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DETERMINANTS OF PROLONGED ICU STAY AND ASSOCIATED COMPLICATIONS AMONG ADULTS AT HIWOT FANA COMPREHENSIVE SPECIALIZED HOSPITAL: A CROSS-SECTIONAL STUDY

EYOBEL ABAYNEH TIRUNEH (MD)

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Determinants of Prolonged ICU Stay and Associated Complications among Adults at Hiwot Fana Comprehensive Specialized Hospital: A Cross-Sectional Study

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By Eyobel Abayneh Tiruneh (MD)

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School: Medicine

Program: Anesthesiology, Critical Care and Pain Medicine

Advisor: Seid Ali (Assistant Professor of Anesthesiology, Critical Care & Pain Medicine)

Co-Advisor: Abebe Tolera (Mph, Assistant Professor)

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Haramaya University, Harar, Ethiopia

APPROVAL SHEET

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Seid Ali (MD, Assistant Professor of Anesthesiology Critical Care and Pain Medicine)

Major advisor Signature _____ Date _____

Abebe Tolera (MPH, Assistant Professor)

Co-advisor Signature _____ Date ___

As a member of the board of examiners of the post-graduate Open thesis defense examination, I certify that I have read and evaluated the thesis prepared by Eyobel Abayneh Tiruneh (MD) and examined the candidate. I recommend that the thesis should be accepted as fulfilling the thesis requirement for the Specialty Certificate in Anesthesiology, Critical Care and Pain Medicine.

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Name: By Eyobel Abayneh Tiruneh (MD)

Signature_____

Date_____

School/Department: Medicine

BIOGRAPHICAL SKETCH

My name is Eyobel Abayneh Tiruneh. I was born on April 21, 1996 G.C in Ataye, Ethiopia. I started and completed my primary education at Soressa primary school. I attended my secondary education at Debre Birhan General secondary school and my Preparatory education at Haile Mariam Mamo Preparatory school.

In 2015 G.C, I joined Haramaya University to attend my higher education. After attending for Seven years, I graduated with degree of Doctor of Medicine on 11 March 2021 G.C. Then, I was employed at Haramaya University as Lecturer and General Practitioner, and I served for two years.

On 04 March 2023 G.C, I joined Haramaya University to attend my specialty program in Department of Anesthesiology, Critical care and Pain Medicine.

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LIST OF ACRONYMS AND ABBREVIATIONS

AKI	Acute Kidney Injury
APACHE II	Acute Physiology and Chronic Health Evaluation II
APACHE III	Acute Physiology and Chronic Health Evaluation III
ARDS	Acute Respiratory Distress Syndrome
HFCSH	Hiwot Fana Comprehensive Specialized Hospital
ICU	Intensive Care Unit
ICU-AW	Intensive Care Unit - Acquired Weakness
LMICs	Low- and Middle-Income Countries
LOS	Length of Stay
MODS	Multiple Organ Dysfunction Syndrome
PI	Principal Investigator
PLOS	Prolonged Length of Stay
PTSD	Post-Traumatic Stress Disorder
RRT	Renal Replacement Therapy
SAPS II	Simplified Acute Physiology Score II
SOFA	Sequential Organ Failure Assessment
SPSS	Statistical Package for the Social Sciences
VAP	Ventilator-Associated Pneumonia

ABSTRACT

Background: Prolonged intensive care unit stay is a significant global public health issue, associated with increased mortality, morbidity, and healthcare costs. Despite the advancement in critical care, extended intensive care unit stay remains a problem, particularly in resource-poor settings like Ethiopia. Identification of predictors of extended intensive care unit stay and complications is important to maximize patient outcomes and resource utilization.

Objective: This study aimed to assess determinants of prolonged intensive care unit stays and their complications among adult patients admitted to the intensive care unit at Hiwot Fana Comprehensive Specialized Hospital from October 01 2024 to September 29 2025.

Methods: An institutional-based cross sectional study design was employed at Hiwot Fana Comprehensive Specialized Hospital. The data collection for this study took place from September 5 to September 30 2025. Data was collected using a structured checklist and medical records reviews. Data was analyzed using SPSS version 27. Descriptive statistics, Bivariable and Multivariable logistic regression, were employed.

Results: Among 239 patients, the prevalence of prolonged ICU stay was 25.9%. Multivariable analysis identified several independent predictors of prolonged stay: Age (AOR = 1.02, 95% CI: 1.01–2.04, p = 0.031), those admitted from the Medical ICU (AOR = 7.50; 95% CI: 1.10–11.10), and patients presenting with High BP Stage 1 (AOR = 4.90; 95% CI: 1.55–15.45) on admission. Other significant independent predictors included comorbid illnesses (AOR = 2.70; 95% CI: 1.90–3.20), the occurrence of complications during the stay (AOR = 3.32; 95% CI: 1.41–7.80), a severely depressed GCS (AOR = 2.50; 95% CI: 1.15–5.45), and the requirement for mechanical ventilation (AOR = 2.50; 95% CI: 1.05–5.95).

Conclusion and Recommendations: In this study, the prevalence of prolonged ICU stay was high, affecting approximately one-quarter of adult patients. Factors such as age, presence of comorbidities, admission from the Medical ICU, severely depressed GCS, need for mechanical ventilation, and development of in-ICU complications were significantly associated with prolonged stay. As a result, the hospital should implement early screening protocols for high-risk patients and strengthen preventive care to reduce complications and optimize ICU bed utilization.

Key Words: Prolonged ICU stay, complications, adult patients, critical care, Ethiopia.

INTRODUCTION

1.1 Background

Intensive care unit (ICU) is a special department of a hospital that is outfitted with advanced innovations, for example, life support equipment that is used to assist or replace spontaneous breathing and trained professionals to provide intensive and advanced life-supportive care of critically ill patients (Marshall et al., 2017). While definitions vary across studies, prolonged ICU stay typically refers to an admission exceeding certain duration, often considered more than 7 days, and is a key indicator of healthcare outcomes.

WHO identifies length of stay as one of the key indicators of hospital efficiency Prolonged ICU stays directly affect hospital charges, are an indicator of quality of care, consume disproportionate resources, and are associated with increased patient morbidity, mortality, and hospital readmission rates (Shaw, 2003).In settings of resource limitation, particularly in low- and middle-income countries (LMICs) like Ethiopia, extended ICU stays are significant concerns because of shortages of resources like beds, staff, and required equipment (Kwizera et al., 2012, Baelani et al., 2011). Ethiopia's high infectious disease burden and limited access to standardized algorithms and high-tech diagnostics also exacerbate these issues with increased complications and prolonged ICU stays (Abebe et al., 2014, Baker et al., 2013).

Prolonged ICU admissions are most often the result of interacting conditions, including patient-related factors, admission clinical severity and the need for invasive (Alharbi et al., 2023) Moreover, acquired complications at the hospital and institutional characteristics, importantly influence extended lengths of stay (Lobdell et al., 2012).

The consequences of prolonged ICU stays are profound. Clinically, patients become increasingly vulnerable to ICU-acquired complications like muscle wasting and multi-organ dysfunction syndrome (Teixeira et al., 2023). Psychologically, survivors are often burdened with post-intensive care syndrome (PICS) in the form of PTSD, depression, and cognitive impairment. Economically, these prolonged stays impose considerable strains on healthcare systems, consuming disproportionate resources and reducing availability for other critically ill patients (Bryant and McNabb, 2019). The aim of this research is to identify significant predictors of prolonged ICU stays, review associated risk factors, and evaluate the impact of long admissions on patient outcomes.

1.2 Statement of the Problem

Prolonged ICU stay remains a significant global health issue despite major technology and critical care practice advances. Not only increased mortality and morbidity but also a colossal burden on the healthcare system, particularly in resource-limited settings, is the cause of prolonged ICU stay (Matovu et al., 2024). Identification of the causes of prolonged ICU stays and complications associated with such stays is crucial for improving patient outcomes and maximizing resource utilization (Amador et al., 2022).

Since the last decades, critical illness globally has risen in proportion to the growing population of elderly people, increased prevalence of chronic diseases, and emerging infectious diseases (Adhikari et al., 2010). For instance, the COVID-19 pandemic placed healthcare systems worldwide under significant pressure, with ICUs being prone to getting clogged with numbers of critically ill patients (Grasselli et al., 2020). ICU hospitalization for prolonged periods is generally related to the severity of the underlying condition, comorbidities, and with the development of ICU-acquired conditions such as ventilator-associated pneumonia, sepsis, and acute kidney injury (Zhang et al., 2014). Not only do such complications worsen the patient's condition but also put pressure on health resources that result in over hospitalization and expense.

The human cost of increased ICU stay is staggering. For the patients, increased ICU stay is typically accompanied by physical and emotional distress, including pain, distress, and loss of control. Families also bear a huge burden because they must cope with the emotional and economic pressure of having a critically ill family member (Van Pelt et al., 2007). On the doctors' and nurses' side, anxiety over treating complex cases and lacking facilities can lead to burnout and moral distress further lowering the quality of care (Dünser et al., 2006). Focus on the determinants of long ICU stay is not only a clinical necessity but also an ethical one since it can reduce suffering and enhance the lives of patients, their families, and caregivers as well.

Intensive Care Units (ICUs) are necessary for the treatment of life-threatening illness, with close monitoring and organ support. However, increased lengths of ICU stay place significant demands on healthcare systems, increasing costs and worsening patient outcomes. While international studies suggest 7–11% of ICU admissions experience prolonged lengths of stay, data from resource-limited nations like Ethiopia reveal much higher rates, implying a critical local issue.

Prolonged ICU stays have devastating effects. Patients are more likely to develop infection, muscle wasting, and cognitive impairment, while hospitals suffer from bed blockages and rising costs. In settings like HFCSH, where there is limited ICU capacity, prolonged stays can delay care for other critically ill patients, compounding public health dilemmas. Despite these implications, no prior studies have systematically investigated the predictors and complications of prolonged ICU stays at HFCSH, leaving a gap in setting-specific solutions.

This study aims to fill this gap by identifying the etiologist of extended ICU length of stay and complications in adult patients at HFCSH. By means of analysis of local patient demographics, clinical, and ICU intervention data, findings informed targeted interventions to trim ICU resource consumption, improve patient outcomes, and facilitate effective critical care service delivery in similar low-resource settings.

1.3 Significance of the Study

This study holds significant importance as it will provide Hiwot Fana Comprehensive Specialized Hospital (HFCSH) with crucial, context-specific insights into the determinants and complications of prolonged ICU stays, thereby enabling clinicians to implement early interventions that can improve patient recovery, reduce complications like infection and organ dysfunction, and ultimately lower mortality rates. By identifying key risk factors, the hospital can optimize its invaluable resources, including ICU beds, medical staff, and life-supporting equipment, fostering more efficient patient management policies and evidence-based protocols for admission and discharge, which will enhance patient flow and mitigate overcrowding. Furthermore, the findings will offer vital data for program implementers and policymakers to develop targeted strategies for critical care delivery in resource-limited settings like Ethiopia, while simultaneously providing a foundational dataset and a framework for future researchers to expand upon, thereby contributing to a broader understanding and continuous improvement in global critical care practices.

1.4 Objectives

1.4.1 General Objective

The main objective of the study was to assess Determinants of Prolonged ICU Stay and Its Complications among Adult Patients Admitted to the ICU at Hiwot Fana Comprehensive Specialized Hospital from October 01 2024 to September 29 2025.

1.4.2 Specific Objectives

- To determine the prevalence of prolonged ICU stays among Adult Patients Admitted to the ICU at Hiwot Fana Comprehensive Specialized Hospital.
- To assess the complications associated with prolonged ICU stays among Adult Patients Admitted to the ICU at Hiwot Fana Comprehensive Specialized Hospital.
- To identify the determinants associated with prolonged ICU stays among Adult Patients Admitted to the ICU at Hiwot Fana Comprehensive Specialized Hospital.

LITERATURE REVIEW

2.1 Prevalence of Prolonged ICU Stay

Intensive care unit (ICU) is an important part of the healthcare system in which dedicated to patients having severe, life-threatening diseases and requiring continuous life-support with specialized healthcare team besides advanced monitoring equipment (Marshall et al., 2017).

Prolonged length of stay (LOS) of ICU patients is a well-defined problem, associated with increased healthcare costs and delayed ICU admissions from the emergency departments, in many studies. In A prospective observational study conducted between January 1998 and December 1999 in a university-based medical-surgical ICU at Switzerland analyzed 5,481 adult patients by grouping them into those who stayed more than 7 days patients staying longer than 1 week in their ICU consumed more than 50% of all ICU resources (Stricker et al., 2003).

Although 'prolonged' is not well defined in the literature, A retrospective study conducted in a surgical ICU at the University of North Carolina School of Medicine (USA) between January 1991 and September 1993, and published in 1996, investigated the survival, quality of life, and charges for 83 critically ill surgical patients requiring prolonged ICU stays (defined as >14 days). The findings revealed that a substantial proportion of patients (62.6%) survived to hospital discharge, with 77% of those followed remaining alive at 18 months. Despite 70% reporting less than 50% functional recovery, a high percentage (80%) reported good to fair quality of life. Economically, prolonged stays incurred significant costs, with average ICU charges of $51,512 and hospital charges of $164,019 per patient. The study concluded that prolonged ICU stays could yield acceptable quality of life and survival rates, suggesting that care should not be limited solely based on age or length of stay despite the considerable economic investment (Fakhry et al., 1996).

While a survival rate of nearly 50% in patients who stayed longer than 14 days in the ICU, An inception cohort study by (Wa, 1993) across 42 ICUs in 40 hospitals analyzed 16,622 patients to assess how admission data predicts ICU outcomes. The study found that 90% of in-hospital mortality and 78% of ICU stay length variation were explained by patient and institutional factors. It concluded that admission data can be used to evaluate ICU performance and improve risk prediction. (Wa, 1993).

In 2002 at the Department of Intensive Care, King Fahad National Guard Hospital in Riyadh, Kingdom of Saudi Arabia , in hospital's adult medical-surgical ICU A prospective study was done , 947 patients admitted over 20 months were studied to evaluate prolonged ICU stays (>14 days) and resource utilization. Although only 11% of patients experienced prolonged stays, they consumed nearly half of all ICU days and more than half of mechanical ventilation time. Despite this high resource use, their outcomes were comparable to those with shorter stays, indicating that a small proportion of patients uses a disproportionate amount of ICU resources without worse clinical results (Arabi et al., 2002).

Time spent in ICU is not accurately predictable and the most encountered question is how long it will take the patient to recover and discharge. There is no consensus definition of the prolonged length of stay (PLOS) and the percentage of patients with LoS varies from one center to another. It has been variously defined as over 10, 21 or 30 days (Williams et al., 2010, Crozier et al., 2007).

More recently (Zampieri et al., 2014) A retrospective study of 3,257 ICU admissions over 1.5 years at a tertiary hospital in São Paulo, Brazil in a year 2014 examined predictors of prolonged ICU stay (>14 days). Although only 6.6% of patients experienced prolonged stays, they used over 40% of ICU bed-days. The study developed a well-calibrated predictive model for prolonged stay.

A population-based cohort study published in 2006, examined long-term mortality associated with prolonged ICU admission (≥14 days) among 4,845 adult patients admitted to multisystem and cardiovascular surgical ICUs in the Calgary Health Region, Canada. The study found that 4% of patients had a prolonged ICU stay, and these patients were nearly twice as likely to die in the ICU compared to those with shorter stays (25% vs. 13%) (Laupland et al., 2006).

A large retrospective cohort study analysed 343,555 ICU admissions across 83 ICUs in 31 U.S. hospitals from 2002 to 2007 to develop and validate a model predicting prolonged ICU stays. Using data from ICU day 5, the model accurately predicted remaining length of stay, outperforming predictions based on admission or day 1 data alone. The model showed strong accuracy in both internal and external validation and can help benchmark ICU performance and guide clinical decisions to reduce prolonged stays this study also implies a small percentage (7% to 11%) of patients with a prolonged ICU stay (Kramer and Zimmerman, 2010).

In a study conducted in developing countries in the year of 2019, A retrospective study was conducted in three tertiary hospitals in Kano, North western Nigeria, examined the prevalence and risk factors of prolonged hospital stay (≥14 days) in medical, surgical, and orthopaedic wards. The study found that 40.34% of patients experienced prolonged stays, with the highest rate in one hospital reaching 50.5%. Older patients, particularly those over 50 years, had higher rates of prolonged stay (Emirate).

In Ethiopia patients had unusually high durations of prolonged ICU stays despite employing different cut off points. According to cross-sectional study research conducted at Addis Ababa in selected public hospitals in, assessed the characteristics and outcomes of mechanically ventilated adult ICU patients from 2019 to 2020. Among 180 patients studied, the mortality rate was high at 41.7%, with respiratory failure being the primary reason for ventilation. almost 50% of patients stayed in the ICU more than 7 days (Alemayehu et al., 2022),

A cross-sectional study was conducted at Nigist Eleni Mohammed Memorial Hospital from January 2015 to January 2016 examined factors influencing prolonged ICU stays. Among 280 patients, the average ICU stay was 5.49 days. approximately 52.9% of patients stayed there longer than 3 days (Obsa et al., 2017).

2.2 Determinants of Prolonged ICU Stay

Prolonged Length of stay (PLOS) in the intensive care unit (ICU) is one of the most important factors that influence health management. There are several factors that influence the ICU PLOS: medical severity factors, psychosocial factors, and institutional factors (Gruenberg et al., 2006). Some studies have treated PLOS as a hospital cost (Rotter et al., 2010). There are also many methods and management strategies that can influence the LOS. A higher nurse-patient ratio results in a lower hospital LOS. The distributions of LOS analyzed by disease or institute are frequently skewed to the right. The mean, median, and range require more in-depth analysis for LOS studies (Weissman, 1997). However, the threshold of a prolonged LOS is useful for managers for analysis of the quality of care and hospital costs for diseases or institutes. The definition of a prolonged ICU stay varies by hospital type, ICU type, and also different diseases.

2.2.1 Socio-demographic factors

Several studies in different settings have investigated the association of socio-demographic factors with prolonged ICU stay.

A cross-sectional study conducted at Nigist Eleni Mohammed Memorial Hospital, Ethiopia (2015–2016) identified poor nutrition, comorbidities, and male gender as significantly associated with prolonged ICU stays. Unconscious patients were nearly twice as likely to have long stays compared to conscious patients (Obsa et al., 2017).

In the same vein, a study done in some public hospitals in Addis Ababa, Ethiopia (2019–2020), among 180 adult ICU patients on mechanical ventilation found that the majority of them were male (54.4%) and that older age had worse outcomes, particularly those with cardiac disease. The mortality rate was 41.7%, and socio-demographic variables like age and gender appeared to have a bearing on outcomes and length of stay (Alemayehu et al., 2022).

A Kano State, Nigeria in the year of 2019, tertiary hospital retrospective study supported these conclusions such that patients older than 50 years and orthopedic ward patients had longer hospital stays and were largely male (Emirate). Collectively, these studies identify the influence of sex, age, and patient condition on ICU length of stay in low- and middle-income nations.

These patterns were also evident in high-income environments. A US retrospective cohort study of more than 343,000 ICU admissions during 2002–2007 discovered that clinical determinants assessed later during ICU stay (day 5) were more predictive of prolonged ICU stay than those assessed at admission, indirectly implicating socio-demographic determinants such as baseline performance status (which may relate to age and place of residence) as more relevant with increasing time (Kramer and Zimmerman, 2010).

Further supporting this, An international, multicenter observational audit, the Intensive Care Over Nations (ICON) audit, was published in 2014, assessing the worldwide burden of critical illness (Vincent et al., 2014) in Europe emphasized that older patients and those with chronic illnesses such as diabetes or cardiovascular diseases stayed longer due to reduced physiological resilience.

(Dellinger, 2004, Koenig and Truwit, 2006) also found that unplanned ICU admission and low functional status were more common among patients from lower socio-economic backgrounds, suggesting socio-demographic disparities impact ICU outcomes.

2.2.2 Clinical factors and Interventions given during ICU stay

A retrospective study by (Cleary et al., 1991) in the United States in the year 1991, examined ICU patients and identified several key clinical predictors of prolonged ICU stay (>3 days), including prolonged mechanical ventilation, hemodynamic instability, serious arrhythmias, and need for renal replacement therapy (RRT).

Similarly, in a cross-sectional study conducted by (Ehikhametalor et al., 2019) in a surgical ICU setting Published in 2019 in the West Indian Medical Journal, patients with sepsis on admission, low preoperative hematocrit and serum albumin, and those undergoing emergency surgery experienced longer ICU stays. The study also considered clinical severity scores like APACHE II, SOFA, and SAPS II, which showed strong associations with extended ICU durations.

In Ethiopia, a cross-sectional study at Nigist Eleni Mohammed Memorial Hospital (2015–2016) involving 280 ICU patients found that poor nutritional status, presence of comorbidities, and unplanned extubation were significantly associated with prolonged ICU stays (Obsa et al., 2017).

Another institutional-based study in Addis Ababa public hospitals (2019–2020) also revealed that inotropic use, absence of sedation, and longer mechanical ventilation duration were independently associated with increased mortality and longer ICU stay among 180 adult patients (mechanically ventilated for at least 24 hours) (Alemayehu et al., 2022).

Other studies reinforced these findings. (Arabi et al., 2002) in Saudi Arabia showed that mechanical ventilation was one of the strongest clinical predictors of prolonged ICU stay. (Zampieri et al., 2014, Tobi and Amadasun, 2015) added that conditions like intracranial masses and blood transfusions extended ICU duration.

In broader European settings, (Vincent et al., 2014) emphasized the role of severe clinical illness, organ failure, and sepsis, while (Papazian et al., 2019) detailed how ventilator-associated pneumonia contributed to longer recoveries.

2.2.3 Impact of Surgical type

A retrospective observational study by (Ehikhametalor et al., 2019) Published in 2019 in the West Indian Medical Journal in a Surgical Intensive Care Unit (SICU) followed the patients admitted in accordance with the "Guideline for ICU Admission, Discharge, and Triage." The study examined several predictors of longer ICU length of stay (>3 days), such as type of surgery. It found that patients who underwent emergency procedures, as opposed to elective procedures, had significantly longer ICU stays. Intraoperative complications and malignancy operations were also identified to be associated with increased ICU recovery duration. Further, postoperative complications like sepsis and hemodynamic instability were also indicated as causative factors that were condition specific and dependent on the urgency and nature of operation.

In Ethiopia, even though Nigist Eleni Mohammed Memorial Hospital (2015–2016) and Addis Ababa public hospitals (2019–2020) cross-sectional studies were mainly targeting ICU outcomes and clinical predictors, they offered indirect supportive evidence regarding surgical type. The Addis Ababa study highlighted that surgical complications and unplanned ICU admission, which were prevalent for emergency surgery cases, were associated with longer ICU stays. They substantiate the contention that high-risk and emergency procedures significantly impact ICU length of stay due to the added likelihood of complication and post-operative critical condition (Alemayehu et al., 2022, Obsa et al., 2017).

2.3 Complications Associated with Prolonged ICU Stays

Prolonged ICU stays are associated with a wide range of complications that affect patients physically, cognitively, and psychologically (Needham et al., 2012).

The "Intensive Care Society State of the Art," a 2019 compilation in the Journal of the Intensive Care Society, highlights various ICU complications. While not a single study, its abstracts address issues like morbidity from multiple rib fractures (impaired cough, pneumonia), prolonged hospitalizations and unplanned readmissions, and an increased risk of End-Stage Renal Disease (ESRD), which was linked to female gender and non-white ethnicities(Bear et al., 2019).

A review article by Epstein, published in Respiratory Care in 2005, meticulously detailed the various clinically important late complications of tracheostomy in critically ill patients. This paper, drawing from existing medical literature rather than a specific study population or area, highlighted several significant issues that can arise well after the procedure. Key late complications discussed include the formation of granulation tissue, tracheal stenosis (noted as the most frequent and a common cause of weaning failure), tracheomalacia, and severe, life-threatening complications such as tracheoinnominate-artery fistula (leading to hemorrhage) and tracheoesophageal fistula. Additionally, the review covered ventilator-associated pneumonia and aspiration as important late complications. The article emphasized the considerable clinical relevance of these complications, whose manifestations range from subtle symptoms to critical conditions, and underscored the varied treatment modalities available, including multidisciplinary approaches for common issues like tracheal stenosis (Epstein, 2005).

A 10-year prospective cohort study conducted in 2012 from a single center investigated the long-term outcomes of 425 consecutive critically ill patients with acute kidney injury (AKI) requiring renal replacement therapy (RRT) who had no pre-existing kidney disease Respiratory impairment is also a critical problem, particularly in those who require invasive ventilation. Long-term exertional dyspnea and failure to return to admission baseline are common, particularly in patients with severe acute respiratory distress syndrome (ARDS) (Schiffl et al., 2012).

A concise clinical review, published in PulmCCM J in 2015, synthesizes existing literature on long-term outcomes after critical illness for survivors. This review, not tied to a specific

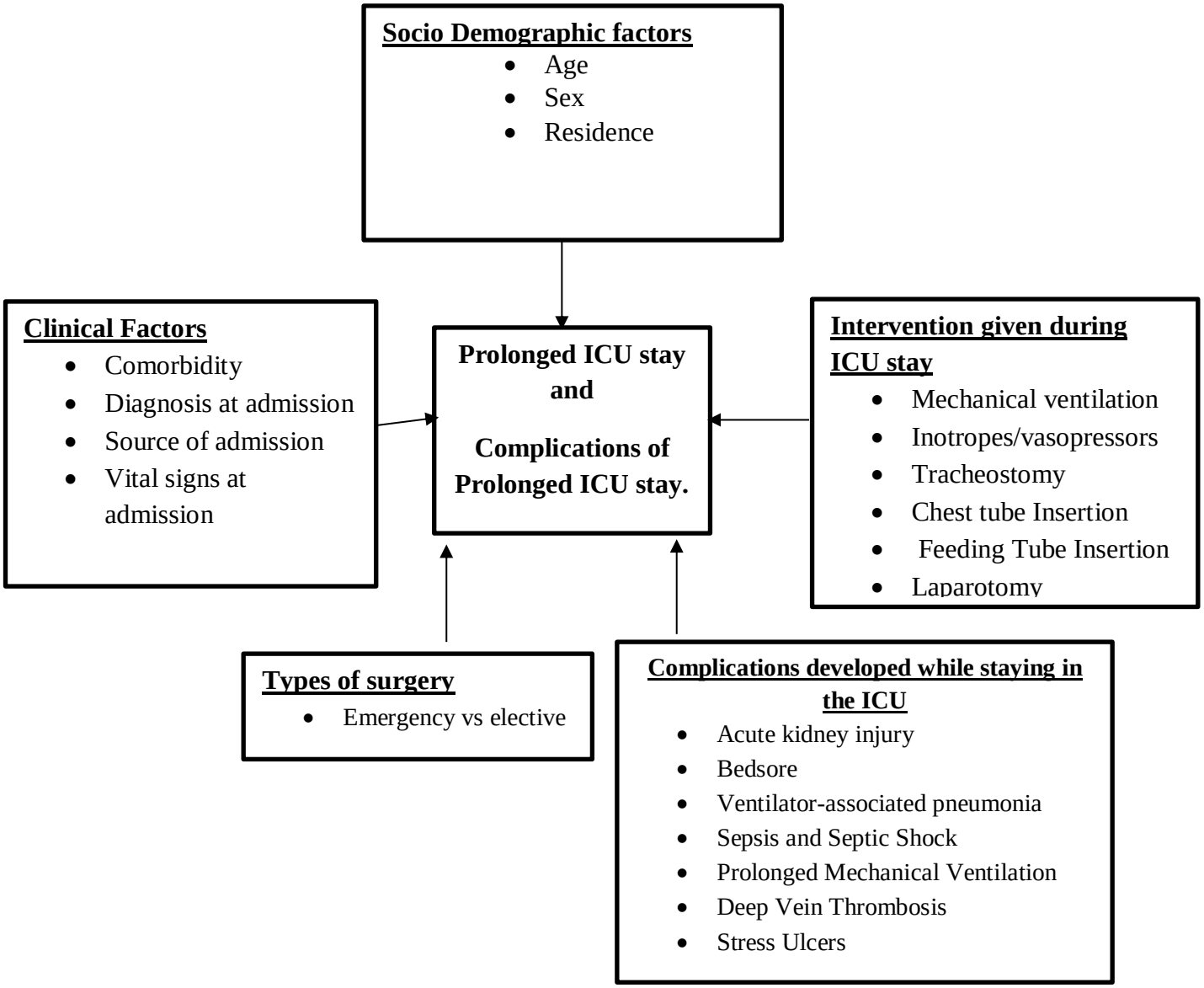
study population or geographic area, highlights that many critical care survivors experience Post Intensive Care Syndrome (PICS), a deterioration in physical, cognitive, and/or psychological health. Key physical impairments include significant muscle mass loss, with up to 15-20% lost in the first week, often leading to ICU-acquired weakness (ICU-AW) affecting global and respiratory muscles, impeding ventilator weaning, and causing incomplete functional recovery even years post-discharge. Contractures are also common after prolonged immobility. Psychologically, survivors frequently suffer from depression, anxiety, and post-traumatic stress disorder (PTSD). The review underscores the importance of interventions like early mobilization to mitigate these long-term sequelae. (Damm and Patel, 2015).

A randomized controlled trial by (Schweickert et al., 2009), published in The Lancet in 2009, investigated the efficacy of early physical and occupational therapy combined with daily sedation interruption in 104 mechanically ventilated, critically ill adult patients across two university hospitals in the United States. Cardiovascular conditions such as limb ischemia and venous stenosis are also prevalent, particularly in those with arterial or central venous catheters.

2.4 Conceptual Framework

(Chandran, 2004) defined a conceptual framework as the representation of study variables showing the relationship between the dependent and independent variables. (Oso and Onen, 2009) Conceptual Framework is a scheme of concept (or variables) which the researcher operationalizes in order to achieve the set objectives. It is a diagrammatic or a schematic presentation of the theory. The theory is presented as a model where study variables and the relationship between them are expressed into a seen picture to explain the interconnections between dependent, independent and extraneous variables if any.

Figure 1 : Conceptual framework illustrating the determinants of prolonged ICU stay and its associated complications among adult patients at Hiwot Fana Comprehensive Specialized Hospital.



METHODS

3.1 Study Area and Study Period

The study took place at Hiwot Fana Comprehensive Specialized Hospital at Harar. Harar is the capital city of the Harari regional state, situated approximately 526 kilometers away from Addis Ababa, the capital of Ethiopia. The Harari regional health bureau report indicates that there are a total of 2 public hospitals, 3 private hospitals, 1 police hospital, and 1 non-government hospital (specializing in fistula treatment) in the Harari region.

HFCSH serves as a Comprehensive Specialized hospital for the entire Eastern part of Ethiopia, including Eastern Oromia, Dire Dawa City Administration, the Somali Regional State, and the Harari Regional State. The catchment population of the hospital is expected to be 5,800,000 of whom 2.85 million are females and 2.95 million are male. Currently, the hospital has about 238 beds with 294 functional rooms to offer different services for the community. It has all specialty service including emergency and critical care department, Orthopedic, Plastic and burn unit department located in Harme and the ED has well-structured Emergency department. There is one General Hospital and Federal Police hospital as well as eight public health centers in the catchment area. Data were collected and analyzed from September 05 to November 10 2025.

3.2 Study Design

An institutional-based cross sectional study design was employed.

3.3 Population

3.3.1 Source Population

All Adult Patients Admitted to the Intensive Care Unit at Hiwot Fana Comprehensive Specialized Hospital.

3.3.2 Study Population

The study population consisted adult patients admitted to the ICU at Hiwot Fana Comprehensive Specialized Hospital during the study period, who meet the inclusion criteria and are selected using a simple random sampling procedure.

3.4. Inclusion and Exclusion Criteria

3.4.1. Inclusion Criteria

- Adult patients (age ≥ 18 years) admitted to the ICU during the study period.
- Patients who stayed in the ICU for at least **24 hours**.

3.4.2. Exclusion Criteria

- Patients with medical records deemed incomplete for the study's data requirements.
- Patients transferred from or to other ICUs after less than 24 hours of admission.

3.5. Sample Size

3.5.1 Sample Size Determination

To calculate the sample size, the number of ICU admissions for adult patients at Hiwot Fana Comprehensive Specialized Hospital for one month is taken into account, and the proportion of prolonged ICU stays (from previous studies) is estimated from the total. The total sample size to be selected for this research is determined using single population proportion formula stated in Equation 1. The formula employs the single population proportion formula, and the value of P is selected as 17% from a previous study (Bekele et al., 2024). The level of significance (Z) is set at 1.96 at 5% significance level, and the margin of error (D) is set at 5%. The total sample size required was calculated as follows:

$$n = \frac{Z\alpha/_2{}^2 p(1-p)}{D^2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots equation\ 1$$

Where;

- n is the required sample size
- Z is level of confidence at 95% interval
- P is prevalence of the problem on previous study
- D is margin of error

$$n = \frac{(1.96)^2 0.17(1-0.17)}{0.05^2} = 217$$

By taking 10% rate for incomplete chart the total sample is 239.

For calculating the sample size to the second objective or determinants by using double population proportion formula:

The formula for calculating sample size using the double population proportion formula for the determinants is:

$$n = \frac{\left(Z\alpha_{/2} + Z_{\beta}\right)^2 (P_1(1-P_1) + P_2(1-P_2))}{(P_1 - P_2)^2}$$

Where:

n = required sample size per group

Zα/2 = Z is level of confidence at 95% interval (1.96)

Zβ = the critical value of the normal distribution at the desired power for 80% power (0.84)

P1 and p2 are the proportions of the associated factor in each group.

Table 1 Sample Size Calculation for risk factors by using double proportion

Factors	**Confidence Interval at**	**Power (1-β)**	**Ratio**	**The proportion of among exposed group**	**The proportion of among non-exposed group**	**Sample size**	
						n	**Adding 10% non-response rate**
Age	95 %	80 %	1	0.60	0.20	46	62
Sex	95 %	80 %	1	0.30	0.15	94	103
Acute kidney injury	95 %	80 %	1	0.40	0.25	68	75
Mechanical ventilation	95 %	80 %	1	0.45	0.20	108	79
Diagnosis at admission	95 %	80 %	1	0.50	0.20	78	102

Based on these sample size calculations, the largest required sample size is 239 from the single population proportion result.

- Finally, to conduct this study, the maximum sample size of **239** is revealed from the single population proportion result and was used for this study.

3.6. Sampling Technique and Procedure

For this study, a simple random sampling was used, and the population of interest is all adult patients who are admitted to the ICU in Hiwot Fana Comprehensive Specialized Hospital during the study period. From hospital documents, previous data had indicated that the average monthly number of admissions to the ICU was approximately 25, or an average of 300 ICU admissions annually. All adult patients admitted to the ICU at Hiwot Fana Comprehensive Specialized Hospital between October 01 2024 and September 29 2025 were included in the study. This includes patients whose medical cards from that period were considered. The data collection for this study took place from September 05 to September 30, 2025. To ensure a true random selection, a complete, sequentially numbered list of all admissions were compiled. From this sampling frame, a computer-generated random number table was used to select the required sample size of 239 participants. This method ensured every patient admitted during the study period has an equal chance of being included.

3.7 Data Collection Methods

3.7.1 Data Collection Tool

This study primarily utilized secondary data through a structured checklist specifically developed by the researcher for this study. This tool is designed to systematically extract essential information from patient medical records, covering key areas such as socio-demographic details, clinical characteristics at ICU admission, interventions provided during ICU stay, surgical information, and crucially, the length of ICU stay and any associated complications like ventilator-associated pneumonia or acute kidney injury. Data collection involved a thorough review of medical charts.

3.7.2 Data Collectors and Supervisors

Three ICU nurses and two general practitioners at the HFCSH were recruited to collect data for this research. Prior to data collection, all the data collectors went through a half day training that makes them familiar with data collection tools and processes and draw proper information from case files of patients.

3.7.3 Data Collection Procedure

Medical records of adult patients admitted to the ICU at Hiwot Fana Comprehensive Specialized Hospital during the study period, who meet the inclusion criteria were selected using a simple random sampling. The data collectors extracted data from the medical records

of the patients regarding socio-demographic factors, clinical conditions, and ICU-related data. To ensure a high-quality secondary data collection process, the data collectors received appropriate orientation. In addition, the principal investigator provided supervision on time when collecting data.

3.8 Study Variables

3.8.1 Dependent Variable

- **Primary outcome:** Prolonged ICU stay.
- **Secondary outcome:** Complications of prolonged ICU stays.

3.8.2 Independent Variables

- Socio-demographic variables:
    - Age
    - Sex
    - Residence
- Clinical characteristics of the patient:
    - Comorbidity
    - Diagnosis at admission
    - Source of admission
    - Vital signs at admission
- Intervention given during ICU stay:
    - Mechanical ventilation
    - Inotropes/vasopressors
    - Tracheostomy
    - Feeding Tube Insertion
    - Laparotomy
    - Chest tube Insertion
- Types of surgery:
    - Emergency vs. elective
- Complications developed while staying in the ICU:
    - Acute kidney injury
    - Bedsore
    - Ventilator-associated pneumonia
    - Sepsis and Septic Shock

- Prolonged Mechanical Ventilation
- Deep Vein Thrombosis
- Stress Ulcers

3.9 Operational Definitions

Prolonged ICU Stay: A stay in the ICU lasting longer than or equal to 7 consecutive days, defined as an extended period of intensive care and monitoring beyond the expected duration for the patient's condition (Böhmer et al., 2014). This was measured with yes or no question category for greater seven days stay and less than or equal to seven days stays.

ICU Complications: Any adverse medical event that occurs during the patient's ICU stay, including infections (e.g., ventilator-associated pneumonia, catheter-associated infections), organ dysfunction (e.g., acute kidney injury, heart failure), or other complications that affect the patient's recovery(Koenig and Truwit, 2006). This was measured with yes or no questions for each complication.

Adult Patients: Individuals who are 18 years or older, who are admitted to the ICU for treatment and monitoring of acute or critical health conditions.

Emergency Surgery: is defined as a surgical procedure performed without delay, often within hours of diagnosis, due to an acute and severe condition that poses an immediate threat to the patient's life, limb, or organ function. This typically includes procedures for conditions such as severe trauma, acute appendicitis with rupture, bowel obstruction, or active bleeding that requires immediate intervention (Haisley and Hunter, 2019).

Elective Surgery: is defined as a surgical procedure that can be scheduled in advance because it does not involve an immediate threat to life, limb, or organ function. The decision to perform an elective surgery is typically made after careful consideration and preparation, allowing for optimization of the patient's health status and convenient scheduling (e.g., hip replacement, hernia repair, and tonsillectomy (Haisley and Hunter, 2019).

Prolonged Mechanical Ventilation: This is defined as requiring continuous mechanical ventilation for a duration of more than 48 hours (> 48 hours) (Paul et al., 2025). This was measured with yes or no question category for greater 48 hours and less than or equal to 48 hours.

Systolic Blood Pressure : Defined as the peak pressure exerted by the blood on the arterial walls during cardiac contraction (Potter et al., 2021). It was recorded in millimeters of mercury First DBP (mmHg) documented in the medical chart within 1 hour of ICU admission.

Diastolic Blood Pressure: Defined as the minimum pressure exerted by the blood on the arterial walls during cardiac relaxation (Williams, 2021). It was recorded in millimeters of mercury (mmHg) as the first documented diastolic blood pressure reading within the first hour of the patient's admission to the ICU, as per the patient's medical chart

Pulse Rate: Defined as the number of heart beats per minute (Potter et al., 2021). It was recorded in beats per minute (bpm) as the first documented pulse rate reading within the first hour of the patient's admission to the ICU, as per the patient's medical chart.

Respiratory Rate: Defined as the number of breaths taken per minute (Williams, 2021). It was recorded in breaths per minute (breaths/min) as the first documented respiratory rate reading within the first hour of the patient's admission to the ICU, as per the patient's medical chart.

Oxygen Saturation: Defined as the percentage of hemoglobin saturated with oxygen in arterial blood, typically measured non-invasively by pulse oximetry (Jacobs et al., 2020). It was recorded as a percentage (%) as the first documented oxygen saturation reading within the first hour of the patient's admission to the ICU, as per the patient's medical chart.

Glasgow Coma Scale: A neurological scale used to assess the conscious state of a person. It comprises three components: eye opening, verbal response, and motor response, yielding a total score from 3 (deep coma) to 15 (fully conscious) (TEASDALE, 1974). It was recorded as a numerical score (out of 15) as the first documented GCS assessment within the first hour of the patient's admission to the ICU, as per the patient's medical chart.

3.10 Data Quality Control

To ensure the quality of data, daily supervision was conducted. Data was checked for completeness, accuracy, and clarity on the day of collection before being entered into the database by the principal investigator. Data clean up and cross-checking were performed before entry.

3.11 Data Analysis

The collected data was checked manually for incompleteness and inconsistencies. Statistical package for Social Sciences (SPSS) version 27 was used for editing, coding, and further analysis. For categorical data, descriptive data was presented as frequencies and percentages. For continuous variables, the means, medians, interquartile ranges, and standard deviations were presented as appropriate. Binary logistic regression was used to assess factors associated with a prolonged stay in the ICU. Variables with $p < 0.25$ in the Bivariate analysis were included in the multivariable logistic regression analysis. An adjusted odds ratio (AOR) with a corresponding 95% confidence interval (CI) was used to show the strength of the association between prolonged ICU stay and independent variables at a P-value < 0.05 as the cutoff point.

3.12 Ethical Consideration

Ethical clearance was obtained from Institutional Health Research Ethics Review Committee of the College of Health and Medical Sciences, Haramaya University (Reference No. IHRERC/179/2025). The ethical clearance approval letters was submitted to Hiwot Fana Comprehensive Specialized hospital. Data collection begins after informed, voluntary, written and signed consent is obtained from hospital CEO. To ensure participants' confidentiality. Names or personal identifiers were not included in the written questionnaires and all the data to be collected during the study was kept confidential.

3.14 Dissemination of Results

The results of this study will be presented to the scientific community of the College of Health Sciences, School of Medicine, Department of Anesthesia, Critical Care, and Pain Medicine, including all healthcare professionals and residents involved in patient care at Hiwot Fana Comprehensive Specialized Hospital. It will be published on reputable journal.

4. RESULTS

4.1 Socio Demographic Characteristics of the Patients

A total of 239 patients were included in the final analysis. The calculated median age was 40 years. Half of the patients were female 120 (50.21%) and majority were from rural areas 147(61.51%)

Table 2 Socio-Demographic Characteristics of Adult Patients Admitted to the Intensive Care Unit at Hiwot Fana Comprehensive Specialized Hospital, October 01 2024 to September 29 2025 (n=239)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18–24	32	13.39
	25–34	62	25.94
	35–44	43	17.99
	45–54	34	14.23
	55–64	41	17.15
	>65	27	11.30
Gender	Female	120	50.21
	Male	119	49.79
Residence	Rural	147	61.51
	Urban	92	38.49

4.2 Average Length of ICU Stay and Associated Complications

Out of 239 patients admitted to the ICU, The average length of ICU stay was 5.23 days (SD = 5.78), ranging from 0 to 40 days. Sixty two (25.9%) patients experienced a prolonged ICU stay. Regarding clinical outcomes, 153 (64.0%) of patients developed complications during their ICU admission. Among the complications, the most frequent were acute kidney injury (16.3%), metabolic complications (12.1%), and cardiovascular events (10.9%).

Table 3 Average Length of ICU Stay and Associated Complications of Adult Patients Admitted to the Intensive Care Unit at Hiwot Fana Comprehensive Specialized Hospital, October 01 2024 to September 29 2025 (n=239)

Variable	Category	Frequency (n)	Percentage (%)
Prolonged ICU Stay	No	177	74.06
	Yes	62	25.94
Complications During ICU Stay	No	86	35.98
	Yes	153	64.02
Type of Complications	Acute kidney injury	39	16.32
	Cardiovascular	26	10.88
	Metabolic	29	12.13
	Neurologic	10	4.18
	Pneumonia	13	5.44
	AKI + Cardiovascular + Metabolic	10	4.18
	Cardiovascular + Metabolic	6	2.51
	Surgical site infection	5	2.09
	Bedsore	5	2.09
	Deep vein thrombosis	3	1.26
	Stress ulcer	2	0.84
	Other	5	2.09
	None	86	35.98

4.3 Clinical Characteristics of the Patients

More than half of the patients (54.8%) had at least one comorbidity, most commonly cardiovascular disease (15.9%) and hypertension (13.8%), followed by diabetes (3.8%) and cancer (3.8%). Acute cardiovascular illnesses (26.4%), trauma and post-surgical conditions (28.5%), and infectious/sepsis cases (23.4%) were the most common ICU diagnoses. The emergency department was the predominant source of ICU admission (53.1%). Nearly one-quarter of patients had hypotension, and 21.8% presented with stage2 hypertension. Tachycardia was present in 64.9% of patients, indicating a high physiological stress response, while 31.8% had tachypnea and 33.1% required assisted ventilation, signaling significant

respiratory compromise. Almost half of patients (48.5%) were hypoxemic, which, coupled with depressed GCS scores (32.6% severely depressed)..

Table 4 Clinical Characteristics of Adult Patients Admitted to the Intensive Care Unit at Hiwot Fana Comprehensive Specialized Hospital, October 01 2024 to September 29 2025 (n=239)

Variable	Category	Frequency (n)	Percentage (%)
Presence of Comorbidities	No	108	45.19
	Yes	131	54.81
Type of Comorbidities	Cardiovascular disease	38	15.90
	Hypertension	33	13.81
	Diabetes	9	3.77
	Chronic kidney disease	6	2.51
	Chronic respiratory disease	5	2.09
	Cancer	9	3.77
	Cardiovascular + Diabetes	2	0.84
	Cardiovascular + Hypertension	3	1.26
	Chronic liver disease	4	1.67
	Diabetes + Cancer	1	0.42
	Hypertension + Respiratory disease	1	0.42
	Hypertension + Diabetes	3	1.26
	Other	17	7.11
	None	108	45.19
Diagnosis at ICU Admission	Trauma & Post-Surgical	68	28.45
	Infectious & Sepsis	56	23.43
	Acute Cardiovascular Illness	63	26.36
	Acute Respiratory Illness	14	5.86
	Neurologic (Non-Traumatic)	14	5.86
	Gastrointestinal & Hepatic	9	3.77
	Renal & Metabolic	15	6.28
Source of ICU Admission	Emergency Department	127	53.14
	Medical ICU	4	1.67
	Obstetrics	16	6.69
	Operating Room	69	28.87

	Ward	23	9.62
Blood Pressure at Admission	Low	59	24.69
	Normal	69	28.87
	Elevated	30	12.55
	High BP Stage 1	29	12.13
	High BP Stage 2	52	21.76
Pulse Rate at Admission	Bradycardia (Low)	1	0.42
	Normal	83	34.73
	Tachycardia (High)	155	64.85
Respiratory Rate at Admission	Normal	84	35.15
	Tachypnea (High)	76	31.80
	Assisted Ventilation	79	33.05
Peripheral Oxygen Saturation (SpO_2)	Hypoxemia (Low)	116	48.54
	Normal	123	51.46
Glasgow Coma Scale (GCS)	Mildly Depressed	123	51.46
	Moderately Depressed	38	15.90
	Severely Depressed	78	32.64

4.4 Interventions Given during ICU Stay

Regarding ICU interventions, 45.2% of patients received no major interventions, while 25.5% were treated with both mechanical ventilation and vasopressors. Mechanical ventilation alone was provided to 14.6%, and vasopressor use alone to 10.9%. Only a small proportion (2.9%) required combined tracheostomy, vasopressor, and mechanical ventilation.

4.5 Surgical Information of the Patients

Of all ICU admissions, 32.6% followed surgery, while 67.4% were non-surgical cases. Among surgical admissions, emergency surgeries account for (19.7%) while elective procedures accounted for (13.0%),

4.6 Assessment of Complications Developed During ICU Stay

Among adult patients who had a prolonged ICU stay at Hiwot Fana Comprehensive Specialized Hospital, 79.03% developed at least one complication during their admission. Several types of complications were recorded, with varying frequencies.

Metabolic complications were the most commonly documented, occurring in 17.74% of the patients with prolonged ICU stay. This was followed by acute kidney injury, which was observed in 14.51% of patients. Pneumonia was also noted among the common complications, identified in 11.29% of the cases.

Other complications occurred less often. Cardiovascular complications were recorded in 6.45% of patients, while surgical site infections were identified in 4.83%. Deep vein thrombosis (DVT) was the least frequent among the listed complications, occurring in 3.22% of patients.

During the study period, no cases of stress ulcer or neurologic complications were documented among patients with prolonged ICU stays.

Overall, the data show variation in the types and frequencies of complications recorded among this group, with metabolic complications, acute kidney injury, and pneumonia occurring most frequently, and no recorded cases of stress ulcer or neurologic complications.

4.7 Factors Associated with Prolonged ICU Stay

In the bivariate logistic regression analysis, several variables with a p-value < 0.25 were taken into the multivariable binary logistic regression model. These variables included age, gender, and presence of comorbidities, complications during ICU stay, source of ICU admission, blood Pressure at Admission, Respiratory Rate at Admission, Peripheral Oxygen Saturation (SpO_2) at Admission, Glasgow Coma Scale (GCS) at admission, and type of interventions given. After adjusting for potential confounders in the multivariable logistic regression model, five variables remained statistically significant predictors of prolonged ICU stay at a p-value < 0.05.

Age was found to be a statistically significant predictor of the outcome. The adjusted odds ratio (AOR = 1.02, 95% CI: 1.01–2.04, p = 0.031). for each one-year increase in age, the odds of prolonged ICU stay is increase by approximately 2%. The likelihood of prolonged ICU stay was also elevated among individuals with comorbid illnesses (AOR = 2.70; 95% CI: 1.90–3.20; p = 0.009). Likewise, the occurrence of complications during ICU care increased the odds of staying longer by more than threefold (AOR = 3.32; 95% CI: 1.41–7.80; p = 0.006). Patients whose admission source was the Medical ICU had the greatest risk of extended ICU stay, showing an almost eightfold increase compared to emergency admissions

(AOR = 7.50; 95% CI: 1.10–11.10; p = 0.039).Additionally, blood pressure status at admission was significantly associated with prolonged ICU stay. Those presenting with High BP Stage 1 and normal BP showed increased odds (AOR = 4.90, 95% CI: 1.55–15.45; p = 0.000 and AOR = 3.80, 95% CI: 1.45–9.95; p = 0.006, respectively). Severely depressed GCS on admission was another predictor, with these patients having more than double the odds of prolonged ICU stay compared to those with mild neurologic impairment (AOR = 2.50; 95% CI: 1.15–5.45; p = 0.021).Individuals requiring mechanical ventilation demonstrated increased risk of prolonged ICU care (AOR = 2.50; 95% CI: 1.05–5.95; p = 0.038).

Table 5 Factors Associated with Prolonged ICU Stay of Adult Patients Admitted to the Intensive Care Unit at Hiwot Fana Comprehensive Specialized Hospital, October 01 2024 to September 29 2025 (n=239)

Variable	Category	Prolonged ICU Stay	Not Prolonged ICU Stay	COR (95% CI)	AOR (95% CI)	P-value
Age				1.2 (1.09, 2.03)	**1.02(1.01, 2.04)**	**0.031***
Gender	Female	**35**	**85**	**1.00**	**1.00**	
	Male	27	92	0.71 (0.39, 1.88)	0.95 (0.50, 1.80)	0.865
Presence of Comorbidities	No	**26**	**82**	**1.00**	**1.00**	
	Yes	36	95	1.20 (1.07, 9.14)	**2.70 (1.90, 3.20)**	**0.009***
Complications During ICU Stay	No	104	73			
	Yes	49	13	2.65 (1.34, 5.23)	**3.32 (1.41 – 7.80)**	**0.006***
Source of ICU Admission	Emergency Department	**38**	**89**	**1.00**	**1.00**	
	Medical ICU	2	2	2.34 (1.32, 7.24)	**7.50 (1.10, 11.10)**	**0.039***
	Obstetrics	2	14	0.34 (0.07, 1.54)	0.45 (0.09, 2.15)	0.315
	Operating Room	14	55	0.60 (0.29, 1.19)	0.65 (0.30, 1.40)	0.275
	Ward	6	17	0.83 (0.30, 2.26)	0.90 (0.30, 2.70)	0.850
Blood pressure at Admission	Low	**6**	**53**	**1.00**	**1.00**	
	Normal	26	43	5.34 (2.02, 14.15)	**3.80 (1.45, 9.95)**	**0.006***
	Elevated	8	22	3.21 (1.07, 10.34)	2.50 (0.80, 7.80)	0.115
	High BP Stage 1	12	17	6.24 (2.030, 19.15)	**4.90 (1.55, 15.45)**	**0.000***

	High BP Stage 2	10	42	2.10 (0.71, 6.26)	1.80 (0.65, 5.00)	0.255
Respiratory Rate at Admission	Normal	**29**	**55**	**1.00**	**1.00**	
	Tachypnea (High)	17	59	0.55 (0.27, 1.10)	0.80 (0.35, 1.85)	0.605
	Assisted Ventilation	16	63	0.48 (0.247, 0.98)	0.70 (0.30, 1.60)	0.395
SpO_2 at Admission	Low	27	89	1.00	1.00	
	Normal	35	88	1.31 (0.23, 2.35)	0.52 (0.232, 2.346)	0.434
Glasgow Coma Scale (GCS) at Admission	Mildly Depressed	**31**	**92**	**1.00**	**1.00**	
	Moderately Depressed	7	31	0.67 (0.27, 1.67)	0.75 (0.25, 2.25)	0.625
	Severely Depressed	24	54	1.32 (1.00, 5.48)	**2.50 (1.15, 5.45)**	**0.021***
Interventions	None	**24**	**84**	**1.00**	**1.00**	
	Mechanical ventilation	12	23	1.83 (1.67, 3.73)	**2.50 (1.05, 5.95)**	**0.038***
	Vasopressor	10	23	1.52 (0.18, 1.81)	1.20 (0.40, 3.60)	0.755
	Mech. Vent. & Vasopressor	16	47	1.19 (0.25, 1.55)	1.50 (0.65, 3.45)	0.335

NB: * Describes Significant Association at 5% Level of Significance.

5. DISCUSSION

This study was conducted to identify Determinants of Prolonged ICU Stay and Associated Complications among Adults at Hiwot Fana Comprehensive Specialized Hospital, Harar, Eastern Ethiopia. Understanding these factors is crucial for resource planning, improving patient flow, and developing targeted interventions to optimize ICU care.

In this study, the overall prevalence of prolonged ICU stay was observed to be one-quarter of the study population. The findings identified age, the presence of comorbidities, the development of complications during the ICU stay, admission source (Medical ICU), specific blood pressure readings at admission, a severely depressed Glasgow Coma Scale (GCS), and the requirement for mechanical ventilation as independent predictors of a prolonged ICU stay.

The prevalence of prolonged ICU stay in this study (25.9%) aligns with other studies conducted in Ethiopia. For instance, a study at Nigist Eleni Mohammed Memorial Hospital found a high proportion of extended stays (Obsa et al., 2017), and research in Addis Ababa public hospitals reported nearly 50% of mechanically ventilated patients staying beyond 7 days (Alemayehu et al., 2022). The finding of this study was higher than studies done in high-income settings like Canada, the USA, and Brazil, where prolonged stay prevalence often ranges from 4% to 11% (Laupland et al., 2006, Kramer and Zimmerman, 2010, Zampieri et al., 2014). Differences in ICU admission thresholds, definitions of "prolonged," availability of step-down care, and the overall burden of critical illness may be the possible reasons for this difference. However, our finding resonates with the global consensus that a small subset of patients consumes a disproportionate share of ICU resources (Arabi et al., 2002, Stricker et al., 2003).

This study revealed that Age was statistically significant, for each one-year increase in age, the odds of prolonged ICU stay is increase by approximately 2%. This finding is consistent with studies from Nigeria and Ethiopia, as well as multinational audits (Emirate, Alemayehu et al., 2022, Vincent et al., 2014). This is because advanced age is associated with reduced physiological reserve, a higher prevalence of chronic diseases, and a slower recovery trajectory from critical illness, all of which can extend the period of intensive care required.

This study depicted that patients who had comorbidities were almost 3 times more likely to have a prolonged ICU stay than those without. This finding is in line with the framework proposed by (Gruenberg et al., 2006) and observations by (Vincent et al., 2014). The association is explained by the fact that pre-existing conditions like cardiovascular disease and hypertension complicate the management of acute critical illness, increase the risk of multi-organ failure, and slow down the overall healing process, thereby lengthening the ICU course.

According to the findings of this study, a significant association was observed between developing complications during the ICU stay and a prolonged stay. Patients who experienced complications were more than 3 times more likely to have a prolonged stay. This is strongly supported by the global ICU literature (Cleary et al., 1991). This is be due to complications such as acute kidney injury or cardiovascular events introducing new, complex problems that require additional time-intensive treatments diverting care from the primary illness and significantly extending recovery time.

The findings of this study showed that respondents whose source of admission was the Medical ICU had almost had higher odds of a prolonged stay compared to those admitted from the Emergency Department. This is a critical finding that highlights system-level factors. This is because admissions from the Medical ICU often represent in-hospital patients who have deteriorated, potentially indicating more refractory or complex illnesses, or delayed recognition of critical care needs, factors associated with worse outcomes and longer recovery (Dellinger, 2004).

Furthermore, patients with a severely depressed GCS at admission and those who required mechanical ventilation were significantly more likely to have a prolonged ICU stay. These findings agree with other studies conducted in Ethiopia and Saudi Arabia (Obsa et al., 2017, Arabi et al., 2002). The association is explained by the fact that a depressed consciousness often necessitates prolonged airway protection and ventilator support, complicates nursing care and communication, and is frequently associated with severe neurological injury that has a long and uncertain recovery pathway. Mechanical ventilation itself is a primary driver of ICU length of stay, as weaning is a gradual process and ventilator-associated complications are common.

5.1Strengths and Limitations

5.1.1 Strengths

This study has several key strengths. It provides vital, context-specific data on a critical care issue in a low-resource setting in Ethiopia, addressing a significant local knowledge gap. A robust methodological approach was employed, using a simple random sampling method and a structured checklist to collect comprehensive patient data. The use of multivariable logistic regression allowed for the identification of key independent predictors of prolonged ICU stay while controlling for potential confounders.

5.1.2 Limitations

The study's limitations must be considered. Due to its cross-sectional design, causal relationships cannot be established. As a single-center study, the findings may not be fully generalizable to other hospitals. The study also lacks long-term follow-up data on patient outcomes after ICU discharge and did not extensively explore psychosocial or health-system factors that could influence ICU stay.

6. CONCLUSION AND RECOMMENDATIONS

6.1 Conclusions

This study demonstrated one in four patients experienced prolonged ICU stay which isis a significant concern at Hiwot Fana Comprehensive Specialized Hospital, The analysis revealed that several patient-related and clinical factors were strongly associated with extended ICU stays. Age, the presence of comorbidities, admission from the Medical ICU, a severely depressed Glasgow Coma Scale (GCS) at admission, and the requirement for mechanical ventilation were identified as key determinants of prolonged ICU stay. Additionally, the development of complications during the ICU stay was significantly linked to longer hospitalization. These findings underscore the complex interplay between patient vulnerability, illness severity, and intensive care interventions in driving extended ICU stays.

6.2 Recommendations

Based on the findings of this study the following recommendations are proposed:

For Healthcare Providers:

- ICU teams should implement early screening protocols to identify high-risk patients such as those with advanced age, multiple comorbidities, low GCS scores, or requiring mechanical ventilation for closer monitoring and proactive management to mitigate prolonged stays.

For Hiwot Fana Comprehensive specialized Hospital Administration:

- Resources should be prioritized to enhance ICU capacity and staffing, particularly for high-acuity patients. Strengthening step-down or intermediate care units could facilitate timely transfer of recovering patients, thereby optimizing ICU bed utilization.

For Harari Regional Health Bureau:

- Guide and enable regional hospitals to implement leading practices in ICU management, prioritizing the use of early risk stratification and preventative care for vulnerable patients.
- Create and manage a platform for continuous learning and shared expertise among hospitals to enhance patient care quality and regionally minimize ICU complications.

- Track and analyze key performance indicators, specifically ICU length of stay and complication frequency, to power targeted, regional quality improvement campaigns.

For Future Research:

- Longitudinal and interventional and large size multi-center studies are recommended to explore causal pathways and test targeted strategies such as early mobilization, sedation minimization, and comorbidity optimization to reduce ICU length of stay in similar resource-limited settings.

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ANNEXES

7.1 Information Sheet and Informed voluntary Consent form for Hospital Administrations

My name is Dr. Eyobel Abayneh. I am the principal investigator of the study to be conducted in Hiwot Fana comprehensive specialized University hospital. I am studying Anesthesiology, Critical Care and Pain Medicine at Haramaya University, College of Health and Medical Science. I kindly request you to lend me your attention to explain about this study.

The Study Title: The study title is "Determinants of Prolonged ICU Stay and Associated Complications among Adults at Hiwot Fana Comprehensive Specialized Hospital: A Cross-Sectional Study".

The purpose/Aim of the Study: The purpose of this study is to establish local hospital based information on factors associated with prolonged ICU stay and its complications among adult patients admitted to the ICU at Hiwot Fana comprehensive specialized hospital. The finding of this study provides up-to-date information for the health professionals working in the Hospital. The finding of this study provides information on the depth of the problem and guidance for preventive intervention. Also serve as entry point for future studies. Moreover, the main aim of this study is to write a thesis as a partial fulfillment of my training in anesthesiology, Critical Care and pain medicine.

Procedure and Duration: The medical charts of all adult patients admitted to the ICU at Hiwot Fana Comprehensive Specialized Hospital from September 05 2024 to September 28 2025 were reviewed. Primary data was collected from these medical charts. From the total number of admitted patients, a sample size of 239 was included in the study to ensure a statistically significant result.

Risk and Benefit: The risk of participating in this study is minimal the investigator did not provide any direct financial compensation for this study. While there are no direct benefits for the individual patients whose charts are reviewed, the study's findings are expected to contribute valuable data that can improve future clinical care, optimize resource management, and ultimately lead to better health outcomes for patients at the hospital.

Confidentiality: Participant's information was confidential. The finding of the study is in general for surgical patients and did not reflect anything about particular individual

information. The data abstraction form was coded with a unique identification number to exclude showing names. No reference was made in oral or written reports that could link participants in the study.

Rights: You have, therefore, a full right to permit or not for this research to be done in this hospital. If you decide to permit you have again the right to stop the study whenever you notice violation of research ethics.

Contact Address: If you have any questions or inquiries about the study any time you can contact the principal investigator by using his mobile phone number: **0924140983 / Dr. Eyobel Abayneh and/or E-mail:** **eyobelab@gmail.com** or the Institutional Health Research Ethics Review Committee of the College of Health and Medical Sciences using their office phone number: +251-254-662-011 or P.O.Box: 235, Harar, Ethiopia.

Declaration of Informed Voluntary Consent

I have read the participant information sheet. I have clearly understood the purpose of the study, the procedure, the risk and benefit of the study, and issues of confidentiality. The contact address was given to me for any queries. I have been given the opportunity to ask questions about things that have been unclear. I understand that participant has the right to withdraw from the study at any time or not to answer any question that they do not want and also I was informed that i have a full right to permit or not for this research to be done or not in this hospital. Therefore, I declare my voluntary on behalf of the Hospital Management to allow this study to be conducted in our Hospital with my signature.

Name of the hospital Manager: _____Signature:_____Date: ____/____/2025

Name of the Principal Investigator: _____Signature: _____Date: ____/____/2025

7.2 Data Collection Checklist

Data collection Checklist for assessing treatment outcome and associated factors for Instructions: write the required information or circle the number

NOTE: If the information is not available on the chart of the patient (either it is not recorded, or the investigation was not done/missed) leave the space provided empty or do not circle the No.

Date: _____/_____/_____ Code no: _____

Instruction: read the following sentences carefully, observe and review cards or ask patients if needed. Write or tick the response on the space provided (additional information can be Referred from the card or an aesthesia sheet)

Section 1: Sociodemographic Information

1. **Age**: _____
2. **Sex:** ☐ Male ☐ Female
3. **Residence:** ☐ Urban ☐ Rural

Section 2: Prolonged ICU Stay and Its Complications

1. Patient ID (For internal use only): _____
2. Length of ICU Stay: ____ days
3. Was the ICU stay prolonged (≥7 days)? (Primary Outcome Variable)
   ☐ Yes ☐ No
4. Did the patient develop any complications during ICU stay? (Secondary Outcome Variable)
   ☐ Yes ☐ No
5. Did the patient develop any of the following complications during ICU stay?
   _____

Section 3: Clinical Characteristics

1. **Does the patient have any pre-existing comorbidities?** _____
2. **Diagnosis at ICU Admission:** _____
3. **Source of ICU Admission:** ☐ Emergency Department ☐ Ward Transfer
   ☐ Operating Room (Surgical) ☐ Referral from another hospital

4. **Vital Signs at ICU Admission**
   - What is the systolic blood pressure at admission (in mmHg)? _____
   - What is the diastolic blood pressure at admission (in mmHg)? _____
   - What is the pulse rate at admission (in bpm)? _____
   - What is the respiratory rate at admission (in breaths/min)? _____
   - What is the oxygen saturation at admission (SpO2) (in %)? _____
   - What is the Glasgow Coma Scale (GCS) at admission score? _____

Section 4: Interventions Given During ICU Stay

1. Did the patient receive any of the following interventions?
   - ☐ Mechanical Ventilation
   - ☐ Inotropes/Vasopressors
   - ☐ Tracheostomy
   - ☐ Chest Tube Insertion
   - ☐ Feeding Tube Insertion
   - ☐ Laparotomy
   - ☐ None

Section 5: Surgical Information

1. Was the patient admitted to the ICU following surgery?
   - ☐ Yes
   - ☐ No
2. If yes, what type of surgery was performed?
   - ☐ Emergency Surgery
   - ☐ Elective Surgery

7.3 Curriculum Vitae

1. Personal information

Full name: **Dr. Eyobel Abayneh Tiruneh**

Gender: **Male**

Age: **29**

Nationality**: Ethiopian**

Date of birth: **April 13, 1988 E.C**

Religion: **Orthodox, Christian**

Marital status: **Single**

Qualification: **Doctor of Medicine**

E-mail: **eyobelab@gmail.com**

Mobile: **+251924140983**

2. Educational background

Name of School	**Time of period**	**Awarded**
Soressa School (Grade 1-2 and 8) (Primary school)	1995-1996 E.C and 2002 E.C	Promoted cards and Appreciation Prizes
Ataye Missionary School (Grade 3-7) (Primary school)	1997–2001 E.C	Promoted cards and Appreciation Prizes
Debre Birhan General secondary school (Grade 9 and 10)	2003-2004 E.C	Promoted cards and Appreciation Prizes
Haile Mariam Mamo Preparatory school (Grade 11 and 12)	2005-2006 E.C	Promoted cards and Appreciation Prizes
Haramaya University CHMS	2007-2013 E.C	Medical Doctorate degree (MD) with cGPA of **3.02**
Haramaya University CHMS	2015 E.C. up to now	

3. Language Skills

Language	**Speaking**	**Writing**	**Reading**
English	Fluent	Excellent	Excellent
Amharic	Fluent	Excellent	Excellent

4. Activities, work experiences and achievements

- I was an active member of Ethiopian medical students association (EMSA) Haramaya and participated in organizing and facilitating voluntary activities at Abrha Bahta elderly care center, blood donation campaigns, student welcome programs, and the 6th General Assembly of EMSA which was held in Harar on 2011 E.C as a technology support division (TSD) leader and received certificates.
- I participated in organizing and facilitating blood donation programs in our campus and hospital by collaborating with Harar blood bank on multiple occasions and received certificate of appreciation from Harari health bureau.
- I was group and ward students' representative in my clinical and internship years, which gave me a lot of leadership experience and character.
- I was an active member in TTP program at Sofi kebele site on 2013 E.C where we actively and successfully completed Team Training Program (TTP) which was assigned by CBE office of Haramaya University and I got certificate of Award for being standing **First** out of six groups
- I have also attached 14 months of internship at Hiwot Fana Specialized University Hospital, under Haramaya University, School of Medicine in four major wards (Surgery, Gyn/Obs, Internal Medicine and Pediatrics).
- I was a representative of my batch during the first 2 years of residency and currently serving as a chief resident, which gave me added leadership experience and character.

5. Short course trainings

- ✓ Essential Surgical Skills, Basic ECG, Basic life support and CPR
- ✓ Basics of Forensic medicine
- ✓ The Professional and Research Exchange Training (PRET), organized by Ethiopian medical students association (EMSA)
- ✓ The communication in health training, organized by Ethiopian medical students association (EMSA)

- ✓ Basic level Public Health Emergency Management (PHEM) training, organized by Ethiopian public health institute in collaboration with Haramaya University, CHMS
- ✓ Employability skills and entrepreneurship as a career option training, organized by Career Development Service Directorate (CDSD) and Industry Linkage & Entrepreneurship Development Directorate (UILEED) of Haramaya University

6. Hobbies

- ✓ Reading books, writing short novels, reviewing medical literatures, watching motivational videos, watching medical movies, watching sports.

7. Future inclination

- ✓ Cardiothoracic anesthesiology and critical care

8. Skills

- Excellent in Microsoft word, Microsoft PowerPoint, Microsoft excel, internet explorer and SPSS.
- Experience in software development

9. References

Haramaya university college of Health and Medical science