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Predictors of Mortality in Adult ICU At Hakim Gizaw Referral Hospital from August 2022 to Augst 2024. Hospital-Based Retrospective Cohort Study in Resource Limited Setup

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Abstract

Background: *Intensive Care Units (ICUs) are essential for managing critically ill patients. Despite advancements in medical care, ICU mortality rates remain high, particularly in low- and middle-income countries (LMICs). ICU outcomes are influenced by factors such as patient demographics, comorbidities, severity of illness, and interventions. This study investigates predictors of inpatient mortality in adult ICU patients at Hakim Gizaw Referral Hospital, Debre Berhan, Ethiopia.*

Objectives: *To determine ICU mortality and analyze the predictors of ICU mortality at Hakim Gizaw Referral Hospital from August 2022 to August 2024.*

Methods: *A retrospective cohort study was conducted from August 2022 to August 2024, reviewing the medical records of 269 patients admitted to the ICU. Data were collected on demographics, admission diagnoses, vital signs, interventions, and complications. Statistical analyses, including bivariate and multivariate logistic regression, were used to identify predictors of ICU mortality.*

Results: *The ICU mortality rate was 30%. Advanced age (≥ 60 years), septic shock, organ failure, and mechanical ventilation were significant predictors of death, with septic shock and mechanical ventilation showing the highest risks. Other factors, such as comorbidities and vital signs, were not statistically significant but suggested trends of higher mortality in some subgroups.*

Conclusion: *This study highlights the critical factors influencing ICU mortality, with advanced age, septic shock, organ failure, and mechanical ventilation being the most significant predictors. These findings underscore the need for targeted interventions and improved resource allocation to enhance patient outcomes in ICUs.*

Keywords: Icu Mortality, Patient Demographics, Comorbidities, Severity of Illness, Treatment Interventions, Clinical Outcomes, Survival Analysis, Critical Care

1. Introduction

Intensive Care Units (ICUs) play a critical role in modern healthcare by providing specialized care to critically ill patients. These units are designed to manage complex and life-threatening conditions, leveraging advanced medical technologies, multidisciplinary teams, and evidence-based practices. Despite these advancements, ICU mortality remains a persistent global health challenge, varying significantly across countries and healthcare settings. The disparity in mortality rates reflects differences in healthcare infrastructure, resource availability, and clinical management approaches, with low- and middle-income countries (LMICs) bearing a disproportionate burden.

In high-income countries (HICs), mortality rates in ICUs range from 10% to 20%, attributed to sophisticated healthcare systems, highly trained personnel, and the availability of state-of-the-art medical technologies [1–4]. These settings demonstrate the potential of well-structured healthcare systems to mitigate critical illness outcomes. For instance, studies in North America and Western Europe report consistent success in managing conditions

like cardiovascular diseases (CVDs) and sepsis through advanced interventions [5–8]. In contrast, LMICs often grapple with mortality rates exceeding 40%, a reflection of systemic limitations such as inadequate staffing, delayed care, and restricted access to essential medical resources [9,10]. Sub-Saharan Africa exemplifies these challenges, with ICU mortality rates between 30% and 50%, often driven by preventable and treatable conditions like trauma, infections, and [1,11,12].

Cardiovascular diseases and strokes are among the leading causes of ICU admissions and mortality worldwide. These conditions demand specialized care and timely intervention to prevent complications. For example, in Ethiopia, studies report ICU mortality rates as high as 45.8% due to CVDs and strokes, underscoring the need for preventative measures and better management strategies [13,14]. Similarly, infectious diseases, particularly sepsis, are critical determinants of ICU mortality. Global data highlight the role of delayed diagnosis, inadequate antimicrobial therapies, and the emergence of multidrug-resistant organisms as major contributors to poor outcomes [15,16]. In Ethiopia, sepsis-related deaths are exacerbated by late recognition and limited treatment options, as evidenced by studies from Tikur Anbessa Specialized Hospital [17,18].

Comorbid conditions, including diabetes, chronic kidney disease, and chronic obstructive pulmonary disease (COPD), amplify the risk of ICU mortality by impairing physiological reserve and immune responses [19]. Acute kidney injury (AKI) is a notable complication, with global prevalence rates between 20% and 50% among ICU patients, significantly higher in resource-constrained settings [20]. Ethiopian hospitals report particularly high mortality rates from AKI due to delayed presentations and the unavailability of renal replacement therapies [21]. Neurological disorders and low Glasgow Coma Scale (GCS) scores are additional predictors of poor ICU outcomes, particularly in trauma cases. Mechanical ventilation, while life-saving, introduces risks such as ventilator-associated pneumonia (VAP) and other healthcare-associated infections (HAIs), which further complicate ICU management [22,23]. Robust infection control protocols, hygiene practices, and staff training in HICs have demonstrated success in reducing such complications, serving as models for LMICs [24,25].

ICU mortality rates are a pressing global health issue, reflecting disparities in healthcare systems, resource allocation, and clinical practices. Despite advancements in medical care, the global burden of ICU mortality remains unacceptably high, particularly in LMICs. In Ethiopia, ICU mortality rates exceed 40%, with certain hospitals reporting rates as high as 50% due to preventable conditions like sepsis, trauma, and CVDs [15,26,27]. This elevated mortality rate highlights systemic inadequacies, including limited ICU capacity, delayed healthcare access, and insufficient critical care training.

Cardiovascular diseases and strokes are significant contributors to ICU mortality, both globally and in Ethiopia. While these conditions account for a substantial proportion of ICU admissions, the lack of early diagnosis and effective management exacerbates outcomes. For example, studies from Hawassa University Comprehensive Specialized Hospital report a 45.8% mortality rate linked to CVDs and strokes, emphasizing the need for targeted interventions [13,14]. Infectious diseases, particularly sepsis, further compound the problem. Sepsis-related deaths are disproportionately high in LMICs due to delays in recognition, limited antimicrobial therapies, and challenges in infection control [15,16]. Ethiopian studies consistently report sepsis as a leading cause of ICU mortality, with complications such as AKI and septic shock being significant predictors of death [17,18,28].

Resource limitations are a critical barrier to improving ICU outcomes in Ethiopia. The scarcity of ICU beds, advanced technologies, and trained personnel undermines the ability to provide timely and effective care. Moreover, the high prevalence of HAIs, driven by inadequate infection control measures, further worsens patient outcomes. For instance, studies from Jimma University Specialized Hospital reveal strong associations between HAIs and adverse outcomes, underscoring the urgent need for improved hygiene protocols and staff training [29,30]. Traditional risk stratification tools like APACHE and SOFA scores, while effective in HICs, have limited applicability in resource-constrained settings due to differences in patient demographics and healthcare infrastructure [9,31,32]. The lack of locally adapted predictive models hampers the ability to stratify risk and implement timely interventions. Additionally, the emergence of multidrug-resistant organisms complicates sepsis management, highlighting the need for robust antimicrobial stewardship programs [33].

This study is significant in addressing the critical issue of ICU mortality in Ethiopia, offering insights into its predictors and potential interventions. By synthesizing global and regional research findings, this study aims to bridge knowledge gaps and inform evidence-based strategies for improving critical care outcomes. Understanding the factors contributing to ICU mortality, such as sepsis, CVDs, and HAIs, is essential for developing targeted interventions that can save lives. Improving ICU outcomes in Ethiopia has broader implications for healthcare delivery and equity. Strengthening ICU capacity, equipping facilities with advanced technologies, and training healthcare personnel will enhance the overall quality of care. Robust infection control measures, antimicrobial stewardship programs, and community engagement initiatives can mitigate the burden of preventable deaths and improve population health outcomes.

Furthermore, the study underscores the importance of adopting predictive tools like SOFA and integrating machine learning-based algorithms to enhance risk stratification and decision-making in resource-limited settings. These approaches can guide the allocation of scarce resources, ensuring that critically ill patients receive timely and

effective care. By addressing these challenges, this study contributes to the global effort to reduce disparities in critical care and improve survival rates for critically ill patients.

1.1. Objective: To identify prevalence of ICU Mortality and determine its predictors at Hakim Gizaw Referral Hospital from August 2022 to August 2024.

2. Methods

This study was conducted at ICU of Hakim Gizaw Referral Hospital which is opened by Debre Berhan University located in Debre Berhan City, around 130km to the north from Addis Ababa, the capital city of Ethiopia. The hospital has around 130 inpatient beds and 4 intensive care unit beds all with functional mechanical ventilator that serve around 3.5 million people combined with Debre Berhan Comprehensive Specialized Hospital. There is no intensivist but has three Consultant Anaesthesiologist and Critical care specialist serving in this ICU. The study was conducted between Aug 2022 and Augst 2024 on all patients who were admitted at ICU of Hakim Gizaw Referral Hospital.

❖ **Study Design:** A hospital-based retrospective cohort study design was used.

❖ **Population:** Source population: All patients who visited Hakim Gizaw Referral Hospital Intensive Care Unit.

❖ **Study Population:** All patients who visited Hakim Gizaw Referral Hospital Intensive Care Unit during the study period.

❖ **Eligibility Criteria Inclusion:** Patients admitted to the ICU at Hakim Gizaw Referral Hospital during the study period.

❖ **Exclusion**

- Patients whose medical records are incomplete or inaccessible.
- Patients managed in the ICU whose age is less than 18 years old.
- Records lacking critical data on variables necessary for analysis (e.g., Glasgow Coma Score, SOFA score).

2.1. Sampling Technique and Procedure

A total of 304 adult patients were admitted to ICU during the two-year study period from the required sample size is determined by using estimation of single population proportion from August 2022 to August 2024. However, 25 patients were under 18 years old and 10 patients were excluded because of incomplete data. Hence, we get the final sample size for our study were 269 patients. Of this 185 were medical patients and the rest 85 patients were surgical patients.

2.2. Variables

2.2.1. Independent Variables

- **Sociodemographic Characteristics:** Age, sex, and place of residence.
- **Clinical Variables and Admission Diagnosis:** Source of Admission, Type of Patient Case, Admission Diagnosis, vital signs at admission like Systolic Blood pressure, Pulse Rate, Respiratory Rate, Temperature, Saturation off oxygen, Glasgow Coma scale at admission, comorbidities.
- **Interventions Given at ICU:** Fluid Resuscitation, Antibiotics, the use of inotropes, use of Mechanical ventilators, Duration of Mechanical Ventilator use.
- **Complications and Outcome:** Number and Type of Organ failure, electrolyte imbalance, duration of mechanical ventilator use, outcome of the patient.

2.3. Dependent: ICU Mortality

2.3.1. Data Collection

Data were collected through trained general practitioners and nurses using a predesigned Google form questionnaire that was developed from previous research after reviewing different literature reviews. All relevant data including patient demography like age, gender, residency; cause of ICU admission, comorbidity, clinical parameters of the patient during ICU admission, medications given during ICU stay, mechanical ventilator use, electrolyte abnormalities, type and number of organ failures, length of ICU stay, history of readmission and patient outcome of each patient were obtained from the patient electronic medical record. To ensure the data quality training was given for data collectors and supervised by an Anesthesiologist. Information was checked before data was entered for analysis for completeness.

2.3.2. Data Analysis

Data were coded recorded, cleaned and evaluated to get missing values. Data were entered into Epi-Data version 3.1 and will be exported for cleaning and analyses to SPSS version 26. In the descriptive analysis we used mean, standard deviation, frequency and percentage. Basic assumption of logistic regression was checked. We used bivariate regression analysis and those with P value less than 0.20 were included in Multivariate Logistic Regression Analysis to assess the combined effect of significant predictors. Adjusted odds ratio (AOR) with 95% confidence interval (CI) and P-value of <0.05 were considered as statistical significance and were considered predictors of ICU mortality.

- **Data Quality Assurance:** Training for data collectors and daily supervision by the principal investigator. Pre-study evaluation of data collection accuracy.
- **Ethical Considerations:** Ethical clearance is obtained from relevant committees and authorities.
- **Dissemination:** Results to be shared with academic institutions, hospitals, and health bureaus, published in journals, and presented at workshops.

3. Results

3.1. Sociodemographic Characteristics

A total of 269 patients, 185 (68.8%) medical and 84 (31.2%) surgical patients were included in our study. The average age of study patients was 46 years and between 18 years

and 93 years old. The majority of 169 (62.8%) patients were males and the rest 100 (37.2%) patients were females, 190 study patients were admitted from the emergency and 79 were from the ward. From this 35 were readmitted patients. 138 patients lived in Urban and the rest 131 patients lived in Rural areas of Ethiopia. (Table one).

Variables	Category	Frequency	Percentage (%)
Sex	Male	169	62.8
	Female	100	37.2
Residency	Rural	131	48.7
	Urban	138	51.3
Source of ICU Admissions	Ward	79	29.4
	Emergency	190	70.6
Type of Patient Case	Surgical	85	31.6
	Medical	184	68.4
History Of Admission	First Admission	234	86.9
	Readmission	35	13.1
Admission Diagnosis	Shock	66	24.5
	Traumatic Brain Injury	51	19.0
	Heart Failure	30	11.2
	Respiratory Failure	40	14.9
	Stroke	30	11.2
	Others	52	19.3
Co-morbidities	Hypertension	35	13.0
	Heart disease	22	8.2
	Diabetes	19	7.1
	Others	14	5.2
	COPD/ASTHMA	4	1.5
	Total Comorbidities	94	34.9
	No Comorbidity	175	65.1
	Total	269	100%

Table 1: Sociodemographic Co-Morbidities and Admission Diagnosis of Adult Patients Admitted to the Icu of Hakim Gizaw Referral Hospital, August 2022 to August 2024

When we see the disease category during ICU admission, Shock specifically septic shock was found to be the most prevalent accounting for a total of 66 (24.5%). Others like Traumatic brain injury account for 51 (19.0%), Respiratory Failure 40 (14.9%), Heart Failure (mainly because of Valvular heart disease and myocardial infarction), and Stroke (mainly due to hemorrhagic stroke) accounts for 30 (11.2%), the rest of 52 (19.3%) patients accounts other causes like Malignancy, RVI, Poisoning and others top on the list. A total of 94 (34.9%) of ICU admitted patients had at least comorbidities. Hypertension is the commonest comorbidity accounting for 35 (13%) of total ICU admitted study patients. The rest 22(8.2%) of the study patients had heart disease and 19 (7.1%) had diabetes during ICU admission. (Table one).

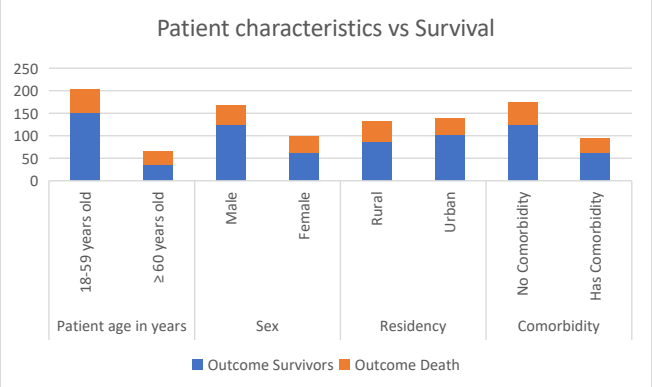

Figure 1: A Bar Graph Showing the Association of Patient Characteristics with Survival

3.2. Admission Vital Signs of Study Participant

A significant percentage of patients presented with one or more abnormal vital signs during ICU first admissions. Specifically, 174 (64.7%) patients had pulse rates above 90 beats per minute, and 146 (54.3%) of patients had respiratory rates above 20 breaths per minute. Whereas 34 (12.6%) of patients had Hypotension, 120 (37.1%) of patients had either a low temperature of less than 36.0°C or a high temperature of 38.0 °C and above, 126 (46.8%) patients had an oxygen saturation of 89% and bellow by peripheral pulse oximeter measurement, 24 (1%) of patients had GCS bellow 8. (Table two).

Variables	Category	Frequency	Percentage (%)
Systolic BP	<90	34	12.6
	90 and above	235	87.4
Pulse Rate	90 and below	95	35.3
	Above 90	174	64.7
Respiratory Rate	20 and bellow	125	46.7
	above 20	146	54.3
Temperature	35.9 and below	80	29.7
	36.0 to 37.9	169	62.8
	38.0 and above	20	7.4
Oxygen Saturation before O2 Administration	89 and bellow	126	46.8
	90 and above	143	53.2
GCS Status at Admission	8 and below	24	1
	9 to 12	245	91

Table 2: Admission Vital Signs of Study Participant admitted to ICU of Hakim Gizaw referral hospital, August 2022 to August 2024

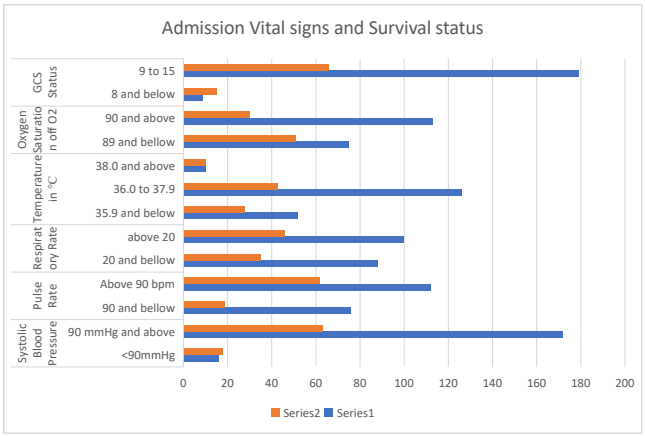

Figure 2: A Bar Graph Showing the Association of Patient Admission Vital Signs with Survival

3.3. Interventions Given at Icu and Complications During Icu Stay

Among studied patients admitted to ICU, 86 (32%) of them had shock during ICU admission; 80 (29.7%) of studied patients needed both potent antibiotics and inotropic medications; 138 patients (51.3%) of patients were put on Invasive Mechanical Ventilation; and 141 (52.4%) of ICU admitted patients stayed in ICU for three days and more, 144 (53.5%) of studied ICU patients took at least one potent intravenous antibiotic from Cefepime/ Vancomycin/Ciprofloxacin/Meropenem) of all studied patients, 167 (62.1%) of patients develop sepsis in ICU, 138 (51.3%) patients develop Organ failure (of which renal failure accounts for the majority 64 (46%) from all organ failures, and around 24% of total ICU patients), 95 (35.3%) of all studied patients develop at least one electrolyte disturbance (majority had hyperkalemia, Hyponatremia, Hypokalemia top on the list) (Table three).

Variables	Category	Frequency	Percent (%)
Resuscitation given	Fluid only	39	14.5
	Fluid + antibiotics	150	55.8
	Fluid + antibiotics + inotropic medications	80	29.7
Shock before ICU admission	No Shock	183	68
	Shock	86	32

Need of Invasive Mechanical Ventilator		No	131	48.7
		Yes	138	51.3
Potent Antibiotics given		No	125	46.5
		Yes	144	53.5
Length ICU stay in days		Less than 3 days	128	47.6
		3 days and more	141	52.4
Complications during ICU Stay	The patient developed sepsis	Yes	167	62.1
	The patient developed electrolyte disturbance	No	102	37.9
	Patients who develop organ failure	Yes	95	35.3

Table 3: Treatment Interventions and Complications of Studied ICU, Hakim Gizaw Referral Hospital, August 2022 to August 2024

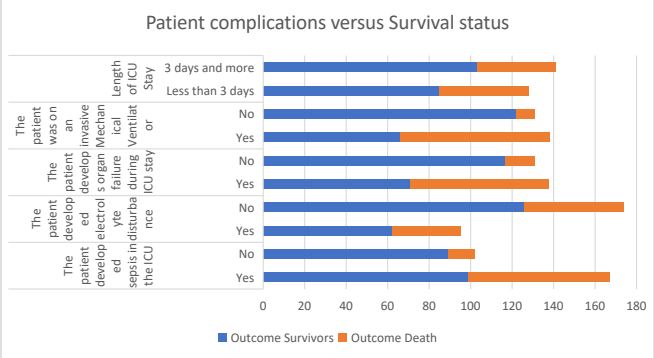

Figure 3: A Bar Graph Showing the Association of Patient Complications with Survival

3.4. Factors Associated with ICU Mortality

The independent variables were checked for possible association using binary logistic regression and Chi2 test. Age, sex, and residency from demographic variables; and systolic blood pressure, pulse rate, oxygen saturation, and GCS from admission vital signs; cause of ICU admission Shock before ICU admission; Organ failure from ICU complications; Type of Interventions given at ICU and Mechanical Ventilator use were selected for Multi-variate Logistic regression analysis, with the P-value less than 0.2 in bi-variate binary logistic regression analysis, four variables; Age 60 years and above(p=0.042), Patients with shock before ICU admission (p=0.003), Patient develop organ failure during ICU stay (p=0.000). Patients on invasive Mechanical Ventilators (p=0.000) were significantly associated with ICU Mortality in the presence of other confounding factors. Those who were on invasive mechanical ventilators are 22 times more likely to die in ICU than those who were not on Mechanical Ventilator (AOR=22.338; CI 7.229-68.363)] (p=0.000). Those who developed organ failure during ICU stay are 7 times more likely to have death outcomes than those who didn't build organ failure (AOR=6.846; CI 2.612-17.941)] (p= 0.000). Those who developed shock before ICU admission are 15 times more likely to have a death outcome than those who didn't build shock (AOR=15.615; CI 2.547-95.722) (p=0.003). Those with age 60 years and above are 2 times more likely to have an outcome of death in the ICU than aged below 60 years old (AOR=2.821; CI 1.039-7.658) (p=0.042). Sex, residency from demographic variables; and systolic blood pressure, pulse rate, oxygen saturation, and GCS from admission vital signs; cause of ICU admission and Type of Interventions given at ICU were not statistically significant for ICU mortality in the multivariate binary logistic regression analysis (Table 4).

Variables	Category	Outcome		COR with 95% CI	AOR with 95% CI	P value
		Survivors	Death			
Patient age in years	18-59 years old	151	52	2.276 (1.275-4.062)	2.821 (1.039-7.658)	.042
	≥ 60 years old	37	29			
Sex	Male	125	44	1.668 (.980-2.840)	.345(.037-.226)	.351
	Female	63	37			
Residency	Rural	86	45	.675 (.399-1.139)	1.627 (.717-3.693)	.244
	Urban	102	36			
Comorbidity	No Comorbidity	126	49	1.327(.774-2.276)		
	Has Comorbidity	62	32			

Systolic Blood Pressure	<90mmHg	16	18	.326 (.156-.677)	2.251 (.622-8.151)	.217
	90 mmHg and above	172	63			
Pulse Rate	90 and bellow	76	19	2.214 (1.227-3.998)	.862 (.323-2.300)	.063
	Above 90 bpm	112	62			
Respiratory Rate	20 and bellow	88	35	1.157 (.684-1.955)		
	above 20	100	46			
Temperature in °C	35.9 and below	52	28	1.004 (.634-1.588)		
	36.0 to 37.9	126	43			
	38.0 and above	10	10			
Oxygen Saturation off O2	89 and bellow	75	51	.390 (.228-.668)	1.680 (.712-3.965)	.236
	90 and above	113	30			
GCS Status	8 and below	9	15	.221 (.092-.530)	1.743 (.515-5.902)	.372
	9 to 15	179	66			
Source of ICU Admissions	From Ward	51	28	.705 (.403-1.233)		
	From Emergency	137	53			
Cause of ICU Admissions	Shock (1)	32	34	8.146 (3.063-21.664)	.384 (.043-3.405)	.334
	Traumatic Brain Injury (2)	42	9	1.643 (.539-5.007)	.395 (.082-1.909)	
	Heart Failure (3)	26	4	1.179 (.305-4.566)	.325 (.036-2.948)	
	Respiratory Failure (4)	23	17	5.667 (1.970-16.303)	.555 (.121-2.546)	
	Stroke (5)	19	11	4.439 (1.435-13.730)	1.934 (.369-10.125)	
	Others (6)	46	6	4.482 (2.564-7.834)		
Shock before ICU admission	No Shock	147	36	4.482 (2.564-7.834)	15.615 (2.547-95.722)	.003
	Septic Shock	41	45			.324
Type of Interventions given at ICU	Fluid only	24	15			
	Fluid + Antibiotics	101	49	2.316 (1.001-5.357)	2.539 (.700-9.208)	
	Fluid + Antibiotics + inotropic medication	63	17	1.798 (.953-3.393)	1.780 (.673-4.705)	
Potent Antibiotics given	No	83	42	1.362 (.808-2.297)		
	Yes	63	81			
The patient developed sepsis in the ICU	Yes	99	68	4.702 (2.433-9.087)		
	No	89	13			
The patient developed electrolyte disturbance	Yes	62	33	1.397 (.816-2.392)		
	No	126	48			
The patient develops organ failure during ICU stay	Yes	71	67	7.886 (4.129-15.062)	6.846 (2.612-17.941)	.000
	No	117	14			
The patient was on an invasive Mechanical Ventilator	Yes	66	72	14.788 (6.951-31.460)	22.338 (7.299-68.363)	.000
	No	122	9			
Length of ICU Stay	Less than 3 days	85	43	.729 (.433-1.230)		
	3 days and more	103	38			

Table 4: Multivariate Analysis of Factors Associated with Icu Mortality in Hakim Gizaw Referral Hospital, August 2022 to August 2024

4. Discussion

This study included 269 patients admitted to the ICU during the study period. The overall mortality rate from admitted ICU patients in our study is 30.0% which is relatively comparable with a study done in Bahir Dar (1), Tigray(2), and lower than other similar studies done in Ethiopia such as studies from Southern Ethiopia(4), Addis Ababa(47)(48), Hawassa(49), and Debre Berhan(23); and in Kenya(50), Nigeria(51), and highest as compared to studies done in USA and India(52), and an overall global study spanning 84 countries examined the burden of critical illness in ICUs and reported an overall mortality rate of 16.2% (53) The

differences in mortality rates may be explained by disparities in healthcare infrastructure and the availability of human resources across the various study locations. This discrepancy may also be attributed to factors such as the smaller sample size and variations in treatment settings among the patients included in this study. [23,31].

Different clinical research has identified several factors that may predict ICU mortality including old age, low GCS, shock at admission, presence of sepsis in ICU stay, length of ICU stays, invasive mechanical ventilator use, antibiotics use, low oxygen saturation, organ failure, stroke, drug/alcohol poisoning, and vasopressor support during ICU stay [4,23,47,49,50,54]. Collaborating these findings our study identified Age 60 years and above, Patients with shock before ICU admission, Patients developing organ failure during ICU stay, and Patients on invasive Mechanical Ventilators as statistically significant independent predictive factors for ICU mortality. Aged 60 years and older have more than 2 times higher likelihood of mortality in the ICU compared to those younger than 60 years old (AOR=2.821; CI 1.039-7.658) Different studies strengthen our result that old age is highly associated with mortality in ICU emphasizing our study result [2,50,55].

Patients admitted to the ICU with an initial diagnosis of shock, particularly septic shock, were found to have a 15 times higher likelihood of mortality in the ICU compared to those admitted with other diagnoses (AOR=15.615; CI 2.547-95.722). This elevated risk is largely attributable to the characteristics of the high prevalence of septic shock with its rapid progression of septic shock with the involvement of multiple organ systems, immune dysregulation, and the complexity of treatment. Supporting this observation, studies conducted in Europe, North America, China, and sub-Saharan Africa similarly report higher ICU mortality rates among patients diagnosed with septic shock compared to those with other admission diagnoses. [54,56–58]. In our study patients with invasive mechanical ventilators are more than likely to have ICU death which aligns with the findings of other studies for instance, a study conducted at Tikur Anbessa Specialized Hospital identified a 60.7% ICU mortality rate among mechanically ventilated patients [4,47,59]. Mechanical ventilation requirements, healthcare-associated infections (HAIs), and delayed hospital admissions further worsen patient outcomes [23,47,53,60].

In our study patients having organ failure in the ICU are six times more likely to have ICU death than patients without organ failure (AOR=6.846; CI 2.612-17.941). A large retrospective study that emphasized our study was done in Germany on 23,795 ICU patients by Tobias M. et.al Patients with organ failure had higher ICU mortality than those with no organ failure, specifically respiratory failure, heart failure, and renal failure were the dominant factors [61].

Other studies in Ethiopia showed patients with sepsis, Organ failure, and neurological disorders exacerbate mortality, consistent with global trends like studies in Kenya, where sepsis and sepsis related shock remains a predominant factor [23,50,61–63].

We observed no statistically significant association between ICU mortality and factors like sex, residency admission vital signs like systolic blood pressure, pulse rate, oxygen saturation, low GCS, cause of ICU admission, and Type of Interventions given at ICU like potent antibiotics and inotropic medications. This difference with our study may be due to the small sample size, difference in study participants, and difference in ICU setup [22,23,50,64]. However, other studies have found that factors such as Comorbidities, tachypnea, low GCS, antibiotic use in the ICU, low oxygen saturation at admission, infection in the ICU, and long-duration ICU stays are statistically significant [1,23,50,59].

For instance, a study conducted in Northwest Ethiopia by Demass T and a meta-analysis done by Edenshaw A, a study on Mechanically Ventilated Patients by Debebe all showed the length of stay in ICU and low GCS of patients associated with ICU mortality [23,27,65,66]. Supporting this, a study conducted in Australia reported that most hospital deaths occurred within the first few days of ICU admission, and an extended ICU stay was not associated with a higher risk of in-hospital mortality [54]. Although our findings did not demonstrate this, studies from the USA, France, and India have reported that patients receiving inotropic treatment had a significantly higher likelihood of ICU mortality compared to those who did not receive inotropes. [23,27,65,66].

Although they are not statistically significant, when we see the number of deaths in female patients, in patients with comorbidities, patients with abnormal vital signs like systolic BP less than 90mmHg, oxygen saturation below 90%, GCS below 8, Shock and respiratory failure as cause of ICU admission, Patients who developed sepsis in ICU, and patients who stayed in ICU for less than 3 days, they all have a high percentage of ICU deaths. If these factors are studied in the future with large data they might have statistically significant associations.

5. Conclusion

This study analyzed predictors of ICU mortality among 269 patients admitted to the Hakim Gizaw Referral Hospital ICU. The overall mortality rate was 30%, which aligns with findings from similar studies in Ethiopia, although it was lower than rates reported in certain other regions of the country and higher compared to global averages. Disparities in healthcare infrastructure, treatment protocols, and patient populations likely contribute to these variations.

Significant predictors of ICU mortality identified in this study include advanced age (≥60 years), septic shock on admission, invasive mechanical ventilation, and organ failure during ICU stay. Each factor underscores the complexity of managing critically ill patients, where advanced age and septic shock markedly increase mortality risk due to systemic challenges and treatment limitations. Similarly, patients requiring mechanical ventilation face elevated mortality rates, consistent with global and regional findings. Interestingly, this study did not find statistically significant associations between ICU mortality and factors

like sex, admission vital signs like low oxygen saturation, tachypnea, hypotension, tachycardia, and low GCS, or interventions like inotropic support, differing from some other studies. These discrepancies may stem from variations in study design, sample size, and ICU setup. This research contributes to understanding ICU mortality predictors in a resource-limited setting, aiding clinicians and policymakers in identifying high-risk patients and optimizing critical care strategies.

Recommendations

Given the high mortality risk associated with shock mainly septic shock, early detection, and aggressive management protocols should be prioritized. Training healthcare staff in shock management and sepsis recognition and initiating standardized treatment bundles can improve patient outcomes. Aged 60 and older are at higher risk of ICU mortality. Specialized care plans tailored to the needs of geriatric patients should be developed, including comprehensive assessments and proactive interventions. Strengthen infection control measures and staff training on optimal ventilator management could mitigate risks associated with mechanical ventilation. Addressing disparities in healthcare infrastructure and human resources can reduce ICU mortality rates. Investments in diagnostic tools, medications, and personnel are critical. Large-scale multicenter studies are recommended to further validate these findings and explore additional factors, including the impact of socioeconomic and environmental determinants on ICU mortality.

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