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Prevalence of acute kidney injury and associated factors among adult patients admitted to the intensive care unit at Hiwot Fana Comprehensive Specialized Hospital, Eastern Ethiopia

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APPROVAL SHEET

HARAMAYA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

I hereby certify that I have read and evaluated this thesis entitled "Prevalence of acute kidney injury and associated factors among adult patients admitted to the intensive care unit at Hiwot Fana Comprehensive Specialized Hospital, Eastern Ethiopia". Prepared under my guidance by Dr. Kaleb. I recommend that it can be submitted as fulfilling the thesis requirement.

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As a member of the board of examiners of the Open thesis defense examination, I certify that I have read and evaluated the thesis prepared by Dr. Kaleb 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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By my signature below, I declare and affirm that this thesis is my work. I have followed all ethical and technical principles of scholarship in the preparation, data collection, data analysis and compilation of this thesis. Any scholarly matter that is included in the thesis has been given recognized through citation.

This thesis is submitted in partial fulfillment of the requirements for a speciality certificate in anesthesiology, critical care and pain medicine at Haramaya University. The thesis is deposited in the Haramaya University Library and is made available to borrowers under the rules of the library. I solemnly declare that this thesis has not been submitted to any other institution anywhere for the award of any academic degree, diploma or certificate

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BIOGRAPHICAL SKETCH

My name is Dr. Kaleb Abrham. I was born on January 12, 1996 Addis Ababa, Ethiopia. I have completed my elementary and secondary education at Akaki kale hiwot church school and my preparatory education at Cruise school. In 2015, I have joined Haramaya University College of health and medical science and graduated in 2021. After graduation, I was employed and have served at Haramaya University as Lecturer and General Practitioner for two years.

On March 2023, 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/ ABBREVIATION

ADQI	Acute Dialysis Quality Initiative
AGN	Acute Glomerulonephritis
AKI	Acute Kidney Injury
AKIN	Acute Kidney Injury Network
ATN	Acute Tubular Necrosis
BUN	Blood Urea Nitrogen
CA-AKI	Community-Acquired Acute Kidney Injury
CKD	Chronic Kidney Disease
CR	Creatinine
DM	Diabetes Mellitus
ESRD	End-Stage Renal Disease
ETB	Ethiopian Birr
GFR	Glomerular Filtration Rate
HA-AKI	Hospital-Acquired Acute Kidney Injury
HFCSH	Hiwot Fana Comprehensive Specialized Hospital
ICU	Intensive Care Unit
KDIGO	Kidney Disease Improving Global Outcomes
LMIC	Low- and Middle-Income Countries
MDRD	Modification of Diet in Renal Disease
RIFLE	Risk, Injury, Failure, Loss, End-Stage
RRT	Renal Replacement Therapy
SPHMMC	Saint Paul's Hospital Millennium Medical College
UTI	Urinary Tract Infection

ABSTRACT

Background: Acute Kidney Injury is a highly prevalent condition among critically ill patients admitted to Intensive Care Units globally, significantly contributing to high morbidity and mortality. The significant gap is that there is no prior study establishing the incidence, risk factors, and outcomes of Acute Kidney Injury among Intensive care Unit patients at Hiwot Fana Comprehensive Specialized Hospital. Furthermore, the lack of early diagnostic capacity and limited local data hinder timely intervention and effective management of Acute Kidney Injury in this high-risk population.

Objective: To Assess the prevalence of acute kidney injury and associated factors among adult patients admitted to the intensive care unit at Hiwot Fana Comprehensive Specialized Hospital, Eastern Ethiopia, from October 01-30, 2025.

Methods: An institutional-based retrospective cross-sectional study was conducted at Hiwot Fana Comprehensive Specialized Hospital from September 02, 2024, to September 28, 2025. A sample size of 229 participants was determined using a single population proportion formula. Simple random sampling was employed, and data were collected using a structured data collection tool. Statistical analysis included descriptive statistics, bivariable, and multivariable binary logistic regression.

Results: The magnitude of acute kidney injury among adult intensive care unit patients was 33.62% (95% CI: 27.65%–39.79%). Factors significantly associated with acute kidney injury included complications during ICU stay (AOR = 3.57, 95% CI: 1.60–8.00), assisted ventilation (AOR = 4.19, 95% CI: 1.19–14.68), and leukocytosis (AOR = 5.72, 95% CI: 2.45–13.37). Mortality (AOR = 3.09, 95% CI: 1.29–7.43) was also higher among patients with acute kidney injury.

Conclusion: Approximately one-third of intensive care unit patients developed acute kidney injury. acute kidney injury was significantly associated with intensive care unit complications, assisted ventilation, leukocytosis, and higher mortality. These findings highlight the multifactorial nature of acute kidney injury in critically ill patients and underscore the importance of early risk identification, vigilant monitoring, and proactive supportive care to improve patient outcomes.

Key Words: Acute Kidney Injury, Intensive Care Unit, Prevalence, Risk Factors, Ethiopia.

1. INTRODUCTION

1.1. Background of the Study

Acute kidney injury (AKI) is a sudden decline in renal function, leading to waste accumulation, electrolyte imbalance, and fluid overload. It is prevalent among ICU patients, with high morbidity and mortality (Kellum et al., 2021). It is defined as a sudden loss of excretory kidney function. AKI is part of a range of conditions summarized as acute kidney diseases and disorders (AKD), in which slow deterioration of kidney function or persistent kidney dysfunction is associated with an irreversible loss of kidney cells and nephrons, which can lead to chronic kidney disease (CKD) (Ronco et al., 2019). AKI can also affect other organs such as the brain, heart, and lungs. AKI is common in patients who are in the hospital, in intensive care units, and especially in older adults (Zuk and Bonventre, 2016). ICU patients are more especially vulnerable to AKI due to the severity of their illness, the frequent use of nephrotoxic substances (e.g., antibiotics, contrast dye), and invasive interventions such as mechanical ventilation and vasopressor therapy. In addition, underlying comorbidities such as diabetes, hypertension, and chronic kidney disease further increase their risk. The synergism of these processes compromises renal perfusion and function, putting ICU patients at higher risk for AKI compared to the general hospital population (Schreier et al., 2019).

Annually, acute kidney injury (AKI), an acute loss of kidney function, occurs in over 13 million individuals worldwide causing nearly 2 million deaths (Banda et al., 2020). Nearly 80% of the AKI burden happens in low- and middle-income countries (LMIC) (Abebe et al., 2021b). AKI rates differ based on geographical region, etiology, and health resources but are notably higher in LMIC such as sub-Saharan Africa (SSA) and is associated with increased length of hospital stay, increased hospital, and mortality (Abd ElHafeez et al., 2017).

The progression of AKI in ICU is dictated by several variables including the seriousness of the primary disease, comorbid illnesses such as diabetes and hypertension, and the use of invasive intervention or medications impacting the kidneys. In Ethiopia, the scarcity of early diagnostic tools, such as serum creatinine and urine output monitoring, commonly delays the identification of AKI, and hence more patients with advanced-stage AKI at presentation (Anteneh et al., 2025). Secondly, the prevalence of infectious conditions such as sepsis, malaria, and HIV in Ethiopia is the causative factor behind the high frequency of AKI among ICU patients due to these infections being established risk factors for renal injury (Abebe et al., 2021c).

Even though recent global "zero by 25" initiatives challenge to prevent AKI-related mortality by 2025. Recent studies revealed that high incidence of AKI in the intensive care unit, in South Africa at 58.5% (Aylward et al., 2019), Tanzania at 55.3% (Minja et al., 2021), Sudan at 39.0% (Magboul et al., 2020), Egypt at 37.4% (Abd ElHafeez et al., 2017), China 51.0% (Jiang et al., 2019), Norway 38% (Folkestad et al., 2020), Brazil 40.3% (de Abreu et al., 2010), and Jordan 31.6% (Oweis et al., 2020). Once developed, it markedly deteriorates the outcomes of patients by elevating mortality, hospital stay, and healthcare expenditure. This results burdening healthcare systems heavily increased death rates amongst critically sick patients, prolongs hospital stays, and is highly expensive to manage clinical costs (Palevsky et al., 2013).

While there have been limited studies in Ethiopia that examined the general burden of AKI in ICU populations, hospital-level data, and no study has been done in Hiwot Fana Comprehensive Specialized Hospital. Much of the work has been done in Country trends, therefore there is a knowledge gap in the local incidence, risk factors, and outcomes of AKI at Hiwot Fana. This study addressed this gap through the first comprehensive analysis of AKI in this hospital's ICUs, covering adult patients and both clinical and demographic data. Additionally, unlike other Ethiopian studies that are often founded upon limited diagnostic facilities (Woldeyohanins et al., 2025), this study had a strong focus on early diagnosis and the implications of resource limitations on AKI management, offering a clear picture of the constraints and potential for the advancement of care in this setting.

1.2. Statement of the Problem

Acute Kidney Injury (AKI) is a severe and life-threatening condition with a significant impact on patient outcomes, particularly in those patients admitted to intensive care units (ICUs) (Lameire et al., 2013). In Ethiopia, the burden of AKI is compounded by limited healthcare resources, delayed diagnosis, and limited access to renal replacement therapy (RRT). Despite its overwhelming prevalence and disastrous outcome, the literature is severely lacking in information regarding the incidence, risk factors, and outcome of AKI in ICU patients in Ethiopia and also this ignorance precludes the implementation of effective preventive and therapeutic strategies, with a consequent effect on patient management and survival (Ashine et al., 2024). The government's reaction to manage AKI in ICUs includes bridging healthcare disparities, exploiting clinical potentials, and provoking research to improve patient outcomes. However, the limited scientific information on the risk factors, etiology, and outcome of AKI in Ethiopian ICUs lowers the profile of the problem and prevents the institution of quality care practices (Abebe et al., 2021a). While there are several studies that have examined AKI in general hospital populations or in selected patient populations, those targeting ICU patients who have the greatest risk of developing AKI due to their critical illness and complex treatments are very few (Beyene et al., 2023).

Acute Kidney Injury (AKI) constitutes a significant and understudied burden in Ethiopian Intensive Care Units (ICUs), significantly being a cause of morbidity and mortality among critically ill patients. Despite the existence of estimates that indicate AKI affects approximately 45% of ICU patients in Ethiopia, primarily due to sepsis and hypovolemia (Mequanent Wale et al., 2020), AKI is underdiagnosed due to the absence of diagnosis capacities. This is high prevalence, either consistent with or more than that which has been observed anywhere in the world, including the developed world like Norway (38%) (Folkestad et al., 2020) and Brazil (40.3%) (de Abreu et al., 2010). Consistent with the other Sub-Saharan African nations like Tanzania (55.3%) and Sudan (39.0%) (Mequanent Wale et al., 2020). These figures underscore the crucial role of healthcare facility limitations, late patient presentations, and the high incidence of risk factors like sepsis and infection, which are predominant in low- and middle-income countries like Ethiopia.

Several important gaps exist in the knowledge and practice of AKI in the Hospital ICUs. First, although AKI is a well-documented problem in the general hospital population, data on ICU patients, who are at higher risk due to the severity of illness and intensity of treatments, are lacking. Second, even routine diagnostic procedures, such as serum creatinine and urine output,

are not available in most Ethiopian hospitals including HFCSH, leading to under diagnosis and postponed intervention (Ashine et al., 2024). This delay typically results in late-stage AKI, which is associated with increased mortality and poor patient outcomes. In addition, the limited availability of early and adequate RRT in the ICUs also contributes to the burden of AKI since a high number of critically ill patients are not managed as per need, resulting in high mortality rates. There is also a high prevalence of AKI risk factors, including sepsis, hypovolemia, and the use of nephrotoxic medications (Ponce and Balbi, 2016). However, there is a paucity of studies on how these specific risk factors impact ICU patients and contribute to the incidence and development of AKI in this high-risk setting in this Hospital.

Addressing these gaps is necessary to improve patient outcomes and reduce the overall burden of AKI in the healthcare system. This study investigated the occurrence and predictors of AKI among adult patients who are admitted to the ICUs of Hiwot Fana Comprehensive Specialized Hospital. By providing detailed information on the prevalence, cause, and outcome of AKI in this high-risk population, the study established the burden of AKI in hospital ICUs. The finding guides the development of focused interventions, such as improved diagnostic protocols, early warning systems, and interventions to expand access to RRT, with the ultimate goal of reducing the incidence and mortality of AKI in ICUs. Furthermore, by filling gaps in research in clinical practice and risk factor data, this study plays a part in improving AKI management within intensive care units, thereby augmenting the quality of care for critically ill patients in the hospital.

1.3. Significance of the study

AKI) is a common and serious complication among critically ill patients in the ICU, yet limited evidence exists on its prevalence, risk factors, and outcomes, particularly in low- and middle-income countries. In Ethiopia, few studies have addressed AKI in ICU settings, highlighting a significant gap in local research. A deeper understanding of the factors contributing to AKI is essential to improve patient management and safety in critical care.

Primarily, this study will benefit Hiwot Fana Comprehensive Specialized Hospital (HFCSH) by providing up-to-date information on the magnitude, risk factors, and outcomes of AKI among adult ICU patients. By identifying key predictors of AKI, the hospital can implement targeted preventive and management strategies to reduce the incidence of AKI, optimize the use of ICU resources, and improve patient outcomes. These findings will support the development of clinical protocols and interventions aimed at minimizing preventable complications and mortality associated with AKI.

Furthermore, this research can serve as a foundation for future studies in Ethiopia and beyond, offering valuable contributions to the scientific community and guiding further exploration into the prevention, early detection, and management of AKI in critically ill populations.

1.4. Objectives

1.4.1. General objective

- To Assess the prevalence of acute kidney injury and associated factors among adult patients admitted to the intensive care unit at Hiwot Fana Comprehensive Specialized Hospital, Eastern Ethiopia, from October 01-30, 2025.

1.4.2. Specific objectives

- To determine the incidence of Acute Kidney Injury (AKI) among adult patients admitted to the ICU.
- To identify the risk factors associated with the development of AKI in ICU adult patients.

2. LITERATURE REVIEW

2.1. Incidence of Acute Kidney Injury

A study conducted from April 2004 to august 2012 is a global meta-analysis with largest contributions from North America, Northern Europe, and Eastern Asia; very few from Africa that synthesized data from numerous studies to determine the worldwide incidence of Acute Kidney Injury (AKI). The research, which used the KDIGO definition for AKI, found that it was diagnosed in up to 20% of patients admitted to hospital settings and in 31.7% of patients in critical care settings (Susantitaphong et al., 2013).

In a retrospective cohort study done at British tertiary care hospital ICU conducted between 2000-2009, AKI was the most frequent cause of organ dysfunction in intensive care units (ICUs) and the existence of even mild AKI is concomitant with more than 50% of mortality rate (Linder et al., 2014).

A prospective study in 1980 analyzed 2,262 adult hospital admissions in the U.S., where they found the incidence of hospital-acquired renal insufficiency, or AKI, to be 4.9%. This figure rose to 7.2% on 2001 by a retrospective cohort study which was conducted in the U.S. at an urban tertiary care hospital, which examined 4,622 consecutive patients. A later retrospective cohort study in 2011, conducted at an urban academic medical center in the U.S., further demonstrated a significant increase, finding that 22.7% of the 19,249 hospitalized patients they analyzed developed AKI, highlighting a sharp and continuing rise in hospital-acquired renal insufficiency over three decades (Hou et al., 1983, Nash et al., 2002, Wang et al., 2012).

An international cross-sectional study was performed between 2011-2013 in 97 intensive care units (ICU) on the incidence of AKI in ICU patients using KDIGO criteria. They found that AKI occurred in greater than half (57.3%) of ICU patients. Increasing AKI severity was associated with increased hospital mortality, and AKI patients had worse renal function during hospital discharge. Adjusted risks for AKI and mortality were similar across the world (Hoste et al., 2015).

A meta-analysis done globally in 2012, 21.6% of adults and 33.7% of children encountered with AKI in the course of hospital admission by use of KDIGO definition. The AKI-associated mortality rate decreased over time. In the intensive care unit (ICU) setting, the AKI incidence ranges from 3.2% to 78% (Case et al., 2013).

The study done in 2009 was a prospective investigation conducted at a hospital in Wales that focused on the outcomes of patients with community-acquired acute kidney injury (CA-AKI).

The research followed patients for three years and found that the three-month mortality rate was 16.5%, which was linked to the severity of the initial AKI. Over the long term, 71% of the patients developed progressive chronic kidney disease (CKD), particularly if their renal function did not fully recover or if they had pre-existing CKD. The study ultimately concluded that CA-AKI carries a significant risk of both long-term patient mortality and progressive kidney disease (Talabani et al., 2014).

A study at Imam Khomeini Hospital in Ardebil, Iran, which is a retrospective cohort done between 2013-2015 on 900 critical patients admitted to the ICU within a 1-year duration concludes that AKI is related to a greater mortality rate. The overall incidence rate of AKI was 37%. The mortality rate was 58.3% for AKI patients, and 13.4% for non-AKI patients. Patients in RIFLE-R (Risk) had a mortality rate of 37.8% compared with 48.8% for those in RIFLE-I (Injury) and 76.5% for RIFLE-F (Failure) patients (Kebar et al., 2018).

A review of study done in 2015 in Konstantinos Makris general hospital and Loukia Spanou red-cross Hospital Athens, Greece determined the general incidence of Acute Kidney Injury (AKI) in hospitalized patients. The study found that AKI occurs in 20% of hospitalized individuals and in up to 60% of patients admitted to intensive care units (ICUs) (Makris and Spanou, 2016).

The US commentary on the 2012 KDIGO clinical practice guideline for AKI was done between 2008-2011. This multicenter, Randomized controlled trial focused on the interpretation and application of the new guidelines in the United States and concluded that there was insufficient evidence to support its widespread use in clinical care at the time (Palevsky et al., 2013).

A retrospective cohort study that analyzed 322 trauma patients admitted to the ICU in Brazil done between 2006-2008 the study found that AKI incidence was 6.5% and was an independent predictor of longer hospital stays and higher mortality (de Abreu et al., 2010).

A major multi-center prospective cohort study known as the BAKIT study, done in 30 ICUs in 28 teaching hospitals in Beijing, China, was conducted in 2014. The research, involving 3,107 patients, found a high incidence of AKI at 51.0% and revealed that most patients developed AKI within their first four days in the ICU (Jiang et al., 2019).

A retrospective cohort study at a single intensive care unit in Jordan was the focus of research. The study was done between 2013-2015 and found that 46.8% of the 303 critically ill patients had AKI (Oweis et al., 2020).

A prospective cohort study was conducted in a multidisciplinary intensive care unit (ICU) in South Africa, where they analyzed 849 critically ill adults. Done between 2016-2017, the research found that AKI developed in 58.5% of admissions, many of which were trauma-related. The study concluded that although AKI was common, most survivors experienced good functional renal recovery within 90 days (Aylward et al., 2019).

A separate prospective cohort study from a tertiary hospital in Northern Tanzania examined 320 participants in the ICUs. The study was conducted between 2017-2018 and found that 55.3% of these patients were diagnosed with AKI (Minja et al., 2021).

In Sudan, a prospective observational study involved 187 patients in intensive care units. done in 2018-2019, the investigation revealed a high incidence of AKI at 39%, while also noting that the mortality rate for patients with AKI was 31.2% (Magboul et al., 2020).

An extensive multicenter prospective observational study was carried out across four teaching hospitals in Alexandria, Egypt. This 2016 study included over 500 consecutive patients admitted to ICUs and found that approximately 40% of patients had AKI upon admission. The study's conclusions showed that AKI was a strong predictor of poor outcomes, including a high mortality rate (Abd ElHafeez et al., 2017).

A retrospective cohort study done between 2018-2022 that assessed the incidence of Acute Kidney Injury (AKI) among adults admitted to the medical intensive care unit at Wachemo University Nigist Eleni Mohammed Memorial Comprehensive Specialized Hospital in Hadiya Zone, Southern Ethiopia which analyzed a total of 317 patient charts, found that 40.4% of the participants developed AKI. The incidence rate was 30.1 per 1,000 person-days of observation (Ashine et al., 2024).

2.2. Risk Factors of Acute Kidney Injury

2.2.1. Socio-demographic Variables

The role of socio-demographic factors was evaluated in a retrospective cohort study of 1,124 acute myocardial infarction (AMI) patients in China between October 2013 and September 2015. After controlling clinical variables, the analysis found that advanced age was a significant independent predictor of acute kidney injury (AKI). Specifically, for each yearly increase in age beyond 60 years, the adjusted odds of developing AKI increased by 4% (AOR1.04, 95% CI: 1.02–1.05, P = 0.000), highlighting the increased vulnerability of older patients to renal complications following a cardiac event (Wang et al., 2019).

A retrospective analysis conducted from July 2000 to September 2008 examined 39,938 intensive care unit patients from a large tertiary-care university hospital system to evaluate socio-demographic predictors of AKI across different age groups. The multivariate analysis revealed that age served as a powerful independent risk factor, with patients aged 75 years or older demonstrating substantially increased AKI susceptibility. While the overall AKI incidence was 62.9%, this rate rose to 69.2% among patients aged 55 years or older, establishing a clear age-dependent vulnerability pattern. The predictive value of demographic factors progressively diminished with advancing age, evidenced by declining AUC values from 0.744 (95% CI: 0.735-0.752) in the 18-54 age group to 0.673 (95% CI: 0.661-0.685) in patients aged 75 years or older (Kane-Gill et al., 2015).

A multinational prospective cohort study across 15 academic medical centers in the United States and Europe from 2020-2022, examining 8,743 critically ill patients. Using multivariate logistic regression, they found advanced age (>75 years) significantly increased AKI risk (AOR 2.45, 95% CI 2.18-2.76), male sex was associated with higher risk (AOR1.32, 95% CI 1.18-1.48 P = 0.000), and both obesity (BMI >30 kg/m²; AOR1.67, 95% CI 1.49-1.87 P = 0.000) and underweight status (BMI <18.5 kg/m²; AOR1.24, 95% CI 1.08-1.42 P = 0.001) were independent predictors of AKI development (Johnson et al. 2023).

A systematic review and meta-analysis of 32 studies done between 2000-2021, encompassing 415,239 patients worldwide. Their analysis demonstrated a U-shaped relationship between BMI and AKI risk, with both obesity (AOR1.72, 95% CI 1.58-1.87 P = 0.002) and underweight status (AOR1.31, 95% CI 1.15-1.49 P = 0.000) significantly associated with increased AKI risk across diverse patient populations (Martinez et al. 2022).

2.2.2. Clinical Variables

In their 2019 retrospective analysis of Chinese AMI patients, Wang and colleagues employed multivariate logistic regression to identify clinical predictors of AKI. After adjusting for demographic and treatment factors, they found hypertension doubled the AKI risk (AOR2.51, 95% CI: 1.62–3.87, P = 0.000), while pre-existing chronic kidney disease showed the strongest association among comorbidities (AOR3.52, 95% CI: 2.01–6.16, P = 0.000). Clinical severity indicators proved particularly significant, with Killip class ≥3 demonstrating the strongest overall predictive value (AOR5.22, 95% CI: 3.07–8.87, P = 0.000) and extensive anterior MI tripling AKI risk (AOR3.02, 95% CI: 1.85–4.93, P = 0.000) (Wang et al., 2019).

A retrospective cohort analysis of 12,589 ICU patients in the UK from 2018-2021. Their multivariate logistic regression identified chronic kidney disease as the strongest predictor (AOR3.12, 95% CI 2.78-3.50, P = 0.001), with diabetes mellitus (AOR2.05, 95% CI 1.82-2.31, P = 0.000), congestive heart failure (AOR1.88, 95% CI 1.66-2.13, P = 0.000), high APACHE IV scores (>80; AOR2.89, 95% CI 2.54-3.29, P = 0.000), and septic shock (AOR4.12, 95% CI 3.68-4.61, P = 0.000) all significantly predicting AKI development (Thompson et al. 2022).

A multicenter study of 7,845 patients across 12 ICUs in India from 2017-2020. Their multivariate analysis yielded similar risk magnitudes for chronic kidney disease (AOR3.05, 95% CI 2.74-3.40, P = 0.002) and septic shock (AOR4.25, 95% CI 3.82-4.73, P = 0.001), while also identifying chronic liver disease as an independent predictor (AOR2.15, 95% CI 1.89-2.45, P = 0.000) in their cohort (Kumar et al. 2021).

A meta-analysis of 45 studies done between 2010-2022, encompassing 289,456 critically ill patients globally. The study was conducted in the United Kingdom, specifically in the North of England; the research was affiliated with institutions such as the University of Leeds, University of Sheffield, University of Bradford, University of Vermont, and King's College London. Their analysis confirmed the consistent predictive value of high illness severity scores across diverse populations (AOR2.95, 95% CI 2.68-3.25, P = 0.000) and identified sepsis as the strongest clinical predictor (AOR3.89, 95% CI 3.54-4.28, P = 0.000) of AKI development (Rodriguez et al. 2023).

2.2.3. Management and Laboratory Variables

The retrospective cohort study of intensive care unit patients conducted in the United States specifically in Pittsburgh, Pennsylvania from 2000 to 2010 incorporated analysis of multiple management-related factors, with particular attention to nephrotoxic medication exposure and

clinical interventions. For the oldest age category (≥75 years), specific pharmacological agents including vancomycin, aminoglycosides, and nonsteroidal anti-inflammatory drugs significantly elevated AKI risk. Use of vancomycin (AOR1.56, 95% CI 1.24-1.97), use of aminoglycosides (AOR1.43, 95% CI 1.05-1.96), use of NSAIDS (AOR1.33, 95% CI 1.02-1.73), history of hypertension (AOR1.13, 955 CI 1.01-1.45), presence of sepsis (AOR2.12, 955 CI 1.58-2.84) (Kane-Gill et al., 2015).

A prospective observational study of 6,342 mechanically ventilated patients across 23 ICUs in Australia and New Zealand from 2019-2022. Their multivariate analysis found mechanical ventilation >48 hours significantly increased AKI risk (AOR2.34, 95% CI 2.08-2.63), with admission creatinine >1.5 mg/dL (AOR3.45, 95% CI 3.06-3.89, P = 0.000), albumin <2.5 g/dL (AOR2.12, 95% CI 1.89-2.38, P = 0.000), and lactate >4 mmol/L (AOR2.67, 95% CI 2.35-3.04, P = 0.000) all independently predicting AKI development (Anderson et al. 2023).

A retrospective analysis of 3,857 mechanically ventilated patients in South Korea from 2016-2020. Their propensity-matched analysis demonstrated that lung-protective ventilation strategies were associated with significantly reduced AKI risk (AOR 0.68, 95% CI 0.59-0.78, P = 0.000), while higher driving pressures (>15 cmH_2O) were associated with increased risk (AOR1.89, 95% CI 1.64-2.18, P = 0.000) (Kim et al. 2021).

2.2.4. Drug-Related Variables

The pharmacological management of AMI patients was examined through a retrospective cohort study in beijing, China in 2018 which controlled for demographic and clinical factors, identified significant medication-related predictors. Furosemide administration showed a dose-dependent relationship with AKI risk (AOR1.02 per unit increase, 95% CI: 1.02–1.03, P = 0.000), likely reflecting its use in critically ill patients. Conversely, patients not receiving ACE inhibitors or ARB therapy had 58% higher adjusted odds of developing AKI (AOR1.58, 95% CI: 1.04–2.40, P = 0.032), suggesting potential renal protective effects of these agents (Wang et al., 2019).

In a large tertiary-care university hospital system located in the United States, a retrospective cohort study was conducted from July 2000 to September 2008 identified numerous clinical and comorbidity factors that differentially predicted AKI risk across age strata. For patients aged 75 years or older, hypertension history remained a significant clinical predictor (OR: 1.13, 95% CI: 1.02-1.25). The research demonstrated that fewer clinical variables maintained predictive value for AKI as patient age increased, with the overall clinical prediction model

showing significantly reduced accuracy in older populations ($P < 0.001$). Sepsis emerged as a particularly strong risk factor across all age groups, though its impact was most substantial in older adults (OR: 2.12, 95% CI: 1.68-2.67 for patients ≥75 years) (Kane-Gill et al., 2015).

A population-based study of 45,892 hospitalized patients in the United States from 2018-2022. Their multivariate analysis confirmed the significant AKI risk associated with NSAIDs (AOR1.89, 95% CI 1.72-2.08, $P = 0.000$) and intravenous contrast (AOR2.28, 95% CI 2.07-2.51, $P = 0.001$), while also identifying proton pump inhibitors as independent predictors (AOR1.45, 95% CI 1.32-1.59, $P = 0.000$) in a general hospitalized population (Davis et al. 2023).

2.3 Conceptual Framework

This conceptual framework illustrates the hypothesized relationships between various independent variables and Acute Kidney Injury (AKI), which serves as the dependent variable. It outlines how socio-demographic factors, clinical conditions, management and laboratory results and drug-related aspects can influence the development and progression of AKI. Furthermore, the framework highlights the intricate interconnections among these independent variables, suggesting that they do not operate in isolation but rather influence each other, collectively impacting the risk and severity of AKI.

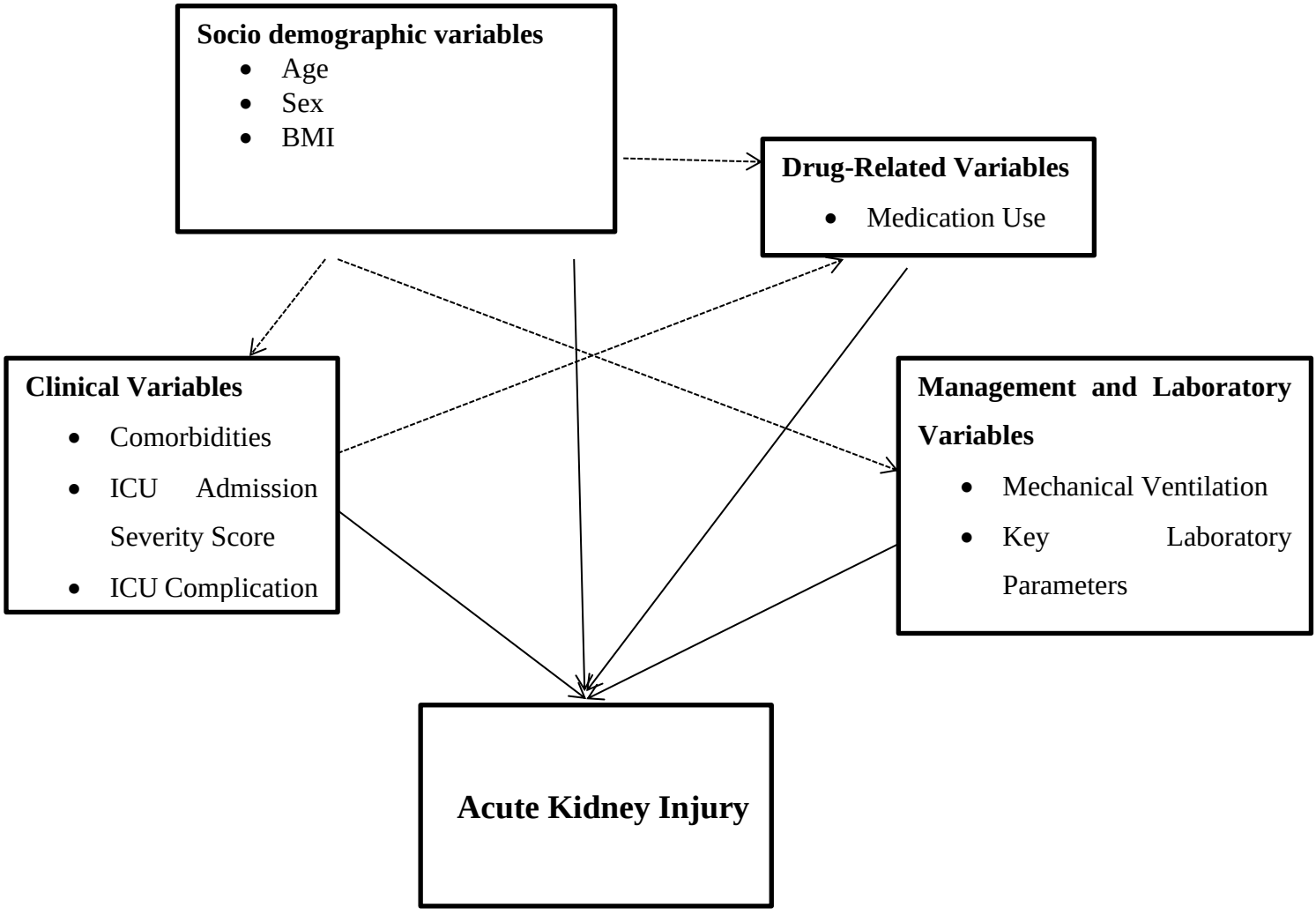

Figure 1: Conceptual frame work for the study on the prevalence of acute kidney injury and associated factors among adult patients admitted to the intensive care units

3. METHODS AND MATERIALS

3.1. Study Area and Study Period

The study was conducted at HFCSH in Harar, the capital of the Harari Regional State, Ethiopia. Harar is located approximately 526 kilometers from Addis Ababa, Ethiopia's capital. HFCSH serves as a comprehensive hospital for the eastern part of Ethiopia, covering Eastern Oromia, Dire Dawa City Administration, the Somali Regional State, and the Harari Regional State. HFCSH is equipped with specialty services, including emergency and critical care, orthopedic care, and a plastic and burn unit. Regarding renal disease management, HFCSH possesses diagnostic capabilities including Kidney Function Tests (KFTs) and systematic monitoring of urine output. The hospital's capacity for managing kidney-related complications includes the availability of one nephrologist and dialysis services for renal replacement therapy (RRT). Furthermore, essential medications such as intravenous fluids and diuretics are readily available for AKI management.

The study was conducted from October 01-30, 2025, focusing on patients within HFCSH's ICUs. The hospital is well-equipped to handle critical cases and offers various services to the surrounding communities, making it a key healthcare provider for the region.

3.2. Study Design

An institutional-based retrospective cross-sectional study design was conducted.

3.3. Population

3.3.1. Source Population

All adult patients admitted to the ICUs at Hiwot Fana Comprehensive Specialized Hospital from September 02 to December 28 2025.

3.3.2. Study Population

All adult patients admitted to the ICU at HFCSH during the data retrieval period.

3.4. Inclusion and Exclusion Criteria

3.4.1. Inclusion Criteria

- All adult patients admitted to the ICUs at Hiwot Fana Comprehensive Specialized Hospital during the study Period.
- Patients with complete and available medical charts during the data collection period.

3.4.2. Exclusion Criteria

- Patients with a previous history of dialysis, renal transplant, or admission with end-stage renal disease.
- Patients whose medical records are incomplete, lost, or contain unreadable data essential for determining AKI incidence or associated factors.

3.5. Sample Size Determination

A single population proportion formula was used to calculate the required sample size for the first objective by considering the assumptions

- P= 16.1%, proportion AKI among patients admitted to ICU from previous study (Getahun et al., 2024)
- d= 5%, margin of error that can be tolerated
- n= minimum sample size for the study
    -

$$n = \frac{(1.96)^2 0.161(1-0.161)}{0.05^2} = 208$$

By taking 10% non-response rate the total sample is **229**.

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

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

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	Assumptions	Proportion of exposed group	Proportion of unexposed group	Sample size	Sample size (with 10% contingency)
Age	CI: 95% Power= 80% Ratio= 1:1	0.40	0.20	56	62
Sex		0.30	0.15	94	103
BMI		0.40	0.25	68	75
Comorbidities		0.35	0.20	72	79
Medication use		0.30	0.20	93	102

- Based on the sample size calculations, the largest required sample size was 229, as determined using the single population proportion formula. Therefore, a final sample size of 229 participants was used for this study.

3.6. Sampling Technique and Procedure

A simple random sampling technique was employed to select a total of 229 adult patients for this study. The source population comprised all adult patients admitted to the ICU at HFCSH during the data retrieval period.

Based on a review of ICU admission records, HFCSH admits an average of 25 patients per month, resulting in approximately 300 ICU admissions annually. A sampling frame was prepared using ICU admission logbooks, in which all eligible patient records were assigned unique identification numbers. From this sampling frame, the required sample size was selected using a computer-generated random number technique.

3.7. Data Collection Methods

All the socio-demographic eligible adult patients were screened and enrolled on admission following informed consent, and baseline socio-demographic, comorbidity, and ICU admission severity data was collected. Every enrolled patient was followed up daily from ICU admission until ICU discharge, hospital discharge, death, or for a maximum of 28 days, whichever occurs first. During this entire follow-up period, all these types of data as required, including the measurement of serum creatinine daily, urine output, clinical observation, and drug administration was collected on a routine basis from the patients' medical records/charts. This broad abstraction of common clinical data enables the identification of AKI development and staging uniformly and performance of robust analysis of associated factors.

3.7.1. Data Collection Tool

This study utilized secondary data to assess the incidence and determinants of Acute Kidney Injury (AKI) in ICU patients. The primary data utilized socioeconomic, demographic, clinical, and laboratory data collected from patient medical records.

A standardized data collection tool was employed to gather systematically relevant clinical parameters like baseline renal function, vital signs, comorbidities, and treatment modalities. Data was obtained from ICUs admission records, laboratory results, and patient monitoring charts. Where additional patient history is required, healthcare providers or caregivers may be interviewed for further clarification.

3.7.2. Data Collectors

Hired for this study were a team of data collectors comprising Four ICU nurses and two GPs working at the Hospital. The data collectors pulled out relevant clinical and demographic information from patients' medical records.

Prior to data collection, all the data collectors underwent a strict training session to ensure uniformity and accuracy in data collection. The training covered the structured data collection tool, reading information from patient charts, and how to record the important variables on Acute Kidney Injury (AKI) in the right manner. The training session lasted for two hours and focused on data quality and reliability maintenance during the duration of the study.

3.7.3. Data Collection Procedure

All admitted patients to the medical ICU of the Hospital throughout the study period and who fulfill the inclusion criteria was included in the study. The data collectors extracted relevant information from patients' medical records, including socio-demographic information, admission clinical conditions, and variables associated with the development of Acute Kidney Injury (AKI).

To ensure the quality of secondary data collection, a standardized data collection tool was used. The data collectors received adequate orientation and training before data collection. The principal investigator also conducted regular supervision to check adherence to standardized data collection protocols, and the accuracy, and completeness of the information gathered.

3.8. Study Variables

3.8.1. Dependent Variable

- Acute Kidney Injury

3.8.2. Independent Variables

- **Socio-demographic Variables**
    - Age
    - Sex
    - BMI
- **Clinical Variables**
    - Comorbidities
    - ICU Admission Severity Score
    - ICU Complication
- **Management and Laboratory Variables**
    - Mechanical Ventilation
    - Key Laboratory Parameters
- **Drug-Related Variables**
    - Medication Use

3.9. Operational Definitions

Acute Kidney Injury (AKI): A sudden decline in kidney function, defined as an increase in serum creatinine by ≥0.3 mg/dL within 48 hours or a 50% rise from baseline within 7 days, or reduced urine output (<0.5 mL/kg/hour for 6 hours) (Zuk and Bonventre, 2016).

Incidence of AKI: The number of new AKI cases diagnosed among ICU patients during a specific period, expressed as a percentage of the total ICU admissions during that time (Mo et al., 2022).

Risk Factors for AKI: Conditions or variables that increase the likelihood of developing AKI, such as sepsis, hypotension, use of nephrotoxic drugs, or pre-existing chronic kidney disease(Kane-Gill et al., 2015).

ICU Admission: The process of admitting a patient to the Intensive Care Unit for critical care and monitoring due to severe or life-threatening conditions (Smith and Nielsen, 1999).

3.10. Data Quality Control

To ensure the quality of data, during the data collection period, the principal investigator oversees the process to ensure that data is checked for completeness, accuracy, and clarity on the day of collection. All collected data was reviewed immediately to identify any discrepancies or missing information.

Before entering the data into the database, a thorough data cleaning process was conducted. This includes cross-checking the data for consistency, eliminating duplicates, and ensuring that all variables are correctly filled out. Any inconsistencies or errors identified during the cleaning process were corrected by the principal investigator or data collection team. This process ensured that only valid, reliable, and complete data is entered into the final database for analysis.

3.11. Methods of Data Analysis

After data collection, the collected data was reviewed for completeness and consistency. The data was entered into Epi-Data Manager Version 4.7. For storage and organization, followed by export to SPSS version 27 for further cleaning, editing, coding, and statistical analysis. Explanatory data analysis was first being conducted to assess missing values, normality, and the presence of outliers. Incomplete or inconsistent data were appropriately addressed. Normality tests was performed on continuous variables, and descriptive statistics, including relative frequency, percent, mean with standard deviation and median values, were used based on the type of data and its distribution.

To analyze the incidence of Acute Kidney Injury (AKI) among ICU adult patients, descriptive statistical analysis was conducted to determine the proportion of patients who developed AKI during the study period. The incidence rate was calculated as the number of new AKI cases divided by the total number of ICU admissions, expressed as a percentage.

Bi-variable analysis was performed to examine associations between AKI and each independent variable using the Binary logistic Regression model. Variables that were statistically significant at a p-value of $\leq 25\%$ in the bi-variable analysis were included in the multivariable analysis to identify independent predictors of AKI. The goal was to determine which factors are most strongly associated with the development of AKI among ICU patients.

To ensure the integrity of the model, multicollinearity among independent variables was assessed using the Variance Inflation Factor (VIF), and it is expected that all VIFs felled within

an acceptable range (mean VIF ≤ 1.5). Model fitness was also checked using Hosmer-Lemeshow test, where a non-significant p-value indicated a well-fitting model.

The final results of the data analysis were presented clearly in tables, graphs, and text, offering an accessible summary of the findings. This comprehensive approach to data analysis provided a robust understanding of the incidence of AKI and its associated risk factors among ICUs adult patients at Hiwot Fana Comprehensive Specialized Hospital.

3.12. Ethical Consideration

Ethical clearance for the research was obtained from the Institutional Health Research Ethics Review Committee of Haramaya University College of Health and Medical Sciences. Once ethical clearance is granted, approval letters was submitted to Hiwot Fana Comprehensive Specialized Hospital to enable them to carry out the research. Data collection only preceded once informed, voluntary, written, and signed consent from the hospital administrators was given.

To maintain participants' confidentiality, no identifiers, like names, put on the questionnaires that have been written. All the information collected during the research was stored securely and access was limited to the research team. At all levels of data collection, analysis, and reporting, patient confidentiality was maintained.

3.13. Dissemination of Results

The results of this study will be presented to the College of Health and Medical Sciences, school of medicine, Department of Anesthesiology, Critical Care, and Pain Medicine., then presented at the final research defense. The study results will also be disseminated to Haramaya University, Regional health bureaus and Federal Ministry of Health to use the data for possible program input or policy amendment. It will be also published in peer reviewed journals to reach the large academic community.

4. RESULTS

4.1. Socio-demographic characteristics

A total of 229 adult patients were included in the study. The largest proportion of participants were aged 25–34 years (26.64%), followed by those aged 35–44 years (18.78%) and 55–64 years (16.59%), while patients aged 18–24 years and those older than 65 years accounted for 12.66% and 11.35%, respectively. Females constituted a slight majority of the study population (52.40%), with males representing 47.60%. Regarding body mass index, most participants had a normal BMI (88.21%), whereas 7.86% were overweight and 3.93% were underweight (Table 2).

Table 2: Socio-demographic characteristics of adult patients admitted to the intensive care units at Hiwot Fana Comprehensive Specialized Hospital, Eastern Ethiopia, September 02, 2024 – September 28, 2025 (n = 229)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18-24	29	12.66
	25-34	61	26.64
	35-44	43	18.78
	45-54	32	13.97
	55-64	38	16.59
	≥65	26	11.35
Gender	Female	120	52.40
	Male	109	47.60
BMI	Underweight	9	3.93
	Normal Weight	202	88.21
	Overweight	18	7.86

BMI: Body mass index

4.2. Clinical characteristics of the participants

A majority of the patients (55.46%) presented with at least one pre-existing comorbidity, highlighting a significant burden of chronic disease within this ICU population. Cardiovascular disease was the most common single comorbidity (15.72%), followed by hypertension (13.97%). The presence of various comorbidity combinations, such as cardiovascular disease with diabetes or hypertension, underscores the complexity of managing patients with multiple chronic conditions. While the overall comorbidity burden is high, later analysis revealed that the high AKI incidence observed in normal-weight and productive-age patients is less correlated with the overall presence of comorbidity and more strongly driven by specific factors, primarily chronic kidney disease (which acts as a powerful vulnerability) and acute illness markers like Leukocytosis and the need for mechanical ventilation. In terms of clinical management, the SOFA scoring system was used more frequently (62.01%) than APACHE II (37.99%) for severity assessment. Complications during the ICU stay were common, affecting more than half of the patients (58.52%), with Acute Kidney Injury (AKI) being the most frequent single complication (14.41%), followed by cardiovascular (10.92%) and metabolic (10.04%) issues (Table 3).

Table 3: Clinical Variables of Adult Patients Admitted to the Intensive Care Units at Hiwot Fana Comprehensive Specialized Hospital, September 02 2024 to September 28 2025 (n=229)

Variable	Category	Frequency	Percentage
Presence of Comorbidities	No	102	44.54
	Yes	127	55.46
Type of Comorbidities	Other (CND, HD, AID)	17	7.42
	Hypertension	32	13.97
	Diabetes	9	3.93
	CKD	6	2.62
	Chronic respiratory disease	4	1.75
	Cancer	9	3.93
	CVD, Diabetes	2	0.87
	CVD, Hypertension	3	1.31

	Chronic liver disease	4	1.75
	Diabetes, Cancer	1	0.44
	Hypertension, Chronic respiratory disease	1	0.44
	Hypertension, Diabetes	3	1.31
	CVD	36	15.72
Scoring System Used	APACHE II	87	37.99
	SOFA	142	62.01
Complications During ICU Stay	No	95	33.62
	Yes	134	66.38
Type of Complications	CVD	25	10.92
	Metabolic	23	10.04
	Neurologic	10	4.37
	Pneumonia	10	4.37
	AKI, CVD, Metabolic	8	3.49
	CVD, Metabolic	6	2.62
	Surgical site infection	5	2.18
	Bedsore	5	2.18
	Deep vein thrombosis	3	1.31
	Stress Ulcer	2	0.87
	AKI	33	14.41
	Other	4	1.75

AID: Autoimmune Diseases; AKI: Acute Kidney Injury; APACHE-II: Acute Physiology and Chronic Health Evaluation II; CKD: Chronic Kidney Disease; CND: Chronic Neurological Disorders; CVD: Cardiovascular Disease; HD: Hematological Disorders; SOFA: Sequential Organ Failure Assessment

4.3. Management and laboratory variables

As shown below in Table 4, the management profile reveals that a substantial proportion of patients required mechanical ventilation (38.43%). Notably, nearly half of the cohort (48.91%) experienced hypoxemia, and a third exhibited tachypnea, indicating a high prevalence of respiratory compromise. Hemodynamically, most patients maintained normal mean arterial pressure (77.73%), though a significant minority (21.40%) experienced hypotension. A striking finding is that nearly all patients (98.69%) had a positive fluid balance, indicating fluid retention evident from the initial 24 hours of the ICU stay. Laboratory results show that over 40% of patients had leukocytosis, suggesting a common inflammatory or infectious response. Renal function was a key concern, with nearly half the patients displaying low or very low urine output (53.27%) and almost half (49.34%) having high or severely elevated serum creatinine levels. Electrolyte abnormalities were relatively uncommon, with the majority (94.32%) showing no significant imbalances.

Table 4 Management and Laboratory Variables of Adult Patients Admitted to the Intensive Care Units at Hiwot Fana Comprehensive Specialized Hospital, September 02 2024 to September 28 2025 (n=229)

Variable	Category	Frequency	Percentage
Mechanical Ventilation	No	141	61.57
	Yes	88	38.43
Peripheral Oxygen Saturation (SpO_2)	Normal	117	51.09
	Hypoxemia (Low)	112	48.91
Respiratory Rate	Normal	84	36.68
	Tachypnea (High)	76	33.19
	Assisted Ventilation	69	30.13
Mean Arterial Pressure (MAP)	Normal	178	77.73
	Abnormal	51	22.27
Fluid Balance (24 hours)	Neutral	3	1.31
	Positive Moderate	226	98.69
White Blood Cell Count ($x10^3/\mu L$)	Normal	133	58.08
	Leukocytosis	96	41.92
Platelet Count ($x10^3/\mu L$)	Normal	224	97.82
	Mild Thrombocytopenia	2	0.87
	Thrombocytosis	3	1.31
Urine Output (24 hours)	Normal	107	46.72
	Low (Oliguria)	105	45.85
	Very Low (Anuria)	17	7.42
Serum Creatinine	Normal	116	50.66
	High	53	23.14
	Severely Elevated	60	26.20

Electrolyte Abnormalities	Hyperkalemia	7	3.06
	Hyperkalemia + Hyponatremia	3	1.31
	Hyperkalemia + Hypernatremia	1	0.44
	Hypernatremia	1	0.44
	Hyponatremia	1	0.44
	None	216	94.32

4.4. Drug-related variables

Pharmacological management was characterized by moderate antibiotic use (45.41%) and vasopressor/inotrope support in a third of patients (33.19%), reflecting the need for hemodynamic stabilization in a significant subset. The use of sedation was also notable, administered to 35.81% of patients, which is consistent with an ICU population requiring mechanical ventilation or procedural comfort. Importantly, the use of nephrotoxic drugs was exceptionally rare (0.87%), indicating a high level of awareness and caution regarding renal safety in this patient population (Table 5).

Table 5 Drug-Related Variables of Adult Patients Admitted to the Intensive Care Units at Hiwot Fana Comprehensive Specialized Hospital, September 02 2024 to September 28 2025 (n=229)

Variable	Category	Frequency (n)	Percentage (%)
Antibiotic Use	No	125	54.59
	Yes	104	45.41
Vasopressor/Inotrope Used	No	153	66.81
	Yes	76	33.19
Use of Nephrotoxic Drugs	No	227	99.13
	Yes	2	0.87
Sedation Use	No	147	64.19
	Yes	82	35.81

4.5. Outcome-related data

Patient outcomes were largely positive, with a 75.11% survival rate. However, renal outcomes were a significant concern. While the need for Renal Replacement Therapy (RRT) was relatively low (5.24%), the recovery of renal function post-injury was incomplete for many. Only 23.14% of patients experienced complete renal recovery, while 30.57% showed no recovery, pointing to a high incidence of persistent kidney damage among survivors. The vast majority of discharged patients (91.70%) were transferred to a general hospital ward, indicating successful stabilization and step-down from critical care for most survivors, with only a small number requiring further intensive care or referral (Table 6).

Table 6 Outcome-Related Variables of Adult Patients Admitted to the Intensive Care Units at Hiwot Fana Comprehensive Specialized Hospital, September 02 2024 to September 28 2025 (n=229)

Variable	Category	Frequency	Percentage (%)
Need for Renal Replacement Therapy (RRT)	No	217	94.76
	Yes	12	5.24
Mortality Status	Alive	172	75.11
	Deceased	57	24.89
Recovery of Renal Function	Complete Recovery	53	23.14
	Partial Recovery	15	6.55
	No	70	30.57
Discharge Disposition	MICU	4	1.75
	Referral	4	1.75
	Self-discharge	11	4.80
	Ward	210	91.70

The average Length of Stay (LOS) for all patients was 5.43 days, though the high standard deviation (5.83 days) and wide range (up to 40 days) indicate significant variability and a likely skewed distribution due to prolonged stays in a minority of patients. For the 79 patients requiring mechanical support, the mean duration of ventilation was 3.71 days, with a similar high variability suggesting diverse clinical needs and outcomes within the ventilated subgroup. Both metrics are key indicators of resource consumption and overall patient morbidity in the ICU (Table 7).

Table 7: Summary statistics of selected continuous clinical variables among adult ICU patients at Hiwot Fana Comprehensive Specialized Hospital, September 02, 2024 – September 28, 2025

Variable	Observations	Mean	Standard Deviation	Min.	Max.
Length of Stay	229	5.43 days	5.83 days	0 days	40 days
Duration of Mechanical Ventilation	79	3.71 days	3.79 days	1 day	23 days

4.6. Incidence of Acute Kidney Injury

The findings reveal that AKI is a profoundly significant clinical challenge within the studied intensive care unit, with an incidence of 33.62% (95% CI, 27.65% - 39.79%). This indicates that approximately one in every three adult patients admitted to the ICU developed this serious kidney complication during their stay. Such a high rate underscores the vulnerability of critically ill patients to renal impairment, likely driven by a confluence of factors such as systemic infections, hemodynamic instability, and the physiological stress of critical illness. This prevalence positions AKI not as a rare occurrence, but as a common and expected complication that demands vigilant monitoring, proactive preventive strategies, and prepared management protocols to mitigate its substantial impact on patient morbidity, mortality, and healthcare resources (Table 8).

Table 8: Distribution of Acute Kidney Injury among adult patients admitted to the intensive care units at Hiwot Fana Comprehensive Specialized Hospital, September 02, 2024 – September 28, 2025 (n = 229)

Variable	Category	Frequency (n)	Percentage (%)
Acute Kidney Injury (KDIGO Criteria)	No	152	66.38
	Yes	77	33.62

KDIGO: Kidney Disease Improving Global Outcomes

4.7. Factors associated with developing acute kidney injury

In the bivariate logistic regression analysis, variables such as age, complications during ICU stay, mechanical ventilation, respiratory rate, mean arterial pressure, white blood cell count, antibiotic use, vasopressor/inotrope use, sedation use, and mortality status were found to have a p-value of less than 0.25, indicating potential associations with acute kidney injury (AKI). These variables were therefore included in the multivariable logistic regression model to identify independent predictors of AKI. In the multivariable analysis, complications during ICU stay, assisted ventilation, leukocytosis, and mortality were found to be statistically significant factors associated with AKI, with a p-value of less than 0.05 (Table 9).

The model fit was assessed using the Hosmer–Lemeshow test, p = 0.72, indicating adequate fit. A mean VIF of 1.89 indicated no significant multicollinearity.

Table 9: Bivariable and multivariable logistic regression analysis of factors associated with acute kidney injury among adult patients admitted to intensive care unit at Hiwot-Fana Comprehensive Specialized Hospital, September 2, 2024 - September 28, 2025

Variables	Category	AKI		COR (95% CI)	AOR (95% CI)
		No	Yes		
Age (Years)	18-24	21	8	1	1
	25-34	43	18	1.10 (0.41, 2.94)	1.04 (0.28, 3.88)
	35-44	29	14	1.27 (0.45, 3.57)	0.90 (0.24, 3.35)
	45-54	21	11	1.38 (0.46, 4.10)	2.04 (0.50, 8.36)
	55-64	24	14	1.53 (0.54, 4.37)	2.31 (0.55, 9.69)
	≥65	14	12	2.25 (0.73, 6.91)	1.70 (0.35, 8.15)
Complication during ICU stay	No	81	14	1	1
	Yes	71	63	5.13 (2.65, 9.94)	**3.57 (1.60, 8.00) ***
Mechanical ventilation	No	107	34	1	1
	Yes	45	43	3.01 (1.70, 5.31)	0.75 (0.26, 2.19)
Respiratory rate	Normal	70	14	1	1
	Tachypnea (High)	49	27	2.76 (1.31, 5.78)	1.45 (0.55, 3.88)
	Assisted ventilation	33	36	5.45 (2.59, 11.47)	**4.19 (1.19, 14.68) ****
Mean arterial pressure	Normal	124	54	1	1
	Abnormal	28	23	1.89 (1.00, 3.57)	0.77 (0.30, 1.99)
WBC count	Normal	115	18	1	1
	Leukocytosis	37	59	10.19 (5.35, 19.41)	**5.72 (2.45, 13.37) ***
Antibiotics use	No	99	26	1	1
	Yes	53	51	3.66 (2.06, 6.53)	1.88 (0.84, 4.20)
Vasopressor use	No	119	34	1	1
	Yes	33	43	4.56 (2.52, 8.25)	1.65 (0.74, 3.70)
Sedative use	No	110	37	1	1
	Yes	42	40	2.83 (1.60, 5.01)	0.54 (0.18, 1.69)
ICU Mortality	No	132	40	1	1
	Yes	20	37	6.11 (3.19, 11.68)	**3.09 (1.29, 7.43) ***

*= P < 0.05; **= P <0.001; Hosmer-Lemeshow test= 0.75

5. DISCUSSION

This study provides a critical analysis of the incidence and risk factors for Acute Kidney Injury (AKI) among adult patients in the intensive care units of Hiwot Fana Comprehensive Specialized Hospital. The key finding of a 33.62% (95% CI, 27.65% - 39.79%) incidence of AKI situates the hospital within the concerning global and regional landscape of this condition. This rate is higher than the 31.7% reported in a global meta-analysis of critical care settings (Susantitaphong et al., 2013) and the 22.7% found in a large U.S. hospital study (Wang et al., 2012), but is consistent with recent studies from similar low-resource settings in Africa, such as Sudan (39.0%) (Magboul et al., 2020) and Southern Ethiopia (40.4%) (Ashine et al., 2024).

However, the incidence is notably lower than the rates found in the multinational AKI-EPI study (57.3%) (Hoste et al., 2015) or in cohorts from South Africa (58.5%) (Aylward et al., 2019) and Tanzania (55.3%) (Minja et al., 2021). This variation likely reflects differences in patient demographics, the predominant case mix (e.g., lower trauma cases compared to South Africa), and potentially, differences in ICU admission criteria and the sensitivity of AKI surveillance.

This finding revealed that complications during ICU stay, assisted ventilation, leukocytosis, and mortality were significantly associated with acute kidney injury in the multivariable analysis ($p < 0.05$).

In this study, patients who developed complications during their ICU stay had significantly higher odds of AKI (AOR = 3.57; 95% CI: 1.60–8.00) compared with those without complications. This finding is consistent with reports from previous studies conducted in Sudan (Sidahmed et al., 2021) and Brazil (da Rocha Guedes[1] et al., 2017) which have demonstrated that ICU-related complications contribute substantially to renal injury through mechanisms such as hemodynamic instability, sepsis, and multi-organ dysfunction. The increased risk may be explained by the cumulative physiological stress associated with complications, including impaired perfusion, inflammatory responses, and exposure to nephrotoxic interventions, all of which predispose critically ill patients to AKI (Peerapornratana et al., 2019, Rroji et al., 2025).

Similarly, patients who required assisted ventilation were nearly four times more likely to develop AKI than those who did not require ventilatory support (AOR = 4.19; 95% CI: 1.19–14.68). This association may be attributed to the severity of underlying illness among ventilated patients, as well as the effects of positive pressure ventilation on renal perfusion and cardiac output, which can compromise renal function. Mechanical and assisted ventilation are also

commonly associated with systemic inflammation and the need for sedatives and vasopressors, further increasing the risk of AKI (Benites et al., 2025, Hepokoski et al., 2018, Seubert and Goeijenbier, 2024).

Leukocytosis was also found to be a strong predictor of AKI, with patients exhibiting elevated WBC counts having more than fivefold higher odds of developing AKI (AOR = 5.72; 95% CI: 2.45–13.37). Similar to studies done in Uganda (Muhindo et al., 2025) and a multicenter randomized controlled trial (Liu et al., 2025). This finding suggests that systemic inflammation or infection plays a central role in the pathogenesis of AKI in critically ill patients. Inflammatory mediators released during sepsis or severe infection can lead to renal microvascular dysfunction, tubular injury, and impaired autoregulation, thereby increasing susceptibility to AKI (Chang et al., 2022, Xu et al., 2025).

Finally, ICU mortality was 3.09 times higher among patients who developed AKI (AOR = 3.09; 95% CI: 1.29–7.43). This finding is consistent with reports from studies conducted in Ethiopia (Ashine et al., 2024) and systematic review report (Søvik et al., 2019), which have consistently demonstrated a strong association between AKI and increased mortality among critically ill patients. This association may be explained by the fact that AKI reflects severe underlying illness and contributes to further physiological deterioration through fluid overload, electrolyte imbalance, metabolic acidosis, and heightened inflammatory responses. In addition, AKI often necessitates complex interventions and prolonged organ support, thereby reducing physiological reserve and increasing susceptibility to multi-organ dysfunction, ultimately leading to poorer clinical outcomes and increased risk of death (Rroji et al., 2025, Malla et al., 2025).

6. STRENGTH AND LIMITATION OF THE STUDY

6.1. Strength of the Study

This research holds significant value because it successfully generates crucial, context-specific data concerning a major critical care issue within a low-resource setting in Ethiopia, thereby filling a substantial void in local medical knowledge. The study employed a methodologically appropriate approach, utilizing a simple random sampling technique and a structured data collection checklist to ensure comprehensive and high-quality patient data. Furthermore, the use of multivariable binary logistic regression stands out as a key strength, allowing the researchers to accurately pinpoint the essential independent factors Incidence of acute kidney injury while effectively adjusting for the influence of confounding variables.

6.2. Limitations

The limitations of this study should be taken into account when interpreting the findings. Since the research utilized a cross-sectional design, it is inherently unable to establish definitive causal relationships between the identified factors and the outcome. Furthermore, because it was conducted at a single center, the results may lack generalizability to Intensive Care Units in other hospitals or different healthcare settings.

7. CONCLUSION AND RECOMMENDATIONS

7.1. Conclusions

Approximately one-third of adult patients admitted to the intensive care units developed acute kidney injury. Key factors associated with an increased likelihood of AKI included complications during ICU stay, assisted ventilation, leukocytosis, and advanced clinical deterioration. Mortality was higher among patients who developed AKI. These findings highlight the multifactorial nature of acute kidney injury in critically ill patients and emphasize the importance of early risk identification, close clinical and laboratory monitoring, and timely optimization of supportive care to reduce the burden of AKI and improve patient outcomes.

7.2. Recommendations

Based on the finding of this study, the following recommendations were made:

For ICU Department:

- Implement targeted screening protocols to identify patients at higher risk of prolonged ICU stay and complications, particularly older patients, those with comorbidities, and patients requiring intensive interventions such as mechanical ventilation or vasopressors.
- Develop and implement individualized care plans, including early intervention strategies for high-risk patients to prevent or mitigate complications.
- Incorporate study findings into ICU protocols to ensure that key risk factors are systematically considered in patient management.

For Hospital Head:

- Support the ICU department in establishing continuous monitoring systems and quality improvement initiatives to reduce the incidence of prolonged ICU stay and related complications.
- Allocate resources for staff training and education on early recognition and management of high-risk patients.

For Regional Health Bureau:

- Provide guidance and support for hospitals in the region to adopt best practices in ICU management, including early risk assessment and preventive measures for high-risk patients.
- Facilitate knowledge sharing among hospitals to improve patient outcomes and reduce ICU complications regionally.
- Monitor ICU stay durations and complication trends to inform regional quality improvement initiatives.

For ICU Physicians and Staff:

- Adhere to established risk assessment protocols and identify patients at high risk of prolonged ICU stay and complications.
- Apply early, tailored interventions for high-risk patients, including close monitoring, timely medical management, and multidisciplinary care.
- Educate patients and families on potential complications, expected ICU course, and preventive strategies.
- Optimize clinical decision-making, including careful use of medications, interventions, and supportive therapies to minimize risks.

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9. ANNEXS

9.1. Information Sheet and Informed Voluntary Consent Form for Head of Hospital

My name is Dr. Kaleb Abrham. 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 Sciences. I kindly request you to lend me your attention to explain about this study.

The Study Title: The study title is "Prevalence of Acute Kidney Injury and Associated Factors among Adult Patients Admitted to the ICUs at Hiwot Fana Comprehensive Specialized Hospital"

The purpose/Aim of the Study: The purpose of this study is to generate hospital-based evidence on the prevalence, risk factors, and outcomes of acute kidney injury (AKI) among adult patients admitted to the intensive care unit at Hiwot Fana Comprehensive Specialized Hospital. The findings of this study provide up-to-date information for health professionals working in the hospital, highlighting the magnitude of the problem and guiding preventive and management strategies. Additionally, this study serves as a foundation for future research on AKI in critically ill patients. Moreover, the primary aim of this study is to fulfill partial requirements for the completion of a thesis in the training program of 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 02 2024 to September 28 2025 were reviewed. Primary data was collected from these medical charts and where additional patient history is required, healthcare providers or caregivers may be interviewed for further clarification. From the total number of admitted patients, a sample size of 229 was included in the study to ensure a statistically significant result.

Risk and Benefit: The risk of participating in this study is very minimal. The investigator did pay any direct cash for study participants for participating in this study.

Confidentiality: Participant's information was confidential. The finding of the study was 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: 0912634475/ Dr. Kaleb Abrham and/or E-mail: klbkifle63@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 and Signature of Head of the Hospital: _____

Name and Signature of Principal investigator: _____

7.2 Data Collection Checklist

Data collection Check list for the study on **"Prevalence of Acute Kidney Injury and Associated Factors among Adult Patients Admitted to the ICUs at Hiwot Fana Comprehensive Specialized Hospital"**

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: Socio-Demographic Information

1. **Age**:_____
2. **Sex**: ☐ Male ☐ Female
3. **BMI:** ☐ underweight ☐ normal weight ☐ overweight ☐ obese

Section 2: Clinical Variables

1. **Presence of Comorbidities**: ☐ Yes ☐ No

(If yes, specify types): _____

2. **Scoring System Used:**

   ☐ SOFA (Sequential Organ Failure Assessment)

   ☐ APACHE II (Acute Physiology and Chronic Health Evaluation II)

   ☐ MEWS (Modified Early Warning Score)

3. **Presence of ICU Complications**: ☐ Yes ☐ No

(If yes, specify types): _____

Section 3: Management and Laboratory Variables

1. **Mechanical ventilation** : ☐ Yes ☐ No
2. **Peripheral Oxygen Saturation (SpO_2) : _____**
3. **Respiratory Rate (breaths/min) : _____**
4. **Mean Arterial Pressure (MAP) : _____**
5. **Fluid Balance (24 hours) : _____**
6. **White Blood Cell Count (x10^3/µL) : _____**
7. **Platelet Count (x10^3/µL) : _____**
8. **urine output (24 hours) ml/kg/hour: _____**
9. **serum critinine (mg/dl) : _____**
10. **electrolyte abnormalities (mmol/L) : _____**

Section 4: Drug-Related Variables

1. **Antibiotic Use**: ☐ Yes ☐ No
2. **Vasopressor Use**: ☐ Yes ☐ No
3. **Use of nephrotoxic drugs:** ☐ Yes ☐ No
4. **Sedation Use**: ☐ Yes ☐ No

Section 5: Outcome-Related Variables

1. **Acute Kidney Injury (Based on KDIGO Criteria)**: ☐ Yes ☐ No
2. **Need for Renal Replacement Therapy (RRT)**: ☐ Yes ☐ No
3. **Mortality Status**: ☐ Alive ☐ Deceased
4. **Duration of Mechanical Ventilation: _____**
5. **Length of ICU Stay: _____**
6. **Length of stay on mechanical ventilator:_____**
7. **Recovery of Renal Function**: ☐ Complete Recovery ☐ Partial Recovery ☐ No Recovery
8. **Discharge Status**: ☐ Discharged Home ☐ Transferred to Ward ☐ Referred to another Facility ☐ Deceased