Original Article

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Prevalence of Mortality and Associated Factors in the Adult Intensive Care Unit of a Private Hospital in Addis Ababa, Ethiopia

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ABSTRACT

Background: *The intensive care unit (ICU) provides specialized care for life-threatening conditions. Critical care remains challenging in developing countries, where health needs exceed resources. ICU mortality in Ethiopia is higher than in developed nations, but data from private-hospital ICUs are lacking. This study assessed mortality prevalence and associated factors among adult ICU patients at a private hospital in Addis Ababa, Ethiopia.*

Methods: *A retrospective cohort study evaluated 366 adult ICU patients selected via simple random sampling from registers at Myungsung Christian Medical Center (MCMC) from January 2018 to December 2019. Data collected via a structured, pre-tested checklist were entered into Epi Info and exported to SPSS. Bivariable and multivariable logistic regressions identified mortality predictors, with model fit assessed using the Hosmer–Lemeshow test.*

Results: *Of 366 patients, 220 (60.1%) were male, and 119 (32.5%) were >60 years (mean age: 50.4 ± 19.18 years). Sepsis (chest or urinary focus) was the primary admission diagnosis (24.3%), followed by surgical conditions (19.4%) and stroke (16.1%). Mechanical ventilation and vasopressors were required by 46.7% and 22.1% of patients, respectively. Overall, 105 patients (29%) died; cardiac arrest caused 31.4% of deaths, and 60% occurred during duty (off-hours) time. In multivariable regression, age >60 years, shock, mechanical ventilation, infection on admission, vasopressor use, and impaired consciousness (GCS ≤8) were independently associated with mortality ($p<0.05$).*

Conclusion: *Private-hospital ICU mortality in Addis Ababa was lower than in Ethiopian public hospitals but remains higher than in developed countries. Older age, shock, mechanical ventilation, vasopressors, admission infection, and impaired **con**sciousness independently predicted mortality, highlighting targets for protocol-driven sepsis and ventilator management.*

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Keywords:Intensive care unit; mortality; associated factors; private hospital; Ethiopia

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1. Introduction

Intensive care, or critical care, is a multidisciplinary specialty dedicated to the comprehensive management of patients with, or at risk of, acute life-threatening organ dysfunction, using an array of technologies to support failing organ systems while the underlying disease is treated. [1] Absolute critical care capacity varies dramatically between countries. Although ICU beds per capita do not strongly correlate with overall health expenditure, they do correlate strongly with mortality, underscoring the need for critical care outcome data from all settings to inform policy. [4,5]

Critical care in resource-poor settings faces distinct challenges, including shortages of drugs, equipment, infrastructure, and trained personnel, alongside late and severe disease presentation due to poor access to care (2). Reported ICU mortality in sub-Saharan Africa ranges widely, from 19.7% in South Africa to 32.9% in Nigeria and 53% in a Kenyan referral hospital, with age extremes, sepsis, acute stroke, and mechanical ventilation or vasopressor requirement consistently identified as risk factors. [8,9,16] In Ethiopia specifically, published studies all conducted in public hospitals report ICU mortality ranging from 12.9% to 39%, with cardiovascular disease and infection among the leading causes of admission. [3,10,11,12,13]

Myungsung Christian Medical Center (MCMC) is one of the largest private hospitals in Addis Ababa and operates a dedicated adult ICU; however, no studies have described ICU mortality or its associated factors in a private-hospital setting in Ethiopia. Since private hospitals typically serve a different patient population and operate under different resource and staffing models than public referral hospitals, mortality patterns observed in public-hospital studies may not generalize to this setting. This study therefore aimed to determine the prevalence of mortality and its associated factors among adult patients admitted to the ICU of MCMC to inform local quality-improvement priorities and contribute comparative data on critical care outcomes in Ethiopia's private health sector.

2. Materials and methods

Study area and period

This study was conducted at Myungsung Christian Medical Center (MCMC), a private hospital in Addis Ababa, Ethiopia, with 210 beds and approximately 32,964 admissions per year. The hospital's ICU was divided into medical and surgical units in April 2019 and currently has 13 beds (4 surgical, 8 medical, and 1 isolation bed), central venous catheterization, vasopressor agents (norepinephrine, epinephrine, and dopamine), broad-spectrum antibiotics, hemodialysis capability, and 10 mechanical ventilators. The hospital has no formal ICU triage policy; admission follows a first-come, first-served approach, and limited bed capacity requires periodic referrals to other hospitals. The study included patients admitted from January 2018 to December 2019.

Study design

This retrospective cohort study with descriptive and analytic components aimed to determine the prevalence of mortality and its associated factors among adult patients admitted to the ICU at MCMC.

Recruitment and study subject

Source population: All patients admitted to MCMC from January 2018 to December 2019.

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Study population: All adult patients admitted to the ICU of MCMC during the study period.

Inclusion criteria: All patients aged 14 years and above admitted to the adult ICU of MCMC between January 2018 and December 2019.

Exclusion criteria: Charts with significant missing data, charts that could not be located

Sample size determination and sampling technique

The sample size was calculated using the single population proportion formula, with a 95% confidence level, an estimated mortality prevalence of 39% based on a prior study at St. Paul's Hospital Millennium Medical College (SPHMMC), and a 5% margin of error, yielding a minimum required sample size of 366 patients. Of the 740 patients admitted during the study period, 47 were excluded because their charts were unlocatable or outcome data were missing. From the remaining 693 records, a pilot study of 37 patients (10% of the sample size) was conducted. Simple random sampling in Microsoft Excel was then used to select the final target sample of 366 complete records from the remaining 656 eligible patient records.

Study variables

Dependent variable: Mortality in the ICU (death vs. survival to discharge/transfer).

Independent variables: Socio-demographic characteristics (age, sex); chronic illness (hypertension, diabetes mellitus, chronic kidney disease, chronic obstructive pulmonary disease, chronic liver disease, cancer, other); length of ICU stay; admission diagnosis; location before ICU admission (emergency department, ward, operating room, or other); length of stay in that location before ICU admission; use of mechanical ventilation; presence of infection at admission and infection acquired after 48 hours; use of vasopressor support; mental status at admission; antibiotic use within one month prior to admission; surgery within one month prior to admission; acute stroke; urethral catheterization; and outcome and timing of death (working hours vs. duty/off-hours).

Operational definitions

Mortality in the ICU: death occurring after ICU admission.

Adult: at MCMC, patients aged 14 years and above are considered adults.

Vasopressor support: use of drugs that constrict blood vessels and/or increase cardiac contractility to maintain systolic blood pressure ≥90 mmHg or mean arterial pressure ≥65 mmHg.

Diagnosed infection: white blood cell count >12,000 or <4,000/µL, chest radiographic evidence of pneumonia, urinalysis evidence of urinary tract infection, or clinical evidence such as fever, cough, or urinary symptoms during ICU stay or at admission.

Mental status: assessed using the Glasgow Coma Scale (GCS); GCS ≤8 was classified as unconscious and GCS >8 as conscious.

Duty (off-hours) time: Defined as weekday night shifts (5:00 PM to 8:00 AM), Saturdays after 12:00 PM, and all hours on Sundays and public holidays.

Data collection and quality assurance

Data were collected using a structured checklist developed by the investigators and pre-tested on 10% of the sample size among patients outside the study sample; the checklist was revised based on pre-test findings. Data collectors received 2–4 hours of training on study objectives, relevance, and confidentiality before data collection. A supervisor reviewed each checklist for completeness, and data were

entered into EpiInfo, configured to automatically check consistency and skip patterns during entry, before export to SPSS version 26 for cleaning and statistical analysis.

Data analysis

Descriptive statistics were used to summarize socio-demographic, clinical, and outcome variables. Bivariable logistic regression was used to screen candidate predictors of mortality; variables with $p<0.25$ were entered into a multivariable logistic regression model. We assessed model fit using the Hosmer–Lemeshow goodness-of-fit test. Associations are expressed as crude and adjusted odds ratios (COR, AOR) with 95% confidence intervals, and $p<0.05$ was considered statistically significant in the multivariable model.

Ethical statement

Ethical approval was obtained from the Department of Emergency Medicine and Critical Care, Addis Ababa University College of Health Sciences, and institutional permission was obtained from MCMC by formal written request. Patient data were recorded using initials only to protect confidentiality, and data were used solely for the purposes of this study. The requirement for informed consent was waived due to the retrospective, observational nature of the study and the use of anonymized patient data.

3. Results

Characteristics of patients

A total of 366 patients were included in the study. Of these, 220 (60.1%) were male, and 119 (32.5%) were older than 60 years, with a mean age of 50.4 (±19.18) years. Most patients were admitted from the emergency department (48.9%), followed by the operating room (26.8%) and the ward (20.8%); the remaining patients were admitted from dialysis or outpatient services (3.5% combined) (Table 1).

Table 1. Characteristics of patients admitted to the adult ICU, MCMC Hospital, Addis Ababa, 2018–2019 (N=366)

Variable	Category	Frequency	Percentage
Sex	**Male**	220	60.1%
	Female	146	39.9%
Age, years	**15–35**	103	28.1%
	36–60	144	39.3%
	>60	119	32.5%
	Mean (±SD)	50.4 (±19.18)	–
Location before ICU admission	**Emergency room**	179	48.9%
	Ward	76	20.8%
	Operating room	98	26.8%
	Dialysis/OPD	13	3.5%

Clinical profile

The most common admission diagnosis was infection, including sepsis of chest or urinary focus (24.3%), followed by surgical conditions (19.4%) and stroke (16.1%). Electrolyte imbalance was present in 13.7% of patients, shock in 17.8%, and impaired consciousness (GCS ≤8) in 31.3% at admission. A chronic illness was present in 61.7% of patients, most commonly cancer (15.6%) and hypertension (13.7%). Infection was present at admission in

39.3% of patients and developed after 48 hours in a further 14.2% (Table 2).

Table 2. Clinical profile of patients admitted to the adult ICU, MCMC Hospital, Addis Ababa, 2018–2019 (N=366)

Variable	Category	Frequency	Percentage
Admission diagnosis	**Sepsis (chest, urinary focus)**	87	24.3%
	Surgical	71	19.4%
	Stroke	59	16.1%
	Trauma	53	14.5%
	Metabolic	30	8.2%
	Cardiac disorders	19	5.2%
	CNS disorders	15	4.1%
	Malignancy complication	12	3.3%
	OBGYN	10	2.7%
	Pulmonary disorders	8	2.3%
Electrolyte imbalance	**Present**	50	13.7%
Shock	**Present**	65	17.8%
Mental status (GCS ≤8)	**Present**	110	31.3%
Chronic illness	**Any**	226	61.7%
	More than one	80	21.9%
	Cancer	57	15.6%
	Hypertension	50	13.7%
	Diabetes mellitus	18	4.9%
Infection	**On admission**	144	39.3%
	≥48 hours after admission	52	14.2%

Management and outcome of patients

Mechanical ventilation was required by 171 patients (46.7%) and vasopressor support by 81 (22.1%), most commonly dopamine (44.5%). Antibiotics were administered to 72.7% of patients, and 41.8% underwent surgery before or during their ICU stay, most commonly neurosurgical procedures (64.8%). Urethral catheterization was performed in 77.3% of patients. Of the total study population, 105 (29%) died, 231 (63.1%) were transferred to the ward, 16 (4.3%) were referred to another hospital, 11 (3%) left against medical advice, and 3 (0.8%) were discharged home. Cardiac arrest accounted for 31.4% of deaths, and 60% of deaths occurred during duty (off-hours) time versus 40% during regular working hours (Table 3).

Table 3. Management and outcome of patients admitted to the adult ICU, MCMC Hospital, Addis Ababa, 2018–2019 (N=366)

Variable	Category	Frequency	Percentage
Mechanical ventilator	**Yes**	171	46.7%
Vasopressor use	**Yes**	81	22.1%
Type of vasopressor	**Dopamine**	36	44.4%
	Norepinephrine	23	28.4%
	Dopamine + norepinephrine	13	16.0%

	Dopamine + epinephrine	3	3.7%
	Epinephrine	2	2.5%
	Other	4	4.9%
Duration of vasopressor use	**<1 day**	12	16.4%
	1 day	16	21.9%
	2 days	15	20.5%
	3 days	13	17.8%
	≥4 days	17	23.3%
Antibiotic use	**Yes**	266	72.7%
Surgery (before/during ICU stay)	**Yes**	153	41.8%
Type of surgery	**Neurosurgery**	99	64.8%
	General surgery	32	20.9%
	Gynecological surgery	9	5.8%
	Other	13	8.5%
Urethral catheterization	**Yes**	283	77.3%
Outcome	**Transfer to ward**	231	63.1%
	Death	105	29.0%
	Referred to another hospital	16	4.3%
	Left against medical advice	11	3.0%
	Discharged home	3	0.8%
Time of death	**Duty (off-hours) time**	63	60%
	Working hours	42	40%

Note: Of the 81 patients who received vasopressors, exact duration was recorded for 73 patients; 8 patients had incomplete timing logs in their medical records regarding exact duration.

Factors associated with mortality

In bivariable logistic regression, variables with p<0.25 were entered into the multivariate model. The Hosmer–Lemeshow test confirmed adequate model fit (p=0.64). In the multivariable logistic regression, age >60 years, shock, mechanical ventilation, infection on admission, vasopressor use, and impaired mental status (GCS ≤8) remained independently associated with mortality after adjusting for other variables (p<0.05). Sex, admission location, previous ICU admission, presence of chronic illness, electrolyte imbalance, infection after 48 hours, recent surgery, acute stroke, and urethral catheterization were not independently associated with mortality in the multivariate model (Table 4).

Table 4. Factors associated with mortality among patients admitted to the adult ICU, MCMC Hospital, Addis Ababa, 2018–2019

Variable	Category	Survivors (n=261)	Deaths (n=105)	COR (95% CI)	P	AOR (95% CI)	P
Age	**>60 years old**	70	49	3.54 (1.87–6.68)	<0.001	3.13 (1.14–8.58)	0.043

	36-60 years old	105	39	1.87 (0.99–3.55)	0.683	1.37 (0.55–3.42)	0.615
	15-35 years old	86	17	1		1	
Sex	**Male**	151	69	1.39 (0.87–2.23)	0.124	1.46 (0.75–2.84)	0.245
	Female	110	36	1		1	
Location prior to admission	**ER**	125	54	1.28 (0.25–6.58)	0.760	0.55 (0.06–4.83)	0.595
	Ward	37	39	3.24 (0.61–17.08)	0.165	1.13 (0.13–10.14)	0.912
	OR	91	7	0.23 (0.03–1.36)	0.154	0.082 (0.006–1.069)	0.056
	Other (HD,OPD,LW)	8	2	1		1	
Previous ICU admission	**Yes**	28	19	1.86 (0.99–3.51)	0.053	1.40 (0.54–3.63)	0.487
	No	233	86	1		1	
Chronic illness	**Yes**	155	71	1.48 (0.91–2.40)	0.107	1.55 (0.68–3.51)	0.295
	No	106	34				
Category of illness	**Medical**	140	76	2.21 (1.35–3.63)	0.002	0.29 (0.11–0.78)	0.015
	Surgical	121	29	1		1	
Electrolyte imbalance	**Yes**	30	20	1.84 (0.99–3.41)	0.053	1.05 (0.44–2.54)	0.900
	No	231	85	1		1	
Shock	**Yes**	28	37	4.61 (2.63–8.08)	<0.001	3.74 (1.22–11.26)	0.019
	No	233	68	1		1	
Mechanical ventilator	**Yes**	84	87	9.94 (5.62–17.59)	<0.001	13.28 (5.22–33.75)	<0.001
	No	177	18	1		1	
Infection on admission	**Yes**	83	61	3.05 (1.91–4.89)	<0.001	2.11 (1.01–4.39)	0.046
	No	179	43	1		1	
	Yes	29	23	2.28 (1.24–4.16)	0.007	0.62 (0.27–1.44)	0.271
	No	232	82	1		1	
Vasopressor use	**Yes**	26	55	10.18 (5.82–17.81)	<0.001	3.86 (1.50–9.92)	0.050
	No	235	50	1		1	

Mental status	**GCS ≤8**	58	52	3.51 (2.17–5.69)	<0.001	2.25 (1.10–4.59)	0.026
	GCS >8	203	53	1		1	
Recent surgery (≤1 month)	**Yes**	113	19	0.29 (0.16–0.51)	<0.001	0.69 (0.21–2.31)	0.546
	No	148	86	1		1	
Acute stroke	**Yes**	45	14	0.75 (0.41–1.35)	0.343	–	–
	No	216	91	1			
Urethral catheterization	**Yes**	193	90	2.08 (1.12–3.83)	0.192	1.04 (0.38–2.86)	0.934
	No	68	15	1		1	

Note: Category of illness (Medical vs. Surgical) reflects primary diagnostic domain, incorporating primary surgical admissions, trauma, and acute perioperative surgical cases.

4. Discussion

This study aimed to describe the demographic and clinical profile, outcome, and associated risk factors of mortality among adult patients admitted to the ICU of a private hospital in Ethiopia.

The mean age in this study (50.4 years) was higher than reported in most African studies, including Ethiopian public-hospital studies from Jimma (32 years), Ayder (43 years), and TASH (37 years) [3,10,11], though lower than a US-based cohort (63 years). [14] This difference may reflect the socioeconomic profile of patients accessing private-sector care in Addis Ababa. L most comparator studies, which showed male predominance, this study, similar to the Jimma cohort [3] showed a slight female predominance.

Infection, particularly sepsis of chest or urinary focus, was the leading admission diagnosis in this study, differing from studies in the USA, Nigeria, Kenya, and South Africa, which reported more surgical admissions [8,9,14,16], and partially differing even within Ethiopia, where cardiovascular disease predominated at Ayder and Jimma, infectious disease at TASH, and diabetic ketoacidosis at St. Paul's Hospital Millennium Medical College. [3,10,11,13]

Overall ICU mortality in this study was 29%, comparable to the 32% reported at TASH (11) but lower than the 39% reported at St. Paul's Hospital Millennium Medical College [13] and substantially lower than the 53% reported in western Kenya. [16] A more recent TASH study reported 12.9% mortality, though the reasons for this lower rate were not discussed in that report. [12] Age older than 60 years was associated with a roughly three-fold increase in mortality risk, consistent with findings from western Kenya (age >50) and the United States. [14,16] Shock and infection on admission were independently associated with mortality in this study; while other studies did not identify shock specifically, sepsis was similarly associated with mortality in the Kenyan cohort. [16] Use of mechanical ventilation and vasopressor support at any point during ICU stay were strongly associated with mortality, consistent with the Kenyan study [16], and impaired consciousness (GCS ≤8) was associated with a substantially increased risk of death, consistent with findings from the United States. [14] Unlike some other

studies, male sex, emergency-department admission, acute stroke, and ICU-acquired infection were not independently associated with mortality in this cohort.

In the bivariable analysis, medical admissions were associated with higher crude mortality. However, after adjusting for key critical care interventions and disease severity, specifically mechanical ventilation and neurosurgical operative status surgical conditions emerged with higher adjusted mortality risk. This directional shift is likely explained by confounding, as surgical patients requiring ICU-level care often presented with severe acute neurological conditions, such as traumatic brain injury or neurosurgical emergencies requiring mechanical ventilation, which were associated with high mortality after adjustment for clinical severity.

Strengths and limitations

This is the first study to describe ICU mortality and its associated factors in a private-hospital setting in Ethiopia, providing comparative data previously available only from the public sector, and its analytic design allowed identification of independent predictors of mortality rather than description alone.

This study is limited by its retrospective design, which made it difficult to follow patients after transfer to the ward, referral to another hospital, discharge, or departure against medical advice, potentially leaving residual confounding unaccounted for in the multivariable model. Data completeness was also constrained by the availability and quality of clinical documentation in the medical record. Finally, given the 105 outcome events relative to the number of candidate predictors, individual estimates with borderline statistical significance should be interpreted with caution due to potential model over fitting and reduced estimate stability.

5. Conclusion and Recommendation

This study provides the first description of ICU mortality and its associated factors in a private-hospital setting in Ethiopia. Although private hospitals are generally assumed to have greater resources than public facilities, ICU mortality in this cohort remained high at 29%. Older age, shock, mechanical ventilation, vasopressor use, infection at admission, and impaired consciousness were independently associated with mortality, pointing to sepsis management and ventilator care as priority targets for quality improvement.

Based on these findings, we recommend the development of standardized sepsis management protocols at both the institutional and national level; standardized protocols for mechanical ventilator management; targeted training of ICU clinicians in sepsis and ventilator care; and prospective studies to further characterize these associations while accounting for additional confounding factors.

Abbreviations

AOR: Adjusted odds ratio
ARDS: Acute respiratory distress syndrome
CI: Confidence interval
CKD: Chronic kidney disease
CLD: Chronic liver disease
COPD: Chronic obstructive pulmonary disease
COR: Crude odds ratio
DKA: Diabetic ketoacidosis
GCS: Glasgow Coma Scale
ICU: Intensive care unit
MAP: Mean arterial pressure
MCMC: Myungsung Christian Medical Center
SBP: Systolic blood pressure
SPHMMC: St. Paul's Hospital Millennium Medical College
TASH: TikurAnbessa Specialized Hospital
TBI: Traumatic brain injury

UTI: Urinary tract infectioN

WBC: White blood cell

Author Contributions

(SH): Conceptualized and designed the study, collected and analyzed data, and drafted the manuscript.
(TB and AA): Supervised study design and data analysis, and critically reviewed and revised the manuscript.

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Competing interests

The authors declare no competing interests.

Data Availability

The data supporting the findings of this study are available from the corresponding author on reasonable request.

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