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ORIGINAL ARTICLE

Epidemiology of Trauma Presenting to the Emergency Medicine Department of the University of Port Harcourt Teaching Hospital

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Factors Associated with Delayed Hospital Arrival among Patients with Acute Coronary Syndrome in Addis Ababa, Ethiopia: A Cross-Sectional Study

CASE REPORT

Severe malaria-associated secondary glaucoma: a case report

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PERSPECTIVE

From Global Frameworks to Africa's Disaster Risk Reduction Realities: Gaps and the Path to 2030

Ethiopian Society of Emergency and Critical Care
Professionals



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Epidemiology of Trauma Presenting to the Emergency Medicine Department of the University of Port Harcourt Teaching Hospital

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ABSTRACT

Background: Trauma is a global burden increasing worldwide. It is important to conduct trauma epidemiological population-based studies to identify the types of traumas, their causes, and dynamics.

Objective: To determine the epidemiology of trauma at the emergency medicine department (ED) of the University of Port Harcourt Teaching Hospital (UPTH).

Method: A prospective descriptive cross-sectional study design was utilized, and it was conducted over 6 months, from September 2025 to February 2026.

Result: The study included 459 trauma patients, of whom 317 (67%) were male; 426 (92.8%) were conscious; and 450 (98.0%) were named (i.e., had a form of identity). The majority of the patients were aged 21-30 years, 125 (27.2%). The most common mechanism of injury was road traffic Accident (RTA), 213 (46.4%), and assault, 107 (23.3%). Most of the RTA victims were pedestrians, 128 (60.1%). Most of the RTAs were car/bus – car/bus 18 (21.2%), motorcycle – motorcycle 17 (20.0%), and the vehicle car, bus, motorcycle, and tricycle did not hit anything 17 (20.0%), and the lower limb 109 (21.1%) was the most common part of the body that sustained injury. Most of the patients, 195 (42.5%), were discharged within 24 hours, and sadly, 8 (1.8%) died.

Conclusion: Males were more frequently affected by trauma than females, and the majority of trauma victims were young adults. RTAs were the most common mechanism of injury. Most of the injuries sustained were in the lower limbs, and most of the patients were discharged home within 24 hours.

Keywords: Injury Patterns, incidence, epidemiology, Road Traffic Accident

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1. Introduction

Injuries are a public health problem of concern worldwide.⁽¹⁻⁴⁾ The burden of trauma is irrespective of the level of socio-economic development and the trauma system available.⁵ Although in modern societies it has been overlooked and neglected, especially in low-resource settings^(5,6), including developing countries like Nigeria, where there is no comprehensive system.⁽⁷⁻⁹⁾ The prevalence of trauma differs from country to country. Annually, more people die from injuries than HIV, tuberculosis, and malaria combined, and the majority of these deaths occur in low- and middle-income countries.⁽¹⁰⁾ The burden, disability, morbidity, and mortality from trauma are highest in sub-Saharan Africa.⁽¹¹⁾ Globally, five million people die after sustaining diverse forms of injury every year⁴, which accounts for 9% of all mortalities globally.⁷ Trauma ranks as the sixth leading cause of death, with injury is 11:2/100,00.⁷ Humans are involved in several activities that can result in injury with physical, psychological, economic, and social impacts. Injuries are a significant cause of socioeconomic burden to the victims.^(12,13)

A common cause of morbidity and mortality in Africa is trauma. However, in developing countries, the systems for the management of trauma are deficient.⁽¹⁴⁾ The ED is a critical aspect of the health facility involved in the management of trauma.¹⁵ The risk factors attributed to injuries are linked to the behavior of man as well as cultural, sociosanitary, occupational, economic, and political variables.⁽¹⁶⁾ The growing incidence of trauma, including road traffic accidents, in developing countries has been associated with urbanization⁽¹⁷⁾, industrialization, and increased motor vehicles.^(5,18) Ballistic injuries resulting from conflicts and wars.⁽¹⁹⁾ The outcome

measures help to assess the impact of the mechanisms of trauma on the health of the patient and the healthcare system.

It is important to conduct trauma epidemiological population-based studies to identify the types of traumas, their causes, and dynamics. Results of such studies may help to facilitate prevention, develop optimal trauma systems, formulation of optimal policies, formulate optimal policies, and support strategic planning, and reduce the morbidity, disability, and mortality associated with it.^(15,20) It is important in developing strategies for the prevention of trauma^(7,21), decision-making, and improvement in the management of trauma⁽⁶⁾, and identification of populations at risk to enable the development of protocols in trauma management.⁽²¹⁾ However, in Nigeria, there is a lack of epidemiological data on trauma. This has been linked to poor record-keeping and accident reporting. Hence, this study aims to investigate the mechanism of injury, injury pattern, and outcome of patients with trauma.

2. Method

This is a descriptive cross-sectional study conducted at the ED of UPTH. It is a census, as all patients with a history of trauma were recruited into the study. The study population was all patients with a history of trauma presenting at the ED of UPTH. The World Health Organization (WHO) Emergency Trauma Form was adapted for data collection. Data were collected for over six months, from September 2025 to February 2026. The Cochrane sample size determination formula was used to calculate the sample size. A prevalence of 24.3% was used, which was derived from a study conducted in Enugu, eastern Nigeria.⁽²²⁾ This gave a sample size of 73. The data were collected on an Excel sheet. It was then

transferred into SPSS and analyzed. The data were then utilized, and the results were presented using charts and tables. The inclusion criteria were patients with a history of trauma, irrespective of their gender or age. The study was limited to the ED of UPTH; hence the limitation, as patients with burns, which is a type of trauma, were not incorporated into the study. This is because patients with burns go directly to the regional burns Centre within the premises of UPTH. Also, the patients recruited into the study were not followed up after leaving the ED.

Inclusion and Exclusion Criteria: The inclusion criteria are patients presenting at the University of Port Harcourt Teaching Hospital with trauma, irrespective of their age, while the exclusion criteria are patients with burns. This is because patients with burns go directly to the Burns Centre located within the premises of UPTH.

Operational definition of terms:

Trauma can be defined as any physical injury that occurs when an external force impacts the body.^(10,23)

Section 252 of the Criminal Code Act of Nigeria defines assault as a person who strikes, touches, moves, or otherwise applies force of any kind to the person or another, either directly or indirectly, who by any bodily act or gesture attempts, or threatens to apply force of any kind to the person.⁽²⁴⁾

The emergency department is a clinical unit in UPTH that attends to patients with medical emergencies and trauma irrespective of age.

3. Result

Data for this study were collected for over 6 months from September, 2025 to February 2026. It comprised 459 patients. The number of patients who presented at the ED over the study period was 2957. The prevalence of trauma at the ED of UPTH is 15.5%. There was a reduced number of patients in November 2025 due to the industrial action by the National Association of Resident Doctors (NARD), and later by another group of health workers. The number of patients with a history of trauma included in this study was 459.

Table 1: Socio-demographics

Variable	Frequency N= 459	Percent
Age Range		
≥10	25	5.4
11-20	60	13.1
21-30	125	27.2
31-40	91	19.8
41-50	66	14.4
51-60	34	7.4
61-70	22	4.8
71-80	7	1.5

81 and above	7	1.5
Unknown age, but an adult	22	4.8
Gender		
Male	317	69.1
Female	142	30.9
Level Of Consciousness		
Conscious	426	92.8
Unconsciousness	33	7.2
Patient's Identity		
Named	450	98.0
Unknown	9	2.0
Month		
September 2025	85	18.5
October 2025	117	25.5
November 2025	33	7.2
December 2025	70	15.3
January 2026	69	15.0
February 2026	85	18.5
Total	459	100

The ages of the patients ranged from 10 months to 92 years. The unknown patients were brought to the hospital by bystanders, good Samaritans, law enforcement agents, military, and paramilitary personnel. Table 1 shows the sociodemo-

graphic characteristics, level of consciousness, and identity of the study participants. The majority of the patients were 21-30 years (27.2%. All the unknown patients were adults.

Table 2: Mechanism Of Injury

Mechanism	N	z	%
Road traffic accident	213		46.4
Assault	107		23.3
Slipped and fell	37		8.1
Domestic accident	22		4.8

Animal bite	20	4.4
Fall from height	18	3.9
Industrial/occupational accident	13	2.8
Sports accident	7	1.5
Gunshot injury	7	1.5
Fell off a moving bus with the door open	3	0.7
Fireworks were thrown at the patient	2	0.4
Fell off a moving motorcycle	2	0.4
Others	8	0.1
Total	459	100

Table 2 shows the mechanism of the injury; 213(46.4%) had a road traffic accident, and 107(23.3%) were victims of assault. For patients

who had animal bites, 60% were bitten by a dog, 20% by a snake, 15% by a cat, and 5.0% by a scorpion.

Table 3: For Assault, the assailant

Person Who Assaulted the Patient	N	%
Neighbour	40	37.4
Armed Robbers	23	21.5
Colleague	7	6.5
Kidnappers	6	5.6
Vigilante	5	4.7
Relative	5	4.7
Boyfriend/Husband	5	4.7
Mop	3	2.8
Bus Conductor/Driver	3	2.8
Communal Conflict	2	1.9
Others	8	7.2
Total	107	100

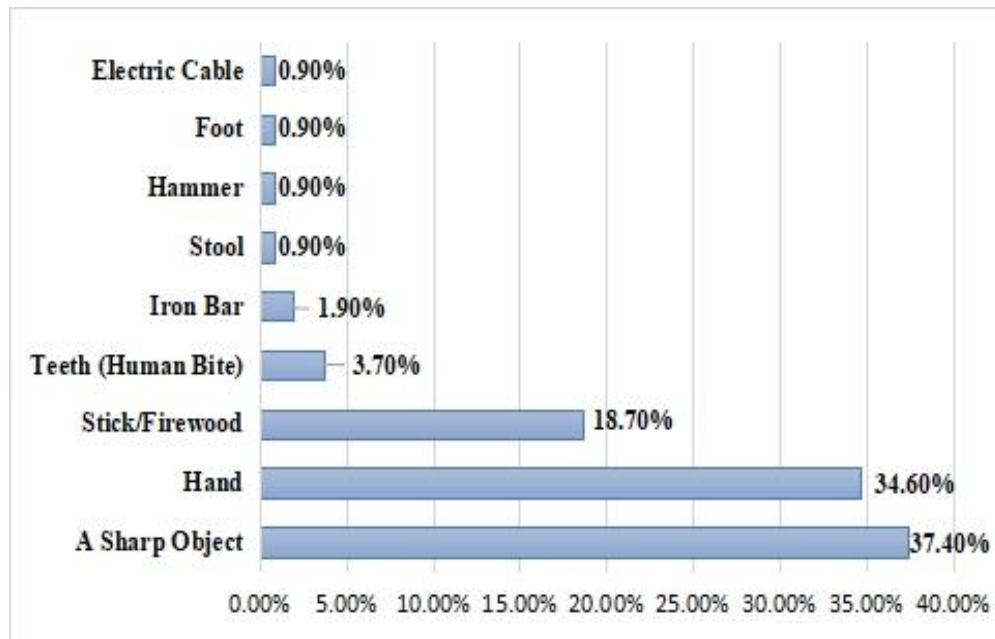


Figure 1: Object used in assaulting the patient

Four (3.7%) of the patient were bitten by their assailant.

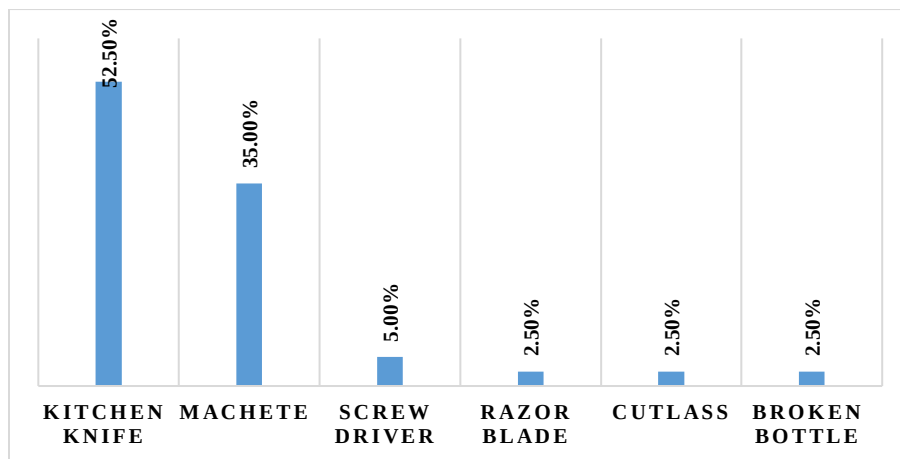


Figure 2: Sharp object used in assaulting the patient

Table 4: Part Of the Body Affected

Part Of the Body Affected	N= 517	Percent
Head, Face And Neck	152	29.4
Lower Limb	109	21.1
Soft Tissue	90	17.4

Upper Limb	88	17.0
Chest	41	7.9
Abdomen	17	3.3
Spine and Spinal Cord	13	2.5
Genitals	4	0.8
The Entire Body	2	0.4
No Bodily Injury	1	0.2
Shoulder	12	31.6
Knee	9	23.7
Temporomandibular	5	13.2
Ankle	4	10.5
Wrist	2	5.3
Elbow	2	5.3
Sternoclavicular	1	2.6
Acromioclavicular	1	2.6
Metatarsal	1	2.6
Hip	1	2.6

The patients sustained several degrees of injury; some patients had injuries to more than one part of the body. The number of injuries is more than the number of patients because some patients sustained more than one injury. The head, face, and neck were injured in 29.4% of patients, while the lower limb was injured in 21.1% of patients. Injuries to the head and neck involved the scalp, various types of traumatic brain injury (mild, moderate, and severe), and injuries to the face, neck, eyes, nose, and ears. Injuries to the

eye, abdomen, and chest were either blunt or penetrating. One patient did not sustain any bodily injury. Table 4 shows the part of the body affected and the joint dislocated, while Table 5 shows the bones fractured. Some patients had more than one bone fractured: 33 (33.0%) had fractures of the tibia and fibula, 15(15.0%) of the ulna and radius, and 11(11.0%) of the femur. The shoulder was the most commonly dislocated joint, occurring in 12 (31.6%) patients, followed by the knee joint in 9 (23.7%) patients.

Table 5: Bone Fractures

Bone Fractured	N	%
Tibia and Fibula	33	33.0
Ulnar and Radius	15	15.0
Femur	11	11.0
Humerus	9	9.0
Skull	7	7.0
Mandible	7	7.0
Pelvic Bone	5	5.0
Spine	4	4.0
Ribs	2	2.0
Zygomatic Bone	2	2.0
Patella	2	2.0
Clavicle	2	2.0
Metatarsal	1	1.0
Total	100	100

Table 5 shows the bone fractures. Some of the patients had fractures in more than one bone fractured, which is why the number of bones fractured exceeds the population in the study.

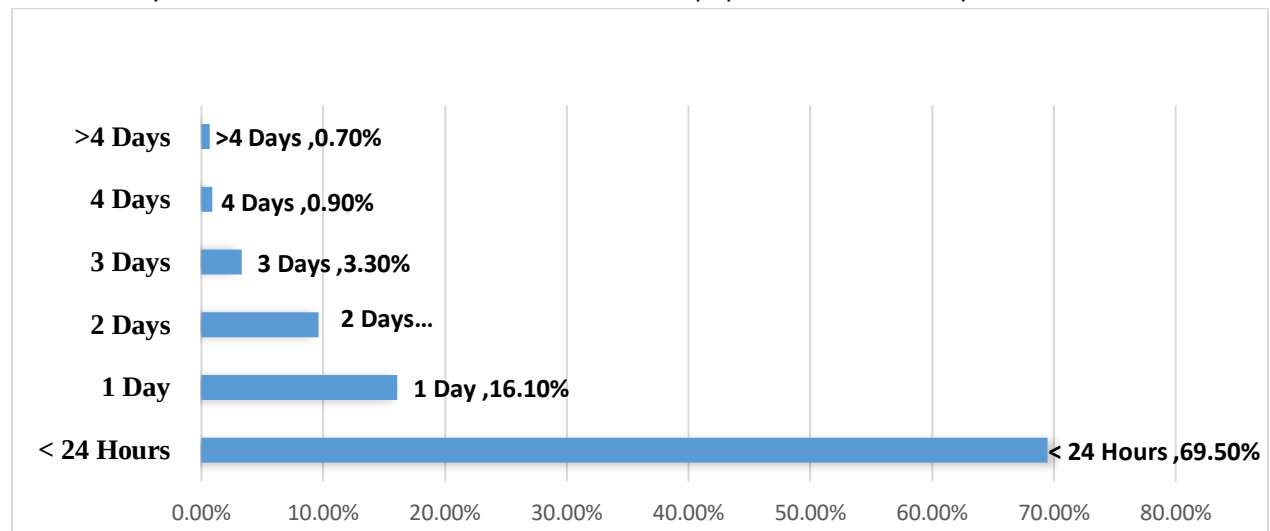


Figure 3: Length of stay in the emergency Department

Figure 3 shows the length of stay in the ED, while Figure 4 shows the outcome. The length of stay of the trauma patients in the ED ranged from <

24 hours to 11 days. Most of the patients spent less than 24 hours in the ED. Concerning the patients who refused admission, one patient left

during physical examination, one patient in haemorrhagic shock refused blood transfusion,

while one patient refused suturing of the laceration sustained.

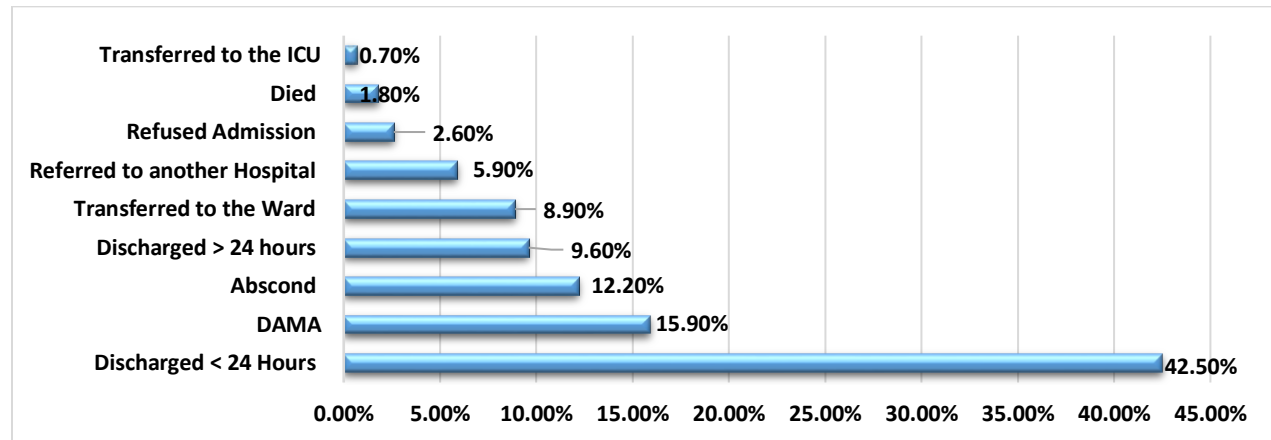


Figure 4: Outcome of Patients with Trauma

4. Discussion

The age range and majority of the patients are similar to a study conducted in Prayagraj, India, where the majority of the patients were aged 11-40 years. It is postulated that young adults are prone to accidents because they are involved in outdoor activities. Some abuse hard drugs and are involved in illicit drug use.⁽⁵⁾ There were more males in the study because males tend to be risk-takers. Also, in Nigerian culture, men are the breadwinners of their families; hence, they are also sometimes away from home on the road. The majority of the patients who sought medical care at the ED of UPTH are non-trauma cases. This agrees with a study conducted among major hospitals, where the prevalence of trauma at the ED was 9.13%.⁽¹⁴⁾ The cause of death in this study was haemorrhagic shock and severe traumatic brain injury. This correlates with other studies conducted in northern Ghana and other studies.^(17,23) This may be because the blood lost needs to be replaced immediately. Also, haemorrhagic shock gets worse and becomes irreversible if it is not promptly managed. There is an increase in mortality in trauma patients with traumatic brain

injury.⁽²⁵⁾ More males were victims of trauma, which was similar to other studies where more males sustained injuries following trauma, like studies conducted in Ghana^(17,23), National Trauma Centre, Abuja, Nigeria⁽²⁶⁾, Nepal⁽¹⁵⁾, and Haiti⁽²⁷⁾. In other studies, conducted in Ethiopia⁴, Tanzania⁽¹⁴⁾, Nepal⁽²⁵⁾, and India.⁽⁵⁾ Even in studies in various hospitals in Nigeria, in Jos⁽²⁸⁾, Makurdi⁽²⁹⁾, and Ilorin.⁽²¹⁾ This has been linked to the adventurous nature of males.⁽³⁾ The majority of the patients were conscious. As in the Tanzanian study¹⁴, males are also known to take risks and, on the road, to make money to cater for their families, especially as the extended family system is practiced in Nigeria.

Most of the patients were known and named; that is, they had an identity, while a few were unknown. The unknown patients were brought to the ED by bystanders who were around the place of the incident, law enforcement agents, military, and paramilitary personnel. Most of the unknown patients were young adults.

The most common mechanism of injury was RTA, followed by assault. This finding is consistent with several studies conducted globally, which have similarly reported RTAs as the lead-

ing cause of traumatic injuries.^(18, 25, 30, 31) This is due to civilization, modernization, and industrialization, with the transformation in the various vehicles used for transportation.^(3,32) There is an increased use of vehicular modes of transportation. The age range of trauma patients in this study is similar to other similar studies.^(8,17,18) Young people are adventurous and also tend to be involved with reckless driving and the use of psychoactive substances, which may interfere with concentration while driving.

Regarding assault-related injuries, most assailants were individuals known to the victims, including neighbors, colleagues, relatives, intimate partners, friends, sons, siblings, supervisors, and community members. The study did not investigate the type of neighborhood the patient was residing in to know if it was a shared apartment known as "face-me-I-face-you" in Nigeria, where the occupants share a common toilet or bathroom. This sometimes leads to conflict in maintaining the cleanliness of the shared sanitary facilities. Most of the injuries are inflicted on the patient using a sharp object, commonly a kitchen knife. Some others were bitten by animals, including domestic animals (cats and dogs), reptiles (snakes), and scorpions. The most common animal bite was by a dog. Some patients suffered more than one type of injury, and some more than one part of the body was affected. The result of this study is in contrast to a study where armed robbers were the common assailants. The head was a common organ affected in previous trauma studies.^(14,15,19,20) It is different from a study conducted in Haiti, where the upper limb was where most of the trauma patients sustained injuries.^(11,19) The result was similar to a Sierra Leonean trauma study, where the head and lower limb were the commonest parts of the body affected.¹¹ The commonest bones were

the long bones of the upper and lower limbs, while the shoulder joint was the most dislocated. Most of the patients were discharged and went home within 24 hours. All the patients who died had severe traumatic brain injury and haemorrhagic shock. Patients who were transferred to another tertiary hospital presented during an industrial strike. This is similar to a systematic review where haemorrhage and injury to the head were the cause of mortality⁷ and also in other studies.⁽²⁰⁾

Traumatic brain injuries remain a leading cause of mortality in trauma patients.⁽³³⁾ Only one patient in the cohort did not sustain any form of injury. There is a clear need for preventative strategies to reduce the incidence and severity of such trauma. There should be injury prevention strategy education of the populace.⁽³⁴⁾

Limitations

The study was limited to the ED of UPTH, as patients with burns, which is a type of trauma, were not recruited into the study. This is because patients with burns go directly to the regional burns Centre located within the premises of UPTH. Hence, this is not a true occurrence of trauma in the UPTH. Patients recruited into the study were not followed up after leaving the ED. This is a single-Centre study, but it does not tell the true epidemiology of trauma in Port Harcourt. It is difficult to determine the exact epidemiology of trauma in Nigeria and Port Harcourt because some accidents are not reported; there is also poor record-keeping in Nigeria.

5. Conclusion and Recommendation

Various mechanisms of trauma were reported, with road traffic accidents (RTAs) being the most common. Males sustained a greater proportion of injuries than females, and young adults were the most commonly affected age group. The injuries sustained affected different parts of the body, but most commonly the head and lower limb. The long bones were mostly fractured. Only one patient in this study did not sustain any injury after an accident or trauma. Most of the patients were discharged within 24 hours. A few patients died. Mortality occurred in patients with severe traumatic brain injury & hemorrhagic shock.

The results of this study can be used for health promotion and trauma education. Most of the accidents were preventable, especially RTAs. Therefore, a trauma registry should be established at UPTH and in Rivers State. The government and the Federal Road Safety Corps should regularly educate road users and drivers on the prevention of RTAs. Also, there should be constant education, public enlightenment, and campaigns on the prevention of accidents. There is a need for pre-hospital emergency care to be strengthened in Rivers State. There is therefore a need to establish regional and national trauma registries to determine the true epidemiology of trauma (2,6). There is a need to conduct multicentre studies collaborating with doctors in other health facilities.

Abbreviations

DAMA: Discharge against Medical Advice

ED: Emergency Medicine Department

UPTH: University of Port Harcourt Teaching Hospital

RTA: Road Traffic Accident

Author Contributions

DYB conceptualized the study and collected the Data; DYB and EBI wrote the manuscript and proofread the final draft.

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Competing interests

Authors declare there was no competing interest

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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 ($GCS \leq 8$) 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 consciousness 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.

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 $<4,000/\mu\text{L}$, 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

Epilnfo, 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 ($\pm$ 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 neuro-surgical 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
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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–	<0.001	3.86 (1.50–9.92)	0.050

				17.81)			
	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. 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, con-

sistent 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 in-

terpreted 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: Myung Sung Christian Medical Center
SBP: Systolic blood pressure
SPHMMC: St. Paul's Hospital Millennium Medical College
TASH: Tikur Anbessa 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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Clinical profile and outcomes of patients without an attendant admitted to the emergency departments of selected governmental hospitals in Addis Ababa, Ethiopia

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ABSTRACT Background: Emergency department provides timely intervention for patients with life-threatening emergency medical and surgical conditions. This is possible through the support and involvement of families or caregivers during clinical evaluation and management. However, in some cases, patients present to the emergency department alone or with other agents, such as police or passersby, making their presence during the patient's emergency stay impractical. Understanding the clinical characteristics and outcomes of patients managed without attendants is important for optimizing emergency care delivery and informing health care planning. This study assesses the prevalence, clinical profile, and outcomes of patients without attendants in selected governmental hospitals of Addis Ababa.

Methods: A prospective cross-sectional study was conducted from August 1 to November 1, 2025, in selected governmental hospitals of Addis Ababa. After obtaining ethical clearance, data were collected by trained personnel from patients using a data extraction tool and a questionnaire from patient documents/EMR. Data were cleaned and exported to SPSS version 26.

Descriptive statistics, including frequencies and percentages, were generated for the prevalence, clinical profile, and outcomes of patients without an attendant at emergency department admissions. Considering a p -value <0.05 with a 95% confidence interval, a logistic regression model was conducted to assess the strength of association between major outcomes and the clinical profile of patients without attendants.

Results: One hundred thirty-seven (79.2%) participants were male. The median age was 35 years (IQR: 25–46). The prevalence of patients without attendants was 2.57%. The median length of stay was 11.2 days (IQR: 5.6–19.7). Thirty-four (19.6%) patients died. Male sex, high-acuity triage category (red and orange), and patients with ventilatory and vasopressor support were significantly associated with patient mortality.

Conclusion: Length of stay and mortality among patients without attendants are higher than standard ED benchmarks. Mortality is significantly associated with male sex, high-acuity triage category, and patients with ventilatory and vasopressor support.

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Keywords: Patient without attendant; prevalence; length of stay; mortality; Addis Ababa

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1. Introduction

The Emergency Department

(ED) is where lifesaving and critical interventions are provided to critically ill patients who depend on coordinated efforts involving health care providers, family members, or attendants, along with a well-prepared emergency setup. ⁽¹⁾ Emergency care can be overwhelmed if any of these components are missing. ⁽²⁾

In most cases, patients arrive at the ED with relatives or caregivers who support care by sharing important clinical information, obtaining medications and supplies, assisting with payments, facilitating transfers, and helping during discharge processes. ^(3–5) Their involvement plays an important role in ensuring smooth patient management and workflow in the ED. ^(4,5)

Patients without attendants (PWOA), defined in this study as patients who remain alone in the ED without support from family members or caregivers until their outcome is determined, represent an increasingly recognized public health concern in many countries. ^(6,7) Globally, although no comprehensive data exist on the prevalence of adults without caregivers or family who are admitted and treated in the ED alone, estimates vary widely by region, health care system, and demographics; most studies have focused on pediatric and elderly cohorts, where unaccompanied rates may reach as high as 68% (8–10). In contrast, some single-center studies have shown much lower prevalence of 0.0007% in Turkey and 0.4% in Nepal and the USA. ^(5,11,12)

Studies have shown that such patients experience impacts on patient flow and morbidity, including prolonged length of stay (LOS) and death, in both busy emergency and non-emergency settings. ^(1,7,13) Vulnerable groups including the elderly, individuals with disabilities, and those from distant or marginalized communities are disproportionately affected. ^(14,15) This

burden is greater in countries lacking strong social security services. ⁽¹⁶⁾

In our setting, little is known about the burden, clinical profile, and outcomes of PWOA. Therefore, this study aims to determine the prevalence, clinical characteristics, outcomes, and predictors of adverse outcomes among these patients. The findings would provide local estimates of the problem and help identify high-risk groups that may benefit from targeted interventions and improved support systems.

The primary beneficiaries of this study are PWOA themselves, who will receive faster, safer, and more organized care as a result of the evidence generated. This study also helps health care providers by identifying gaps in assessment, decision-making, and patient flow, allowing ED teams to design clearer protocols for managing unaccompanied patients. Hospital administrators may use these findings to improve resource planning, including the need for stronger social work support, patient navigation services, or a dedicated support system. In addition, the results can inform regional and national policies aimed at improving the safety, equity, and quality of care for this vulnerable patient group.

2. Materials and methods

Study setting and period

This study was conducted at Tikur Anbesa Specialized Hospital (TASH) and Zewditu Memorial Hospital (ZMH) from August 1 to November 1, 2025. Both hospitals are located in Addis Ababa, the capital city of Ethiopia, in the central part of the country (17).

Study design

A prospective cross-sectional study was conducted within the specified data collection period.

Population

Source population: All patients who visited the ED of governmental hospitals in Addis Ababa during the study period.

Study population: All patients who presented to the TASH and ZMH ED without an attendant during the data collection period and who fulfilled the inclusion criteria.

Sampling/study unit: Individuals who presented at the TASH and ZMH ED during the data collection period, fulfilled the inclusion criteria, and volunteered to participate in the study.

Eligibility criteria

Inclusion criteria: All patients aged ≥ 13 years who visited the ED without an attendant, or who came with an attendant but left unattended before the patient outcome, were included.

Exclusion criteria: Patients who acquired a family member or caregiver after ED admission or during ED stay. Repeated visits by the same patient during the study period

Sample size determination and sampling technique

A consecutive sampling method was used; patients were enrolled based on arrival within the study period until the calculated sample size was reached.

The sample size was calculated using the single population proportion formula, based on a mortality rate of 10.9% among PWOA reported in a Nepali hospital-based study (5), estimating an initial sample size of 150. After adjusting for a 10% non-response rate, the final sample size was 167.

The sample size was also designed to ensure sufficient statistical power for multivariate logistic regression analysis of predictors of mortality among PWOA in the ED. Using an expected mortality of 47% among unattended patients reported in a previous study (18) and the events-per-variable (EPV) rule, the required sample size was calculated as 213. During the study period, 205 PWOA visited the two EDs, of whom 32 were excluded, leaving 173 eligible patients enrolled in the study. Full details are provided in the supplementary information.

Study variables

Independent variables: Socio-demographic characteristics, baseline characteristics, and initial clinical characteristics.

Dependent variables: Length of stay (LOS) and mortality.

Operational definitions

PWOA: any patient visiting the ED by self, referred from a nearby health institution without a significant other, or brought by non-attendants such as police or passersby, who has no caretaker until a final clinical outcome is reached; or any patient brought by family or friends but left unattended until the outcome is determined.

Adult population: any patient aged ≥ 13 years, as our setting accepts and treats patients aged 13 years and above.

LOS: total time a patient stayed in the ED and/or, if admitted to wards or the ICU, the total time the patient stayed in the hospital.

High-acuity patients: patients triaged as red or orange under the ED triage system.

Low-acuity patients: patients triaged as yellow or green under the ED triage system.

Conscious patients: those with a Glasgow Coma Scale (GCS) of 15 at initial clinical assessment.

Impaired level of consciousness (LOC): patients with a GCS ≤ 14 at initial clinical assessment.

Data collection tools and procedures

A data collection tool (questionnaire and checklist) was developed after reviewing multiple studies and a standardized emergency care assessment tool (19–21). Key variables, definitions, and measurement items were adapted from previously published literature and modified to fit the study context (see supplementary Annex 2: Data collection tool).

Data quality management

Data were collected by trained nurses, and the investigator closely supervised the data collection process. Collected data were checked for completeness before entry. Records were excluded if the primary outcome or a key predictor variable was missing; records with more than 20% missing data for other variables were discarded.

Data processing and analysis

Data were collected using Google Forms and exported to SPSS version 26 for analysis. Descriptive statistics were used to determine the prevalence, clinical characteristics, and outcomes of PWOA. Death and LOS were also compared with the general ED population during the same period.

Regression analyses were performed for key outcomes. Variables with a univariate $p < 0.2$, based on clinical relevance, were entered into the multivariable model. Collinearity was assessed using tolerance and variance inflation factor (VIF) values. Model fit was assessed using the Hosmer–Lemeshow goodness-of-fit test

($p > 0.05$ considered a good fit). Associations are expressed as odds ratios (OR). Some independent variables were regrouped, recoded, and dichotomized for sample adequacy and ease of analysis, with cutoff points selected based on clinical relevance, prior literature, or data distribution (11,12,22). Hospital-level effects were assessed separately for TASH and ZMH using sensitivity analysis. Variables with more than 10% missing or unknown values were excluded. Results are presented in tables, charts, and graphs.

Ethical statement

Data collection commenced after obtaining approval from the Department of Emergency and Critical Care Medicine (Ref. No. 487/17) and the Addis Ababa Health Bureau Research Institutional Review Board (IRB) (Ref. No. A.A/Gov/21959). An official letter was submitted to each participating institution prior to data collection. Given the emergency nature of the presentation, informed consent procedures followed the approved IRB protocol; full ethical declarations are available in the supplementary information.

3. Results

Socio-demographic characteristics of participants

A total of 173 eligible patients participated in the study, with an 86% response rate. Of these, 137 (79.2%) were male. The median age was 35 years (IQR: 14–56). Forty-seven (27.2%) participants were unemployed, and 102 (59%) were single. A total of 97 (56%) participants had a monthly income below 1,500 birr or an unknown income (Table 1).

Table 1. Sociodemographic characteristics of patients without an attendant (PWOA) in the selected health institutions of Addis Ababa, Ethiopia (N=173)

Variable	Category	Frequency (N=173)	Percentage
Hospital	TASH	90	52.0%
	ZMH	83	48.0%
Gender	Female	36	20.8%
	Male	137	79.2%
Age (years)	13–17	13	7.5%
	18–39	90	52.0%
	40–59	51	29.5%
	60–79	19	11.0%
Place of living	Addis Ababa	152	87.9%
	Out of Addis Ababa	19	11.0%
	Unknown	2	1.2%
Marital status	Married	43	24.9%
	Divorced	3	1.7%
	Single	102	59.0%
	Unknown	17	9.8%
	Widowed	8	4.6%
Educational status	Basic literacy (read/write)	29	16.8%
	Illiterate	38	17.9%
	Primary education	66	38.1%
	Secondary education	16	26.6%
	Higher education	1	0.57%
	Unknown	23	13.3%
Monthly earnings (birr)	≤1500	30	17.3%
	1501–3000	41	23.7%
	3001–9000	35	20.2%

	Unknown	67	38.7%
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Baseline clinical characteristics of patients

A total of 146 (84.3%) patients were referred from a nearby health center, and 147 (84.9%) arrived by ambulance. Treatment had been giv-

en at the referring institution for 144 (83.2%) patients. On arrival, 63 (36.4%) patients were triaged as red and 52 (30.1%) as orange (Table 2).

Table 2. Distribution of PWOA by baseline clinical information, Addis Ababa, Ethiopia, 2025 (N=173)

Variable	Category	Frequency (N=173)	Percentage
Chief complaint	CNS	35	20.8%
	Fever and headache	68	38.8%
	GI	17	9.8%
	Skin/MSS	6	3.5%
	Non-specific	7	4.1%
	Respiratory	24	13.9%
	Sexual assault	2	1.2%
	Trauma	12	6.9%
Mode of arrival	Ambulance	147	84.9%
	On foot/people's shoulder	21	12.1%
	Private car/taxi	3	1.76%
	Unknown	2	1.2%
Source of referral	Public health center	146	84.3%
	Other public hospitals	7	7.14%
	Private health facility	1	0.6%
	Self/other	19	10.98%
Patient brought by	Family member	19	11%
	Friends/neighbor	25	14.5%
	Health professional	72	41.6%
	Passerby	6	3.5%

Police	26	15.0%
Self	25	14.5%

Prevalence and nature of Emergency Department admissions

During the 3-month data collection period, 6,715 patients visited the ED of both institutions; 173 PWOA were identified and included in the study, giving a prevalence of 2.57%. Seventy-two (41.6%) patients were transported to the hospi-

tal by health professionals alone, while 26 (15%) were brought by police. The top three causes of ED admission were febrile illness (relapsing fever) and related complications, 99 (54.3%); trauma and related conditions, 33 (19%); and respiratory tract infection and related conditions, 10 (5.8%) (Figure 1).

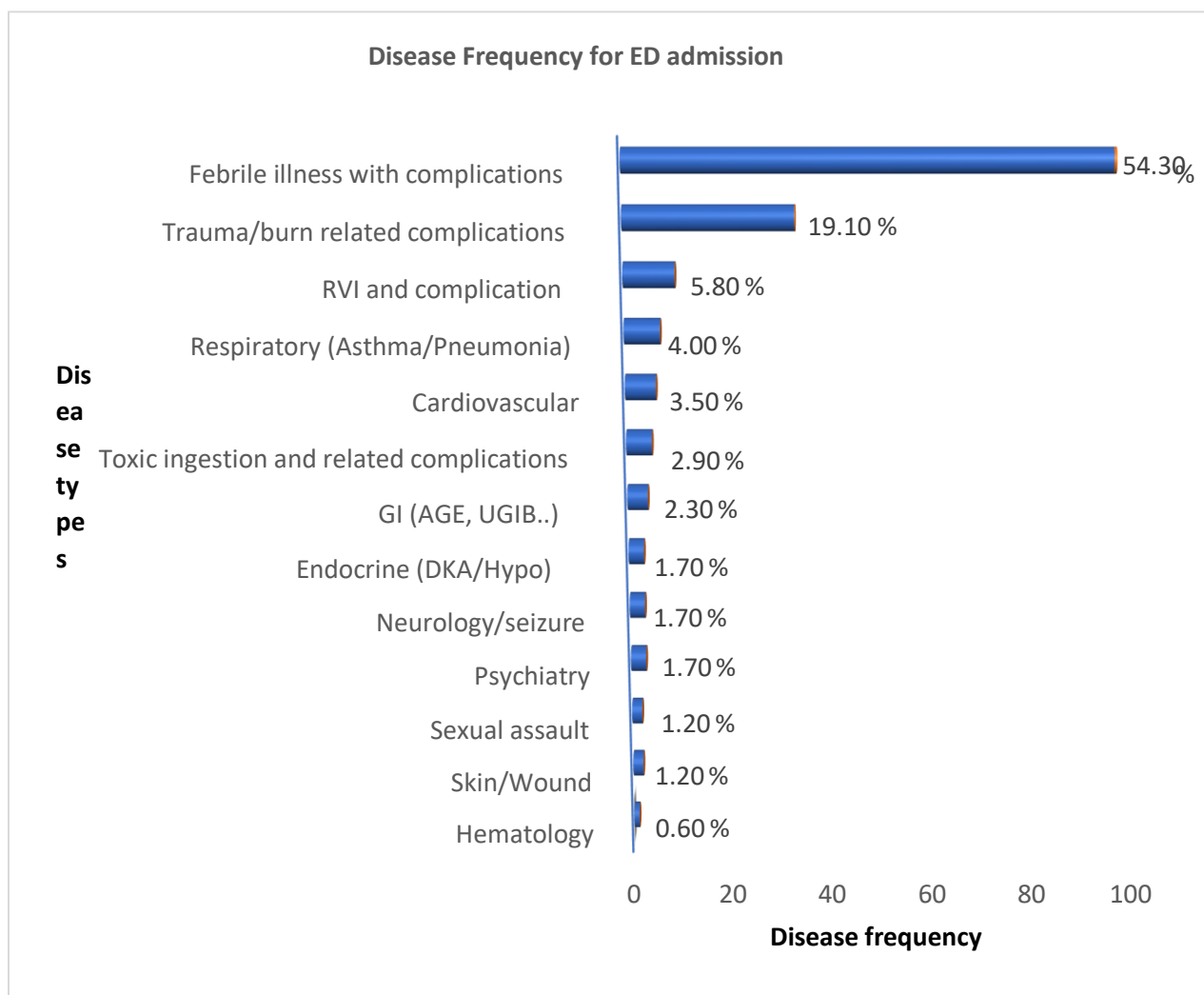


Figure 1. Disease frequency of PWOA admitted in the selected health institution of Addis Ababa, Ethiopia

Table 3. Patient disease characteristics, emergency care, and outcomes for PWOA after admission, Addis Ababa, Ethiopia

Variable	Category	Frequency	Percentage
Treatment at referring hospital	Yes	130	75.14%
	No	43	24.86%
Intervention post-referral	Medical	132	76.3%
	Surgical	7	4.0%
	Both	34	19.7%
Needs ventilatory support	Yes	33	19%
	No	136	81%
Needs vasopressor support	Yes	56	32.36%
	No	117	67.64%
Patient outcome	Discharged from ED	71	41.0%
	Died at ED/ICU	34	19.6%
	Remained in ED	9	5.2%
	Admitted and discharged (ward/ICU)	40	23.1%
	Transferred elsewhere	12	6.9%
	Discharged AMA	7	4.0%
Length of stay	<24 hours	10	5.8%
	≥24 hours	163	94.2%

Patient outcome

Among all PWOA seen over the 3 months, 34 (19.6%) died, including 26 (15%) who died in the ED. Seventy-one (41%) were discharged from the ED; 32 (18.5%) and 18 (9.2%) were admitted to the ward and ICU, respectively, and 8 (4.6%)

were admitted to and died in the ICU (Table 3). Regarding LOS, only 10 (5.8%) patients stayed less than 24 hours, while 23 (13.3%) stayed longer than one month. LOS was right-skewed and is presented as median (IQR): 11.2 days (IQR: 5.6–19.7) (Figure 2).

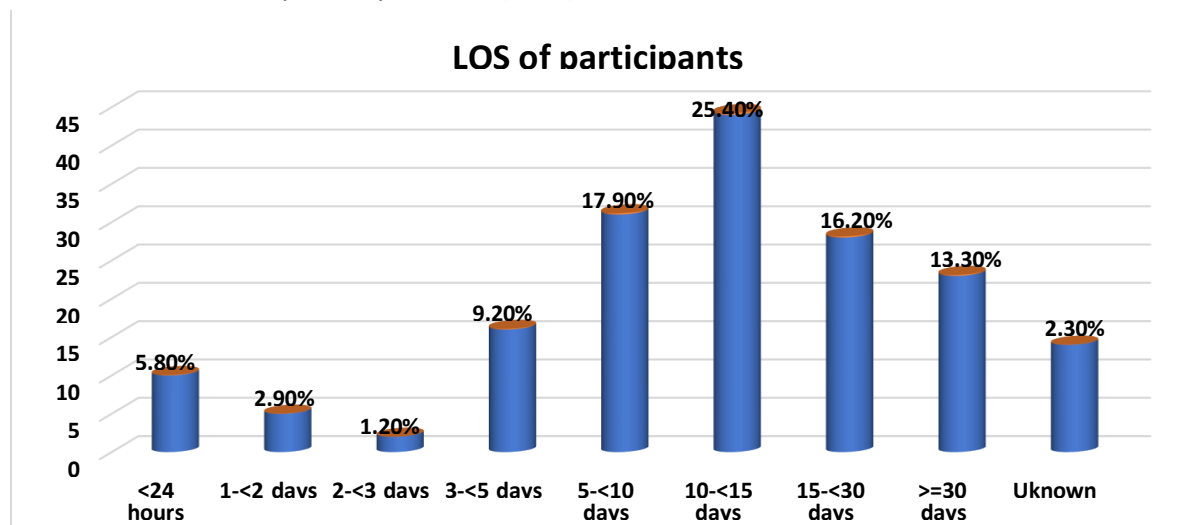


Figure 2: Showing LOS of PWOA in the selected health institution of Addis Ababa Addis Ababa, Ethiopia.

Factors affecting outcomes of patients without attendants

Table 4 shows the association between predictor variables and mortality. All predictors had acceptable tolerance (0.4–0.9) and VIF (1.2–2.5)

values, indicating no multicollinearity. The logistic regression model showed good fit (Hosmer–Lemeshow $\chi^2 = 5.8$, $df = 8$, $p = 0.66$) and

explained 54.4% of the outcome variance. Variables with $p < 0.2$ in binary regression were entered into the multivariate model.

Table 4. Association of socio-demographic and clinical characteristics with patient outcome (death) among PWOA, Addis Ababa, Ethiopia

Variable	Category	Alive N(%)	Death N(%)	COR (95% CI)	AOR (95% CI)
Age	<35	76 (54.7%)	10 (29.4%)	1	1
	≥35	63 (45.3%)	24 (70.6%)	2.90 (1.29–6.50)	1.44 (0.54–3.85)
Gender	Female	34 (24.5%)	1 (2.9%)	1	1
	Male	105 (75.5%)	33 (97.1%)	10.69 (1.4–81.09)	10.2 (1.1–100)
Living condition	With someone else	113 (81.3%)	25 (73.5%)	1	1
	Alone	26 (18.7%)	9 (26.5%)	0.86 (0.75–0.99)	3.28 (0.96–11.9)
Triage category	Low acuity	57 (41%)	1 (2.9%)	1	1
	High acuity	82 (59%)	33 (97.1%)	25.0 (3.0–167)	6.25 (1.7–14.3)
Chronic medical illness	Yes	41 (29.5%)	14 (41.2%)	1	1
	No	73 (70.5%)	20 (58.5%)	1.52 (1.02–2.26)	1.74 (0.99–3.04)
Arrival LOC	Conscious	42 (30.2%)	17 (50%)	1	1
	Impaired LOC	97 (69.8%)	17 (50%)	0.43 (0.20–0.93)	0.94 (0.36–2.50)
Time to start of treatment	Immediate (<10 min)	27 (19.4%)	15 (44.1%)	1	1
	Late (≥10 min)	112 (80.6%)	19 (55.9%)	0.305 (0.14–0.68)	0.56 (0.18–1.70)
Received ventilator support	Yes	9(6.5%)	24(70.6%)	0.001	34.67(12.75-94.26)
	No	130(93.5%)	10(29.4%)	1	1
Vasopressor support	Yes	27(19.4%)	29(85.3%)	0.001	24.06(8.52-67.93)
	No	112(80.6%)	5(14.7%)	1	1

Of the total deaths, 33 (97.1%) were male, and 1 (2.9%) was female; males had 10.2 times higher odds of death compared with females (AOR:

10.2, 95% CI: 1.1–100, $p < 0.02$). Similarly, 33 (97.1%) deaths occurred in the high-acuity group, who were 6.25 times more likely to die

than the low-acuity group (AOR: 6.25, 95% CI: 1.7–14.3, $p < 0.014$).

Even though they are mediator variables, the two variables; patients who were given invasive ventilatory support (AOR: 0.036, 95% CI: 0.006–0.219, $P < 0.001$) and vasopressor support (AOR: 0.05, 95% CI: 0.10–0.266, $P < 0.001$), were significantly associated with patient outcomes.

Patients without chronic illness had higher odds of death (AOR: 1.74, 95% CI: 0.99–3.04, $p < 0.053$), approaching statistical significance. Living alone was similarly associated with an in-

creased likelihood of death (AOR: 3.28, 95% CI: 0.96–11.9, $p < 0.057$), also approaching significance.

Sensitivity analysis

Site-specific sensitivity analysis did not reveal major hospital-level variation overall. In TASH, high acuity triage category, not significant in the pooled model, became near significant predictor of mortality (AOR: 1.32, 95% CI: 0.02–01.02, $p < 0.054$). No significant associations were observed at ZMH. Other pooled predictors were not significant in the separate hospital-level analyses (see supplementary material) Table 5).

Table 5. Sensitivity analysis of socio-demographic and clinical predictors of mortality among PWOA patients, Addis Ababa, Ethiopia

Sensitivity Analysis	variables	Category	Out come		Crude Odds Ratio		Adjusted Odds Ratio	
			Alive	Death	Sig.	COR (95% CI)	Sig.	AOR (95% CI)
TASH Patients	Patient triage	Low acuity	32(45.1%)	1(5.3%)	1	1	1	1
		High acuity	39(54.9%)	18(94.7%)	0.01	0.07(0.09-0.54)	0.054	1.32(0.02-
	Chronic medical illness	Yes	30(42.3%)	10(52.6%)	1	1	1	1
		No	41(57.7%)	9(47.4%)	0.07	1.69(0.96-2.97)	0.45	1.36(0.60-3.07)
	Intervention given	Medical	51(71.8%)	17(89.5%)	1	1		1
		Medical and surgical	15(21.1%)	2(10.5%)	0.20	2.5(0.52-12.06)	0.23	3.16(0.49-20.38)
	LOC on arrival	Conscious	20(28.2%)	11(57.9%)	1	1	1	1
		Impaired LOC	51(71.8%)	8(42.1%)	0.01	0.29(0.1-0.83)	0.07	0.13(0.02-1.20)
	Arrival-to-treatment time	Late (≥ 10 minutes)	60(84.5%)	11(57.9%)	1	1	1	1
		Immediate (< 10 minutes)	11(15.5%)	8(42.1%)	0.01	0.25(0.08-0.77)	0.34	0.44(0.08-2.38)
	Gender	Female	15(22.1%)	1(6.7%)	1	1	1	1

ZMH Patients		Male	53(77.9%)	14(93.3%)	0.20	3.96(0.48-32.62)	0.22	3.88(0.45-33.54)
		Yes	11(16.2%)	4(26.7%)	1	1	1	1
	Chronic medical condition	No	57(83.8%)	11(73.3%)	0.02	0.12(0.03-0.46)	0.23	1.53(0.77-3.02)
		Immediate (<10 minutes)	16(23.5%)	7(46.7%)	1	1	1	1
	Arrival-to-treatment interval	Late (>=10 minutes)	52(76.5%)	8(53.3%)	0.08	0.35(0.11-1.12)	0.18	0.38(0.09-1.55)

4. Discussion

Over the 3-month study period, we identified 173 PWOA cases, accounting for 2.57% of 6,715 ED visits. This figure is similar to rates reported in pediatric and youth populations (2–3%)⁽¹⁰⁾, but higher than findings from Nepal, Turkey, and the USA.^(5,18,23) This variation likely reflects differences in population characteristics, socioeconomic conditions, disease burden, and access to social support systems. It may also highlight how local health system structure, institutional policies, and emergency response systems can influence who is classified as PWOA.⁽²⁴⁾ In addition, comparisons across studies are challenging because the definition of PWOA is not uniform and may encompass different groups, including unidentified and unconscious patients, unrepresented adults, socially isolated individuals, patients isolated from family during the COVID-19 era, and similar terms.^(5,6,11,16)

Most PWOA in our study presented with febrile illness, mainly relapsing fever (54.3%), followed by trauma-related conditions (19.1%). This pattern differs from reports in India, Brazil, Japan, and Canada, where trauma, substance use, psychiatric conditions, and chronic disease complications are more common.^(4,13,18) This difference may reflect local epidemiology and the seasonal, recurrent nature of relapsing fever in our setting compared with other regions.

Regarding outcomes, the main measures assessed were mortality and LOS. Overall mortality among PWOA was 19.6%, accounting for 11.7% of all ED deaths during the study period. This rate is higher than reported in some studies,^(18,23,25) but similar to others.^(4,5) The variation may relate to differences in social vulnerability, prehospital care, disease severity at presentation, and study design.

Compared with unpublished monthly audit data, the overall ED mortality rate within 24 hours at the respective institutions was approximately 0.6%, while the overall ED mortality rate during the data collection period was 3.85%. This unpublished finding is comparable to some studies;^(23,26) however, our study found significantly higher mortality among PWOA, consistent with other reports.^(27,28)

As shown in the results, death was significantly associated with male gender, high-acuity triage category, patients with ventilatory and vasopressor support which is consistent with several other studies.^(27,29–31) In contrast, our findings differ from studies where older age, rural residence, non-communicable disease status, and language barriers among foreign patients were strongly associated with mortality.^(32,33)

Although living alone was not statistically significant, the effect size was large, suggesting a clinically meaningful increase in risk. Similarly, chronic

medical illness showed a borderline association with outcome, with the result falling slightly above the conventional significance threshold ($p=0.053$). The direction and magnitude of this effect are consistent with existing literature showing worse outcomes among patients with chronic illness.^(6,28, 34–36)

Although the pooled model identified four significant predictors of mortality, hospital-level sensitivity analysis revealed heterogeneity across sites; neither hospital individually reproduced a significant association with the outcome variable, though TASH patients showed a near-significant association with LOC. This variation may reflect smaller hospital-level sample sizes reducing statistical power, differences in patient case mix, severity, and referral patterns, variability in clinical practice, and differences in resource availability.

The other key outcome examined was LOS, defined as total ED boarding and inpatient stay, which was markedly prolonged among PWOA relative to ED standards. Nearly 94.2% of patients stayed longer than 24 hours, and 28.5% remained hospitalized for more than two weeks. The median LOS was 11.2 days (IQR: 5.6–19.7), substantially higher than standard ED expectations. While this contrasts with some studies,^(25,37) it is consistent with reports from Ethiopia and South Africa.^(38,39) Prolonged stays in our setting may relate to bed shortages, limited isolation capacity, severe illness requiring ICU care, and social challenges that delay discharge or transfer to supportive facilities.

Strengths and limitations

This study may be one of the few in our setting to evaluate the prevalence, clinical profile, and

outcomes of this patient group and provides a baseline for future research. The participating institutions are major referral centers for this population, so the findings may reflect one estimate of burden, although broader multicenter studies are still needed.

This study has several limitations, including a relatively small sample size and lower-than-expected mortality, which reduced statistical power and precision and widened confidence intervals. Data collection was constrained by time and resources, limiting the number of sites included. The absence of a matched comparison group may introduce confounding from unmeasured factors, such as staff workload and institutional care processes, which may have influenced patient outcomes.

5. Conclusion and recommendations

This study reported the prevalence of patients without attendants in emergency departments at major specialized hospitals in Addis Ababa. Mortality in this group is significant compared with the overall ED population, and length of stay is markedly prolonged. Mortality was significantly associated with male sex and high-acuity triage category, in patients with ventilatory support and patients with vasopressor support.

These findings support targeted protocols, stronger social work and patient identification support, and improved resource planning for unaccompanied patients in emergency care settings.

Abbreviations

AAU: Addis Ababa University

ED: Emergency Department

EMR: Electronic Medical Record

IRB: Institutional Review Board

LOC: Level of consciousness

LOS: Length of stay

OR: Odds ratio

AOR: Adjusted odds ratio

PWOA: Patients without an attendant

TASH: Tikur Anbesa Specialized Hospital

ZMH: Zewditu Memorial Hospital

Author Contributions

STM: Selected the title, drafted the proposal (conceptualized and designed the study), analyzed and interpreted the data, and drafted the manuscript.

GTM: Revised and finalized the study protocol, provided constructive comments on overall preparation, and commented on and finalized the manuscript.

MKM: Approved the title and proposal with revisions, finalized the study protocol, revised the manuscript, and provided constructive comments to finalize the manuscript.

FDY: Approved the title and proposal with revisions, finalized the study protocol, revised the manuscript, and provided constructive comments to finalize the manuscript.

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Competing interests

The authors declare no competing interests.

Data Availability

The data are available with the PI upon formal request.

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Clinical Profile and Outcome of Louse-Borne Relapsing Fever Among Patients at Zewditu Memorial Hospital and Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia: A Cross-Sectional Study

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ABSTRACT

Background: Louse-borne relapsing fever (LBRF), caused by *Borrelia recurrentis*, is a re-emerging vector-borne infectious disease that remains endemic in the highlands of Ethiopia, particularly among populations living in crowded, unhygienic conditions. Although it is among the leading causes of hospital admission in Ethiopia, data on its clinical profile and outcome in Addis Ababa are lacking.

Objective: To assess the clinical profile, associated factors, and outcome of patients with LBRF at Zewditu Memorial Hospital (ZMH) and Tikur Anbessa Specialized Hospital (TASH), Addis Ababa, Ethiopia.

Methods: An institution-based, multicenter, retrospective cross-sectional study was conducted among 172 patients treated for LBRF at ZMH and TASH between July 2022 and July 2023. Data were extracted from medical records using a structured checklist and analyzed using SPSS version 26. Descriptive statistics summarized socio-demographic and clinical characteristics; univariate and multivariable binary logistic regression identified factors associated with in-hospital mortality, with adjusted odds ratios (AOR), 95% confidence intervals (CI), and *p*-values used to test significance.

Results: Males predominated (82.6%), and nearly half of patients (49.4%) were aged 14-20 years; most (70.3%) were living on the street. Fever (84.3%) and headache (25.6%) were the most common presenting symptoms. Hematologic complications (85.5%), hypotension (53.5%), and sepsis (17.4%) were the most frequent complications. The in-hospital mortality rate was 4.1%. In multivariable analysis, hematologic complications (AOR=0.11, 95% CI 0.018-0.739, *p*=0.023) and sepsis (AOR=0.14, 95% CI 0.02-0.993, *p*=0.0049) were significantly associated with mortality.

Conclusion: LBRF predominantly affects young, socially marginalized men in Addis Ababa. Hematologic complications and sepsis were independently associated factors of mortality, and the overall case fatality rate was comparable with reports from other Ethiopian settings. Early identification and management of these complications, together with targeted public health measures for high-risk populations, may help reduce mortality from LBRF.

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1. Introduction

Relapsing fever is an acute, recurrent febrile illness caused by *Borrelia* species, transmitted to humans by body lice in louse-borne relapsing fever (LBRF) or by soft ticks in tick-borne relapsing fever.^[1] *Borrelia recurrentis* is the sole causative agent of LBRF, for which humans are the only known reservoir.^[2] The disease is characterized by abrupt onset of fever, headache, myalgia, and chills, with febrile episodes recurring up to four times if untreated.^[3] If untreated, LBRF can progress to meningitis, renal failure, pulmonary complications, hepatic failure, and myocarditis.^[3,4]

Historically, LBRF caused major epidemics associated with war and population displacement, with an estimated 15 million cases and more than 5 million deaths recorded across Africa, Eastern Europe, and Russia.^[2] The disease is now largely confined to North-Eastern Africa, particularly the Ethiopian highlands, where it disproportionately affects homeless and displaced populations living in crowded, unhygienic conditions, especially during the rainy season.^[3] LBRF has historically ranked among the top ten causes of hospital admission in Ethiopia and remains an important cause of morbidity and mortality.^[5,6]

Reported case fatality rates for LBRF vary widely, ranging from approximately 40% among untreated patients to 2-5% among those receiving antibiotic therapy such as doxycycline, penicillin, or chloramphenicol.^[3] The Jarisch-Herxheimer reaction (JHR), a potentially life-threatening reaction that may occur before or after treatment initiation, has been reported with widely varying frequency (0-100%), largely reflecting inconsistent diagnostic criteria.^[3] A meta-analysis of six randomized controlled trials comparing antibiotic regimens for LBRF found no significant difference in mortality between tetracycline and

penicillin. However, tetracycline reduced relapse rates while penicillin was associated with fewer JHR episodes.^[7]

Previous Ethiopian studies from Bahir Dar, Gondar, Hosanna, and Arsi have described the socio-demographic profile, clinical presentation, and mortality of LBRF, identifying young age, male sex, low educational attainment, and crowded or street-based living conditions as characteristic features, with case fatality rates ranging from 2% to 13%.^[5,9,10,8,6] Similar clinical patterns, including a high burden of hepatosplenomegaly and thrombocytopenia, have also been reported from Sudan.^[11]

Despite evidence from other regions of Ethiopia, no previous study has characterized the clinical profile, associated factors, and outcome of LBRF among patients managed in Addis Ababa, where numerous cases continue to be seen at referral hospitals such as Zewditu Memorial Hospital (ZMH) and Tikur Anbessa Specialized Hospital (TASH). As a neglected disease that receives limited attention from public health authorities and funding bodies, LBRF remains poorly characterized in the capital despite ongoing internal migration and urban crowding that sustain transmission. This study therefore aimed to assess the clinical profile, socio-demographic characteristics, and outcomes of patients with LBRF managed at ZMH and TASH, Addis Ababa, Ethiopia, between July 2022 and July 2023, and to identify factors independently associated with in-hospital mortality.

2. Methods and material

Study design and setting

This institution-based, multicenter, retrospective cross-sectional study was conducted at Zewditu Memorial Hospital (ZMH) and Tikur Anbessa Specialized Hospital (TASH), two public hospitals in Addis Ababa, Ethiopia. TASH, established in

1972, is one of the country's largest tertiary teaching hospitals and serves as the main national referral center. ZMH, established in 1910, is one of the oldest public hospitals in Addis Ababa and provides emergency, inpatient, outpatient, surgical, diagnostic, and maternal and child health services. Data were collected retrospectively from medical records covering July 2022 to July 2023; data abstraction took place between August and November 2023.

Study population and sampling

The source population comprised all patients presenting with acute febrile illness to the emergency departments of ZMH and TASH during the study period, while the study population consisted of all patients diagnosed with LBRF at either hospital during the same period. A consecutive census of all eligible patients during the study period was performed. Patients aged 14 years or older with a presumed or confirmed diagnosis of complicated LBRF at admission, or in whom LBRF was diagnosed after admission, were included. Patients whose initial presumed diagnosis of relapsing fever was later revised after a negative blood film were excluded. The minimum required sample size, calculated using a single population proportion formula based on a previously reported LBRF prevalence of 2.5%, [8] a 95% confidence level, and a 1% margin of error, with adjustment for the finite source population and a 10% non-response allowance, was 182; a total of 172 eligible patients were identified and included over the study period.

Data collection

Data were abstracted from patients' medical records using a structured, pre-tested checklist covering socio-demographic characteristics, clinical presentation, complications, treatment, and outcome. The checklist was pre-tested on 5% of

the sample size outside the study sites and refined accordingly. Data collectors with a health professional background were trained on the data collection procedure and the importance of confidentiality, and completed checklists were reviewed daily for completeness and consistency by the data collectors and the principal investigator.

Study variables

The outcome variable was in-hospital mortality. Independent variables included age, sex, socioeconomic and educational status, hygiene status, living condition, presenting symptoms, length of hospital stay, type and severity of complications, antibiotic regimen, vasopressor use, and presence of Jarisch-Herxheimer reaction. Complicated LBRF was defined as a diagnosis of relapsing fever accompanied by at least one complication, including hypotension, jaundice (acute liver failure), bleeding diathesis, acute respiratory distress syndrome (ARDS), renal failure, or encephalopathy. In-hospital mortality was defined as death occurring at any time during the hospital admission for LBRF.

Statistical analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 26. Descriptive statistics (frequencies and percentages) were used to summarize socio-demographic and clinical characteristics. Associations between independent variables and in-hospital mortality were first examined using univariate binary logistic regression; variables with a p-value <0.25 were entered into a multivariable binary logistic regression model. Adjusted odds ratios (AOR) with 95% confidence intervals (CI) were used to assess the strength and significance of associations, and the Hosmer-Lemeshow test was used to assess model fit. A p-value <0.05 was considered statistically significant.

Ethical considerations

Ethical clearance was obtained through the Addis Ababa University Department of Emergency and Critical Care Medicine, and permission was granted by the medical directors and emergency department heads of both study hospitals prior to data collection. Patient confidentiality was maintained throughout by excluding all personal identifiers from the data collection checklist and restricting data access to the research team.

A total of 172 patients diagnosed with LBRF were included in the study. Males predominated, accounting for 142 (82.6%) of participants, giving a male-to-female ratio of 4.7:1. Nearly half of the patients, 85 (49.4%), were aged between 14 and 20 years. More than half, 97 (56.4%), had no formal education, and the majority, 121 (70.3%), reported living on the street; 19 (11%) lived in crowded homes, and 27 (15.7%) were incarcerated (Table 1).

3. Results

Socio-demographic characteristics

Table 1. Socio-demographic characteristics of patients with louse-borne relapsing fever, July 2022-July 2023, Addis Ababa, Ethiopia (n=172).

Sex	n(%)
Male	142(82.6)
Female	30(17.4)
Age group	
14-20 years	85(49.4)
21-30 years	60(34.9)
31-40 years	20(11.6)
>41 years	7(4.1)
Educational status	
No formal education	97(56.4)
1st-8th grade	18(10.5)
Not documented	57(33.1)
Living condition	
Living on the street	121(70.3)
Crowded shared housing	19(11.0)
Prison	27(15.7)
Not documented	5(2.9)

Clinical characteristics

Fever was the most common presenting complaint, documented in 145 (84.3%) patients, followed by headache in 44 (25.6%) and bleeding in 7 (4.1%); jaundice was the least frequent presenting symptom. Hematologic complications, mainly thrombocytopenia, were the most common, affecting 147 (85.5%) patients, followed by hypotension in 92 (53.5%) and sepsis in 30 (17.4%); myocarditis was the least common

complication, occurring in 1 (0.6%) patient. Most patients (112; 65.1%) received procaine penicillin, 47 (27.3%) received ceftriaxone, and the remainder received doxycycline. Jarisch-Herxheimer reaction was documented in 17 (9.9%) patients, and 7 (4.1%) patients required intensive care unit admission. The overall in-hospital case fatality rate was 4.1% (7/172) (Table 2).

Table 2. Clinical characteristics of patients with louse-borne relapsing fever, July 2022-July 2023, Addis Ababa, Ethiopia (n=172).

Symptoms at presentation	N (%)
Fever	145(84.3)
Headache	44(25.6)
Bleeding	7(4.1)
Altered mental status	4(2.3)
Jaundice	2(1.2)
Complications	
Hematologic (thrombocytopenia)	147(85.5)
Hypotension	92(53.5)
Sepsis	30(17.4)
Renal failure	14(8.1)
ARDS	9(5.2)
Acute liver failure	5(2.9)
Myocarditis	1(0.6)
Treatment received	
Procaine penicillin	112(65.1)
Ceftriaxone	47(27.3)
Doxycycline	13(7.6)
Jarisch-Herxheimer reaction	
Yes	17(9.9)

No	155(90.1)
ICU admission	
Yes	7(4.1)
No	165(95.9)
Length of hospital stay	
< 7 days	153(89.0)
>= 7 days	19(11.0)
In-hospital outcome	
Alive	165(95.9)
Dead	7(4.1)

Factors associated with outcome

On univariate analysis, age group, ARDS, liver failure, central nervous system (CNS) complica-

tions, and sepsis were significantly associated with in-hospital mortality ($p < 0.25$) (Table 3).

Table 3. Univariate analysis of factors associated with in-hospital mortality among patients with louse-borne relapsing fever, Addis Ababa, Ethiopia (n=172).

Variables	Categories	Outcome /Mortality		P value
		Dead	Alive	
Age	14- 20yrs	0	85	0.004
	21-30yrs	4	56	
	31-40yrs	1	19	
	>41yrs	2	5	
Gender	Male	7	135	0.998
	Female	0	30	
Living condition	Living in street	5	116	0.851
	Living in small homes with a lot of people	0	19	
	Prison	2	25	
Complication	ARDS	3	6	<0.001
	Hypotension	7	85	<0.997
	Hematology	2	145	<0.05
	Change in mentation	4	0	0.999
	Sepsis	5	25	0.171
	Liver failure	1	4	0.112
	Vasopressor use	7	11	0.995
	Cardiac complication	0	1	1
	Renal failure	0	14	0.998

	CNS	1	1	0.025
Presence of JHR	JHR	0	17	0.999
Treatment	Procaine penicillin	1	111	0.525
	Ceftriaxone	6	41	
	Doxycycline	0	13	

*P-value from univariate logistic regression; variables with $p < 0.25$ entered into the multivariable model.

In the final multivariable binary logistic regression model, which fit the data well (Hosmer-Lemeshow $p = 1.00$), hematologic complications (AOR=0.11, 95% CI 0.018-0.739, $p = 0.023$) and

sepsis (AOR=0.14, 95% CI 0.02-0.993, $p = 0.0049$) remained independently and significantly associated with mortality (Table 4).

Table 4. Final multivariable logistic regression model for in-hospital mortality among patients with louse-borne relapsing fever (n=172).

ARDS	Present vs absent	reference model, NS	0.084
Hematologic complication	Present vs absent	0.114 (0.018-0.739)	0.023*
Sepsis	Present vs absent	0.140 (0.020-0.993)	0.0049*
Liver failure	Present vs absent	2.400 (0.146-39.0)	0.539
CNS complication	Present vs absent	7.100 (0.327-156.7)	0.211

*AOR: adjusted odds ratio; CI: confidence interval; NS: not significant; $p < 0.05$ (Hosmer-Lemeshow $p = 1.00$).

4. Discussion

This study characterized, for the first time, the clinical profile and outcome of patients with LBRF managed in Addis Ababa, Ethiopia. Nearly half of the patients were adolescents and young adults aged 14-20 years, and males markedly predominated (male-to-female ratio 4.7:1), consistent with findings from Bahir Dar, Gondar, and Arsi, where LBRF disproportionately affected young men with low educational attainment living in crowded conditions, on the street, or in correctional facilities.^[8,10,9] This pattern likely reflects rural-to-urban migration and displacement of young men seeking daily labor in Addis Ababa, combined with limited health-seeking behavior and constrained access to preventive information among street-connected populations. In contrast to some previous reports, age and sex were not statistically associated with mortality in this study ($p > 0.05$), suggesting that,

once infected, disease severity may be driven more by clinical complications than by demographic factors.

Fever and headache were the predominant presenting symptoms, mirroring findings from Sudan, where fever and headache were similarly the leading symptoms.^[11] Hematologic complications, particularly thrombocytopenia, were the most frequent complication in this cohort, consistent with reports from Sudan and Gondar.^[11,10] While hypotension and ARDS were also common, only hematologic complications and sepsis remained independently associated with mortality after adjustment for other covariates. This finding diverges from studies in Sudan, where severe liver failure, lobar pneumonia, and CNS complications were the leading causes of death.^[11] This may reflect differences in disease severity at presentation, access to supportive care, or sample size between settings.

The prevalence of JHR in this study (9.9%) was lower than the 28.8% reported from Gondar,^[10] which may relate to earlier referral from health centers or to differences in treatment regimens rather than a true difference in incidence, given the well-recognized difficulty of standardizing JHR diagnosis.

The overall in-hospital case fatality rate of 4.1% was comparable to rates reported from Gondar (4.6%)^[10] and earlier surveys from southern Ethiopia (2-4%),^[12] but considerably lower than the 13% reported during an LBRF outbreak in Arsi.^[9] This is reassuring and may reflect early treatment initiation and a relative absence of documented comorbidities among patients in this cohort. However, it should be interpreted cautiously given the retrospective nature of data collection

Strengths and limitations

This study has several limitations. Its retrospective design relied on medical chart review, which was occasionally limited by missing or illegible documentation, and other clinically relevant variables, including detailed laboratory parameters and behavioral risk factors, were not consistently recorded and could not be analyzed. The relatively modest sample size may have limited the statistical power to detect associations with less common complications, and findings from these two hospitals may not be generalizable to other settings. Despite these limitations, to our knowledge, this is the first study to describe the clinical profile and predictors of mortality among patients with LBRF in Addis Ababa, and its findings may help guide clinical vigilance and public health planning in this setting.

5. Conclusion

Louse-borne relapsing fever in Addis Ababa predominantly affects young, socially marginal-

ized men, particularly those experiencing homelessness, incarceration, or crowded living conditions. Hematologic complications and sepsis were independently associated with higher in-hospital mortality, while the overall case fatality rate was comparable to other Ethiopian settings. Early recognition and management of these complications, alongside public health interventions addressing homelessness, overcrowding, and population displacement, may help reduce the burden of LBRF-related mortality in this population.

Abbreviations

AAU: Addis Ababa University;

AOR: Adjusted Odds Ratio;

ARDS: Acute Respiratory Distress Syndrome;

CI: Confidence Interval;

CNS: Central Nervous System;

ICU: Intensive Care Unit;

JHR: Jarisch-Herxheimer Reaction;

LBRF: Louse-Borne Relapsing Fever;

MOH: Ministry of Health;

OR: Odds Ratio;

RRT: Renal Replacement Therapy;

SPSS: Statistical Package for the Social Sciences;

TASH: Tikur Anbessa Specialized Hospital;

ZMH: Zewditu Memorial Hospital.

Author Contributions

All authors contributed to the conception and design of the study. Data acquisition was performed by KZ. All authors contributed to data analysis and interpretation, drafted and critically revised the manuscript for important intellec-

tual content, and read and approved the final manuscript.

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Competing interests

The authors declare no competing interests.

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Ethical Dilemmas among Healthcare Professionals in the Emergency Center of Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia: A Mixed-Methods Study

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ABSTRACTBackground: Ethical dilemmas are intrinsic to emergency care, arising from tensions among respect for patient autonomy, resource allocation, confidentiality, and end-of-life decision-making. Data on the prevalence and nature of such dilemmas from emergency departments in low- and middle-income countries, including Ethiopia, remain scarce. This study aimed to determine the prevalence, nature, and determinants of ethical dilemmas among healthcare professionals in the Emergency Center of Tikur Anbessa Specialized Hospital (TASH).

Methods: An institution-based, cross-sectional, mixed-methods study was conducted in the Adult Emergency Center of TASH from 1 to 30 August 2025. Ninety Emergency and Critical Care Medicine (ECCM) residents and emergency nurses, selected by stratified random sampling, completed a structured, pretested questionnaire; 12 additional participants took part in two profession-specific focus group discussions. Quantitative data were summarized descriptively and analyzed by multivariable logistic regression; qualitative data were analyzed thematically and triangulated with the quantitative findings. Statistical significance was set at $p < 0.05$.

Results: Ethical dilemmas were common: 75.6% of participants reported resource-allocation dilemmas, 70.0% confidentiality/communication dilemmas, and 62.2% end-of-life dilemmas, driven mainly by shortages of ventilators, intensive care beds, oxygen, and essential medicines, compounded by culturally influenced expectations around communication and consent. Longer clinical experience was independently associated with lower odds of autonomy-related dilemmas (AOR 0.10; 95% CI 0.01-0.52; $p = 0.011$), whereas higher job satisfaction was associated with higher odds of resource-allocation dilemmas (AOR 5.4; 95% CI 1.2-23; $p = 0.02$). Sex, professional role, and prior ethics training were not significantly associated with dilemma occurrence. Qualitative accounts converged on themes of moral distress, emotional exhaustion, and decisional paralysis in the absence of institutional guidance.

Conclusions: Ethical dilemmas are frequent among healthcare professionals in this emergency center and appear predominantly structural. Strengthening resource availability, codifying institutional guidelines (including do-not-resuscitate policy), and embedding practical, case-based ethics training may reduce moral distress and support more consistent ethical decision-making.

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1. Introduction

Emergency departments are high-acuity, time-compressed environments in which clinicians must frequently make consequential decisions under clinical uncertainty and incomplete information. This operational reality generates a steady stream of ethical tension, as staff attempt to reconcile respect for patient autonomy with the competing imperatives of beneficence, non-maleficence, and distributive justice.^[1,2] The dilemmas that arise are rarely abstract: they concern whether to disclose a poor prognosis, how to preserve confidentiality when family members are present and emotionally invested, and how scarce life-sustaining resources should be allocated among patients with comparable need.^[3,4] Ethical practice in this setting therefore depends not only on clinical competence but on moral judgment, empathic communication, and the capacity to support patients and families through emotionally difficult decisions.^[5]

These challenges are magnified in resource-constrained health systems, where shortages of beds, ventilators, monitoring equipment, and essential medicines force clinicians into de facto rationing decisions that would rarely arise in better-resourced settings.^[6,7] Repeated exposure to such situations, particularly when clinicians recognize the ethically preferable course of action but are structurally prevented from pursuing it, is a recognized precursor of moral distress.^[8,9] Left unaddressed, moral distress is associated with emotional exhaustion, burnout, reduced empathic capacity, and attrition from clinical practice, compounding strain on already fragile health systems.^[10] High-income health systems have partly mitigated these harms through institutional ethics committees, published guidelines, and clinical ethics consultation services; such

infrastructure remains largely unavailable in many low- and middle-income countries (LMICs), leaving frontline staff to navigate ethically complex situations without structured support.^[11]

Evidence from Europe indicates that ethical difficulties, particularly around end-of-life care and disagreement with patients or families, are a near-universal feature of clinical practice, even where institutional ethics support exists.^[12] In sub-Saharan Africa, the absence of comparable infrastructure appears to intensify these difficulties: studies from South Africa and Ghana describe nurses and junior doctors encountering ethical dilemmas and professional role ambiguity with little formal preparation or institutional recourse.^[6,7] At the same time, research conducted during the COVID-19 pandemic showed how acute resource scarcity can fundamentally alter the character of professional obligation, compelling providers to make rationing decisions rarely required in well-resourced systems.^[13] Prevailing sociocultural and religious norms, under which family members often expect a central role in decisions about patient care, add a further layer of complexity distinctive to many African clinical contexts.^[8]

Within Ethiopia specifically, the ethical dimensions of emergency care remain poorly characterized. Available reports suggest that resource shortages, overcrowding, and limited formal ethics education converge to intensify the ethical burden on residents and nurses, who provide most frontline emergency care, often without clear institutional guidance on triage, resuscitation, or end-of-life decisions.^[10,11,14,15] Existing curricula have been criticized as overly theoretical and poorly aligned with the practical realities of high-acuity clinical environments, leaving many clinicians without confidence in their ca-

capacity to navigate ethically complex encounters. This gap constrains the development of evidence-informed institutional policy, targeted ethics curricula, and staff-support interventions.

The Emergency Department of Tikur Anbessa Specialized Hospital (TASH), Ethiopia's largest public referral and teaching hospital, manages a high volume of critically ill patients under conditions of intermittent resource scarcity, making it a relevant setting to examine this question. Accordingly, this study aimed to (i) determine the prevalence and principal categories of ethical dilemmas encountered by healthcare professionals in the TASH Emergency Center; (ii) identify sociodemographic, professional, and institutional factors associated with the major dilemma categories (autonomy, resource allocation, confidentiality, and end-of-life decision-making); and (iii) characterize, through the perspectives of residents and nurses themselves, the emotional and professional consequences of these dilemmas and how they are navigated in day-to-day practice.

2. Method

Study design, setting, and period

An institution-based, cross-sectional study employing a convergent mixed-methods design was conducted, in which quantitative and qualitative data were collected and analyzed independently and integrated at the interpretive stage, allowing estimation of prevalence and correlates alongside an in-depth account of lived experience. The study was carried out in the Adult Emergency Center of TASH, Addis Ababa, Ethiopia's largest public teaching and referral hospital. Established in 1950, with its Faculty of Medicine formally recognized in 1963 and postgraduate training initiated in 1979, TASH's Department of Emergency and Critical Care Medicine (ECCM) was

founded in 2010 in partnership with Addis Ababa University and international collaborators. The Emergency Center provides continuous, 24-hour tertiary emergency services staffed by ECCM consultants, ECCM residents, nurses, interns, and other detaching residents. Data were collected between 1 and 30 August 2025.

Study population and eligibility

The source population comprised all ECCM residents and nurses working in the Adult Emergency Center. Eligible participants had worked actively in the unit for at least six months and were present during the data-collection period. ECCM consultants and senior staff, residents from other departments on rotation, medical interns and nursing students, and staff on leave were excluded.

Sample size and sampling procedure

The quantitative sample size was calculated using the single-population-proportion formula ($Z_{\alpha/2} = 1.96$; assumed prevalence $P = 0.5$ in the absence of local estimates; margin of error $d = 0.05$), yielding an initial estimate of 384. Because the total eligible source population was small ($N = 100$; 45 ECCM residents, 55 nurses), the finite-population correction was applied, reducing the required sample to 80; a 10% allowance for non-response yielded a final target of 88, and 90 participants were ultimately recruited by stratified random sampling proportional to professional cadre. For the qualitative component, 12 participants (6 residents, 6 nurses) were purposively sampled to ensure diversity by sex and years of experience and allocated to two profession-specific focus groups.

Data collection

Quantitative data were collected electronically via Kobo Toolbox using a structured, self-

administered questionnaire adapted from previously used instruments assessing moral distress and ethical dilemmas in emergency care ^[16,17], modified for local context and organized into four sections: sociodemographic characteristics; frequency and type of ethical dilemma; institutional and resource-related factors; and professional factors. The instrument was piloted with 5% of the target sample to assess clarity and validity, and internal consistency was supported by a Cronbach's alpha of 0.75.

Qualitative data were collected through two semi-structured focus group discussions (one with residents, one with nurses; six participants each, a size informed by anticipated thematic saturation), using a guide adapted from published studies of healthcare workers' ethical experiences. ^[4,17] Discussions, conducted in English and Amharic in a private setting, lasted 60-90 minutes, were audio-recorded with participant consent, and were supplemented by field notes documenting non-verbal cues and group dynamics.

Data quality assurance

Completeness and internal consistency of quantitative data were checked daily during collection. Qualitative rigor was addressed through methodological triangulation, peer debriefing, purposive sampling to support transferability, iterative re-analysis to support dependability, and maintenance of an audit trail with verbatim quotations to support confirmability. Data collection continued until thematic saturation was reached.

Data analysis

Quantitative data were exported from KOBO Toolbox, cleaned in Microsoft Excel, and analyzed in SPSS version 27. Descriptive statistics

characterized participants and estimated the prevalence of ethical dilemmas; dilemmas reported as occurring daily or weekly were classified as "frequent." Variables associated with each dilemma domain at $p < 0.25$ in bivariate analysis were entered into four separate multivariable logistic regression models corresponding to resource allocation, confidentiality/communication, end-of-life decision-making, and autonomy. Multicollinearity was assessed using variance inflation factors (range 1.03-1.30) and tolerance statistics (range 0.85-0.93), indicating no material collinearity; model fit was assessed with the Hosmer-Lemeshow test ($p = 0.70$ - 0.87 across models). Pseudo- R^2 values ranged from 0.078-0.086 for the resource-allocation and end-of-life models to 0.34-0.36 for the confidentiality/communication and autonomy models. Associations are reported as adjusted odds ratios (AOR) with 95% confidence intervals; statistical significance was set at $p < 0.05$.

Qualitative data were analyzed using thematic content analysis combining inductive and deductive coding. Focus group recordings were transcribed verbatim and translated into English; an initial coding framework derived from the study objectives was iteratively refined during analysis, and codes were grouped into themes reflecting recurrent patterns in participants' ethical experience. Reflexivity regarding the investigating team's own emergency medicine background was maintained throughout coding to mitigate interpretive bias. Quantitative and qualitative findings were triangulated at the interpretive stage, and results were reviewed by academic supervisors to enhance credibility.

Ethical considerations

The study protocol was approved by the Department of Emergency Medicine Research Ethics Review Committee. Written informed consent was obtained from all quantitative survey participants; verbal consent, including separate consent for audio-recording, was obtained from focus group participants. Confidentiality was maintained through de-identification with participant codes, and recordings and datasets were stored securely with access restricted to the research team. Participants were informed of their right to withdraw at any time without consequence.

3. Result

Participant characteristics

Ninety healthcare professionals completed the quantitative survey (53.3% nurses, 46.7% ECCM residents), complemented by 12 focus group participants drawn in equal numbers from each cadre. Most survey respondents were male (63.3%) and aged 30-40 years (52.2%); most were single (70.0%). Among residents, the R3 level was most represented (41.5%); among nurses, 67.8% had 2-5 years of emergency department experience (Table 1).

Table 1. Sociodemographic and professional characteristics of healthcare professionals in the TASH Emergency Center (N=90).

Sex	Male	57	63.3
	Female	33	36.7
Age (years)	<30	40	44.4
	30-40	47	52.2
	>40	3	3.3
Profession	ECCM resident	42	46.7
	Nurse	48	53.3
Residency level (ECCM)	R1	11	28.3
	R2	15	30.2
	R3	16	41.5
Nurses' ED experience (years)	1-2	19	21.1
	2-5	61	67.8
	>5	10	11.1
Marital status	Single	63	70.0
	Married	24	26.7
	Divorced	2	2.2

	Widowed	1	1.1
Prior ethics training	Yes	24	26.7
	No	66	73.3
Satisfied with profession	Yes	63	70.0
	No	27	30.0

Percentages for residency level and nurses' ED experience are calculated within each subgroup (residents, n=42; nurses, n=48).

Prevalence and nature of ethical dilemmas

Ethical dilemmas were reported by a majority of participants across all domains assessed. When "daily" and "weekly" responses were combined, resource-allocation dilemmas were most prevalent: 75.6% (n=68) of participants reported that inadequate resources had forced a difficult clinical decision, most often reflecting shortages of ventilators, oxygen, monitoring equipment, and

intensive care beds (Table 2). Confidentiality- and communication-related dilemmas were reported by 70.0% (n=63) of participants, principally arising when family members were present during clinical discussions or requested information on the patient's behalf; end-of-life dilemmas, particularly around resuscitation of patients perceived to be dying, were reported by 62.2% (n=56).

Table 2. Frequency of specific ethical dilemmas reported by healthcare professionals in the TASH Emergency Center (N=90).

Lack of resources forced a difficult decision	56.7	18.9	6.7	17.8
Confidentiality compromised by others present	51.1	18.9	17.8	12.2
Difficulty maintaining confidentiality due to family presence	43.3	25.6	15.6	15.5
Challenges disclosing information to the patient	44.4	28.9	7.8	18.9
Several patients require the same equipment	44.4	27.8	15.6	12.1
Challenges disclosing information to the family	41.1	24.4	13.3	21.1
Patient unable to communicate their wishes	38.9	38.9	5.6	16.6
Resuscitating a terminally ill patient	37.8	24.4	14.4	23.3

Qualitative accounts illustrated the clinical texture behind these figures. Participants described the distress of allocating a single available ventilator among several patients with comparable need, and of managing critically ill patients in lower-acuity triage areas because monitored

beds were unavailable. Communication dilemmas frequently centered on tension between disclosing information directly to patients and deferring, per family expectation, to relatives as the primary recipients of clinical information; one participant described weighing a husband's

request for confidentiality against his wife's deteriorating health, illustrating how competing duties of confidentiality and beneficence can come into direct conflict in this setting. End-of-life dilemmas commonly involved performing resuscitation regarded by the treating team as non-beneficial, in the absence of an institutional do-not-resuscitate (DNR) policy and amid concern about family disagreement.

Decision-making, personal cost, and institutional context

When facing an ethical dilemma, most participants (76.7%) reported consulting colleagues rather than deciding independently (13.3%) or referring formally to a department head (32.2%); 18.9% reported feeling powerless to act. For decisions concerning unconscious or terminally ill patients, joint decision-making with family was the most common approach (67.8% and 62.2%,

respectively), reflecting the centrality of family involvement in this context. Notably, 76.7% of participants reported having personally paid for a patient's treatment from their own funds, most commonly to save a life (40.5%) or because they could not tolerate the patient's suffering (24.4%). This finding shows how frontline staff personally absorb structural resource gaps.

Institutional support for ethical decision-making was inconsistent (Table 3). While triage protocols were reported by most respondents (76.7%), awareness of DNR guidelines (22.2%) and of guidelines for disclosure of medical error (14.4%) was low, and the large majority (83.3%) reported inadequate physical resources (beds, equipment, medicines) to deliver recommended care. Several participants were unaware of the existence or accessibility of the hospital's ethics committee.

Table 3. Availability of institutional guidelines and resources as reported by healthcare professionals at TASH Emergency Center (N=90).

Triage protocols for patient priority	76.7	13.3	10.0
Treatment guidelines for patient care	61.1	22.2	16.7
First-come, first-served resource distribution	56.7	33.3	10.0
ICU admission guidelines	55.6	24.4	18.9
Pain management guidelines	54.4	28.9	16.7
Operating room priority guidelines	35.6	28.9	35.8
Sufficiently qualified health workers	41.1	53.3	5.6
Routine disclosure of treatment costs	38.9	45.6	15.6
DNR (do-not-resuscitate) guidelines	22.2	47.8	30.0
Guidelines for disclosure of medical error	14.4	60.0	24.0
Adequate resources (beds/equipment/medicines)	13.3	83.3	3.3

Factors associated with ethical dilemmas

In multivariable logistic regression, longer clinical experience (≥ 5 years) was independently associated with substantially lower odds of autonomy-related dilemmas relative to less experienced staff (AOR 0.10; 95% CI 0.01-0.52; $p=0.011$) (Table 4). Higher job satisfaction was independently associated with higher odds of resource-allocation dilemmas (AOR 5.4; 95% CI 1.2-23; $p=0.02$). Sex, professional cadre, and prior ethics training were not significantly associated with

either outcome after adjustment. Model fit was adequate across all four domain-specific models (Hosmer-Lemeshow $p=0.70-0.87$), and variance explained was higher for the autonomy and confidentiality/communication models (pseudo- $R^2=0.34-0.36$) than for the resource-allocation and end-of-life models (pseudo- $R^2=0.078-0.086$), consistent with the qualitative observation that structurally driven dilemmas were less closely tied to individual-level characteristics than were dilemmas with a stronger interpersonal or experiential dimension.

Table 4. Factors associated with autonomy-related (Panel A) and resource-allocation (Panel B) ethical dilemmas, multivariable logistic regression, TASH Emergency Center (N=90).

Panel A. Autonomy/consent-related dilemma

Profession	Nurse	2.5 (0.4-14)	0.29
Years of experience (<5 vs >5)	>5 years	0.10 (0.01-0.52)	0.011*
Prior ethics training	Yes	0.6 (0.08-3.8)	0.57
Sex	Male	2.5 (0.5-12)	0.25
Job satisfaction	Yes	6.6 (0.8-55)	0.07

Panel B. Resource-allocation dilemma

Profession	Nurse	1.6 (0.5-5.3)	0.40
Years of experience (<5 vs >5)	>5 years	0.7 (0.14-3.6)	0.69
Prior ethics training	Yes	2.3 (0.6-8.0)	0.20
Sex	Male	1.1 (0.3-3.3)	0.80
Job satisfaction	Yes	5.4 (1.2-23)	0.02*

AOR: adjusted odds ratio; CI: confidence interval. * $p<0.05$.

Emotional and professional impact

Across both quantitative and qualitative data, participants described substantial emotional burden. Although only 18.9% endorsed “feeling powerless” as a general coping style, qualitative accounts described recurrent moral distress,

emotional exhaustion, and what participants termed “moral residue” following ethically fraught encounters, particularly around futile resuscitation and rationing decisions. Several participants described a process of emotional desensitization over time, and others described

a defensive orientation toward self-protection from perceived legal risk, which some framed as being in tension with patient-centered practice.

4. Discussion

This mixed-methods study found that ethical dilemmas are frequent, multidimensional, and predominantly structural in origin among healthcare professionals working in the Emergency Center of TASH. Consistent with evidence from other low- and middle-income emergency care settings, dilemmas most commonly stemmed from resource scarcity, followed by communication/confidentiality conflicts and end-of-life decision-making.^[12,18]

Resource-allocation dilemmas, reported by more than three-quarters of participants, mirror findings from Kenya and South Africa, where clinicians in similarly resource-constrained emergency and critical care settings routinely confront *de facto* rationing decisions.^[19,20] The qualitative accounts in this study, describing the emotional toll of allocating a single ventilator among multiple patients, suggest that these are not abstract policy questions but recurrent, high-stakes clinical realities for frontline staff.

Confidentiality and communication dilemmas, affecting 70% of participants, appear closely tied to the sociocultural context of Ethiopian emergency care, in which family involvement in clinical communication is both expected and, at times, in direct tension with a patient's individual right to confidentiality and autonomous decision-making. This pattern is consistent with prior descriptions of family-centered decision-making norms complicating individual patient autonomy in African clinical settings,^[21] and suggests that ethics guidance developed in individualist, high-income contexts may require

substantial local adaptation rather than direct adoption.

The prevalence of end-of-life dilemmas (62.2%) and the qualitative theme of performing resuscitation regarded as non-beneficial echo findings from other sub-Saharan African settings, where the absence of a formalized DNR policy leaves clinicians to negotiate emotionally and ethically difficult decisions on an *ad hoc* basis.^[22] Only 22.2% of participants in this study reported awareness of an institutional DNR guideline, suggesting that policy gaps, rather than clinician uncertainty about the underlying ethical principles, may be the more tractable target for intervention.

The independent association between greater clinical experience and lower odds of autonomy-related dilemmas is consistent with the broader literature on the maturation of ethical reasoning and communication skills through sustained clinical exposure.^[23] Qualitatively, participants attributed this pattern to growing comfort with family communication and increasing confidence navigating ethically ambiguous situations, rather than to any reduction in the underlying frequency of ethically complex encounters.

The finding that higher job satisfaction was associated with greater odds of reporting resource-allocation dilemmas warrants cautious interpretation. Rather than implying that satisfaction causes dilemmas, this pattern is more plausibly explained by the moral-distress framework, in which clinicians most invested in providing guideline-concordant care may be more attuned to, and more troubled by, the gap between recommended and actually deliverable care.^[24] This interpretation is supported by the qualitative data, in which participants most

committed to patient welfare described the greatest frustration when unable to deliver best-practice management.

The absence of a significant association between sex, professional role, or prior ethics training and dilemma occurrence, together with qualitative reports describing existing ethics training as largely theoretical and poorly aligned with clinical reality, is consistent with prior observations from other LMIC settings that formal training alone, without institutional infrastructure and case-based pedagogy, may be insufficient to meaningfully reduce the ethical burden experienced by frontline staff.^[25,26]

Reported institutional deficits, limited awareness of DNR and medical-error-disclosure guidelines, and the near-universal perception of inadequate physical resources align with the broader literature associating structural constraints, rather than individual moral failure, with the ethical dilemmas and moral distress experienced by emergency and critical care clinicians in resource-limited settings.^[27,28] The convergence of quantitative and qualitative findings on moral distress, emotional exhaustion, and self-protective behavior in the face of perceived legal risk aligns with the global moral-injury literature describing the psychological toll of repeated exposure to ethically constrained clinical decision-making.^[29-31]

Taken together, these findings suggest that ethical dilemmas in this setting arise predominantly from systemic and institutional gaps, resource scarcity, absent or unclear guidelines, and communication structures poorly adapted to local sociocultural expectations, rather than from deficits in individual clinician judgment. Addressing these gaps directly, rather than relying solely on individual-level ethics education, is

likely necessary to meaningfully reduce moral distress and support more consistent, ethically defensible decision-making in this and comparable settings.

Limitations

This study has several limitations. The cross-sectional design precludes causal inference regarding the associations identified. Self-reported data on dilemma frequency and personal financial contributions to patient care may be subject to recall and social-desirability bias. As a single-center study, findings may not generalize to other Ethiopian or regional emergency care settings with different resource profiles or staffing structures. Certain organizational and cultural factors that may influence ethical decision-making were not systematically captured by the study instruments. We also note, and recommend resolving prior to submission, the internal inconsistencies described above between certain narrative and tabulated socio-demographic figures (prior ethics training and, across the two regression models, the ethics-training subgroup counts), which should be reconciled against the primary dataset.

5. Conclusion

Ethical dilemmas are common among healthcare professionals in the TASH Emergency Center and appear to arise predominantly from structural and institutional gaps rather than individual failings. More experienced staff reported fewer autonomy-related dilemmas, while more satisfied staff more often identified resource-allocation dilemmas, a pattern consistent with a moral-distress framework in which engaged clinicians are most attuned to gaps between recommended and deliverable care. Strengthening resource availability, codifying institutional guidelines for do-not-

resuscitate decisions and medical-error disclosure, and reorienting ethics education toward practical, case-based training may reduce moral distress and support more ethically consistent emergency care in this and similar resource-constrained settings. Priorities for future work include multicentre replication with larger samples and longitudinal designs capable of examining the relationship between moral distress, staff retention, and patient-care quality over time.

Abbreviations

AOR, adjusted odds ratio;
CI, confidence interval;
DNR, do-not-resuscitate;
ECCM, Emergency and Critical Care Medicine;
ED, emergency department;
FGD, focus group discussion;
ICU, intensive care unit;
LMIC, low- and middle-income country;
TASH, Tikur Anbessa Specialized Hospital;
VIF, variance inflation factor.

Author Contributions

All authors contributed to the conception and design of the study. Data collection was coordinated by the PI with support from the research team. All authors contributed to data analysis and interpretation, drafted and critically revised the manuscript for important intellectual content, and read and approved the final manuscript.

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Competing interests

The authors declare no conflict of interest.

Data Availability

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Pattern and trend of trauma-related deaths in the Emergency Medicine department of Tikur Anbessa Specialized teaching hospital, 2014-2016

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ABSTRACT

Background: Trauma is a major global public health problem and a leading cause of death and disability. Despite evidence that timely prehospital care can reduce trauma-related mortality, access to such services remains limited in many low- and middle-income countries, including Ethiopia. Data describing trauma-related deaths and prehospital care are scarce. This study aimed to assess the patterns of trauma-related deaths presenting to the emergency department (ED) of a tertiary hospital and describe factors associated with mortality.

Objective: To describe the patterns of injury and characteristics of trauma-related deaths among patients presenting to the Emergency Department of Tikur Anbessa Specialized Hospital (TASH).

Methods: A retrospective descriptive study was conducted at the Emergency Department of Tikur Anbessa Specialized Hospital. Medical records and trauma sheets of all 113 eligible trauma-related deaths occurring during six-month intervals (April to September) between 2014 and 2016 were reviewed (46 in 2014, 36 in 2015, and 31 in 2016). Patients who arrived alive at the ED and subsequently died from traumatic injuries, excluding poisoning and burn injuries, were included. Data were analyzed using SPSS version 20.0, and descriptive statistics were summarized using frequencies, percentages, means, tables, and figures.

Results: Males accounted for the majority of trauma-related deaths across the three six-month study periods (April–September of 2014, 2015, and 2016: 84.8%, 80.6%, and 83.9%, respectively). The mean age of male victims was 42.6, 39.2, and 38.3 years, while the mean age of female victims was 32.1, 45.6, and 47.2 years. Trauma-related deaths represented 17.6%, 13.9%, and 10.9% of total ED deaths during the respective periods. Only 45.6%, 27.8%, and 25.8% of victims arrived at the ED within six hours of injury. Motor vehicle accidents (MVAs) were the leading mechanism of injury (65.2%, 55.6%, and 80.6%), followed by assault and falls. Blunt trauma was the predominant injury mechanism (93.4%, 97.2%, and 100%), with blunt head injury being the most common anatomical injury (89.1%, 88.9%, and 74.3%), followed by poly-trauma and maxillofacial injuries. The mean Revised Trauma Score (RTS) on arrival was 5.29 ± 1.74 , 5.02 ± 1.77 , and 5.43 ± 1.90 . Head injury was the leading cause of death (82.6%, 83.3%, and 67.7%), followed by sepsis/multiple organ failure syndrome, hemorrhagic shock, and respiratory failure.

Conclusion: Trauma-related deaths predominantly affected males of productive age. A relatively small proportion of patients reached the hospital within six hours of injury, indicating potential delays in accessing definitive care. Although the overall trend of trauma-related mortality decreased during the study period, deaths resulting from motor vehicle accidents increased. These findings highlight the need to strengthen injury prevention strategies, improve prehospital and emergency trauma care, and optimize the trauma care system to reduce preventable trauma-related deaths.

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1. Introduction

Trauma and physical injuries represent a major global public health challenge, accounting for more than five million deaths annually, approximately 9% to 10% of global mortality, and nearly 16% of the global burden of disease.^[1, 2] An injury is conventionally defined as physical damage resulting from the acute transfer of energy (mechanical, thermal, electrical, chemical, or radiant) or the sudden deprivation of vital elements such as oxygen.^[3] Injuries are broadly categorized by intent into unintentional injuries (such as road traffic accidents, falls, drowning, burns, and poisoning) and intentional injuries (including interpersonal violence, self-harm, and armed conflict).^[1, 4] Globally, trauma is the leading cause of mortality among individuals under 40 years of age and disproportionately affects young adults aged 15–29 years.^[2, 5]

Timely prehospital care and organized emergency medical services (EMS) are critical determinants of trauma survival.^[2, 6] In high-income settings, established trauma systems utilizing Advanced Trauma Life Support (ATLS) guidelines, built around rapid transportation, structured resuscitation (the ABCDE approach), and dedicated trauma teams, have significantly reduced preventable deaths.^[7] Conversely, in low- and middle-income countries (LMICs), a substantial proportion of trauma-related deaths occur before patients reach a healthcare facility due to fragmented prehospital care, inadequate ambulance infrastructure, prolonged transport times, and inefficient referral pathways.^[2, 6]

In Ethiopia, the burden of trauma is high, yet emergency care systems remain underdeveloped.^[8] Many health facilities lack dedicated emergency departments, essential resuscitation equipment, and healthcare providers formally

trained in emergency and trauma care.^[8] Consequently, trauma victims face significant delays in diagnosis, triage, and definitive management.^[8] To address these systemic gaps, Tikur Anbessa Specialized Hospital (TASH), Ethiopia's principal tertiary referral center, established its Emergency Department in 2010, establishing a foundation for standardized emergency care in the country.^[8] However, despite this milestone, the hospital continues to face operational challenges driven by surging patient volumes, resource limitations, and the absence of a coordinated national trauma network.^[8]

Despite the substantial impact of trauma in Ethiopia, empirical evidence describing the detailed epidemiology of trauma mortality remains scarce.^[1, 8] Existing literature provides limited data regarding injury mechanisms, anatomical injury patterns, time elapsed from injury to presentation, physiological severity at arrival, and immediate causes of death in emergency departments.^[1, 8] Furthermore, longitudinal data evaluating trends in trauma-related mortality over time are lacking.^[1] Understanding these factors is crucial for identifying systemic bottlenecks, informing targeted injury prevention policies, and strengthening prehospital and hospital-based trauma care.^[1]

Therefore, this study aimed to assess the patterns, clinical characteristics, and multi-year trends of trauma-related deaths among patients who died from traumatic injuries at the Emergency Department of Tikur Anbessa Specialized Hospital during the six-month study periods (April–September) between 2014 and 2016. Specifically, the study evaluated the socio-demographic profile of trauma victims, determined the distribution of injury mechanisms and anatomical patterns, identified the immediate

clinical causes of death, and assessed the temporal relationship between time of injury, presentation, and mortality.

2. Method

Study Area

The study was conducted at the Emergency Department (ED) of Tikur Anbessa Specialized Hospital (TASH) in Addis Ababa, Ethiopia. TASH is the country's largest tertiary referral and teaching hospital and serves as the primary clinical training site for the College of Health Sciences at Addis Ababa University. The hospital receives high-acuity referral patients from all regions of Ethiopia and provides specialized surgical, medical, pediatric, and subspecialty care. During the study period, the facility operated with approximately 800 inpatient beds and over 130 specialist physicians.

The Emergency Department was established in 2010 within the Department of Emergency Medicine and Critical Care and provides 24-hour emergency and trauma resuscitation services for adult patients. Emergency medicine residents, general practitioners, interns, and emergency nurses deliver care under the direct supervision of consultant emergency physicians. Clinical care follows standardized international guidelines, including Advanced Trauma Life Support (ATLS) protocols. The department is equipped for critical trauma resuscitation, initial stabilization, emergency surgical decision-making, and definitive care or subspecialty admission.

Study Period

The study reviewed trauma-related deaths occurring over three consecutive years, focusing on a standardized six-month period (April 1 to September 30) for each year from 2014 to 2016. The

April–September window was purposefully selected as it encompasses the transition through the primary heavy rainy season (*Kiremt*) in Ethiopia, a period characterized by increased road traffic hazards, altered transportation dynamics, and heightened trauma risks. Utilizing an identical six-month timeframe across all three years controlled for seasonal confounding, enabling a standardized evaluation of multi-year temporal trends.

Study Design

A retrospective descriptive study was conducted through review of medical records of trauma-related deaths that occurred in the Emergency Department of TASH during the study period. Information was obtained from patients' medical charts, emergency department records, and trauma registration forms maintained by the hospital medical records unit.

The study included all eligible trauma-related deaths that fulfilled the predefined inclusion criteria during the study period.

Study Population

The study population comprised all trauma victims who presented alive to the ED of TASH and subsequently died while receiving emergency care during the study period.

Criteria for Determining Trauma-Related Death

A death was classified as directly resulting from trauma if it met the following standardized clinical criteria based on retrospective review of emergency medical records, triage logs, resuscitation sheets, and official death summary reports:

- **Direct traumatic etiology:** The primary anatomical injury or acute physical energy transfer (e.g., severe traumatic brain injury, trau-

matic asphyxia, massive hemorrhage, or poly-trauma) was documented by the attending emergency or surgical team as the main trigger leading to cardiac arrest or death.

- **Acute traumatic complications:** Death resulted directly from secondary systemic complications that directly stemmed from the primary traumatic event during the ED stay, including acute hemorrhagic shock, refractory traumatic shock, acute respiratory distress secondary to chest trauma, or rapid post-traumatic sepsis/multiorgan failure.
- **Exclusion of primary medical Events:** Patients were excluded if clinical evaluation indicated that an underlying non-traumatic acute medical event (e.g., primary myocardial infarction, cardiac arrhythmia, or cerebrovascular accident) preceded and directly caused the collapse or secondary minor injury, or if trauma was incidental to the cause of death. Patients who were Dead on Arrival (DOA) without undergoing ED resuscitation were also excluded.

Eligibility Criteria

Inclusion Criteria

The study included all patients who fulfilled the following criteria:

- Patients with trauma-related deaths who presented alive to the Emergency Department of TASH Hospital during the study period.
- Patients whose deaths resulted from traumatic injuries other than burns and poisoning.

- All eligible trauma-related deaths occurring during the study period (April to September for each year from 2014 to 2016).

Exclusion Criteria

The following patients were excluded from the study:

5. Patients who were declared dead on arrival at the Emergency Department.
6. Patients whose deaths resulted from burn injuries or poisoning.
7. Medical records with incomplete or missing information required for the study.

Study Variables

The study collected information on patients' demographic characteristics, injury characteristics, clinical findings, and hospital-related variables.

Data Collection Procedure

A structured data abstraction form was developed to collect information from patients' medical records and trauma registration sheets. Medical charts of all eligible trauma-related deaths were retrieved from the hospital medical records department and reviewed systematically.

Information regarding demographic characteristics, injury mechanism, anatomical site of injury, clinical findings, treatment, complications, and causes of death was extracted from the patients' records. Records with incomplete documentation or missing essential information were excluded from the analysis.

Data Management and Analysis

The collected data were checked for completeness and consistency before data entry. Data were entered, cleaned, and analyzed using Statistical Package for the Social Sciences (SPSS) version 20.0.

Descriptive statistical methods were used to summarize the study findings. Continuous variables were summarized using means and standard deviations where appropriate, while categorical variables were presented as frequencies and percentages. Results were presented in tables, charts, and graphs to facilitate interpretation.

Ethical Considerations

Ethical approval for the study was obtained from the Institutional Review Board of TASH. The relevant hospital authorities granted permission to access patients' medical records before data collection.

Patient confidentiality was maintained throughout the study by collecting data anonymously and excluding personal identifiers from the data collection tool. The information obtained from medical records was used solely for research purposes.

Operational Definitions

Hospital stay: The duration of hospitalization before death was categorized as acute if death occurred within 48 hours of admission, delayed if death occurred between 3 and 7 days, and late if death occurred more than 7 days after admission.⁽¹³⁾

Mechanism of injury: The external cause responsible for the injury, including motor vehicle accidents, falls from height, assault (excluding sexual assault), and other traumatic events.

Other mechanisms of injury: Injuries resulting from machinery, animal bites, war-related injuries,

and other mechanisms not included in the predefined categories.

Unknown mechanism of injury: Cases in which the mechanism of injury could not be determined because the patient was brought by police, bystanders, or other individuals without reliable information regarding the incident.

Self-referral: Patients who presented directly to the Emergency Department either by themselves or accompanied by family members or friends without referral from another health facility.

Referred patient: Patients transferred from another healthcare facility with an official referral document.

Source of referral – Other: Patients for whom no referral document or documentation regarding the source of referral was available in the medical record.

Revised Trauma Score (RTS): A physiological trauma scoring system calculated using the Glasgow Coma Scale (GCS), systolic blood pressure (SBP), and respiratory rate (RR). The weighted RTS is calculated using the formula:

Weighted RTS = (0.9368 × GCS score) + (0.7326 × SBP score) + (0.2908 × RR score)

RTS is the Revised Trauma Score. It is calculated using GCS, SBP, and RR (tin17 (10), 706).

The raw RTS score ranges from 0 to 12

Weighted RTS = **0.94 × RTS GCS** + **0.73RTS SBP** + **0.29RTS RR** and max score 7.84 and min score is

- a. Maximum is 7.84
- b. Minimum is 0
- c. Survival correlation
- d. 80% with RTS of 5
- e. 50% with RTS of 3.5
- f. 20% with RTS of 23

3. Result

Across the three six-month study periods (April 1 to September 30 in 2014, 2015, and 2016), a total of 5,433 trauma patients presented to the Emergency Department (ED) of Tikur Anbessa Specialized Hospital (TASH), comprising 1,761 patients in 2014, 1,819 in 2015, and 1,853 in 2016. Overall, trauma admissions accounted for

approximately one-quarter of total ED patient volume across each study period (24.1% in 2014, 24.6% in 2015, and 24.8% in 2016).

During the study periods, 113 trauma-related deaths occurred in the ED. Trauma deaths represented 17.6% ($n = 46/262$) of total ED mortality in 2014, 13.9% ($n = 36/259$) in 2015, and 10.9% ($n = 31/282$) in 2016 (Figure 1).

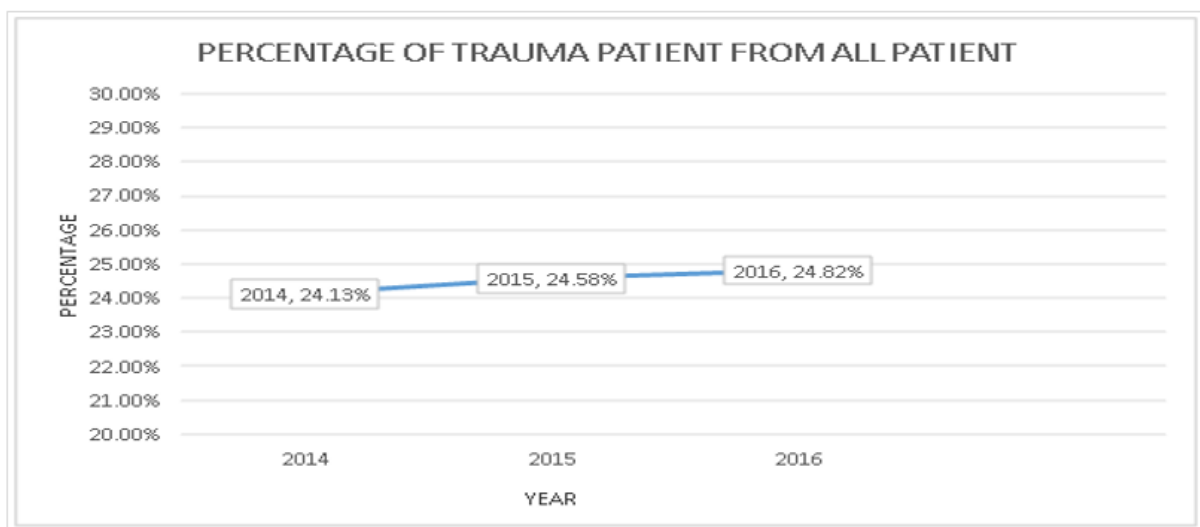


Figure 1: Percentage of trauma patients from all patients

Among all presenting trauma cases, the overall trauma case-fatality rate was 2.1% ($113/5,433$), showing a downward trend across the three

study periods from 2.6% ($46/1,761$) in 2014 to 2.0% ($36/1,819$) in 2015 and 1.7% ($31/1,853$) in 2016 (Figure 2, 3).

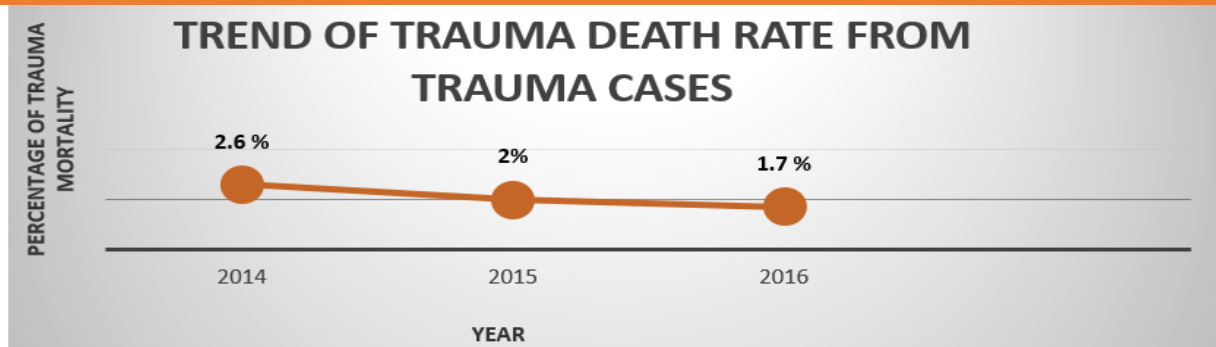


Figure 2: Trend of trauma death rate from trauma cases

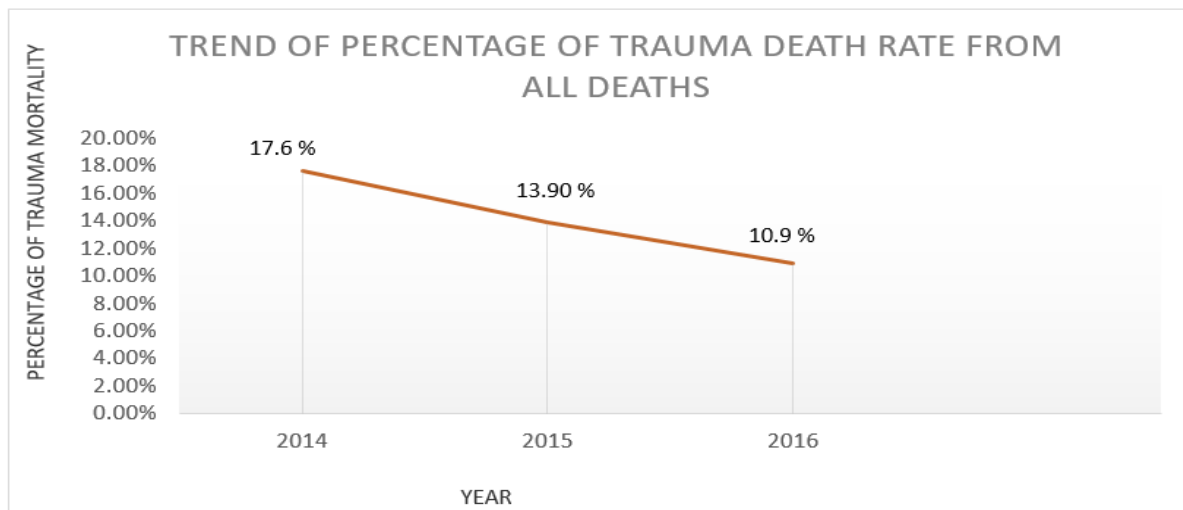


Figure 3: Trend of percentage of trauma death rate from all deaths

Table 1 Socio-demographic characteristics and base line vital signs upon arrival among trauma-related deaths (N = 113) at the Emergency Department of Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia (April–September, 2014–2016).

Demographic & clinical variable	Characteristics	2014n(%)	2015n(%)	2016n(%)
Gender	Male	39(84.8%)	29 (80.6%)	26 (83.9%)
	Female	7(15.2%)	7 (19.4%)	5 (16.1%)
Age (Years)	<18 year	6(13.0%)	2 (5.6%)	0 (0%)
	18-55 year	25(54.3%)	27 (75.0%)	24 (77.4%)
	>55 year	15(32.6%)	7 (19.4%)	7 (22.6%)
	MVA	30(65.2%)	20 (55.6%)	25 (80.6%)
	Fall down accident	6(13.0%)	5 (13.9%)	2 (6.5%)

Mechanism of Injury	Assault/fighting, bullet, sharp injury, stab injury etc./	8(17.4%)	8 (22.2%)	2 (6.5%)
	Unknown	1(2.2%)	1 (2.8%)	1 (3.2%)
	Other	1(2.2%)	2 (5.6%)	1 (3.2%)
Source of Referral	Self-Referral	3 (6.5%)	4 (11.1%)	1 (3.2%)
	Referred from other health institution	37 (80.4%)	25 (69.4%)	28 (90.3%)
	Unknown	6 (13.0%)	7 (19.4%)	2 (6.5%)
Mode of Arrival	Ambulance	19 (41.3%)	11 (30.6%)	11 (35.5%)
	Taxi	10 (21.7%)	12 (33.4%)	8 (25.8%)
	Private car	7 (15.2%)	1 (2.8%)	4 (12.9%)
	Police Car & Other	10 (21.7%)	12 (33.4%)	8 (25.8%)
Systolic Blood Pressure	>=90 mmHg	35 (76.1%)	30 (83.3%)	27 (87.1%)
	<90 mmHg	11 (23.9%)	6 (6.7%)	4 (12.9%)
Respiratory Rate	<10 breath/min	3 (6.5%)	1 (2.8%)	1 (3.2%)
	10-29 breath/min	33 (71.1%)	22 (61.1%)	15 (48.4%)
	>29 breath/min	10 (21.7%)	13 (36.1%)	15 (48.4%)
GCS	>=9	17 (37%)	8 (22.2%)	13 (41.9%)
	<9	29 (63%)	28 (77.8%)	18 (58.1%)

The most common triage classification in 2014 was orange, followed by red, yellow, and green, at 22 (47.8), 15 (32.6%), 8 (17.4), and 1 (2.2%), respectively. For the year 2015 both red and orange were equal at 13 (36.1%) each followed by

yellow and green at 7(19.4%) and 3 (8.4%) but for the year 2016 red was the commonest 22 (71%) followed by orange and yellow at 7 (22.8%) and 2 (6.5%) (Figure 4).

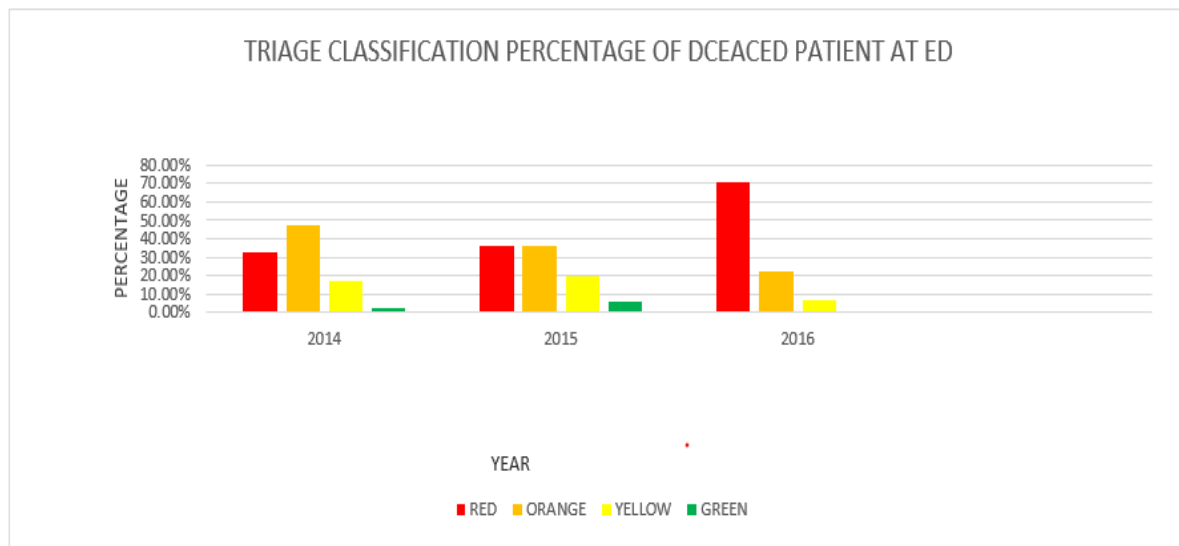


Figure 4: Triage classification percentage of deceased patient at ED

Males were most affected by trauma deaths in all the study periods, accounting for 39 (84.8%), 29 (80.6%), and 26 (83.9%), with a male-to-female ratio of (5.57:1), (4.14:1), and (5.2:1), respectively. The mean ages were (38.13 $\pm$ 14.34), (40.22 $\pm$ 16.52), and (39.74 $\pm$ 18.99), respectively. The age group most affected by the trauma deaths was between the ages of 18-55 years, accounting for 25 (54.3%), 27 (75%), and 24 (77.4%), respectively. The mean age for males was 42.62, 39.17, and 38.31, and the mean age

for females was 32.14, 45.57, and 47.20. In all three years, the 18–55-year age group accounted for the largest proportion of trauma deaths, increasing from approximately 55% in 2014 to 75% in 2015 and 78% in 2016. Deaths among people older than 55 years represented about 32% in 2014, decreasing to 20% in 2015, before increasing slightly to 22% in 2016. The under-18 age group had the lowest proportion, accounting for approximately 13% in 2014, 6% in 2015, and almost none in 2016 (Figure 5).

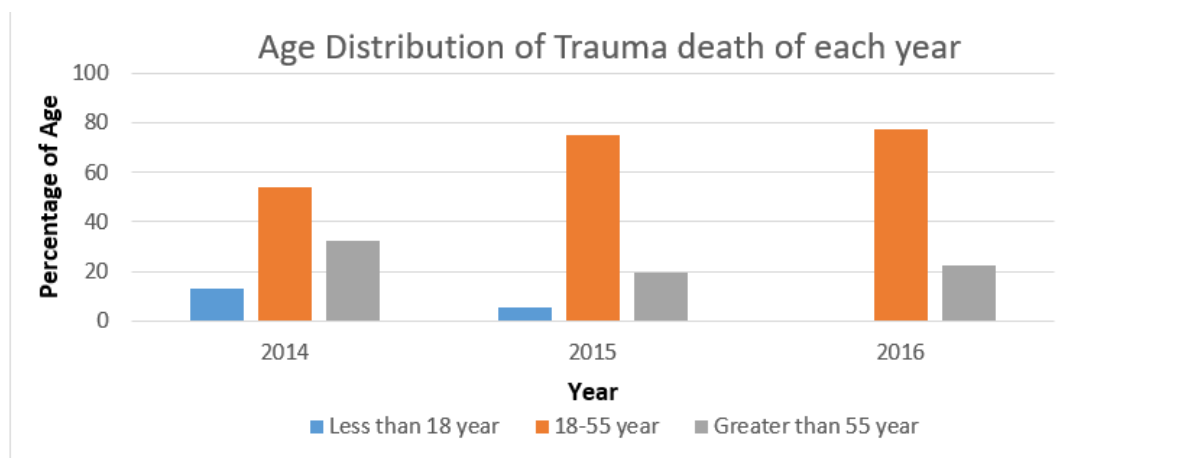


Figure 5: Age distribution of trauma death of each year

The general demographic distribution of the study period is shown in Table 1)

Addis Ababa and Oromia were the regions which contributed for most of the deaths followed by

Amhara at [23 (50%) ; 17 (37%) ; 4 (8.7%)], [12 (33%); 12 (33%) ; 6(16.7%)] and [8 (25.8%); 10(32.3%) ;12.9%]in all the study periods (Figure 6).

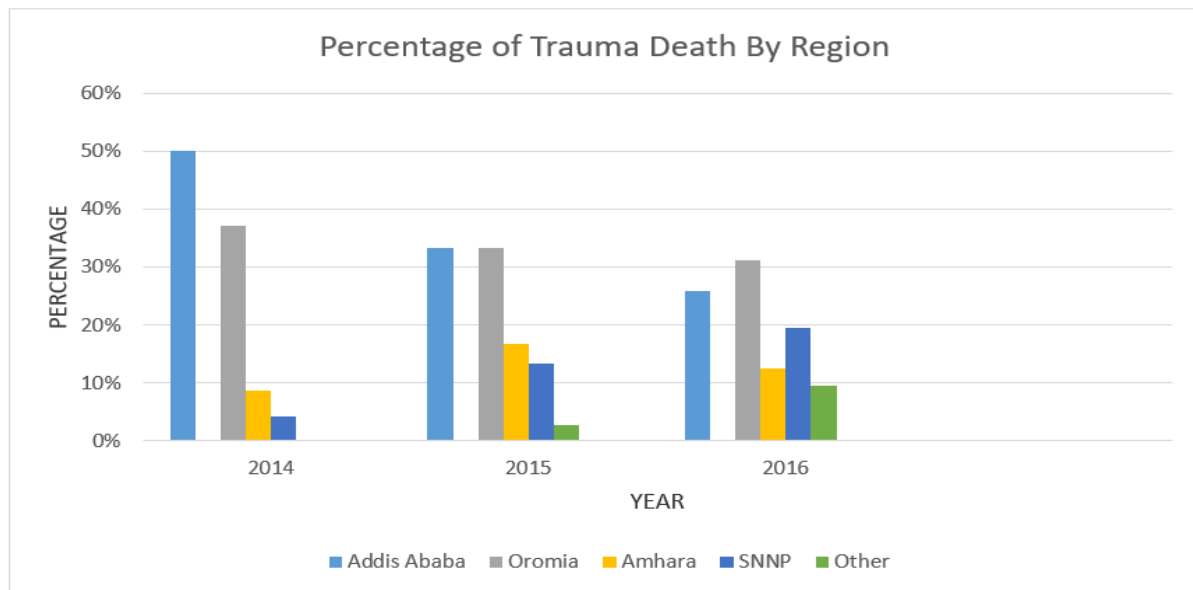


Figure 6: Percentage of trauma death by region

Across the three study periods, the majority of fatal trauma victims were referred from government or private health facilities before pre-hospital. In 2014 and 2016, ambulance transport was the primary mode of arrival (41.3%, n = 19 and 35.5%, n = 11, respectively), followed by commercial taxis (21.7%, n = 10 and 25.8%, n = 8,

senting to the ED: 80.4% (n = 37/46) in 2014, 69.4% (n = 25/36) in 2015, and 90.3% (n = 28/31) in 2016.

respectively). In contrast, in 2015, commercial taxis were the predominant arrival modality (33.3%, n = 12), followed by ambulance transport (30.6%, n = 11) (Figure 7).

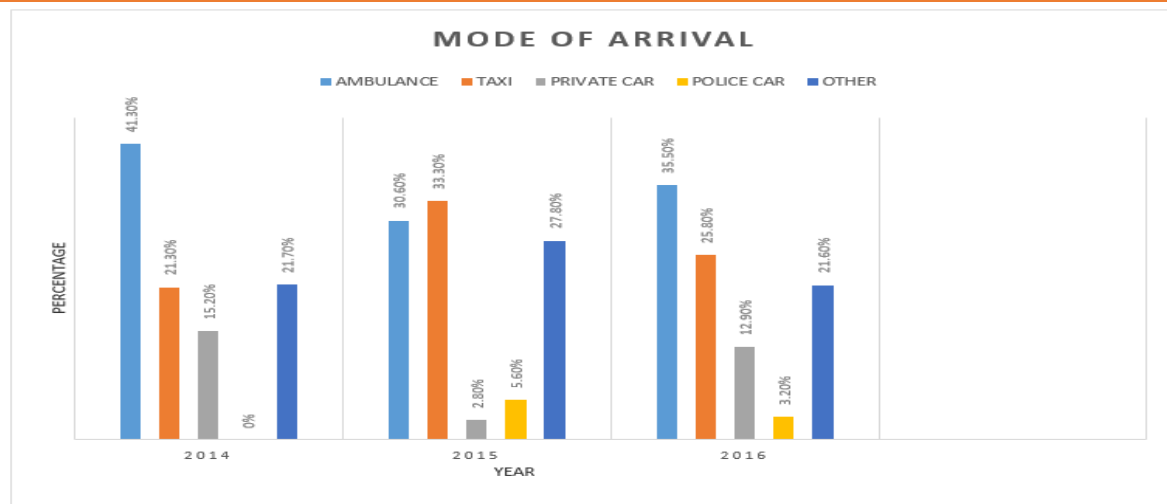


Figure 7: Mode of arrival

Overall, fewer than half of the fatal trauma victims reached the ED within six hours of injury: 45.6% ($n = 21/46$) in 2014, 27.8% ($n = 10/36$) in 2015, and 25.8% ($n = 8/31$) in 2016. Complete time-interval records were documented for 108 of the 113 patients. The mean time elapsed from injury to ED presentation was 23.89 ± 39.20 hours in 2014, 36.08 ± 54.96 hours in 2015, and 34.30 ± 50.33 hours in 2016. As detailed in Table 3, the majority of victims died within 48 hours of ED arrival across all three periods: 65.2% ($n = 30$) in 2014, 80.6% ($n = 29$) in 2015, and 71.0% ($n = 22$) in 2016. The mean length of ED stay was 58.94 ± 87.19 hours in 2014, 54.58 ± 97.31 hours in 2015, and 32.41 ± 35.94 hours in 2016, while

the overall mean time from initial injury to death was 86.70 ± 101.91 hours, 87.78 ± 109.29 hours, and 65.17 ± 61.72 hours across the respective study periods.

The most common mechanism of trauma deaths is Motor Vehicle Accidents (MVAs), accounting for 30 (65.2%), 20 (55.6%), and 25 (80.6%) for the study years, respectively (Figure 9). Assault was the next most common mechanism, accounting for 8 (17.4%), 8 (22.3%), and 2 (6.5%) deaths, and falls from height accounted for 6 (13.2%), 5 (13.9%), and 2 (6.5%). Most deaths in the age group 18-55 were due to MVAs during the study period, with 14 (30.43%), 14 (38.88%), and 20 (64.51%).

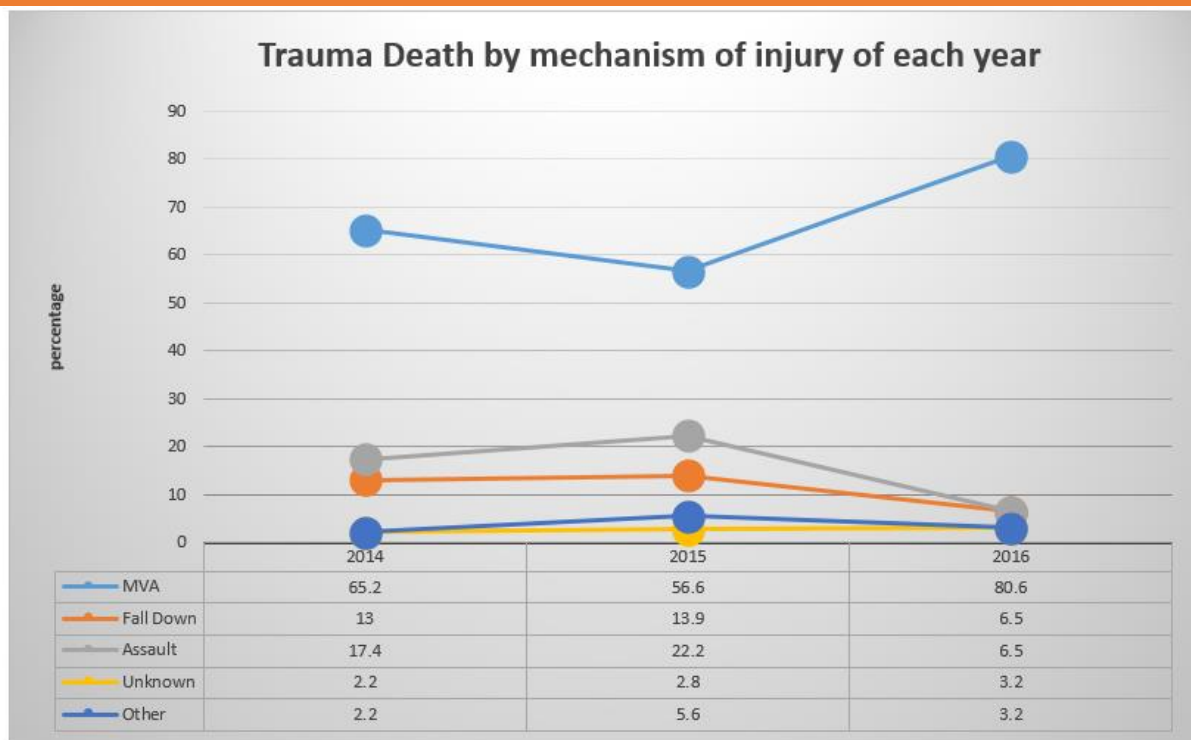


Figure 9: Trauma death by mechanism of injury of each year

Blunt trauma is the most commonly encountered mechanism among the deceased during the study periods, accounting for 43 (93.4%), 35 (97.2%), and 31 (100%). Blunt trauma from MVAs was the most common. Penetrating trauma

only occurred in 3 (6.5%), 1 (2.77%), and 0 (0%) of the deceased patients. Of the 3 penetrating traumas that occurred in 2014, 2 were stab injuries to the chest and the other one was a gunshot wound to the head. The other penetrating trauma in 2015 was an axe injury to the head.

Blunt head injury is the most common injury anatomically occurring in 41 (89.1), 32 (88.9%) and 23 (74.3%) respectively followed by poly-trauma and maxillofacial injuries at in [21 (45.7%); 19 (41.9%)], [27 (75%) ; 20 (55.6)] and [21 (67.7%); 17 (54.8)] respectively (**Table 2**).

Most patients who died initially presented with systolic blood pressure of more than 90 mmHg

Table 2 Anatomy of trauma

Anatomical Location of injury	Year	Year	Year
	2014	2015	2016

Head Injury	44(93.4%)	32(88.9%)	23(74.2%)
Maxillofacial Injury	19(41.3%)	20(55.6%)	17(54.8%)
Neck Injury	0(%)	6(16.7%)	0(%)
Chest Injury	8(17.4%)	5(13.9%)	5(16.1%)
Abdominal Injury	5(10.9%)	2(5.6%)	1(3.2%)
Pelvic Injury	2(4.3%)	0(0%)	0(0%)
SCI	2(4.3%)	5(13.9%)	12(38.7%)
Long Bone Injury	7(15.2%)	4(11.1%)	2(6.5%)
Poly-trauma	21(45.7%)	27(75%)	21(67.7%)
Other site injury	7(15.2%)	3(8.3%)	4(12.9%)

The mean RTS and ISS on arrival to the ED were (5.29+/-1.74; 38.13+/-14.34), (5.02+/-1.77; 32.33+/-7.79), and (5.43+/-1.90; 30.83+/-9.91), respectively.

CT was done in 23 (50%), 23 (63.9%), and 22 (71.0%), respectively. FAST/EFAST was done and documented for only 18 (39.1%), 19 (52.8%), and 10 (32.3%). FAST/EFAST was positive in 8 (17.4%), 4 (11%), and 3 (11.1%), respectively.

Documentation on whether FAST/EFAST was performed during the study periods was missing in 28 (60.9%), 17 (47.2%), and 21 (67.7%) cases.

In the study periods, head injury is the most common cause of death, accounting for 38 (82.61 %), 30 (83.33%), and 21 (67.74%), respectively, followed by sepsis/MOFS, hemorrhagic shock, and respiratory failure (**Table 4**).

Table 3: Distribution of demographic and injury mechanism, according to Hospital stay.

Variables	Characteristics	Hospital Stay of the Patient								
		2014	2014	2014	2015	2015	2015	2016	2016	2016
		Acute	Early	Late	Acute	Early	Late	Acute	Early	Late
Gender	Male	25(54.4%)	11(23.9%)	3	22(61.1%)	5(13.30)	2	19(61.3)	7	0
Gender	Female	5(10.9%)	2	0	7(19.4)	0	0	3	2	0
Mechanism of injury	MVA	22(47.8%)	8	0	18(50%)	1	1	17(54.80)	8	0
Mechanism of injury	Fall from height	2	2	2	3	1	1	1	1	0
Mechanism of injury	Assault	4	3	1	6	2	2	2	0	0
Mechanism of injury	Unknown	1	0	0	0	1	0	1	0	0

Mechanism of injury	Other	1	0	0	0	0	1	0	0
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Table 4 Clinical condition leading to Death

Clinical diagnosis	2014	2015	2016
Head Injury	38(82.61%)	30 (83.33%)	21(67.74%)
Hemorrhagic shock	10 (21.74%)	4 (11.11%)	7 (22.58%)
RF	2 (4.35%)	9 (25.00%)	11(35.48%)
Sepsis/MOFS	15 (32.61%)	12 (33.33%)	9 (29.03%)

4. Discussion

Understanding the patterns and trends of trauma-related mortality is essential for improving injury prevention strategies, optimizing trauma care systems, and guiding future trauma research. The three fundamental pillars of trauma management include injury prevention, effective trauma care, and trauma research. ⁽²⁵⁾ In Ethiopia, information regarding trauma-related mortality remains limited, largely due to the absence of comprehensive trauma registries and inadequate documentation systems. This study therefore provides valuable information on the epidemiology and trends of trauma-related deaths among patients presenting to the Emergency Department (ED) of Tikur Anbessa Specialized Hospital (TASH).

The proportion of trauma-related deaths was highest during 2014 and 2015, with a noticeable decline observed in 2016. Although the mortality rates during the first two years were higher than the current global estimate of approximately 9%, ^(1,13) the proportion of trauma-related deaths progressively decreased over the study period. This was consistent with the 2016 Federal Ministry of Health indicators. ^(20,24) Furthermore, the proportion of trauma-related deaths observed in this study was lower than that reported in previous studies conducted in Ethiopia and Tanzania, where mortality rates of 27% and 16.7%, respectively, were document-

ed. ^(17,20) The declining trend in trauma mortality despite a relatively stable trauma patient load may reflect improvements in emergency care following the establishment of the Department of Emergency Medicine at TASH, including the increasing availability of trained emergency physicians, residents, and emergency nurses.

Triage plays a critical role in the early identification and management of severely injured patients. In the present study, a considerable proportion of patients who subsequently died had initially been triaged into lower-acuity categories (yellow or green). Specifically, 19.6%, 27.8%, and 6.5% of trauma-related deaths in 2014, 2015, and 2016, respectively, had initially received lower-priority triage classifications. Although substantial improvement was observed in 2016, these findings suggest the need for continuous evaluation of triage practices, regular training for emergency nurses, and periodic revision of triage protocols to improve the identification of critically injured patients. Frequent staff turnover may also contribute to inconsistencies in triage performance, emphasizing the importance of continuous professional development and standardized training.

The majority of patients who died during the study period were referred from government or private health institutions. Compared with an earlier Ethiopian study, which reported referral rates of approximately 55%, ⁽²⁰⁾ the present find-

ings suggest some improvement in the referral system. However, this study did not assess the appropriateness or timeliness of referrals. Ambulances and taxis were the most common modes of transportation to the hospital. Although ambulance utilization appeared to have increased compared with previous reports, a substantial proportion of patients still arrived by taxi, private vehicle, or other informal means of transportation. This finding highlights persistent deficiencies in Ethiopia's prehospital emergency medical services and suggests that many trauma victims do not receive appropriate stabilization before reaching hospital care. Strengthening emergency medical services, improving ambulance availability, and increasing public awareness of safe transportation for injured patients are essential measures to improve trauma outcomes.

Consistent with previous studies conducted both internationally and within Africa, males accounted for the majority of trauma-related deaths in the present study. ^(10,12,13,17,18,22) The predominance of male victims may be explained by greater occupational exposure, increased participation in outdoor activities, and higher involvement in road traffic and interpersonal violence. In many low-income countries, including Ethiopia, men are more frequently engaged in occupations that require travel and expose them to greater risk of injury. ^(17,18) Furthermore, the majority of trauma-related deaths occurred among individuals within the economically productive age group, highlighting the substantial social and economic consequences of trauma for affected families and the country. This observation is consistent with previous reports demonstrating that traumatic injuries disproportionately affect young adults. ^(13,17,18,22)

Blunt trauma was the predominant mechanism of injury throughout the study period, account-

ing for the overwhelming majority of trauma-related deaths. This finding is consistent with reports from Malaysia and other low- and middle-income countries. ⁽¹³⁾ In contrast, studies from South Africa have demonstrated relatively similar proportions of blunt and penetrating trauma, reflecting regional differences in injury epidemiology and interpersonal violence. ⁽¹⁵⁾

Motor vehicle accidents were the leading mechanism of trauma-related death in all three study periods. This finding is consistent with previous studies conducted in Ethiopia and other countries, where road traffic injuries remain the principal cause of fatal trauma. ^(9,15,17,18) Similarly, a systematic review conducted in Ethiopia reported that road traffic accidents and assault were the leading causes of trauma-related mortality. ⁽²²⁾ Although the overall number of trauma-related deaths declined over the study period, deaths resulting from motor vehicle accidents showed an increasing trend, particularly in 2016. This finding underscores the urgent need for comprehensive road safety interventions. Effective prevention requires coordinated efforts involving the transport, health, education, and law enforcement sectors to improve road infrastructure, strengthen enforcement of traffic regulations, enhance vehicle safety standards, and promote safer road-user behavior.

Assault represented the second leading mechanism of trauma-related death in this study. The proportion of assault-related deaths was higher than that reported by the WHO and in studies from Nigeria, ^(1,16) although lower than reports from Kenya and Tanzania. ^(17,18) Because violence is largely preventable, reducing assault-related mortality requires coordinated interventions involving healthcare providers, law enforcement agencies, community organizations, and policymakers. Public education, conflict

prevention programs, and strengthened legal enforcement may contribute to reducing violence-related injuries and deaths.

Falls from height were also an important contributor to trauma-related mortality. The proportion of deaths resulting from falls was higher than that reported by the WHO and Nigerian studies, ^(1,16) although lower than findings from Tanzania. ⁽¹⁷⁾ Preventive measures such as enforcing occupational safety regulations, implementing building safety standards, and improving the safety of recreational facilities could substantially reduce fall-related injuries and deaths.

Timely access to definitive trauma care is a critical determinant of survival. Previous studies have demonstrated that prolonged emergency department length of stay is associated with increased mortality among trauma patients. ⁽⁹⁾ In the present study, the mean length of stay in the Emergency Department was substantially longer than the 3.2-hour average reported in previous studies, with mean stays of 59.0, 54.6, and 32.4 hours during the three study periods. Conversely, the majority of deaths occurred within 48 hours of hospital admission, indicating shorter in-hospital survival compared with previous reports. ⁽¹³⁾ The relatively short survival following admission may reflect delayed presentation to hospital, as only a small proportion of patients reached the Emergency Department within six hours of injury. This finding contrasts with previous reports in which approximately 73.8% of trauma patients arrived within six hours. ⁽¹⁶⁾

The classical trimodal distribution of trauma mortality describes immediate deaths occurring within minutes of injury, early deaths occurring within the first few hours, and late deaths occurring days to weeks after injury ⁽¹⁴⁾. This

study could not demonstrate this pattern because most patients presented to the Emergency Department more than six hours after injury. Delayed referral, poor transportation infrastructure, long travel distances, inadequate pre-hospital care, and shortages of trained personnel may all contribute to delayed presentation and reduce opportunities for timely life-saving interventions.

Head injury was the leading cause of trauma-related death throughout the study period, a finding that is consistent with previous studies conducted in Ethiopia and other countries. ^(5,13,14,17,18) Other important causes of death included sepsis and multiple organ failure syndrome, hemorrhagic shock, and respiratory failure, all of which have been commonly reported among severely injured trauma patients. ^(13,14) These findings highlight the need for early recognition and aggressive management of traumatic brain injury, hemorrhage, and secondary complications to reduce preventable trauma-related mortality.

Limitations

This study has several limitations. First, its retrospective design relied on review of medical records, some of which contained incomplete or missing information, resulting in unavoidable data limitations. Second, the study was conducted in a single tertiary referral hospital, limiting the generalizability of the findings to other healthcare facilities in Ethiopia. Third, the relatively short study period may have reduced the representativeness of the findings and limited the ability to evaluate long-term trends in trauma mortality.

In addition, Tikur Anbessa Specialized Hospital serves as a tertiary referral center that primarily manages severely injured patients. Consequently, the proportion of trauma-related deaths ob-

served in this study may be higher than that seen in general hospitals. Finally, the study evaluated trauma-related deaths only after the establishment of the Emergency Department and therefore could not assess changes in mortality before implementation of organized emergency medicine services.

5. Conclusion and recommendation

This study demonstrates that the epidemiological characteristics of trauma-related deaths at Tikur Anbessa Specialized Hospital are consistent with findings reported in other national and international studies. Young adult males constituted the majority of trauma-related deaths, with blunt trauma and motor vehicle accidents representing the predominant mechanisms of injury. Head injury was the leading cause of death throughout the study period.

Although the overall number and proportion of trauma-related deaths decreased over the three-year study period, deaths resulting from motor vehicle accidents continued to increase. In addition, most patients presented to the Emergency Department more than six hours after injury, indicating significant delays in accessing definitive trauma care.

The findings suggest that continued improvements in trauma prevention, prehospital care, referral systems, emergency department management, and trauma system organization are essential for reducing preventable trauma-related mortality in Ethiopia. The establishment of the Department of Emergency Medicine at Tikur Anbessa Specialized Hospital and the increasing availability of trained emergency care providers appear to have contributed to improvements in trauma outcomes during the study period.

Recommendations

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

1. Government agencies should strengthen national road safety strategies through coordinated interventions involving the health, transport, police, and education sectors to reduce motor vehicle accidents.
2. Public awareness programs should promote injury prevention and encourage safe behaviors to reduce road traffic injuries, interpersonal violence, and falls.
3. Prehospital emergency medical services should be strengthened by improving ambulance availability, standardizing triage systems, establishing timely referral mechanisms, and enhancing training for emergency medical personnel.
4. Emergency department staff should receive continuous education and competency-based training to improve triage accuracy and early recognition of critically injured patients.
5. Healthcare institutions should strengthen trauma care systems by establishing well-equipped emergency departments, expanding access to trained emergency medicine professionals, and ensuring the availability of essential trauma care resources.
6. Future multicenter prospective studies with larger sample sizes should be conducted to characterize trauma-related mortality and evaluate the effectiveness of trauma care systems in Ethiopia.

All data collection, statistical analyses, clinical evaluations, and final draft approvals were conducted independently by the authors, who maintain full accountability for the entire work.

Abbreviations

ATLS: Advanced Trauma Life Support

DOA: Dead on Arrival
ED: Emergency Department
EMS: Emergency Medical Services
FAST/EFAST: Focused Assessment with Sonography for Trauma / Extended FAST
GCS: Glasgow Coma Scale
ISS: Injury Severity Score
LMICs: Low- and middle-income countries
MOFS: Multiple organ failure syndrome
MVAs: Motor vehicle accidents
RR: Respiratory rate
RTS: Revised Trauma Score
SBP: Systolic blood pressure
SPSS: Statistical Package for the Social Sciences
TASH: Tikur Anbessa Specialized Hospital
WHO: World Health Organization

Author Contributions

HT conceptualized the study, conducted data collection, performed statistical analysis, and drafted the initial manuscript. NM, AA, and SK contributed to clinical evaluations, data interpretation, and critical revision of the manuscript. All data collection, statistical analyses, clinical evaluations, and final draft approvals were conducted independently by the authors, who maintain full accountability for the entire work.

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Competing interests

The authors declare that they have no competing interests.

Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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Factors Associated with Delayed Hospital Arrival among Patients with Acute Coronary Syndrome in Addis Ababa, Ethiopia: A Cross-Sectional Study

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ABSTRACT

Background: Acute coronary syndrome (ACS) carries substantial mortality and morbidity, and delayed presentation worsens outcomes. Prehospital delay is common but poorly characterized in Ethiopia and other low-resource settings.

Objective: To identify factors associated with delayed hospital arrival among patients with ACS in Addis Ababa.

Methods: A prospective cross-sectional study was conducted from May to September 2024. Among 114 ACS patients treated at four hospitals in Addis Ababa (Tikur Anbessa Specialized Hospital, Zewditu Memorial Hospital, St. Paul's Hospital Millennium Medical College, and St. Peter Hospital), enrolled by convenience sampling. Data were collected using an interviewer-administered semi-structured questionnaire and analyzed in SPSS version 27 using descriptive statistics and bivariate/multivariate logistic regression. Delayed presentation was defined as arrival more than 12 hours after symptom onset.

Results: Most participants were male (68.4%) and aged 40–60 years (53.5%). Mean time from symptom onset to first medical contact was 14.0 hours, and 57% of patients presented after 12 hours. Chest pain was the presenting symptom in 77.9% of patients; the overall complication rate was 30.7%, with acute decompensated heart failure most common (15.8%). On multivariate analysis, no formal education (AOR 1.55, 95% CI 1.20–3.10, $p = 0.018$), absence of health insurance (AOR 3.20, 95% CI 2.67–4.21, $p = 0.002$), and residence more than 10 km from a health facility (AOR 1.70, 95% CI 1.25–4.21, $p = 0.004$) were independently associated with delayed presentation, while ambulance use was protective (AOR 0.86, 95% CI 0.23–0.97, $p = 0.032$).

Conclusion: More than half of ACS patients in this study presented beyond the 12-hour window. Education, health insurance coverage, distance from care, and ambulance utilization are key modifiable determinants of prehospital delay. Targeted public health education and strengthened emergency medical services are needed to promote timely presentation.

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Keywords: Acute coronary syndrome; prehospital delay; emergency medical services; Ethiopia; cross-sectional study

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1. Introduction

Acute coronary syndrome (ACS), encompassing ST-segment elevation myocardial infarction (STEMI), non-ST-segment elevation myocardial infarction (NSTEMI), and unstable angina, results from compromised coronary blood flow and remains one of the most significant causes of mortality and morbidity worldwide.^[1,2] Complications may be electrical, such as arrhythmia occurring early in the disease course, or mechanical, such as cardiogenic shock, free wall rupture, or ventricular septal rupture, which typically occur later.^[3] Because rapid diagnosis and treatment minimize irreversible cardiac damage, timely access to prehospital and emergency care is critical to reducing ACS-related morbidity and mortality.^[3,4]

Numerous patient-related, system-related, sociocultural, and health-literacy barriers can delay presentation of ACS patients to care, and such delays are consistently associated with worse outcomes.^[5,6] In Ethiopia, more than 30% of ACS patients are reported to die from related complications,^[7] yet data characterizing the drivers of prehospital delay remain limited, particularly outside single-center or emergency-department-only samples. Understanding these barriers is important both for guiding clinical practice and for informing policy: timely presentation reduces the need for costly interventions, shortens hospital stays, and improves survival.^[7-9]

This study aimed to examine the factors associated with delayed hospital arrival among patients with ACS presenting to major referral hospitals in Addis Ababa, with specific objectives of describing the time from symptom onset to arrival, identifying sociodemographic and system-

level determinants of delay, and assessing the level of prehospital care utilization.

2. Materials and Methods

Study design and setting

This was a prospective cross-sectional study conducted from May to September 2024 at four government hospitals in Addis Ababa, Ethiopia: Tikur Anbessa Specialized Hospital, a national referral and teaching hospital; Zewditu Memorial Hospital, a referral hospital serving patients from within and outside Addis Ababa; St. Paul's Hospital Millennium Medical College, which maintains a cardiac intensive care unit and catheterization laboratory; and St. Peter Hospital. These sites were selected as principal referral centers for ACS in the city.

Study subject and sampling

The source population comprised patients diagnosed with ACS; the study population comprised ACS patients treated at the four study hospitals during the study period. Patients were enrolled by convenience sampling. Using a single population proportion formula ($Z_{\alpha/2} = 1.96$, $p = 0.5$, $d = 0.05$), a minimum sample of 384 was calculated and then corrected for the finite eligible population (approximately 120 patients over the preceding four months), yielding a corrected sample of 102; after adjusting for a 10% non-response rate, the final target sample size was 114, which was achieved.

Patients aged 18 years or older with a confirmed diagnosis of ACS who consented to participate were included. Patients who declined participation, whose ACS diagnosis was not confirmed, who were under 18 years of age, or who had

cognitive impairment affecting recall were excluded.

Study variables and operational definitions

The primary outcome was time from symptom onset to first medical contact, dichotomized as early (≤ 12 hours) or delayed (> 12 hours) presentation, consistent with a cut-point used in prior regional research; ^[13] time to presentation was additionally analyzed using a 4-hour cut-point. Independent variables included age, sex, marital status, education level, occupation, comorbidities, health insurance status, awareness of ACS symptoms, mode of transport, and distance from a health facility.

Data collection and analysis

Data were collected using an interviewer-administered, semi-structured questionnaire adapted from a previously validated instrument used in Bangladesh [13] and modified for the local context, administered via Google Forms by five trained data collectors in the patient's preferred language. The instrument was pretested on 5% of the target population prior to full data collection. Completed questionnaires were reviewed for completeness, coded, and entered into Microsoft Excel before export to SPSS version 27 for analysis. Descriptive statistics (frequencies, means, medians, standard deviations) summarized sociodemographic and clinical characteristics. Bivariable and multivariable logistic

regression were used to identify factors associated with delayed presentation; variables with $p < 0.05$ in the multivariable model were considered statistically significant.

Ethical considerations

Ethical clearance was obtained from the ethical review committee of the Department of Emergency and Critical Care Medicine, Addis Ababa University, prior to data collection. The principles of beneficence, non-maleficence, autonomy, and justice were upheld throughout the study, and written informed consent was obtained from all participants.

2) Results

Sociodemographic characteristics

Of 114 participants, 78 (68.4%) were male, and 36 (31.6%) were female; 61 (53.5%) were aged between 40 and 60 years. Most participants (66.7%) were married, and educational attainment was fairly evenly distributed, with college-level education most common (28.1%). Just over half of participants (51.8%) had no health insurance. Comorbidities included hypertension (55.8%), type 2 diabetes mellitus (28.3%), ischemic heart disease (10.5%), chronic kidney disease (6.1%), and chronic obstructive pulmonary disease (4.4%). Fewer than 40% of participants demonstrated awareness of ACS symptoms prior to their event (Table 1)

Table 1. Socio-demographic characteristics of patients with acute coronary syndrome, May-September 2024, Addis Ababa, Ethiopia (n=114).

Age group (years)	< 40	14 (12.3)
	40–60	61 (53.5)
	> 60	39 (34.2)
Sex	Female	36 (31.6)
	Male	78 (68.4)

Marital status	Married	76 (66.7)
	Single	8 (7.0)
	Divorced	19 (16.7)
	Widowed	11 (9.6)
Highest education level	No formal education	24 (21.1)
	Primary	17 (14.9)
	Secondary	23 (20.2)
	College	32 (28.1)
	University	18 (15.8)
Health insurance	Yes	55 (48.2)
	No	59 (51.8)
Distance from health facility	< 5 km	18 (15.8)
	5–10 km	53 (46.5)
	> 10 km	43 (37.7)

Prehospital care-seeking and time to presentation

The point of first medical contact was a health center for 42.1% of participants, while 24.6% presented directly to one of the four study hospitals. Only 37.7% of participants knew a government ambulance number, and 34.2% knew a private ambulance number. Ambulance was the mode of arrival at the study hospital for 39.5% of

patients; taxis (37.7%), private vehicles (12.3%), and walking (10.5%) accounted for the rest (Table 2). The mean time from symptom onset to first medical contact was 14.0 hours (range 1–144 hours), and the mean time from first medical contact to arrival at the study hospital was 7 hours (range 1–66 hours). Only 14 patients (11.9%) presented within 4 hours of symptom onset, and 57% presented more than 12 hours after onset.

Table 2. Prehospital care-seeking and transport characteristics of patients with acute coronary syndrome, Addis Ababa, Ethiopia (n=114).

Point of first contact	This hospital (direct)	28 (24.6)
	Health center	48 (42.1)
	Private clinic	19 (16.7)
	Other hospital	19 (16.7)
Knew a government ambulance number	Yes	43 (37.7)

	No	71 (62.3)
Knew a private ambulance number	Yes	39 (34.2)
	No	75 (65.8)
Mode of arrival at hospital	Ambulance	45 (39.5)
	Taxi	43 (37.7)
	Private car	14 (12.3)
	Walking	12 (10.5)

Clinical presentation, complications, and management

Chest pain was the presenting symptom in 88 patients (77.9%), followed by shortness of breath (76.1%), diaphoresis (46.5%), and nausea/vomiting (43.9%). By subtype, 52% of patients had STEMI and 32% had NSTEMI. The

overall complication rate was 30.7%, with acute decompensated heart failure the most frequent complication (15.8%), followed by death (7.9%) and arrhythmia (7.0%). Most patients (72.6%) received no reperfusion therapy; 27.4% underwent percutaneous coronary intervention, and none received thrombolytics (Table 3).

Table 3. Clinical presentation, complications, and management of patients with acute coronary syndrome, Addis Ababa, Ethiopia (n=114).

Presenting symptom	Chest pain	88 (77.9)
	Shortness of breath	86 (76.1)
	Diaphoresis	53 (46.5)
	Nausea and vomiting	50 (43.9)
Complication	None	79 (69.3)
	Acute decompensated heart failure	18 (15.8)
	Death	9 (7.9)
	Arrhythmia	8 (7.0)
Reperfusion therapy received	None	82 (72.6)
	Percutaneous coronary intervention	31 (27.4)

Determinants of delayed presentation

On multivariable logistic regression, no formal education (AOR 1.55, 95% CI 1.20–3.10, $p = 0.018$), absence of health insurance (AOR 3.20, 95% CI 2.67–4.21, $p = 0.002$), and residence

more than 10 km from a health facility (AOR 1.70, 95% CI 1.25–4.21, $p = 0.004$) were independently associated with delayed presentation. Residence within 5 km of a facility was protective (AOR 0.80, 95% CI 0.53–0.96, $p = 0.015$), and

use of an ambulance for transport (AOR 0.86, 95% CI 0.23–0.97, $p = 0.032$). Age, sex, marital status, awareness of ACS, and mode of transport

other than ambulance were not independently associated with delay (Table 4).

Table 4. Bivariable and multivariable logistic regression analysis of factors associated with delayed presentation among patients with acute coronary syndrome, Addis Ababa, Ethiopia (n=114)

Variable	COR (95% CI)	p-value	AOR (95% CI)	p-value
Age	1.90	0.977	1.40 (0.16–12.59)	0.764
Male sex	1.80 [†]	0.931	2.50 (0.50–12.56)	0.266
Marital status	1.01 (0.94–1.09)	0.799	1.50 (0.22–10.04)	0.676
No formal education	1.50 (1.06–2.13)	0.023*	1.55 (1.08–2.23)	0.018*
Primary education	1.02 (0.97–1.07)	0.450	5.05 (0.30–85.55)	0.262
College/university education	1.76 (0.24–13.03)	0.580	1.61 (0.28–9.36)	0.596
No health insurance	2.30 (1.29–4.11)	0.005*	3.20 (1.53–6.69)	0.002*
Low awareness of ACS	1.20 (0.97–1.48)	0.090	1.03 (0.96–1.10)	0.377
Ambulance transport	0.75 (0.49–1.14)	0.180	0.86 (0.75–0.99)	0.032*
Taxi transport	1.05 (0.96–1.15)	0.300	1.67 (0.17–16.06)	0.657
Walking to facility	1.45 (0.97–2.17)	0.070	1.06 (0.85–1.32)	0.607
Residence <5 km	0.70 (0.51–0.97)	0.030*	0.80 (0.67–0.96)	0.015*
Residence 5–10 km	1.03 (1.00–1.07)	0.090	1.08 (0.91–1.28)	0.380
Residence >10 km	1.23 (1.05–1.44)	0.010*	1.70 (1.18–2.44)	0.004*
ACS subtype	1.07 (0.99–1.15)	0.070	1.23 (0.98–1.54)	0.070
Presence of chest pain	1.40 (0.99–1.99)	0.060	1.21 (0.37–3.91)	0.750

3. Discussion

This study identified sociodemographic, economic, and system-level factors independently associated with delayed hospital arrival among ACS patients in Addis Ababa. Most participants were over 40 years of age and male, consistent with established coronary risk patterns; however, unlike some prior evidence in which female

sex was associated with delay,^[13] sex was not an independent predictor of delay in this cohort.

Over half of participants (57%) presented more than 12 hours after symptom onset, and only 11.9% presented within the first 4 hours, a markedly longer delay than the roughly 4-hour average reported in a large Chinese cohort,^[12] though shorter than the multi-day delays reported in one prior Ethiopian study.^[15] The clin-

ical profile in this cohort, dominated by chest pain (77.9%), is consistent with a 2019 Addis Ababa study reporting chest pain in 81.7% of ACS patients.^[19]

Lack of formal education, absence of health insurance, and greater distance from a health facility each independently predicted delay, while ambulance use and residence within 5 km of a facility were protective. These findings align with prior work from China and Bangladesh identifying education, insurance status, and geographic access as key structural determinants of prehospital delay.^[8,13] In particular, prehospital ambulance-based anti-ischemic medication administration was essentially absent in this cohort, and most participants lacked knowledge of an ambulance phone number, underscoring substantial gaps in the local emergency medical services system.

This study has several limitations. The relatively short enrolment period estimates a modest sample size, and convenience sampling across four hospitals may limit generalizability to the broader ACS population in Addis Ababa. Comparative regional evidence on this topic is scarce, limiting the ability to contextualize some findings against similar settings.

4. Conclusion

More than half of ACS patients presenting to major referral hospitals in Addis Ababa arrived more than 12 hours after symptom onset. Educational attainment, health insurance coverage, distance from care, and ambulance utilization were the principal modifiable determinants of delay, while overall awareness of ACS symptoms and use of emergency medical services remained low. Public health campaigns to raise awareness of ACS symptoms, expansion of health insurance coverage, and strengthening of prehospital emergency medical services, partic-

ularly ambulance availability and public knowledge of ambulance access, are recommended to promote timely presentation and improve outcomes.

Abbreviations

ACS: Acute coronary syndrome

ADHF: Acute decompensated heart failure

AOR: Adjusted odds ratio

CI: Confidence interval

COR: Crude odds ratio

NSTEMI: Non-ST-segment elevation myocardial infarction

PCI: Percutaneous coronary intervention

STEMI: ST-segment elevation myocardial infarction

Author Contributions

Conception and design, data acquisition (AB), analysis and interpretation (AB, NM), drafting the manuscript (AB, NM), critical revision, and final approval (AA)

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Competing interests

The authors declare no competing interests.

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Severe malaria-associated secondary glaucoma: a case report

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ABSTRACT

Introduction: Malaria remains a significant global health challenge, particularly in endemic regions, with severe complications affecting multiple organ systems. Ocular manifestations, though less common, can include vision-threatening conditions such as secondary glaucoma. This report describes a rare case of secondary acute angle-closure glaucoma developing in the context of severe *Plasmodium falciparum* malaria.

Case Presentation: A 55-year-old Ethiopian woman presented to the emergency room with a 5-day history of high-grade intermittent fever, headache, and joint pain. Laboratory findings confirmed *falciparum* malaria, with marked thrombocytopenia. Despite initial antimalarial therapy, she developed blurred vision and ocular redness. Ophthalmologic evaluation revealed shallow anterior chambers, mid-dilated pupils, and significant intraocular pressure elevation. She received topical glaucoma treatment, resulting in symptomatic relief and intraocular pressure reduction. Her platelet count improved during hospitalization, and she was discharged in stable condition.

Conclusion: This case underscores the importance of promptly recognizing ocular complications in severe malaria. Secondary glaucoma, although rare, can develop rapidly and requires timely ophthalmologic intervention to prevent irreversible vision loss. Awareness of such associations is vital for the comprehensive management of malaria patients presenting with visual symptoms.

Keywords: Malaria, glaucoma

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1. Introduction

Malaria remains a devastating global public health crisis, causing over 282 million cases and 610,000 deaths annually. The burden is heavily concentrated in sub-Saharan Africa, which accounts for approximately 95% of global cases. In highly endemic countries like Ethiopia, it is a leading cause of morbidity and mortality, severely impacting rural livelihoods.⁽¹⁾

Severe *Plasmodium falciparum* malaria is a life-threatening medical emergency. Its defining hallmark is rapid multisystem involvement, largely driven by the parasite's ability to sequester in the microvasculature and trigger widespread endothelial dysfunction.⁽²⁾

Although malaria is primarily known for causing systemic symptoms, the *Plasmodium* parasite can also cause a range of ocular complications. The most distinct ophthalmic presentation of the disease is malarial retinopathy, which is specifically associated with *Plasmodium falciparum* infections.⁽³⁾

Secondary glaucoma, particularly acute angle-closure glaucoma, is a rare but important ocular complication associated with severe malaria. It is primarily driven by inflammatory changes, such as acute panuveitis, which can trigger cilio-choroidal effusion, block aqueous humor outflow, and lead to an irreversible, rapid rise in intraocular pressure.⁽⁴⁾

Documenting rare ocular complications in malaria patients is essential to improve awareness, enable early recognition and management, and prevent irreversible vision loss.

2. Case report

A 55-year-old Ethiopian woman presented to the Emergency room with a 5-day history of

headache, high-grade fever, joint pain, chills, and rigors, along with loss of appetite, dry cough, and shivering. She reported recent travel to a malaria-endemic area ten days prior. She denied any loss of consciousness, seizures, or vomiting.

Vital signs were stable, except for the fever (38.5°C). HEENT examination revealed pink conjunctiva and non-icteric sclera. Neurological assessment showed a Glasgow Coma Scale (GCS) score of 15/15.

Laboratory investigations revealed:

Complete Blood Count (CBC): WBC $6.5 \times 10^3/\mu\text{L}$, neutrophils 65.2%, hemoglobin 12.3 g/dL, platelets $36 \times 10^3/\mu\text{L}$ (severe thrombocytopenia)

Peripheral blood film confirmed intraerythrocytic ring forms consistent with *Plasmodium falciparum*. Other labs showed: Creatinine 1.21 mg/dL, blood glucose 196 mg/dL, electrolytes within normal limits. Viral markers: negative. Based on these findings, she was started on artesunate and antipyretics.

Clinical Course

On day 3 of hospitalization, she developed blurred vision, nausea, vomiting, and a persistent headache. Suspecting meningitis, a brain MRI was performed, which showed no acute abnormalities. Subsequently, she exhibited reddish discoloration of her eyes (occurred later on the same day after the MRI.)

During the ophthalmologic assessment, the patient showed reduced visual acuity, measuring 6/18 in the right eye and 6/24 in the left. Examination with a slit-lamp and tonometry revealed a shallow anterior chamber, mid-dilated fixed pupils, corneal edema, and significantly elevated intraocular pressures (IOP) of 40 mm Hg in

the right eye and 44 mm Hg in the left. These findings are consistent with secondary acute angle-closure glaucoma (AACG). The fundus examination revealed optic discs exhibiting signs of cupping, with no signs of uveitis. Due to resource limitations, additional assessments such as gonioscopy, B-scan ultrasonography, or OCT were not performed.

The patient received topical timolol maleate 0.5% drops (one drop every 12 hours), along with dexamethasone eye drops. The rationale for dexamethasone was to manage intraocular inflammation and prevent posterior segment involvement.

Her systemic malaria treatment continued with artesunate. The ocular hypertension responded well to topical therapy, with IOP decreasing to 23 mm Hg (right) and 29 mm Hg (left) within 24 hours. Her platelet count improved from $36 \times 10^3/\mu\text{L}$ to $84 \times 10^3/\mu\text{L}$ and then to $164 \times 10^3/\mu\text{L}$ during hospitalization. The decision was made to monitor her closely, and no surgical intervention was necessary. The patient was discharged after six days with stable systemic and ocular status.

Follow-up and Outcome:

Follow-up at 1 month post-discharge showed stable visual acuity, normal optic disc appearance, and maintained intraocular pressures without glaucoma medications. No recurrent angle closure or other ocular issues were noted.

3. Discussion

This case highlights a rare but severe ocular complication, secondary acute angle-closure glaucoma, associated with severe *Plasmodium falciparum* malaria.

Secondary angle-closure glaucoma in severe malaria typically results from a "posterior pushing" mechanism triggered by systemic illness.

Malarial retinopathy, microvascular occlusions, and severe inflammation can cause the ciliary body and choroid to swell, forcing the lens-iris diaphragm forward and blocking the eye's drainage angle ⁵.

While common malarial ocular complications include retinal hemorrhages and malarial retinopathy, secondary glaucoma remains an extremely rare and distinct clinical event. Its rarity underscores a potentially severe immune-mediated or inflammatory pathway triggered by the malarial parasite ⁶.

Prompt ophthalmologic assessment is critical for malaria patients presenting with visual symptoms to prevent rapid progression to irreversible vision loss. Because the retina shares the same microvascular bed as the brain, ocular symptoms often indicate severe central nervous system complications and require immediate, coordinated care ⁷.

Timely ocular interventions, such as topical IOP-lowering eye drops (e.g., prostaglandin analogs or beta-blockers), are the mainstay for reducing intraocular pressure (IOP). When administered promptly, these interventions effectively preserve the optic nerve and prevent irreversible vision loss by decreasing aqueous humor production or improving its drainage ⁸.

Raising awareness about ocular manifestations of malaria is crucial. Routine ocular examinations should be integrated into the management protocols for severe malaria to ensure timely intervention and preservation of vision ⁹.

This case highlights a rare ocular complication of malaria, but more research is needed to understand its prevalence and management. Limitations include being a single case and lack of detailed ocular imaging.

4. Conclusion

This case underscores the importance of prompt recognition of ocular complications in severe malaria. Secondary glaucoma, although rare, can develop rapidly and requires timely ophthalmologic intervention to prevent irreversible vision loss. Awareness of such associations is vital for comprehensive management of malaria patients presenting with visual symptoms.

Abbreviations

AACG: Acute angle-closure glaucoma

IOP: Intraocular Pressure

MRI: Magnetic Resonance Imaging

OCT: Optical Coherence Tomography

Author Contributions

- Dr. Ephrem Basazineu: Participates in all aspects of this case report
- Dr. Yohannes Tilahun: Participates in Conception and design
- Dr. Getachew Alemu: Participates in drafting the manuscript
- Dr. Alemu Bimrew: Participates in Final approval
- Dr. Getahun Derso: Participates in writing original draft
- Temesgen Alemayehu: Participates in conceptualization
- Dr. Getachew Abebe: Participates drafting the manuscript

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Competing interests

The authors declare no conflict of interest.

Data Availability

All relevant data are available upon reasonable request from the corresponding author.

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Delayed Diagnosis of Community-Acquired Pneumonia-Associated Spontaneous Pneumomediastinum Following Nonspecific Symptoms: A Case Report

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ABSTRACT

Pneumonia is a common acute lower respiratory tract infection, whereas pneumomediastinum is uncommon and may present with nonspecific symptoms, making it easy to overlook on initial assessment. We report a 25-year-old male smoker who presented to the emergency department with a three-week history of malaise, fatigue, and loss of appetite, followed in the days before admission by chills, worsening fatigue, productive cough, retrosternal pleuritic chest pain, and nausea. On respiratory examination, fine crackles were auscultated over both upper lobes, with no palpable subcutaneous crepitus. Laboratory tests showed elevated C-reactive protein and leukocytosis. Chest radiography did not demonstrate pneumomediastinum, but computed tomography revealed bilateral upper lobe pneumonia with mediastinal and Para cardiac air and cervical subcutaneous emphysema. The patient was managed conservatively with antibiotics, supportive care, analgesia, antiviral treatment, and inhaled therapies. He improved clinically and was discharged without complications or invasive intervention. The distinctive features of this case were the prolonged nonspecific symptom course, the absence of clinically palpable cervical subcutaneous emphysema, and the failure of chest radiography to demonstrate pneumomediastinum despite its detection on CT. These findings emphasize that spontaneous pneumomediastinum may be overlooked in patients with community-acquired pneumonia when clinical and radiographic findings are subtle.

Keywords: Spontaneous pneumomediastinum; subcutaneous emphysema; Community-acquired pneumonia; Chest pain; Symptoms

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1. Introduction

Pneumonia is a common acute lower respiratory tract infection involving the distal airways and alveoli. Although it is broadly categorized as community-acquired or hospital-acquired, multiple classification systems are also used. The most frequently identified causative pathogens of CAP include *Streptococcus pneumoniae*, respiratory viruses, *Haemophilus influenzae*, *Mycoplasma pneumoniae*, and *Legionella pneumophila*. Symptoms such as cough, dyspnea, pleuritic chest pain, or acute functional and cognitive decline, together with abnormal vital signs, suggestive lung examination findings, and supportive radiological imaging, are key elements that guide the diagnosis. Mild CAP is generally managed in the outpatient setting, moderate cases are treated on inpatient wards, and severe cases are managed in intensive care units. ⁽¹⁻³⁾

The mediastinum is defined as a visceral compartment bounded by the pleurae, thoracic inlet, diaphragm, sternum, and thoracic vertebral column. It contains multiple critical structures, including the heart, great vessels, the trachea, and major nerves. ⁽⁴⁾ Pneumomediastinum is a clinical entity characterized by the presence of air within the mediastinum. Although chest pain is the most common presenting symptom, dyspnea, neck swelling, cervical pain, dysphagia, odynophagia, and dysphonia may also be re-

ported at presentation. Pneumothorax, subcutaneous emphysema, and air within the spinal canal may accompany this condition. Pneumomediastinum is mainly classified as primary or secondary. Primary spontaneous pneumomediastinum is generally self-limited and typically resolves spontaneously. In general, distinguishing primary spontaneous pneumomediastinum from secondary causes remains a diagnostic challenge. ⁽⁵⁻⁷⁾

Pneumomediastinum is a rare complication of pneumonia, with only a limited number of pneumonia-associated cases reported in the literature. ⁽⁸⁾ Up to 30% of patients with pneumomediastinum may have a normal chest radiograph, and chest CT has therefore been suggested when clinical suspicion persists despite normal radiographic findings. ⁽⁷⁾ This diagnostic challenge is particularly relevant in the emergency setting, where prolonged nonspecific presentations, as in the present case, may delay recognition of spontaneous pneumomediastinum.

In this article, we present a case of a patient whose symptoms initially began with atypical features and who presented to our department approximately three weeks later due to clinical worsening, at which time pneumonia, pneumomediastinum, and cervical subcutaneous emphysema were identified. Through this case, we aim to provide a multidimensional discussion and to

raise clinicians' awareness of the need for heightened vigilance in delayed presentations.

2. Case report

A 25-year-old male patient presented to our emergency department. He had undergone tonsillectomy during childhood. He had no other known medical history or chronic disease. He had no known allergies. He was an active smoker.

He reported malaise, fatigue, and loss of appetite that had started approximately three weeks prior to presentation. These symptoms did not fully resolve and persisted during this period. Approximately five days before presentation, chills and shivering developed. His fatigue also worsened during this time. He reported intermittent cough and sputum production in the preceding period. However, these symptoms became more prominent over the last one to two days.

He presented primarily with retrosternal chest pain, cough, sputum, and nausea. The chest pain was described as sharp and stabbing, and it varied with inspiration and expiration. He stated that the sputum was slightly green. He also re-

ported that his cough had worsened over the last two to three days.

On admission, his blood pressure was 109/74 mmHg, respiratory rate was 19 breaths/min, heart rate was 98 beats/min, oxygen saturation was 97% on room air, and body temperature was 36.7°C. His BMI was approximately 21.2 kg/m². He was conscious and fully oriented, with a Glasgow Coma Scale score of 15. No neck swelling or tenderness was present. On respiratory examination, fine crackles were auscultated over both upper lobes, and no palpable subcutaneous crepitus was detected. Abdominal examination was unremarkable, and peripheral pulses were palpable. Laboratory tests revealed a CRP level of 202 mg/L and a white blood cell count of $18.05 \times 10^9/L$. The CURB-65 score was 0 at presentation, consistent with low-severity community-acquired pneumonia.

Chest CT demonstrated findings consistent with pneumonia in both upper lobes. In addition, diffuse air densities were detected in the mediastinum and paracardiac regions. Air densities were also observed in the included cervical soft tissues. These findings were consistent with pneumomediastinum and subcutaneous emphysema.

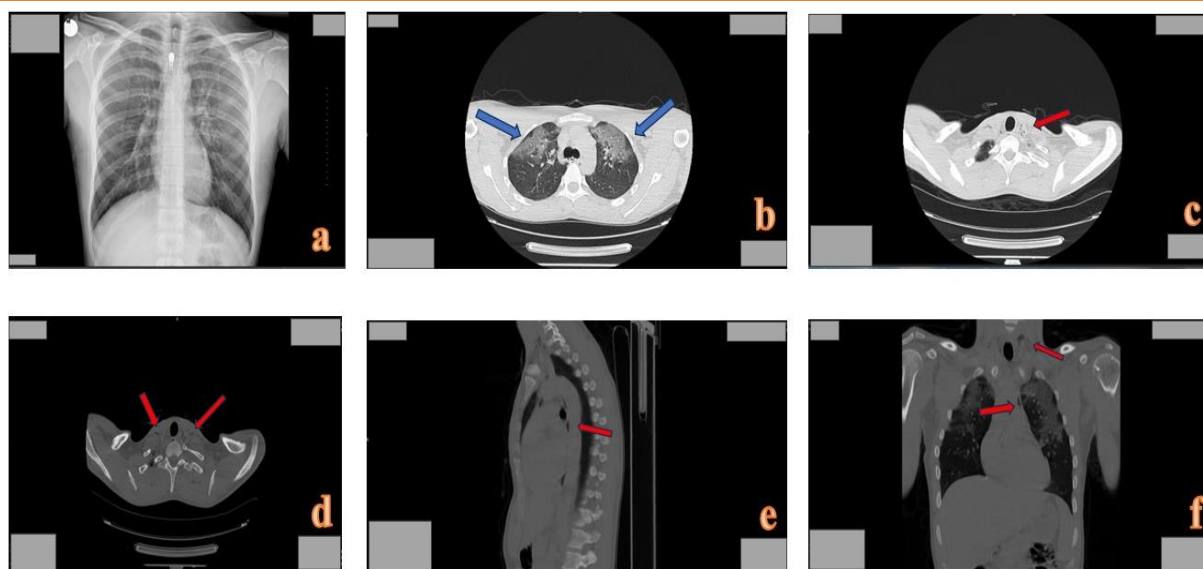


Figure 1: Radiological imaging obtained at emergency department presentation. (a) Posteroanterior (PA) chest radiography. (b) Axial chest CT (lung window) demonstrating bilateral upper-lobe parenchymal opacities consistent with pneumonia (blue arrows). (c–d) Axial CT images showing cervical soft-tissue air consistent with subcutaneous emphysema (red arrows). (e) Sagittal and (f) coronal CT reconstructions demonstrating mediastinal and cervical soft-tissue air consistent with pneumomediastinum and subcutaneous emphysema (red arrows)

No history of trauma, forceful vomiting/retching, recent invasive airway or esophageal procedures, or substance inhalation was reported, and CT did not demonstrate findings suggestive of tracheobronchial or esophageal injury. No microbiological investigations were performed; therefore, a specific causative pathogen could not be identified.

The patient was evaluated in consultation with the Pulmonology and Thoracic Surgery departments and was admitted to the Thoracic Surgery ward for close observation. After clinical assessment and multidisciplinary evaluation with Pulmonology and Thoracic Surgery, bronchoscopy was not pursued because no clinical or CT findings raised suspicion of tracheobronchial injury. In the absence of microbiological testing, empirical antimicrobial treatment was administered during inpatient follow-up, including intravenous ceftriaxone (1 g twice daily) and oral levofloxacin

(750 mg once daily), together with empirical antiviral therapy with oseltamivir (75 mg twice daily). Analgesic therapy was administered for chest pain. During follow-up, oxygenation remained stable and no clinically significant oxygen requirement developed. In the ward, inhaled ipratropium (three times daily) and budesonide (once daily) were also prescribed as supportive respiratory therapy. The patient was advised about the adverse health effects of smoking and was informed that support could be obtained from a smoking cessation clinic. The patient was monitored for six days and discharged after clinical improvement. Laboratory parameters returned to normal ranges, and follow-up imaging demonstrated regression of radiological findings without complications. No surgical intervention was required. Post-discharge follow-up data were unavailable; therefore, we could not assess subsequent symptom recurrence or smoking cessation status.

The clinical course, key diagnostic findings, and conservative management from symptom onset

to discharge are summarized in Figure 2.

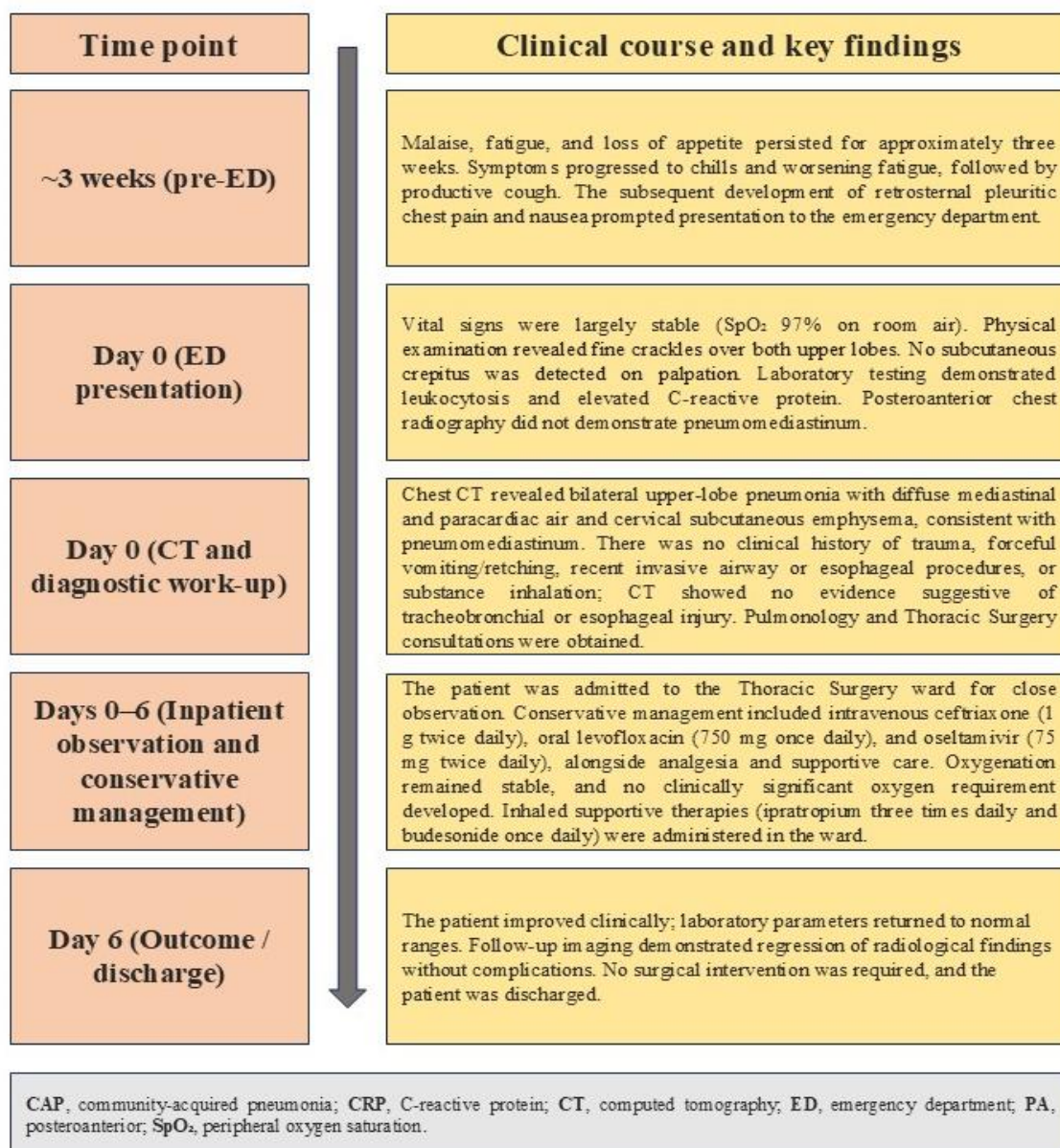


Figure 2: Timeline diagram summarizing the clinical course, key diagnostic findings, and conservative management of the presented case from symptom onset to discharge

3. Discussion

Spontaneous pneumomediastinum is a relatively uncommon condition that is most often observed in young adult males who are tall and have a slender body habitus. It typically occurs

without an identifiable underlying pathology. Our patient similarly matched the commonly described young male demographic. However, given his concurrent illness, a facilitating factor such as cough was also present. Spontaneous

pneumomediastinum is generally reported to be self-limited, and the mean age at presentation has been reported to be 25 years. We found that our case closely aligned with the patterns described in the literature. ^(9, 10)

Spontaneous pneumomediastinum associated with respiratory infections has been reported previously; however, our case showed several distinctive features. The patient had approximately three weeks of nonspecific symptoms, while cervical subcutaneous emphysema was not clinically palpable and pneumomediastinum was not evident on chest radiography but was detected on CT. A recent clinical review also emphasized that pneumomediastinum may not be apparent on chest radiography and that CT can aid diagnosis when suspicion persists. ⁽⁷⁾ These features may complicate the diagnosis and increase the likelihood of pneumomediastinum being overlooked.

A recent comprehensive review of 1,134 patients with spontaneous pneumomediastinum reported a recent respiratory infection in 9% of cases. ⁽¹¹⁾ In the same review, chest pain and dyspnea were the predominant presenting symptoms, whereas subcutaneous emphysema was the most frequent physical examination finding. ⁽¹¹⁾ Against this background, the present case was notable for a prolonged period of nonspecific constitutional symptoms, the absence of clinically palpable subcutaneous emphysema, and the lack of radiographic evidence of pneumomediastinum on the initial chest radiograph, with the diagnosis subsequently established by CT. Taken together, these features distinguish the present case from the more typical clinical profile described in the broader spontaneous pneumomediastinum literature and underscore the potential for delayed recognition in atypical presentations.

Although determining the exact incidence is difficult, one report describes an incidence of approximately 1 case per 30,000 emergency department visits. This finding is important because it underscores that the condition is relatively rare. ⁽¹²⁾ The precise etiology also remains unclear. One of the proposed mechanisms is alveolar rupture that occurs after a triggering event. ⁽¹³⁾ Asthma exacerbation has been reported as one of the most common triggers. Barotrauma, increased intrathoracic pressure, and the Valsalva maneuver have also been implicated. Withdrawal symptoms related to substance use have similarly been described as potential triggers. ^(13, 14) Other reported associated factors include cough, mechanical ventilation, pneumonitis, emphysema, pulmonary fibrosis, acute respiratory distress, heroin, cannabis, and cocaine use, infections of the head and neck region, tracheobronchial and esophageal tears, and trauma involving the maxillary sinus wall ^(9, 15, 16). In our patient, cough was present and could be considered a plausible contributing symptom. However, because of the delayed presentation, it should also be emphasized that the exact course and sequence of events cannot be reliably determined. A potential contributory role of pneumonia-associated cough in the development of pneumomediastinum cannot be excluded; however, the available findings are insufficient to establish a direct causal relationship in a single observational case.

As part of the differential diagnostic evaluation, potential secondary causes of pneumomediastinum were also systematically considered. A recent clinical review describes trauma, iatrogenic airway or thoracic interventions, mechanical ventilation, underlying pulmonary diseases, inhalational exposures, forceful vomiting or retching, and physical activity among recog-

nized causes or precipitating factors of pneumomediastinum.⁽⁷⁾ In the present case, there was no history of trauma, asthma or other chronic pulmonary disease, mechanical ventilation, recent invasive procedures, forceful vomiting, inhalational drug use, or strenuous physical activity. Furthermore, CT revealed no findings suggestive of tracheobronchial or esophageal injury.

The most common symptoms of pneumomediastinum include chest pain, neck pain, dyspnea, dysphagia, and a sense of tightness or swelling involving the face and neck. Among these, chest pain is the most frequently reported presenting symptom.⁽¹⁷⁾ In our patient, chest pain was also present at the time of presentation and represented the most prominent symptom.

Physical examination findings may include subcutaneous emphysema. Crepitus may be detected on palpation, particularly when the emphysema extends more superficially. A characteristic precordial crackling sound may also be heard on cardiac auscultation.⁽¹⁶⁾ In our patient, subcutaneous emphysema was detected on imaging. However, palpable crepitus was not identified on physical examination. This was considered to be related to the deeper distribution of the emphysema.

Nonspecific laboratory abnormalities such as elevated CRP and leukocytosis have been reported in pneumomediastinum, and our case similarly showed marked elevations in these parameters.⁽¹⁷⁾ However, because our patient had concomitant pneumonia, it is not possible to attribute these laboratory findings solely to pneumomediastinum.⁽¹⁷⁾

From a pathophysiological perspective, an increased pressure gradient between the intra

alveolar and interstitial spaces causes air to leak from small alveolar openings and ruptured alveoli into the perivascular space. This process leads to interstitial emphysema.⁽¹⁵⁾ It has also been reported that this pressure gradient may extend along the vascular sheaths and cause air dissection.⁽¹⁵⁾ In addition, a sudden increase in mediastinal pressure has been emphasized as a factor that may also lead to pneumothorax.⁽¹⁵⁾

In the diagnostic evaluation, radiographic imaging modalities are recommended, primarily chest radiography, as well as ultrasonography, contrast esophagography, and CT.⁽¹⁸⁾ For chest radiography, an anteroposterior view together with a lateral view is recommended. It has been emphasized that PA chest radiography alone may miss the diagnosis in up to 50% of cases. This limitation has been attributed to the radiolucent appearance between the left cardiac border and the mediastinal pleura.⁽¹⁸⁾ CT is more sensitive and can detect mediastinal air that may not be visible on chest radiography. For this reason, CT has been reported as the gold standard for diagnosing spontaneous pneumomediastinum.^(9, 19) In our case, a similar pattern was observed. Pneumomediastinum was not detected on PA chest radiography (Figure 1) but was identified on CT imaging (Figure 1).

In general, the management of spontaneous pneumomediastinum is primarily conservative and supportive. Rest is recommended. Patients should be advised to avoid maneuvers that may increase intrathoracic pressure. Oxygen therapy and adequate analgesia are also central components of treatment.⁽⁹⁾ If an underlying triggering condition is identified, targeted management of that condition should be planned as part of the overall approach.⁽⁹⁾

A recent clinical review emphasized that management largely consists of supportive care, while further invasive diagnostic evaluation should be selectively guided by clinical suspicion rather than routinely performed.⁽⁷⁾ This approach was consistent with the present case, in which no tracheobronchial or esophageal injury was identified, and the patient improved with conservative inpatient management without surgical intervention. Regarding the concomitant community-acquired pneumonia, current CAP guidance recommends a β -lactam plus a macrolide or respiratory fluoroquinolone monotherapy for hospitalized patients with non-severe CAP. In contrast, a β -lactam plus a respiratory fluoroquinolone is among the recommended options for severe CAP.⁽²⁰⁾ In the present case, ceftriaxone and levofloxacin were administered empirically during inpatient follow-up. Given the patient's low CURB-65 score and the recommended regimens for non-severe inpatient CAP, this regimen is best interpreted as an individualized inpatient treatment approach rather than a standard regimen for non-severe CAP.

After diagnosis, inpatient observation for at least the first 24 hours is recommended. This strategy aims to facilitate early recognition of potential complications and to minimize the risk of adverse outcomes.⁽²¹⁾ The prognosis of spontaneous pneumomediastinum is generally favorable. Most cases tend to resolve spontaneously within a few days.⁽¹⁷⁾ In a retrospective study, no recurrence was reported during a two-year follow-up period.⁽¹⁷⁾ However, based on the currently available data, it is not possible to definitively exclude the possibility of post-discharge recurrence.⁽⁹⁾

4. Conclusion

The coexistence of community-acquired pneumonia and spontaneous pneumomediastinum may present a diagnostic challenge, particularly when the clinical course is prolonged and non-specific and typical physical or radiographic findings are absent. In the present case, pneumomediastinum was not evident on initial chest radiography and cervical subcutaneous emphysema was not clinically palpable, whereas CT established the diagnosis. This case highlights the importance of maintaining clinical suspicion and considering CT when pneumomediastinum remains a diagnostic possibility despite nondiagnostic initial findings. In clinically stable patients without evidence of secondary structural injury, conservative management may result in a favorable outcome.

Abbreviations

BMI: Body mass index;

CAP: Community-acquired pneumonia;

CRP: C-reactive protein;

CT: Computed tomography;

CURB-65: Confusion, Urea, Respiratory rate, Blood pressure, and age ≥ 65 years;

PA: posteroanterior

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From Global Frameworks to Africa's Disaster Risk Reduction Realities: Gaps and the Path to 2030

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A disaster is an acute ecological event whose severity overwhelms the affected community's coping capacity, requiring assistance from outside sources. It carries profound socio-economic and political repercussions. ^(1, 2)Between 2005 and 2015, disasters globally claimed over 700,000 lives, injured more than 1.4 million people, displaced approximately 23 million from their homes, and affected over 1.5 billion individuals, with women, children, and vulnerable populations bearing a disproportionately heavy burden. ⁽²⁾Disasters damage and destroy infrastructure and cause loss of life; in 2000, total GDP loss in the African region due to disaster deaths was estimated at approximately 2.2 billion. This represented about 0.4% of the region's total GDP. ⁽³⁾

To mitigate these impacts, the United Nations developed a strategic framework known as the Sendai Framework for Disaster Risk Reduction. ⁽²⁾ The Sendai Framework for Disaster Risk Reduction (2015-2030) is the global blueprint for substantially reducing disaster risk and losses in lives, livelihoods, and assets by 2030. It outlines four priorities for action: understanding disaster risk; strengthening disaster risk governance to manage it; investing in disaster risk reduction for resilience; and enhancing disaster preparedness for effective response and "Build Back Better" recovery. To guide the progress, the framework sets Seven global targets by 2030: (A) reduce global disaster mortality, (B) reduce the number of affected people, (C) reduce direct disaster economic loss in relation to Gross Domestic Product, (D) reduce damage to critical infrastructure and disruption of basic services, (E) increase number of the number of countries with national and local and local DRR strategies within 2030 deadline, (F) enhance international cooperation to developing countries, and (G) increase the availability of and access to multi-hazard early warning system and disaster risk information. ⁽²⁾ Since 2017, the African Union has adapted and implemented the strategy. ⁽⁴⁾

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As the world approaches the 2030 deadline for the Sendai Framework for Disaster Risk Reduc-

tion, African countries held a review meeting in Windhoek, Namibia, from Oc-

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tober 21–24, 2024. The review found a major gap between what global plans promise and what is happening on the ground. It also highlighted several ongoing problems that make it hard to implement these plans effectively. These include a lack of funding, insufficient reliable data on disaster risks, poor integration of disaster planning into broader development efforts, and failure to turn strategies into actions that help local communities.⁽⁵⁾

With less than five years to 2030, Africa must shift from planning to accelerated action. This requires strengthening inclusive partnerships, mobilizing resources, and securing political will. Key actions include: embedding DRR across all government ministries, investing in localized risk data systems, decentralizing financing to community levels, enforcing "Build Back Better" standards in recovery, and establishing a biennial Africa-wide peer-review mechanism to share lessons and foster accountability. Only through these concrete steps can Africa close the implementation gap and build genuine resilience by 2030.

In conclusion, while the Sendai Framework has provided a crucial global blueprint, Africa's journey to 2030 reveals a persistent gap between policy aspiration and on-the-ground implementation. The path forward demands a decisive shift from planning to accelerated action, driven by stronger partnerships, political will, and tangible community-level investment. Only through this paradigm shift can Africa build genuine resilience and meet the framework's ambitious targets.

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