variable	11

4.6.2 Independent variable.....	12
4.7 Operational definition.....	12
4.8 Data collection tool and procedure.....	14
4.9 Data quality control.....	14
4.10 Data processing and analysis.....	15
4.11 Ethical consideration.....	15
4.12 Plan for Dissemination.....	15
5. Result.....	16
5.1 Socio-Demographic characteristics of the study participants.....	16
5.2 Clinical characteristics of the study participants.....	16
5.3 Site of suspected infection among sepsis patients admitted at emergency unit.....	17
5.4 Laboratory investigation related characteristics of the study participants.....	17
5.5 Clinical course of measurement at emergency.....	19
5.6 Outcome of the septic patients.....	19
5.7 The prediction of mortality using admission NLR.....	20
5.8 The prediction of mortality using NLR after resuscitation and treatment initiation.....	21
5.9 The relation between demographic characteristics with sepsis outcome.....	22
5.10 Clinical characteristics of the study participants.....	23
5.11 Laboratory investigation related with the patient outcome at emergency.....	23
5.12 Clinical course of measurement related with patient outcome.....	26
6. Discussion.....	27
7. Conclusion.....	29
8. Recommendation.....	29
Reference.....	30
Annexes.....	33
Annex I: Participants information sheet.....	33

List of tables

Table 1. Socio-demographic characteristics of the study participants.....	16
Table 2. Clinical characteristics of the study participants	17
Table 3. Laboratory investigation related characteristics of the study participants.....	18

List of figures

Figure 2. Outcome of the septic patients	19
Figure 3. Receiver operating characteristic (ROC) curves showing the performance of the admission Neutrophil to-Lymphocyte Ratio (NLR) in predicting septic shock mortality	20
Figure 4. Receiver operating characteristic (ROC) curves showing the performance of the Neutrophil to-Lymphocyte Ratio (NLR) after resuscitation in predicting septic shock mortality	21

Abbreviation and acronym

AS-LYMP Antibody Stimulating Lymphocytes

AUC Receiver Operating Characteristic Curve

AUROC Area Under the ROC Curve

CAD Coronary Artery Disease

CI confidence interval (CI)

CRP C-reactive protein

ED Emergency Department

hsCRP Acute Inflammatory Markers

MAP Mean Arterial Pressure (MAP)

NEUT-RI Neutrophil Reactivity Intensity

NLCR Neutrophil-Lymphocyte Count Ratio

NLR Neutrophil-To-Lymphocyte Ratio

OR odd ratio

PLR Platelet to Lymphocyte Ratio

WBC White Blood cell

Abstract

Background: - Sepsis is life-threatening condition resulting from a deregulated immune response to infection with high morbidity and mortality particularly in low- and middle-income countries such as Ethiopia. The significant burden of sepsis in Ethiopian emergency departments underscores the need for improved diagnostic tools and treatment strategies. The Neutrophil-to-Lymphocyte ratio (NLR) has emerged as a promising biomarker that may predict clinical outcomes in sepsis, yet its utility in Ethiopian context remains unexplored.

Objective: - The prognostic value of neutrophil to lymphocyte ratio in sepsis among adult emergency patients at Tikur Anbessa specialized hospital (TASH) Addis Ababa and Zewditu Memorial Hospital (ZMH), Ethiopia Multicenter prospective cross-sectional study

Methods: - The study was conducted at TASH & ZMH in the emergency department. The research design used for this study is institutional-based prospective cross-sectional study design, which involves collecting data at over 3 months period from selected sepsis patients after diagnosis by SOFA guideline admitted at the Emergency. The data were collected from Aug 15- November 30, 2025, through a standard checklist and laboratory results by a data collector.

Results: Among the study population, 58% recovered while 42% died. Non-survivors had higher WBC counts, neutrophil percentages, and markedly elevated NLR at admission (24.52) compared to survivors (14.1). NLR after treatment remained significantly higher in non-survivors (28.99 vs. 11.46). ROC analysis showed that NLR had a moderate predictive accuracy with an AUC of 0.713 (95% CI: 0.618–0.808; p=0.000).

Conclusion: The findings align with extensive literature (21–30) showing that elevated NLR is consistently associated with poor prognosis, severity, and increased risk of death. Routine NLR monitoring may enhance early risk stratification and guide timely clinical interventions in sepsis care.

Work plan – The total research work from title selection to presentation was completed in 6 months

Key words - sepsis , NLR , mortality, prognostic value, biomarker, TASH, ZMH

1.Introduction

1.1 Background

Sepsis is characterized by life-threatening organ dysfunction and an irregular host response to severe infection (1). It is a syndrome that includes physiological, pathological, and biochemical abnormalities, and is an important public health problem (1).

The Neutrophil-to-lymphocyte ratio (NLR) has emerged as a promising biomarker for predicting sepsis severity. It is calculated by dividing the number of neutrophils by the number of lymphocytes in a complete blood count test. This easily obtainable marker from routine laboratory tests provides valuable information regarding the systemic inflammatory status (2-4).

Neutrophil to lymphocyte ratio calculated from white cell differential count provides a rapid indication of the extent of an inflammatory process (5-6). A study demonstrated that NLR could serve as a predictor of hospital mortality in patients with sepsis with a sensitivity of 55.1% and specificity of 70.7 %(7). In addition, a meta-analysis suggested that NLR may be a prognostic biomarker in patients with sepsis, and higher NLR levels may indicate an adverse prognosis (8).

This study aimed to investigate the diagnostic and prognostic value of the NLR in sepsis, as it represents a critical health concern in Ethiopia. Despite advances in medical technology, resource limitations often hinder the ability to utilize complex diagnostic tools, making it imperative to identify simple cost-effective biomarkers, such as the NLR, which can enhance clinical decision-making.

1.2 Statement of the Problem

Sepsis is a major public health concern, with mortality rates of 25%–30% for severe sepsis and 40%–70% for septic shock (9). In Ethiopia, the burden of sepsis is particularly pronounced, contributing to high mortality and morbidity rates. A retrospective study at the TASH Emergency Department reported an overall in-hospital sepsis mortality rate of 56.7% (10). The rapid decline in survival rates by approximately 7.7% in the 72-hour survival rate for every hour that effective antimicrobial therapy is delayed highlights the urgent need for timely diagnosis and treatment (11). Thus, it is important to identify predictors of sepsis. The diagnosis of sepsis has shifted from the SIRS criteria to the sepsis-3 definition involving the quick Sepsis Related Organ Failure Assessment (12).

The neutrophil-to-lymphocyte ratio is a readily available parameter that can be analyzed from the complete blood count. The NLR reflects the balance between pro-inflammatory and anti-inflammatory responses, which can be useful for predicting disease severity and patient outcomes. Higher NLR values generally correlate with a worse prognosis and increased mortality in patients with sepsis (13, 14). While NLR has been studied in various global settings there is a lack of localized evidence that addresses the health care challenges and patients' demographics in Ethiopia.

The NLR is useful in predicting bacteremia, diagnosing sepsis, predicting mortality, and monitoring response to therapy (15). Thus far, the evidence supports the use of NLR as a reliable and valuable biomarker for predicting the severity and outcomes of sepsis, with higher values correlating with worse prognosis and increased mortality.

The predictive value of the NLR in patients with suspected bacteremia in the Emergency Department (ED) and the association between the NLR and both short- and long-term outcomes in critically ill patients have been described (18-20).

However, studies on the predictive value of NLR in supporting the diagnosis sepsis in emergency patients in Ethiopia are lacking. We investigate the association between the NLR and prognostic marker at tertiary and teaching hospital emergency, at Tikur Anbessa specialized hospital to enable the healthcare professional adopt a simple and cost-effective biomarker that could enhance early diagnosis and treatment, ultimately improving patient survival rate and informing clinical guidelines tailored to local needs.

1.3 Significance of the study

This study investigated the Neutrophil-to-lymphocyte ratio (NLR), a simple, inexpensive, and readily available biomarker, as a potential tool for the early diagnosis and prognosis of sepsis in emergency settings. If the NLR proves to be a reliable predictor of sepsis severity and patient outcomes, it can serve as an accessible and cost-effective alternative to more complex laboratory investigations. This will help healthcare professionals in Ethiopia gain insights into utilizing NLR as a practical tool. Additionally, patients diagnosed with sepsis will benefit from improved diagnostics and treatment strategies. The study contributes to the limited body of local evidence on sepsis biomarkers and offers context-specific insights that can inform national clinical guidelines and protocols.

2. Literature review

A study conducted at Millennium COVID 19 care center in Addis Ababa , Ethiopia demonstrated the significant value of NLR where a value greater than 9.47 was identified as a strong predictor on in hospitable mortality with 88,7 % sensitivity and 95.4% mortality among covid patients (20)

A meta-analysis done on predictive value of the NLR in the prognosis and risk of death for adult sepsis patients comprising 10,811 patients between January 1, 2000 and May 21 , 2023 . The research systematically searched multiple database at the study period and found that the pooled results indicated that patients with a higher NLR level were associated with a poor prognosis which made NLR a reliable and valuable biomarker for predicting prognosis and risk of death in septic patients (21).

An observational study over 3 Spanish hospitals done on association between NLR ratio in the first seven days of sepsis and mortality, The NLR values were determined and associated with 30 days mortality after adjusting for sepsis severity. The study found that the thirty-day non-surviving patients compared to surviving patients ,showed higher NLR on the first , fourth , and eighth day of sepsis diagnosis. (22).

A prospective observational study conducted in India on the diagnostic and prognostic role of Neutrophil-to-Lymphocyte Ratio in early and late phases of sepsis found that the NLR in the early phase of sepsis was > 56 in patients admitted to the ICU. The NLR was calculated daily during their hospital stay. The results had significant association (diagnostic $P=0.001$; prognostic $P=0.045$) (23)

A study conducted in Netherlands on the value of the neutrophil-lymphocyte count ratio in the diagnosis of sepsis revealed that the significant differences in NLCR values were observed between sepsis (15.3)and non-sepsis patients (median 9.3) however the NLCR was less accurate than the conventional marker such as CRP and PCT(24). But according to study done on the role

of NLR in predicting the severity of sepsis in a tertiary care hospital in South India used NLR above 10 and was linked with highest mortality rates and organ impairment correlating the results with SOFA and markers like presepsin in sepsis(25).

Another prospective case-control study conducted in India supported the same finding, where elevated NLR aided in diagnosing sepsis at very early stages, and the trend of NLR demonstrated an dynamic course throughout the process, which made NLR advantageous due to its availability from routine blood counts, low cost, and ease of use in clinical settings, which showed its potential role in guiding early management decisions in sepsis care. (26).

A study conducted in China on the prognostic value of the neutrophil-to-lymphocyte ratio and platelet-to-lymphocyte ratio in patients with sepsis and lymphopenia showed that the total hospital mortality rate was higher in patients with high NLR and PLR ratios (27).

The study done in Dali university on prognostic value of neutrophil-to-lymphocyte ratio in patients with sepsis revealed that NLR level was significantly higher in the septic patients compared to the case controls and healthy individuals ($P < 0.05$), and was much higher in septic patients who died ($P < 0.05$). (28).

According to a prospective single centered observational study which included 130 patients a reversed NLCR evolution was observed according to the time of death. Septic shock patients at risk of early death had low NLCR at admission, although late death was associated with higher NLCR during the first 5 days which nuanced the understanding of NLCR in risk stratification of septic patients (29)

A retrospective study that included 591 patients by Sari R KZ, Ay M et al. (2019) investigated the NLR as treatment response and mortality in septic shock patients in the ICU. They found after 3rd day of antibiotic initiation, an NLR value >15 was strongly associated with increased mortality, with an odds ratio of 6.96 indicating a 7-fold higher risk of death if the NLR remained high despite treatment. The study found that the NLR was a valuable, easily accessible biomarker for

monitoring treatment response and predicting mortality when measured on the 3rd day of antibiotic therapy. (30)

Ljungstorm et al evaluated performance level of several markers including procalcitonin , lactate and NLR ratio among 1570 patients admitted for sepsis in the emergency department and found NLCR or PCT alone exhibit equivalent performance.(32)

3. Objective

3.1 General objective

The prognostic value of neutrophil to lymphocyte ratio in sepsis among adult emergency patients at Tikur Anbessa specialized hospital (TASH) and Zewditu memorial hospital (ZMH) Addis Ababa , Ethiopia

3.2 Specific objective

- To evaluate the predictive value of NLR for disease prognosis in patients with sepsis in the emergency department.
- To compare the NLR values between survivors and non-survivors of sepsis in the emergency setting.

4. Method and materials

4.1 Study area

The study will be conducted at TASH and Zewditu Memorial Hospital both located in Addis Ababa, the Capital city of Ethiopia which both hospitals are located in the central part of the city.

TASH is the largest referral hospital in Ethiopia, established in 1972 GC, located in the Lideta sub-city. Since 1998, the GC has served as the main teaching hospital, administered by Addis Ababa University, with 25, 000 patients visiting annually. The Emergency department comprises Red, Yellow, Green, Fast Track, and Triage Bay, consisting of 40 beds, and more than 50 patients visit the emergency department daily. The Emergency Medicine and Critical Care Department has 11 specialists with 50 residents currently enrolled in the program.

Zewditu Memorial Hospital is a public hospital established in 1976, named after Empress Zewditu, located in the central part of Addis Ababa. The facility is the leading hospital for ART center for HIV/AIDS patients and treats over 6000 patients each month. The emergency department contains the red, triage, yellow, and green areas, comprising 25 beds.

4.2 Study design and period

The research design used for this study is institutional-based prospective cross-sectional study design, which involves collecting data at a specific time from selected sepsis patients after diagnosis by SOFA guideline. The data were collected from Aug 15- November30, 2025, through a standard checklist by a data collector. Additionally, basic demographic characteristics of patients, their source of referral, mode, of arrival, and previous any medical & surgical history were checked to identify their impact on the study.

4.3 Population

4.3.1 Target population

All adult patients with sepsis presenting to emergency departments in Ethiopia.

4.3.2 Source population

All patients admitted for emergency care in emergency and critical care unit will be the source of population

4.3.3 Study population

All patients with diagnosis of sepsis using SOFA criteria was the study population.

4.4 Eligibility criteria

4.4.1 Inclusion criteria

All adult (age>13) septic patients visited to ER during the study period diagnosed by SOFA Score

4.4.2 Exclusion criteria

Pregnant patients, Hematological malignancy, Liver failure, HIV/AIDS, advanced metastatic cancer, stroke, and patients taking immunotherapy drugs, steroid > 5 days.

4.5 Sample size determination and Sampling technique

4.5.1 Sample size determination

The sample size was determined to estimate the proportion of unfavorable outcomes (death or severe complications) among adult sepsis patients with adequate precision. In the absence of prior local estimates, a proportion (p) of 0.5 was assumed to maximize sample size.

Using the **single population proportion formula**:

$$n_0 = \frac{(Z_{\alpha/2})^2 p(1-p)}{d^2}$$

Where:

- $Z_{\alpha/2} = 1.96$ (for 95% confidence level)
- $p = 0.5$ (assumed proportion)
- $d = 0.05$ (margin of error)

$$n_0 = \frac{(1.96)^2 \times 0.5 \times 0.5}{(0.05)^2} \approx 384$$

From monthly ED audit reports of TASH and ZMH and a short pilot review, the estimated number of adult sepsis cases presenting during the 3.5-month study period was approximately **N = 180**. Since the target population during the study period was <10,000, a finite population correction was applied:

$$n = \frac{n_0}{1 + \frac{(n_0-1)}{N}}$$
$$n = \frac{384}{1 + \frac{384-1}{180}} \approx 123$$

4.5.2 Sampling method

A consecutive sampling approach was used. All patients presenting to the EDs of TASH and ZMH during the study period who met the inclusion criteria and none of the exclusion criteria were approached for enrollment until the required sample size was reached. This approach was chosen as the most practical and unbiased method in a high-throughput emergency setting.

4.6 Study variable

4.6.1 Dependent variable

- ✓ NLR
- ✓ **Severity of sepsis** (sepsis with evidence of organ dysfunction)
- ✓ **Prognosis of sepsis** (favorable/unfavorable outcome)

4.6.2 Independent variable

- ✓ Age
- ✓ Sex
- ✓ Comorbidities (preexisting illness that could affect the patient's prognosis such as diabetes, Hypertension or chronic kidney disease)
- ✓ Vital signs on admission
- ✓ Laboratory values
- ✓ Time to antibiotic administration
- ✓ Source of infection (e.g respiratory, urinary or abdominal)

4.7 Operational definition

Emergency Medical Services: a comprehensive system that provides the arrangements of personnel, facilities, and equipment for the effective, coordinated, and timely delivery of health and safety services to the victim.

Sepsis A clinical syndrome defined by suspected or confirmed infection plus signs of systemic inflammation, based on Sepsis-3 criteria: Sequential Organ Failure Assessment (SOFA) score ≥ 2 points from baseline. (1)

Severe Sepsis is Sepsis accompanied by signs of organ dysfunction, hypo-perfusion, or hypotension, but not yet meet the criteria for septic shock. (Note: This term is less used under Sepsis-3 but may be included if older criteria are considered.)(1)

Septic Shock: - A subset of sepsis in which the underlying circulatory and cellular/metabolic abnormalities are profound enough to substantially increase mortality. The diagnosis is made when vasopressors are needed to maintain mean arterial pressure ≥ 65 mmHg and serum lactate > 2 mmol/L despite fluid resuscitation. (3)

The **SOFA score** is a clinical tool used to assess the extent of organ dysfunction in patients with sepsis or critical illness. It evaluates six organ systems; each scored from 0 (normal) to 4 (most abnormal). (12)

A SOFA: - score increases of ≥ 2 points from baseline is associated with a higher risk of mortality and is used in the Sepsis-3 definition.

SOFA Score Components

Organ System	Parameter	Score 0	Score 1	Score 2	Score 3	Score 4
Respiratory	PaO ₂ /FiO ₂ (mmHg)	>400	≤400	≤300	≤200 (with resp. support)	≤100 (with resp. support)
Coagulation	Platelet count (×10 ⁹ /L)	≥150	<150	<100	<50	<20
Liver	Bilirubin (mg/dL)	<1.2	1.2–1.9	2.0–5.9	6.0–11.9	≥12.0
Cardiovascular	MAP or use of vasopressors	MAP ≥70 mmHg	MAP <70 mmHg	Dopamine ≤5 or dobutamine (any dose)	Dopamine >5 or norepinephrine ≤0.1	Dopamine >15 or norepinephrine >0.1
Central Nervous System	Glasgow Coma Scale (GCS)	15	13–14	10–12	6–9	<6
Renal	Creatinine (mg/dL) or urine output	<1.2	1.2–1.9	2.0–3.4	3.5–4.9 or <500 mL/day	≥5.0 or <200 mL/day

Neutrophil to Lymphocyte Ratio: -A calculated value obtained by dividing the absolute neutrophil count by the absolute lymphocyte count, both measured in ×10⁹/L. Used as an indicator of systemic inflammation. (4)

High NLR: - An NLR value above the identified cutoff point (e.g., >9.84 or institutionally validated threshold) indicating more severe inflammatory response. (20)

Diagnostic Value: -The ability of NLR to correctly identify patients with sepsis. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were measured. Value (NPV).

Prognostic Value: -The ability of NLR to predict clinical outcomes such as ICU admission, hospital length of stay, or mortality among patients with sepsis.

Favorable Outcome: -Discharge with clinical improvement and no need for ICU care or advanced life support.

Unfavorable Outcome: - Includes death, prolonged ICU stay, mechanical ventilation, or development of multi-organ failure.

Mortality: - Defined as in-hospital death due to sepsis-related complications during the study period.

Length of stay - patients who stay for 24 h or more are considered to have prolonged LOS(33)

4.8 Data collection tool and procedure

Development of the items of the checklist is accomplished by adapting valid tools from the literature review. The checklist has closed-ended and some open-ended questions including of Socio-demographic characteristics and, basic information. Informed consent, in verbal form, was obtained before data collection.

Data were collected from patient's medical record and laboratory results including complete blood count, biochemistry panel (urea, creatinine, electrolytes, aspartate aminotransferase, alanine aminotransferase) within the first 24 hours of emergency admission. The NLR is then calculated as the absolute neutrophil count is divided by lymphocyte count. Then the patient clinical course and outcome were assessed and their data were collected on the end after 7th days. The Data collection period were between Aug 15 to November 30, 2025

Data collectors after they receive training on the study and data collection tools for 3 hours. The patient's data was submitted electronically by Kobo tool .The completeness of the data was checked and evaluated by the data evaluator before completion of data. A pretest was performed on 5% of the study population. Additionally, basic demographic characteristics of patients, their source of referral, mode, of arrival, and previous any medical surgical history were checked to identify their impact on the study

4.9 Data quality control

The checklist was articulated clearly to be understood by respondents. To reduce the guessing effect the possible choices are large in number. The data were collected while respondents are gathered while the data collector is there. The trained data collector was largely responsible for collecting data, and before entering the information into the SPSS program, the responses was reviewed by the data evaluator for completeness of the data.

4.10 Data processing and analysis

The completed data were coded and entered into version 27 SPSS for analysis by the principal investigator. The descriptive data were described using mean with standard deviation, median with interquartile range, and mode to characterize the study population using socio-demographic and background characteristics. Two categorical variables were analyzed using the chi-square test and Fisher exact test. For single dependent variables and multiple predictors, multiple regression was used. Sensitivity of the NLR to the diagnosis of sepsis were assessed by the receiver operator characteristic (ROC) curve, and the prognostic value of NLR, white blood cell (WBC), SOFA score for sepsis was further evaluated by 95% confidence interval (CI) and area under the ROC curve (AUC). $P < 0.05$ indicated statistical significance.

4.11 Ethical consideration

A formal letter was taken from Addis Ababa University College of Health Sciences, Department of Emergency and Critical Care Medicine to get approval to conduct this study and the study was conducted after ethical clearance is obtained from the head of the hospital's Emergency Department (ED) with letter reference number EM/SM/440/17.. The Ethical clearance for Zewditu Memorial Hospital was obtained from Addis Ababa public health research & Emergency management Directorate bureau (AAPHREM). Then, the data were collected after getting an official letter of permission. Informed consent was taken from participants upon filling out the checklist. Confidentiality of the information were ensured by filling out the checklist anonymously. All the collected data were organized and analyzed by the principal investigator. Additionally, strict confidentiality measures will be enforced to ensure that no medical records are disclosed to unauthorized third parties.

4.12 Plan for Dissemination

Based on the work plan after data will be collected and analyzed conclusion will be drawing and discussion will be made and public defense will be done at AAU department of emergency

medicine and critical care. After accommodating the examiner comment, and after getting permission from the concerned authority, information will be disseminated for the concerned body and to the public and publication of the findings will be considered.

5. Result

5.1 Socio-Demographic characteristics of the study participants

The study participants found that 53.3% individuals aged 60 years and above, 26.7% individuals aged 13–39 years, and 20% individuals aged 40–59 years. In terms of sex, 56.7% participants were female. Regarding place of residence, 75% individuals lived in urban areas, while 25% individuals resided in rural areas.

Table 1. Socio-demographic characteristics of the study participants

Variable	frequency	Percent
Age in years		
13-39	32	26.7
40-59	24	20.0
≥60	64	53.3
Sex of the participants		
Female	68	56.7
male	52	43.3
Residency		
Urban	90	75
Rural	30	25

5.2 Clinical characteristics of the study participants

During the first 48 hours of ED admission, the majority of patients had blood pressure <90/60 mmHg (83.3%), GCS <14 (56.7%), and respiratory rate >22 (91.7%). Regarding previous medical history, most patients had a history of chronic illness (65.8%), with diabetes mellitus being the most common condition among them (39%).

Table 2. Clinical characteristics of the study participants

Variable	frequency	Percent
SOFA criteria during the first 48 hours of ED admission		
Blood pressure <90/60		
No	20	16.7
yes	100	83.3
GCS <14		
No	52	43.3
yes	68	56.7
RR>22		
No	10	8.3
Yes	110	91.7
Previous history of chronic illness		
Yes	79	65.8
no	41	34.2
List of chronic illness (N=79)		
DM	30	39
Cardiac illness	22	28.6
others	21	27.3

5.3 Site of suspected infection among sepsis patients admitted at emergency unit

The most common site of suspected infection is the lung, accounting for about 70.07% of the cases. Skin infections follow with approximately 12.24%, while abdominal infections make up about 10.20%. Urinary tract infections represent around 4.76% of the total, and infections involving the central nervous system (CNS) are the least common, at about 2.72%.

5.4 Laboratory investigation related characteristics of the study participants

At admission, the patients (n=120) showed elevated inflammatory and metabolic markers, with a mean WBC count of 13.99 (range 3.2–35.5), lymphocytes at 15.38% (0.7–92), neutrophils at 76.6% (2.1–95.8), and a high mean NLR of 18.42 (2.20–72), indicating significant immune activation. Kidney function markers were also raised, with creatinine at 2.83 (0.2–18) and BUN at

99.29 (0.9–372), while electrolytes showed slight deviations: sodium at 133.6 (112–168), potassium at 4.1 (2.2–8.2), and chloride at 100.3 (35.2–137). Liver enzymes were elevated, with ALT at 78.68 (8–479) and AST at 103.4 (10–422).

After resuscitation and treatment initiation (sample size 79–92 depending on test), there were general improvements: mean WBC slightly decreased to 13.4, lymphocytes increased to 21.7%, neutrophils decreased to 70.1%, and NLR declined modestly to 17.4, though its range widened (2.4–120). Kidney function markers improved with creatinine lowering to 2.06 and BUN to 82.39. Electrolytes showed minor adjustments with sodium at 134.3, potassium at 3.93, and chloride increasing to 102.7. Liver enzymes also decreased with ALT at 59.5 and AST at 83.8.

Table 3. Laboratory investigation related characteristics of the study participants

Variable	Number of observed patients	Mean (min, max)
Investigation at admission		
WBC	120	13.99(3.2, 35.5)
Lymphocyte	120	15.38(0.7, 92)
Neutrophil	120	76.6(2.1, 95.8)
NLR	120	18.42(2.20, 72)
Creatinine	120	2.83(0.2, 18)
BUN	120	99.29(0.9, 372)
Sodium	120	133.6(112, 168)
Potassium	120	4.1(2.2, 8.2)
Chloride	120	100.3(35.2, 137)
ALT	120	78.68(8, 479)
AST	120	103.4(10, 422)
Investigation after resuscitation and treatment initiation of treatment		
WBC	90	13.4(4.3, 34.1)
Lymphocyte	92	21.7(0.8, 92)
Neutrophil	92	70.1(1.2, 97)
NLR	88	17.4(2.4, 120)
Creatinine	88	2.06(0.2, 11.3)
BUN	88	82.39(12, 384)
Sodium	86	134.3(111, 168)
Potassium	86	3.93(2.0, 6.8)

Chloride	84	102.7(77, 137)
ALT	79	59.5(2.0, 332)
AST	79	83.8(8.0, 460.0)

5.5 Clinical course of measurement at emergency

All patients (100%) received fluid therapy, while vasopressors were administered to about 56% of the patients. Antibiotics were started in nearly all cases, with 96.7% of patients receiving them. Mechanical ventilation was necessary for around 41% of patients. Regarding hospital stay duration, most patients (55.8%) stayed between 2 to 7 days, about 21% stayed less than 2 days, and nearly 23% experienced a longer stay of more than 7 days.

5.6 Outcome of the septic patients

The pie chart shows the outcome of sepsis patients in the emergency department. Out of the total patients, 58% recovered, while 42% died.

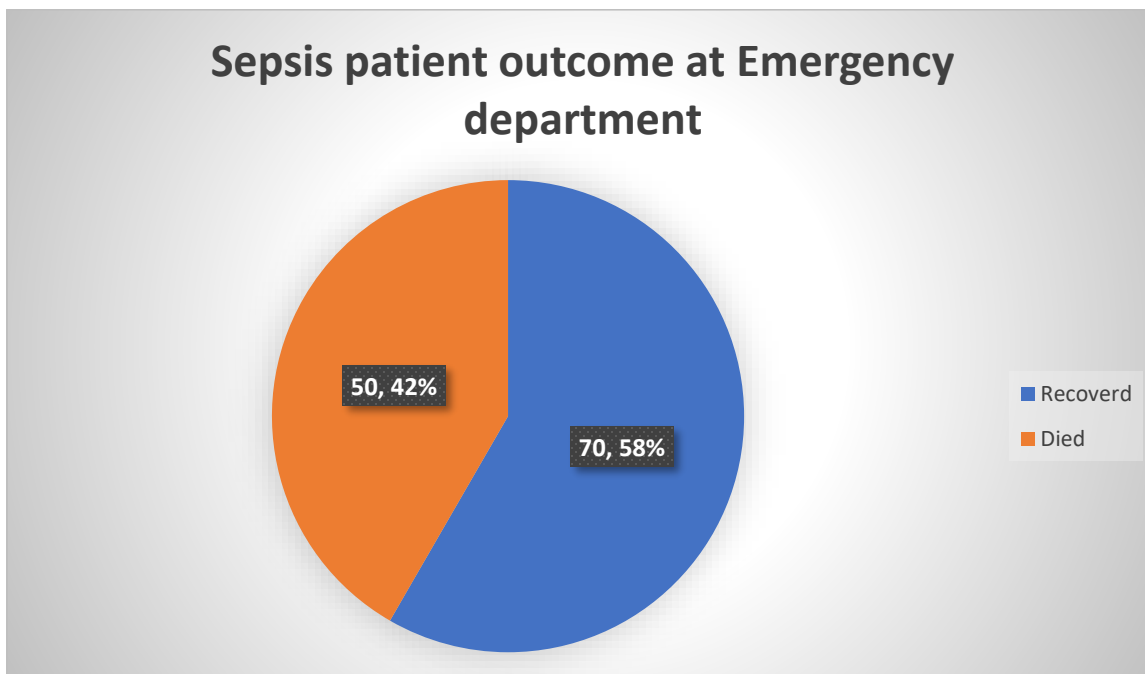


Figure 1. Outcome of the septic patients

5.7 The prediction of mortality using admission NLR

The Area under the Curve (AUC) for NLR is 0.713 with a standard error of 0.049, and a highly significant p-value (Asymptotic Sig. = 0.000). This indicates that NLR is a good predictor in distinguishing between the positive and negative actual states, performing significantly better than chance (where an AUC of 0.5 would indicate no predictive ability). The 95% confidence interval for the AUC ranges from 0.618 to 0.808, which further supports the reliability of NLR as a moderately accurate diagnostic test.

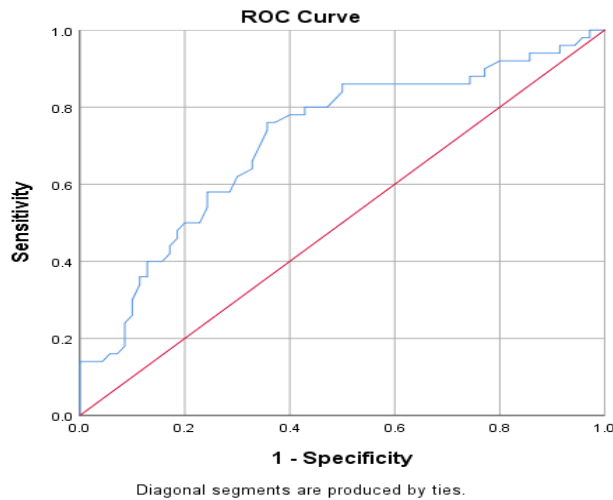


Figure 2. Receiver operating characteristic (ROC) curves showing the performance of the admission Neutrophil to-Lymphocyte Ratio (NLR) in predicting septic shock mortality

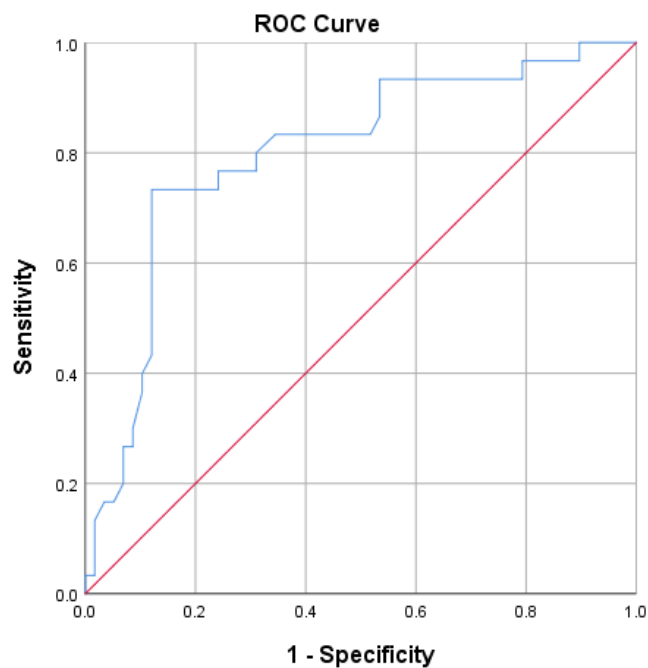
Area Under the Curve				
Test Result Variable(s): NLR				
Area	Std. Error	Asymptotic Sig. ^b	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
.713	.049	.000	.618	.808
The test result variable(s): NLR has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.				

a. Under the non-parametric assumption

b. Null hypothesis: true area = 0.5

5.8 The prediction of mortality using NLR after resuscitation and treatment initiation

The ROC analysis for NLR (Neutrophil-to-Lymphocyte Ratio) indicates that it has good discriminative ability for distinguishing between positive and negative cases, with an area under the curve (AUC) of 0.799. This suggests that NLR can reliably differentiate between the two groups, as an AUC between 0.7 and 0.8 is considered acceptable to good. The standard error of 0.052 indicates a reasonably precise estimate, and the 95% confidence interval, ranging from 0.698 to 0.901, further supports that the true AUC is likely in the acceptable to excellent range. The statistical significance of the AUC, with a p-value of less than 0.001, confirms that the discriminative ability of NLR is significantly better than random chance



Diagonal segments are produced by ties.

Figure 3. Receiver operating characteristic (ROC) curves showing the performance of the Neutrophil to-Lymphocyte Ratio (NLR) after resuscitation in predicting septic shock mortality

Area Under the Curve				
Test Result Variable(s): NLR				
Area	Std. Error ^a	Asymptotic Sig. ^b	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
.799	.052	.000	.698	.901
The test result variable(s): NLR has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.				
a. Under the nonparametric assumption				
b. Null hypothesis: true area = 0.5				

5.9 The relation between demographic characteristics with sepsis outcome

The data presents the relationship between demographic and outcomes (died or recovered) in a study participant. For age, the death rates were 46.9% for 13–39 years, 33.3% for 40–59 years, and 42.2% for those aged 60 and above. The chi-square test for age groups yielded a value of 1.05 with a p-value of 0.592, indicating no statistically significant association between age group and outcome. Regarding sex, 44.1% of females and 38.5% of males died, with a chi-square of 0.39 ($p = 0.533$), showing no significant difference in outcomes between males and females. For residency, 41.1% of urban residents and 43.3% of rural residents died, with a chi-square of 0.046 ($p = 0.831$), suggesting that residency also had no significant effect on mortality.

Table 4. The relation between demographic characteristics with sepsis outcome

Variable	died	recovered	Chi-square(p-value)
Age in years			
13-39	15(46.9)	17(53.1)	
40-59	8(33.3)	16(66.7)	1.05(0.592)
>=60	27(42.2)	37(57.8)	
Sex of the resident			
Female	30(44.1)	38(55.9)	0.39(0.533)
male	20(38.5)	32(61.5)	
Residency			
Urban	37(41.1)	53(58.9)	0.046(0.831)
rural	13(43.3)	17(56.7)	

5.10 Clinical characteristics of the study participants

Among blood pressure <90/60 mmHg, 41% of patients with hypotension died compared to 45% without hypotension. For GCS <14, 51.5% of patients with reduced consciousness died versus 28.8% of those with normal GCS. Regarding respiratory rate >22, 39.1% of patients with elevated RR died compared to 70% of those with normal RR. For previous history of chronic illness, 45.6% of patients with chronic conditions died versus 34.1% without. When looking at specific chronic illnesses among 79 patients, diabetes mellitus was associated with a 36.7% mortality rate, and cardiac illness with 28.6% mortality.

Table 5. The relation between clinical characteristics with sepsis outcome at emergency unit

Variable	Died	Recovered	Chi-square
SOFA criteria during the first 48 hours of ED admission			
Blood pressure <90/60			
No	9(45)	11(55)	0.11(0.74)
yes	41(41)	59(59)	
GCS <14			
No	15(28.8)	27(71.2)	6.21(0.013)
yes	35(51.5)	33(48.5)	
RR>22			
No	7(70)	3(30)	3.6(0.058)
Yes	43(39.1)	67(60.9)	
Previous history of chronic illness			
Yes	36(45.6)	43(54.4)	1.45(0.229)
no	14(34.1)	27(65.9)	
List of chronic illness (N=79)			
DM	11(36.7)	19(63.3)	1.53(0.216)
Cardiac illness	6(28.6)	15(71.4)	3.32(0.068)

5.11 Laboratory investigation related with the patient outcome at emergency

At admission, 120 patients were observed for various laboratory investigations. The mean (SD) values for WBC were 12.12 (6.76) in recovered patients and 16.61 (8.17) in those who died. Lymphocyte counts were 17.05 (24.10) and 13.1 (23.94), while neutrophil counts were 74.96 (24.49) and 78.89 (25.1) for recovered and deceased patients, respectively. Notably, the NLR was 14.1 (11.17) in recovered patients and 24.52 (14.96) in those who died.

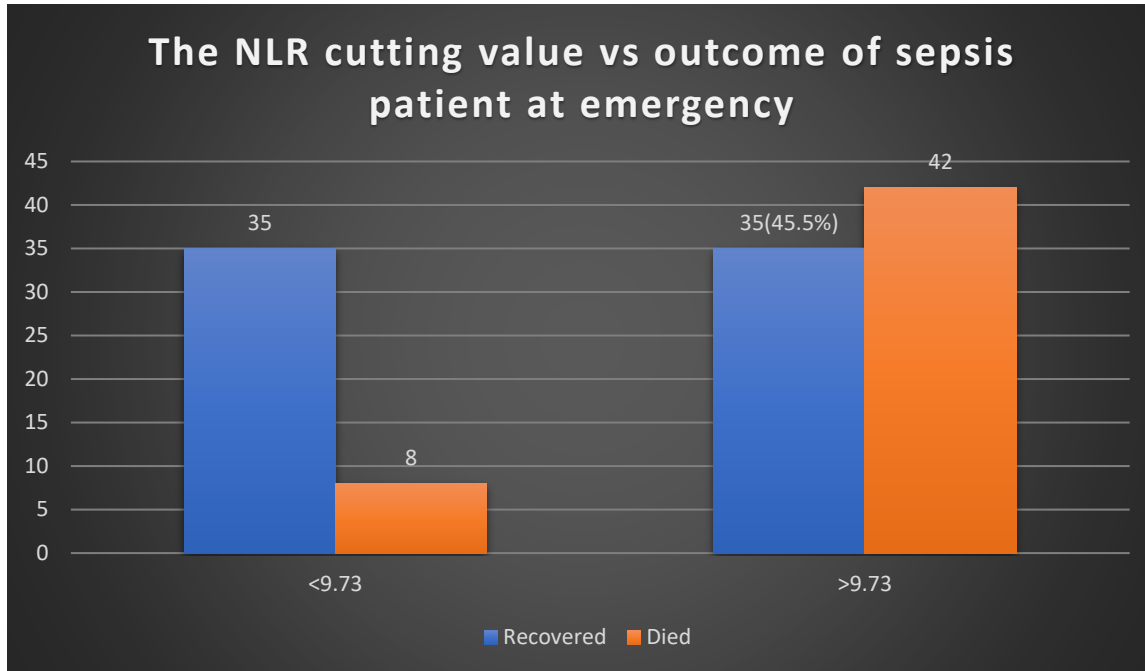
After the establishment of treatment, the number of observed patients varied slightly. WBC counts were 11.23 (5.42) in recovered patients and 17.62 (7.98) in those who died. Lymphocytes were 23.1 (25.32) vs 75.35 (33.1), and neutrophils were 67.57 (26.51) vs 18.79 (31.27). The NLR was 11.46 (13.92) in recovered patients and 28.99 (25.43) in deceased patients.

Table 6. Laboratory investigation related with the patient outcome at emergency

Variable	Number of observed patients	recovered (mean, SD)	Died (mean, SD)
Investigation at admission			
WBC	120	12.12(6.76)	16.61(8.17)
Lymphocyte	120	17.05(24.10)	13.1(23.94)
Neutrophil	120	74.96(24.49)	78.89(25.1)
NLR	120	14.1(11.17)	24.52(14.96)
Creatinine	120	2.61(2.89)	3.14(3.1)
BUN	120	90.0(74.13)	112.2(82.67)
Sodium	120	134.3(6.73)	132.78(8.11)
Potassium	120	4.1(1.27)	4.16(1.18)
Chloride	120	99.14(13.82)	101.8(12.55)
ALT	120	77.89(111.0)	79.78(103.1)
AST	120	106.5(121.69)	98.92(120.63)
Investigation after establishment of treatment			
WBC	90	11.23(5.42)	17.62(7.98)
Lymphocyte	92	23.1(25.32)	75.35(33.1)
Neutrophil	92	67.57(26.51)	18.79(31.27)
NLR	88	11.46(13.92)	28.99(25.43)
Creatinine	88	1.56(1.92)	3.11(2.54)
BUN	88	58.14(45.79)	131.76(96.94)
Sodium	86	133.28(5.89)	136.43(13.6)
Potassium	86	3.72(0.91)	4.38(1.11)
Chloride	84	100.34(9.17)	107.34(15.63)
ALT	79	50.59(40.21)	78.76(86.26)
AST	79	67.98(69.91)	118(117.7)

The cut of point of NLR

In this study 9.73 were a cut of point for predicting of mortality and from those of having NLR above the cut of point 54.5% have died while from those of NLR below the cut of point only 18.6% died.



Using an NLR cutoff value of >9.73 to predict mortality (20), the sensitivity of the test was 84%, indicating that it correctly identified 84% of patients who died. The specificity was 50%, meaning that half of the patients who recovered were correctly classified as having an $NLR \leq 9.73$. The type I error rate (false positive rate) was therefore 50%, reflecting the proportion of recovered patients incorrectly predicted to die. The type II error rate (false negative rate) was 16%, representing the proportion of patients who died but were incorrectly classified as having an $NLR \leq 9.73$.

NLR	outcome of the patient	
	recovered	Died

<9.73	35	8
>9.73	35	42

5.12 Clinical course of measurement related with patient outcome

Among patients who received fluids, 41.7% died while 58.3% recovered. Vasopressor use was associated with markedly higher mortality, with 61.2% of patients who received vasopressors dying compared to 17% among those who did not, and this association was highly significant ($p=0.000$). Mechanical ventilation similarly showed a strong relationship with death; 71.4% of ventilated patients died compared to 21.1% of non-ventilated patients, also highly significant ($p=0.000$). Antibiotic initiation did not show a statistically significant effect on mortality (43.1% vs. 0% in non-recipients; $p=0.086$). The length of hospital stay was also significant, with patients staying less than two days experiencing the highest mortality (72%) compared to those staying 2–7 days (32.8%) or more than 7 days (35.7%), indicating that shorter stays likely reflect early death among severely ill patients ($p=0.002$).

Table 7. Clinical course of measurement related with patient outcome

Variable	Died	Recovered	Chi square (p-value)
Fluid given			
yes	50(41.7)	70(58.3)	
Vasopressor given			
Yes	41(61.2)	26(38.8)	23.8(0.000)
no	9(17)	44(83)	
Antibiotic initiated			
Yes	50(43.1)	66(56.9)	2.96(0.086)
no	0	4(100)	
Mechanical ventilation required			
Yes	35(71.4)	14(28.6)	30.18(0.000)
no	15(21.1)	56(78.9)	
Length of hospital stay in days			
<2	18(72)	7(28)	12.0(0.002)

2-7	22(32.8)	45(67.2)	
>7	10(35.7)	18(64.3)	

6. Discussion

The study finding highlights sepsis as major public health concern as evidenced by high death rate of 42 % lower than the retrospective study at the TASH which had 56.7 % mortality rate (10). NLR demonstrated strong predictive ability for mortality, with an AUC of 0.713 and a significant p-value, suggesting the predictive accuracy of NLR as a prognostic tool for mortality in septic patients, showing its potential benefit in early risk stratification in emergency department. Additionally, NLR levels were considerably higher in non-survivors at admission (24.52) and after treatment (28.99) compared to survivors (14.1 and 11.46, respectively).

These findings strongly support NLR as an important prognostic biomarker. The results are consistent with a comprehensive meta-analysis of 10,811 patients and an observational study across three Spanish hospitals and Dali University found that non-survivors consistently exhibited higher NLR levels and were significantly associated with worse outcomes in sepsis, confirming its reliability in predicting mortality (21, 22, 26-28).

A retrospective ICU study likewise revealed that NLR >15 on the third day of antibiotic therapy increased mortality risk nearly seven-fold, emphasizing NLR as an indicator of treatment response (30). These findings collectively support the robustness of NLR as a prognostic marker, aligning with the results of the present study. However, the identified cutoff points of NLR (>9.47 %) accurately identified 84% of patients who died but also reflected a 50% false-positive rate , meaning while the NLR is valuable , it should be considered alongside other clinical assessments and biomarkers for comprehensive evaluation of sepsis

Demographic variables had no significant associations with mortality. Age groups (p=0. 592), sex (p=0. 533), and residency (p=0. 831) did not significantly change the results, indicating that the severity of sepsis has the main impact on the outcomes. The findings are in line with the worldwide

observations where demographic risk factors are less predictive than physiological and immunological markers for sepsis outcomes. The majority of subjects were older adults (53.3 % aged 60 and above), suggesting the findings are primarily reflected outcome in older patients

From the clinical perspective, decreased consciousness (GCS <14) was linked with significantly higher mortality (51.5%), thus, it can be considered as a marker of severe neurological dysfunction in sepsis. Hypotension and elevated respiratory rate, however, only showed trends toward higher mortality, and thus, significance was not reached. Chronic illness was more common among non-survivors, with diabetes mellitus and cardiac illness associated with moderate fatality rates, consistent with known vulnerabilities among patients with co-morbid conditions.

Treatment interventions showed strong associations with mortality. Vasopressor use was linked with a high mortality rate (61.2%), while mechanical ventilation corresponded to a significantly elevated death rate (71.4%)—findings that reflect the advanced severity of sepsis requiring organ support. The length of hospital stay also correlated significantly with outcomes: patients staying less than two days had the highest mortality (72%), indicating early death among severely ill cases. Antibiotic initiation timing showed no significant association, though interpretation may be limited due to sample distribution.

The research was done in two hospitals, although the sample of 120 patients allows for some insights, it may not be sufficient to allow visualize the full spectrum of sepsis presentation or outcome in broad population. Additionally, the study design did not account the long term outcome or recovery post discharge.

7. Conclusion

NLR ratio is very good tool that can be used as a reliable and easily accessible prognostic biomarker. Since almost all patients have a CBC workup, NLR can be easily calculated supporting the use in diverse clinical settings and resource limited settings.

Increased NLR, reduced GCS, the need for vasopressors or mechanical ventilation were strongly associated to mortality, reflecting advanced disease states. The findings of this study demonstrate the importance of incorporating NLR into routine clinical practice. Further research is needed to validate these findings and explore the implications of NLR ratio in clinical guidelines for sepsis management.

8. Recommendation

- I. NLR should be incorporated into the standard laboratory workup for all suspected sepsis patients due to its strong prognostic value.
- II. Patients presenting with elevated NLR, reduced GCS, or abnormal inflammatory markers should receive prompt intervention and close monitoring to reduce mortality risk.
- III. Protocols should emphasize rapid identification of organ dysfunction and timely initiation of resuscitative measures, especially for patients requiring vasopressors or mechanical ventilation.
- IV. Training emergency and critical care staff on interpreting NLR and related biomarkers may improve early recognition and intervention.

Reference

1. Garcia-Alvarez M MP, Bellomo R. . Sepsis-associated hyperlactatemia. *Crit Care*. 2014;18(5):503.
2. Singer M DC, Seymour CW, et al. The third international consensus definitions for sepsis and septic shock (Sepsis-3). *JAMA*. 2016;315(8):801-10.
3. Shankar-Hari M PG, Levy ML, et al. Developing a new definition and assessing new clinical criteria for septic shock: for the third international consensus definitions for sepsis and septic shock (Sepsis-3). *JAMA*. 2016;315(8):775-87.
4. Cataudella E GC, Di Marca S, et al. . Neutrophil-to-lymphocyte ratio: an emerging marker predicting prognosis in elderly adults with community acquired pneumonia. *J Am Geriatr Soc*. 2017;65:1796-801.
5. Grasselli G GM, Zanella A, et al. Risk factors associated with mortality among patients with COVID-19 in intensive care units in Lombardy, Italy. *JAMA Intern Med*. 2020;180:1345-55.
6. Shinde V KV, Gokhale V et al. (2016): Comparison of neutrophil to lymphocyte count ratio, APACHE II score and SOFA score as prognostic markers in the setting of emergency medicine. *International Journal of Healthcare Biomedical Research*. 2016;4:46-5.
7. Ni J WH, Li Y, et al. . Neutrophil to lymphocyte ratio (NLR) as a prognostic marker for in-hospital mortality of patients with sepsis: A secondary analysis based on a single-center, retrospective, cohort study. . *Medicine (Baltimore)*. 2019;98:e18029.
8. Huang Z FZ, Huang W, et al. . Prognostic value of neutrophil-to-lymphocyte ratio in sepsis: A metaanalysis. *Am J Emerg Med*. 2020;38:641-7.
9. Shinde V KV, Gokhale V et al. Comparison of neutrophil to lymphocyte count ratio, APACHE II score and SOFA score as prognostic markers in the setting of emergency medicine. *International Journal of Healthcare Biomedical Research* 2016;4(4):46-50.
- 10, Zewdu T. Sepsis in the emergency department of Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia [master's thesis]. Addis Ababa University; 2013. <http://etd.aau.edu.et/handle/123456789/1918>
11. Kumar A RD, Wood KE, Light B, Parrillo JE, Sharma S, et al. . Duration of hypotension before initiation of effective antimicrobial therapy is the critical determinant of survival in human septic shock. *Crit Care Med*. 2016:1589-96.

12. De Backer D DT. Surviving sepsis guidelines: A continuous move toward better care of patients with sepsis. *JAMA*. 2017;317:807-8.
13. de Jager CP vWP, Mathoera RB, de Jongh-Leuvenink J, van der Poll T, Wever PC. . Lymphocytopenia and neutrophil-lymphocyte count ratio predict bacteremia better than conventional infection markers in an emergency care unit. *Crit Care Med*. 2010;14(5).
14. Ljungström L PA, Jacobsson G, Andersson R, Usener B, Tilevik D. Diagnostic accuracy of procalcitonin, neutrophil-lymphocyte count ratio, C-reactive protein, and lactate in patients with suspected bacterial sepsis. *PLoS One*. 2017;12(7):e0181704.
15. Manohar V PS, Raj S, Sreekrishnan TP, Gireesh Kumar KP. . The eminence of neutrophil-lymphocyte count ratio in predicting Bacteremia for Community-acquired infections at an Emergency Medicine Department in a Tertiary Care Setting. *J Emerg Trauma Shock*. 2018;11(4):271-5.
16. Jiang J LR, Yu X, et al. . The neutrophil-lymphocyte count ratio as a diagnostic marker for bacteraemia: a systematic review and meta-analysis. *Am J Emerg Med* 2019;37(8):1482-9.
17. Marik PE SE. The ability of Procalcitonin, lactate, white blood cell count and neutrophil-lymphocyte count ratio to predict blood stream infection. Analysis of a large database. *J Crit Care* 2020;60(135-139).
18. Saliccioli JD MD, PimentelMA, Santos MD,PollardT,Celi LA,etal. . The association between the neutrophil-to-lymphocyte ratio and mortality in critical illness: an observational cohort study. *CritCare*. 2015;19(13).
19. Akilli NB YM, Mutlu H, Gunaydin YK, Koylu R, Akca HS,etal. . Prognostic importance of neutrophil-lymphocyte ratio in critically ill patients: short- and long-term outcomes. *Am J Emerg Med*. 2014;32(12):1476-80.
20. Tadesse Z, Bekele Bayissa A, Diriba T, Chernet N, Tsegaye S, Tsega M. Neutrophil-to-Lymphocyte Ratio and Cut-off Values as Predictor of Severity and Mortality in COVID-19 Patients in Millennium COVID-19 Care Center, Addis Ababa, Ethiopia. *Int J Gen Med*. 2022 Aug;Volume 15:6739–55..
21. WuH CT, Ji T, Luo Y, Huang J and Ma K. Predictive value of the neutrophil-to lymphocyte ratio in the prognosis and risk of death for adult sepsis patients: a meta-analysis. *Front Immunol*. 2024;15:1336456.
22. Leonardo Lorentea MMM, Raquel Ortiz-Lópezc, Andrea Alvarez-Castillod, Candelaria Ruize, Luis Uribed, Agustín F. González-Riverof, Antonia Pérez-Cejasg, Alejandro Jiménezh. Association between neutrophil-to-lymphocyte ratio in the rst seven days of sepsis and mortality. *Enfermedades Infecciosas y Microbiología Clínica*. 2022;40:235-40.
23. Kaushik R GM, Sharma M, Jash D, Jain N, Sinha N, et al. . Diagnostic and prognostic role of neutrophil to lymphocyte ratio in early and late phase of sepsis. *Indian J Crit Care Med*. 2018;22:660-3.
24. Westerdijk K SK, Zegers M, Wever PC, Pickkers P, de Jager CPC. (2019) The value of the neutrophil-lymphocyte count ratio in the diagnosis of sepsis in patients admitted to the Intensive Care Unit: A retrospective cohort study. *PLoS ONE*. 2019;14(2):e0212861.
25. Alfy Ann George TPT, Abdul Gaffor. . The role of neutrophil/lymphocyte ratio in predicting the severity of sepsis in a tertiary care hospital in South India: a retrospective study.

International Journal of Research in Medical Sciences George AA et al Int J Res Med Sci 2020;8(5).

26. Bhadade R NI, Harde M, et al. Neutrophil-to-lymphocyte Ratio as a Marker for Diagnosis and Prognostication of Sepsis. J Assoc Physicians India 2024;72(6):33-8.

27. Xianming Qiu QW, Yuke Zhang, Qiannan Zhao, Zhiming Jiang, and Lei Zhou. . Prognostic Value of Neutrophils-to-Lymphocytes Ratio and Platelets-to-Lymphocytes Ratio in Sepsis Patients with Lymphopenia. Biomarker Insights. 2024;19:1-6.

28. Xinyu Liao FL, Fuke Wang, Guoliang Wang, Yaxing Zheng and Ruiying Zhong. Prognostic Value of Neutrophil-to-Lymphocyte Ratio in Patients With Sepsis research square. 2019.

29. Riché F GE, Barthélémy R, Le Dorze M, Matéo J, Payen D, et al. . Reversal of neutrophil-to-lymphocyte count ratio in early versus late death from septic shock. Crit Care Med. 2015;19(439).

30. Sari R KZ, Ay M et al. . Neutrophil to lymphocyte ratio as a predictor of treatment response and mortality in septic shock patients in the intensive care unit. Turkish Journal of Medical Sciences. 2019;49(5):1336-49

31. Tadesse Z, Bekele Bayissa A, Diriba T, Chernet N, Tsegaye S, Tsega M. Neutrophil-to-Lymphocyte Ratio and Cut-off Values as Predictor of Severity and Mortality in COVID-19 Patients in Millennium COVID-19 Care Center, Addis Ababa, Ethiopia. Int J Gen Med. 2022 Aug;Volume 15:6739–55.

32. Ljungström L, Pernestig AK, Jacobsson G, Andersson R, Usener B, Tilevik D. Diagnostic accuracy of procalcitonin, neutrophil-lymphocyte count ratio, C-reactive protein, and lactate in patients with suspected bacterial sepsis. Azevedo LCP, editor. PLOS ONE. 2017 July 20;12(7):e0181704.

33. Fetene D, Tekalegn Y, Abdela J, Aynalem A, Bekele G, Molla E. PROLONGED LENGTH OF HOSPITAL STAY AND ASSOCIATED FACTORS AMONG PATIENTS ADMITTED AT A SURGICAL WARD IN SELECTED PUBLIC HOSPITALS ARSI ZONE, OROMIA, ETHIOPIA, 2022 [Internet]. Health Systems and Quality Improvement; 2022 [cited 2025 Dec 25]. Available from: <http://medrxiv.org/lookup/doi/10.1101/2022.10.18.22281234>

Annexes

Annex I: Participants information sheet

Hi there, I'm _____. As a member of the research team led by _____, who is pursuing his emergency medicine and critical care specialty at Addis Ababa University's College of Health Science, we are doing a research on “The prognostic value of neutrophil to lymphocyte ratio in sepsis among adult emergency patients at Tikur Anbessa specialized hospital (TASH) Addis Ababa and Zewditu Memorial Hospital, Ethiopia”. I respectfully ask that you consider participating in the study by providing your attention. The primary goal of this research is to contribute to the development of appropriate policies and programs that will enhance the quality of care provided by enhancing the emergency medicine for better sepsis outcome.

Study procedure: If you consent to take part, you will be questioned about some variables on socio-demographic and reproductive history, which may support the outcome variable. It should take about 30 minutes to complete the survey. You must comprehend and sign the consent form found in Annex II if you are willing to take part in this data.

Confidentiality: The data gathered will be kept private and utilized exclusively for study. The information gathered will only be accessible to the members of the research team, and participant personal information—such as name and phone number and card number—will not be disclosed. The primary investigator alone will be able to view the password-protected soft copy of the data, while the hard copy will be stored in a locked cabinet. Nothing unique to any one participant will be reflected in the study's conclusions.

Benefits of the study: For your participation in the study no payment will be granted or has no any special privilege to you or no additional/ special service offered. But, participating in the study and giving your genuine information will provide great input to bring change in quality emergency service for sepsis management.

Risks of the study: The procedure does not bear any risk, but you may feel some discomfort in wasting your time (a maximum of 30 minutes). Furthermore, you will not be forced to respond to information you do not know.

Rights: Participation in this study is fully voluntary. You have the right to declare to participate or not in this study. If you decide to participate, you are given the right to with draw from the study at any time and also, you have the right not to answer that you do not want to answer. This study has no impact on your hospital service that your received

Having stated information above, would you like to participate in this study?

1. Yes _____

2. No _____

Thank you for your collaboration!

If you have any questions regarding the study or would like to be informed of the result after its completion you can contact the principal investigator.

Dr Awetahegn Ephrem Cell phone: +251 910551114

II. Verbal Consent form

I have told all the process & the objective of the study & I have understood the same as that includes informed about the purpose, advantage, & disadvantage of this study titled Diagnostic and prognostic value of neutrophil to lymphocyte ratio in sepsis as prognostic marker. I also understood that the research imposes no risk & no compensation would be provided to me. I have been told that if I feel discomfort to respond to any of the question, I am free to drop it any time wish to do so.

After the provider clearly explained and the participant agrees, the provider can sign for the accepted verbal consent for the participant

I have understood the information given & the participation is completely voluntary based. I have been told that my answers to the questions will not be given to anyone & not expect to write my name. Now I am giving my consent to participate in the study voluntarily.

Could I have your permission to continue?

1. Yes
2. No, Stop & thank the respondent.

Questionnaire

Section A: Socio-Demographic Information

Age	13-39	
	40-59	
	>60	
sex	Male	
	Female	
Residence	Urban	
	rural	

Section B -SOFA criteria during the first 48 hours of ED admission

Blood Pressure	
Respiratory Rate	
GCS	

Section C : Clinical History and Comorbidities

Any previous chronic illness	yes	No
------------------------------	-----	----

If Yes

Diabetes	
Hypertension	
Cardiac disease	
Other specify	

Section D -Site of Suspected Infection

Lung	
Intra-abdominal	
Skin	
Brain	
Urinary	
Unknown focus	

Section E - Laboratory Investigation

WBC	
Neutrophil	
Lymphocyte	
NLR ratio	

Creatinine	
BUN	
ALT	

AST	
Na	
k	

Clinical course and outcome

Antibiotics initiated Yes No

Fluids given Yes No

Vasopressors given Yes No

Steroids given Yes No

Mechanical ventilation required Yes No

ICU admission required? Yes No

Length of hospital stay _____ days

Outcome Recovered Referred Died