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Admission Pattern and Factors Associated with Treatment Outcome of Orthopedics Patients in Intensive Care Unit of Addis Ababa Burn Emergency and Trauma (AaBET) Hospital

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Abstract

Background: Trauma is the main cause of death and disability worldwide. As a result of increased trauma burden, orthopedics patient account for a considerable and growing proportion of patients in intensive care unit. Access to intensive care is an important part of the health care system to reduce mortality and morbidity.

Objective: To assess admission patterns and factors associated with treatment outcomes of orthopedics patients in the ICU of Addis Ababa Burn Emergency and Trauma (AaBET) Hospital.

Method: The study employed analytical cross-sectional study design, reviewing ICU admissions of orthopedic patients from June 2017 to November 2021. A total of 117 patients were included. Descriptive statistics such as mean, median, and standard deviation (SD) were used to summarize the demographic data and pattern of injury. Univariate and multivariate logistic regression analysis were applied to assess the impact of various factors on the outcome variable and p-values < 0.05 were considered statistically significant.

Result: The study included 117 orthopedic patients who had been admitted to the ICU, with a 6.3:1 male-to-female ratio. Traumatic causes of admission accounted for 93.2% of the admissions. Road traffic accidents 88(75.2%) and fall-down accidents from a height 20 (17.1%) were the two most common mechanisms of injury. Fracture was present in 109 (93.2%) patients. Apart from orthopedics conditions associated medical, surgical, and neurosurgical conditions were present in 84(72.4%), 75(64.7%), and 74(63.8%)cases respectively. Respiratory failure 57 (48.7%) was the major reason for admission. The overall ICU mortality was 24 (20.5%). Factors associated with death outcome in the ICU include GCS ≤8 (P=.045) (AOR=4.344, 95% CI; 1.106-17.064), septic shock (P=.030) (AOR=10.495, 95% CI; 1.257, 87.630) and ICU length ≤5 days (P=.015) (AOR=4.118, 95% CI; 1.306, 12.986).

Conclusion: Traumatic admission as a result of road traffic accident accounted for the largest proportion of orthopedics patients to end up in AaBET ICU. To reduce the observed mortality, more emphasis should be given for orthopedic patients with GCS ≤8, septic shock, and those within the first five days of admission.

Keywords: Admission pattern, ICU, Orthopedics, treatment outcome

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Background

The intensive care unit (ICU) is a unit that provides a continuum of care for patients who require frequent vital sign assessments, invasive hemodynamic monitoring, intravenous drugs and fluid management, ventilators, and nutritional assistance to ensure a safe and effective outcome (1). Admissions can come from a variety of places, including inpatient wards, post-anesthesia care, and emergency department (1). An Intensive Care Unit necessitates the extensive utilization of cutting-edge technology and highly qualified personnel. Intensive care also necessitates a significant amount of time and effort on the part of medical and nursing staff to treat and enhance the survival of a critically ill patient. (2)

The leading global cause of death and disability is trauma. According to the WHO, injury is responsible for more than 5 million fatalities per year, which is more than HIV, malaria, and tuberculosis combined (3,4). It is the leading cause of death in the first four decades of life and remains a major public health issue in every country, regardless of socioeconomic development level. More than 90% of injuries occur in low and middle-income countries, where formal trauma systems and data-tracking mechanisms have yet to be substantially established (3,4).

Musculoskeletal injuries are the most frequent lesions needing surgical intervention in patients with multiple trauma, and survivors usually exhibit difficult situations in terms of functional results and quality of life(5). Patients with multiple injuries frequently experience challenges with expensive management, including emergency care, diagnostic examinations, surgical operations, prolonged postoperative and ICU hospital stays, and also protracted rehabilitation programs (5) .

Surgeons in poor nations who treat major or severe trauma have diagnostic and therapeutic hurdles(7). Due to increased urbanization, motorization, war, criminal activity, and civil unrest, injuries are rising in developing nations. Major trauma still accounts for a sizable portion of hospital admissions, intensive care use, and health care budget in these nations(2). Orthopedic injuries, together with the orthopedic surgeon's treatment choices, play a significant role in determining both the short- and long-term patient outcomes(5).

There are triphasic incidences of mortality in trauma patients, with one-third occurring at the scene of the injury and thus being unavoidable death. The early stage of trauma-related death occurs when the patient arrives at the hospital and cannot be saved without immediate action. However, patients who receive advanced trauma care were thought to be safe at this stage(8). Access to intensive care is an important part of the health care system. Therefore, critically ill patients are admitted to intensive care units to reduce mortality and morbidity. Mortality in the ICU takes a toll on the nation's economy, depleting the productive workforce and incurring huge economic costs (8-11).

There is a dearth of knowledge regarding the pattern of admission and variables influencing the course of treatment for orthopedic patients in multidisciplinary ICUs, both in Ethiopia and globally. Therefore, the objective of this study is to determine the hospitalization pattern, outcome, and related factors of orthopedic patients admitted to the ICU of AaBET hospital, and to provide guidance for future planning to improve the quality of services at the center.

Methods and materials

Study setting, design, period, and population

A hospital-based retrospective cross-sectional study design was conducted in the ICU of AaBET Hospital, an affiliate of St. Paul's Hospital Millennium Medical College, which is located in Addis Ababa, Ethiopia. The trauma hospital was established in 2015, with 145 beds, 12 ICU beds, and 4 operating theatres. AaBET provides orthopedics, neurosurgery, trauma, burn, emergency, and critical care services. The data was collected over 2 month period, from January 1, 2022, to February 28, 2022.

All patients with orthopedics cases, both acute and chronic, and complete clinical information treated in the ICU of AaBET hospital from June 2017 to November 2021 (the total duration since the ICU registry started) were eligible for inclusion. Patients with incomplete data and those transferred to other hospital before completing their treatment were excluded from the study. Of the 125 patients, 117 patients met the inclusion criteria.

Data collection, tools and procedures

The HMIS registration book of the ICU department was used to get the card numbers of ICU patients who were admitted during the study

period. A structured questionnaire adapted from literature's was used to collect data from the case charts (admission register and case file). one-day training was given to three General Practitioners who worked as data collectors and one orthopedic resident supervisor on how to fill a structured data collection sheet and a pre-test was performed after completion of the training. Missing data were coded as missing after two unsuccessful searches for files.

Operational definitions

Outcome: The condition of the patient written on the medical chart upon completion of treatment (Improved or Died), based on a similar study by Surya Gandham on Orthopedic patients who require Intensive Care admission in Warrington Hospital(12).

Source of Admission: The location of the patient before admission to the ICU (Emergency, PACU).

Associated Injuries: Other associated trauma the patient has apart from the orthopedic injury.

Length of Stay: The number of days the patient stayed in the ICU after admission.

Data processing and analysis

The questionnaires were checked for completeness and coded in Epi Info and later exported into SPSS V.25. For categorical variables, frequencies were generated, while means, median, mode, and standard deviation were used to characterize continuous variables. Percentages, tables, frequency distributions, and graphs are also used to present the results of univariate analyses. Results are presented using cross tabulation, chi-square test, p-values, odds ratios, and 95% confidence intervals. The impact of covariates on the outcome variable and potential confounders was examined using bivariate and multivariate logistic regression analysis. Bivariate analysis was used and variables associated with the dependent variable (with p-value < 0.05) were subjected to multivariable regression, and in multivariable regression variables with (p-value < 0.05) were considered to declare statistical significance.

Results

Socio-demographic characteristics of patients

A total of 117 patients who met the inclusion criteria were hospitalized at AaBET hospital. Of the study population,101(86.3%) were males and 16 (13.7%) were females, with a 6.3:1 male-to-female ratio. Patients' ages ranged from 4 to 80. The mean age of the patients was 32.74 (SD=16.495). More than half of the patients were in the age group of 20-29 (32.5%) and 30-39 (24.8%) (Table 1).

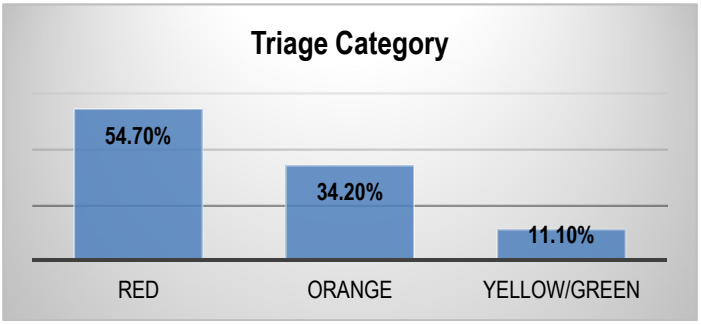
Table 1. Socio-demographic characteristics of orthopedics patient that got admitted into AaBET ICU, June 2017 to November 2021 G.C.

		Number	%
Age	0-9	9	7.7%
	10-19	8	6.8%
	20-29	38	32.5%
	30-39	29	24.8%
	40-49	11	9.4%
	50-59	13	11.1%
	60-69	7	6.0%
	>70	2	1.7%
Sex	Male	101	86.3%
	Female	16	13.7%

Triage category & admission source of patients

Admission from the emergency was the major source accounting for 70 patients, the mean length of stay was 3.79 (SD=3.021) days before they got transferred into the ICU. The second major source of admission was post-anesthesia care unit, from which 42 (35.9%) patients were admitted and the orthopedics ward accounted for 5(4.3%) of admissions. Of the 117 ICU admitted orthopedic patients more than half of the patients were triaged as red during their initial evaluation (Figure 1).

Figure.1 Distribution of triage category of orthopedics patients admitted from emergency to AaBET ICU, June 2017 to November 2021 G.C.



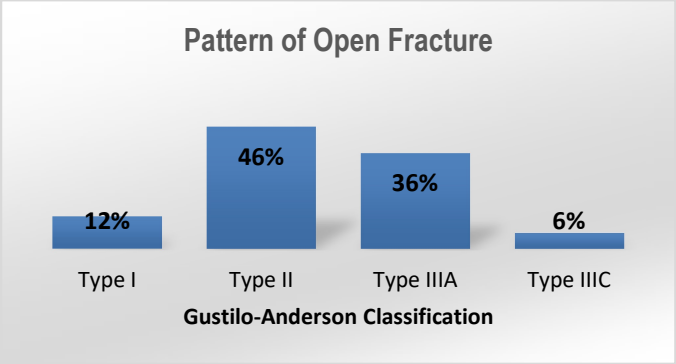
Pattern of injury in orthopedics patient

The majority of patients,109 (93.2%) were admitted due to a traumatic cause and the rest were non-traumatic for 8 (6.8%) patients. The non-traumatic admissions were infectious causes that were managed by the orthopedics team. The two most common mechanisms of injury from

traumatic admissions were RTA 88 (75.2%) and fall-down accidents from height 20 (17.1%). The least common cause of injury was assault.

When assessing the distribution of cases, the fracture was present in 109(93.2%) patients, soft tissue injury in 15 (12.8%), infection in 10 (8.5%) and the least common was dislocation accounting for a single case. Of the patients who had fractures half of them were closed, 26 (23.8%) patients had open fractures and 24 (22%) patients out of the total had a combination of closed and open fractures. The lower limb was involved in 77.1%, the upper limb in 45%, and the pelvis & acetabulum in 38.5% of cases who had fractures. Of those who had fractures, 52 (47.7%) of them had fractures in two or more areas.

Figure.2 Pattern of open fracture among orthopedics patients admitted to AaBET ICU, June 2017 to November 2021 G.C.

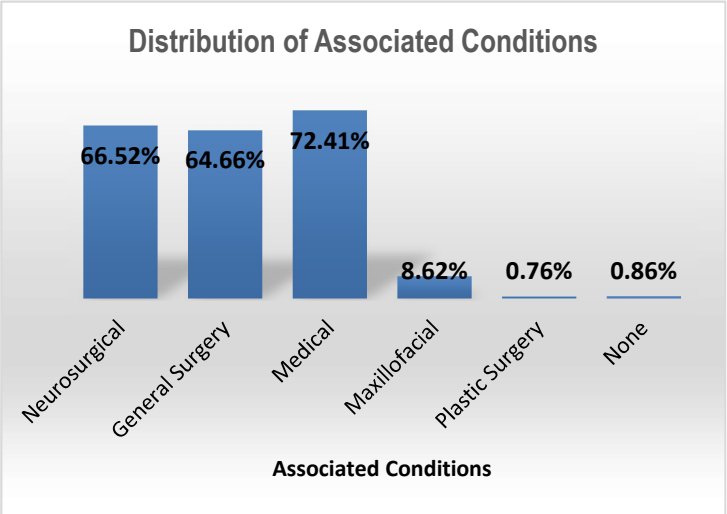


For patients with upper limb fracture the three most frequently involved areas were humeral shaft fracture, fracture around the wrist and clavicular fracture accounting for 25%, 23.3%, and 20% respectively. For patients with lower limb fracture, the commonly affected specific anatomic areas were tibia & fibula fracture, femur shaft fracture, and hip fracture accounting for 35.3%, 34.5%, and 13.8% respectively.

Tile A 37.8% and Tile B 31.1 % for the pelvic fracture and elementary acetabular fracture (13.3%) for the acetabulum were the commonly encountered fractures around the pelvis. The common interventions done for patients with fractures were gutter or cast (30.8%), skeletal traction (20.7%), and External fixation (12.4%). Out of the total reviewed patients 10 had an infection and there was a single case of knee dislocation for whom open reduction was done.

Of the 117 ICU admitted orthopedic patients associated medical, general surgery, and neurosurgical conditions were present in 84(72.4%),75 (64.7%), and 74 (63.8%) patients, respectively (Figure 3).

.**Figure 3**. Distribution of associated injuries in orthopedics patient, June 2017 to November 2021 G.C.



Of the reviewed patients who had a neurosurgical condition, 76 patients were diagnosed with Traumatic Brain Injury (TBI) of different severity. The most common CT findings of TBI patients was Diffuse Axonal Injury (DAI) 43 (55.1%) followed by Basal Skull Fracture (BSF) and epidural hematoma. From the surgical condition, the three common findings were hemothorax 54 (72%), Pneumothorax 27 (36%), and solid organ injury (including injury to the spleen, liver, etc.) 23 (30.7%).

Respiratory conditions apart from orthopedic injury were present in 61(52.1%) cases, the commonest finding being Type 1 respiratory failure which was found in 59 patients. Hemorrhagic shock was present in 23 and septic shock in 13 patients. Out of all the reviewed cases, Respiratory failure 57 (48.7%) was the major reason for admission, followed by monitoring purposes 51 (43.6%) and 9 (7.7%) patients for an indication of hemodynamic support.

Orthopedics patient course of stay in ICU

A total of 109 patients were intubated during the study period, the mean length of intubation was 12.51 (SD=8.016) days, and the average length of stay for orthopedics patients in the intensive care unit was 14.9 (SD=10.069) days. Complications in the ICU were present in 88.64%. The three most common complications were hospital acquired pneumonia (HAP) at 17.27%, electrolyte imbalance at 16.36% and urinary tract infection (UTI) at 15.91% (Table 2).

Complications	Percent
Bed Sore	10.91 %
Organ failure	12.27 %
Ventilator associated pneumonia (VAP)	2.73 %
Hospital acquired pneumonia (HAP)	17.27 %
Urinary tract infection	15.91 %

Electrolyte imbalance	16.36 %
Prolonged intubation	8.19 %
Deep vein thrombosis (DVT)	3.64 %
Upper gastrointestinal bleeding	1.3 %
No complication	11.36 %

Table 2. Distribution of complication of orthopedics patient admitted to ICU, June 2017 to November 2021 G.C.

Outcome of orthopedics patient in AaBET ICU

In the study period, 117 orthopedic patients were admitted to the AaBET intensive care unit, of which 93 (79.5%) patient improved from their condition. Overall ICU mortality was 24 (20.5%) based on death certificate reports of patients who died. Cardiopulmonary arrest secondary to refractory septic shock accounted for 9 (37.5%) cases, followed by cardiopulmonary arrest secondary to multi-organ failure and respiratory failure each accounting for 6 (25%) cases.

Determinants of ICU outcome

Based on bivariate analysis of factors that may affect the outcome of orthopedics patient admitted to the ICU, Age ≤40 (p=.010) (OR=0.292, 95% CI; .114, .744), Pulse rate 60-100 (p=.017) (OR=.145, 95% CI; .029, .712), GCS≤8 (p=.026) (OR=2.901, 95% CI;1.135, 7.416), presence of septic shock(p=.001) (OR=8.307, 95% CI; 2.388, 28.906), amount of transfusion within initial 24 hours (p=.015) (OR=0.133, 95% CI; .260, .678), presence of complication within the ICU (p=.047) (OR=8, 95% CI; 1.024, 62.473) and ICU length of stay(p=.000) (OR=8.990, 95% CI; 3.048, 26.519) were significantly (P<0.05) associated with the patient death outcome (Table 3).

Based on the multivariate analysis presence of septic shock, GCS and ICU length were determinant of death. A patient with severe TBI, GCS ≤8 was 4.34 times(p=.045) (AOR=4.344, 95% CI; 1.106, 17.064) more likely to die than those with higher GCS, those who have mild or moderate TBI. Patients who had a septic shock during their course of ICU stay have 10.5 times (p=.030) (AOR=10.495, 95% CI; 1.257, 87.630) more odds to die than patients who didn't. Patients who spent less than 5 days have 4 times more odds to die than those who stayed more than 6 days (p=.015) (AOR=4.118, 95% CI; 1.306, 12.986).

Table 3. Bivariate and multivariate analysis of factors associated with outcome of orthopedics patient admitted to AaBET ICU, June2017 to November 2021 G.C.

Variable	Category	Outcome		Bivariate analysis		Multivariate analysis	
		Died	Improved	COR.(95% C.I)	P-value	AOR.(95% C.I)	P-value
Age	≤40	12	72	0.292 (0.114-.744)	0.010*	7.972(0.984-64.576)	.052
	≥41	12	21	1		1	
Pulse Rate	60-100	4	23	.145(0.029-0.712)	.017*	3.015(0.035-262.946)	.628
	100-140	14	65	.179(0.048-0.672)	.011*	.867(0.019-38.756)	.941
	>140	6	5	1		1	
GCS	≤8	11	21	2.901(1.135-7.416)	.026*	4.344(1.106-17.064)	**.045***
	>8	13	72	1		1	
Associated Medical condition (Septic Shock)	Yes	9	5	8.307(2.388-28.906)	0.001*	10.495(1.257-87.630)	**.030***
	No	13	60	1		1	
Amount of transfusion in 24 hours	≤3	11	62	0.133(0.0260-0.678)	.015*	6.254(0.533-73.329)	.144
	≥4	4	3	1		1	
Complication in the ICU	Yes	23	69	8(1.024-62.473)	.047*	.569(0.017-19.128)	.753
	No	1	24	1		1	
ICU Length of Stay	≤5 days	11	8	8.990(3.048-26.519)	.000*	4.118(1.306-12.986)	**0.015***
	≥6 days	13	85	1		1	

*** p-value <0.05**

Discussion

The purpose of this study was to describe the pattern of injuries and determine the factors associated with treatment outcomes of orthopedic patients treated in ICU, which are key for identifying gaps to improve quality of critical care.

The current study showed that 57.3% of orthopedics patient admitted to the ICU were in the age group of 20-39 years, with the mean age of 32.74 (SD=16.495) years. The mean age of the patients is comparable to the studies done in Nigeria(25) and Botswana(16) , which had a mean age of 32.8 and 33.5 years respectively. This result shows that a large number of patients were in their productive age year, and subsequently led to loss of productivity and impacted the economy of the family and nation. There was also male preponderance with 86.3% (n=101) and male to female ratio of 6.3:1, even though the ratio is larger than other studies, the male predominance is consistent with studies done in developing nations(2,16,19). The young & male predominance maybe as a result of increased level of participation in high-risk activities and occupational exposure to trauma, e.g. most drivers are male in our country.

The study also revealed traumatic causes as a major reason for orthopedic ICU admissions 93.2% . Road traffic accident (RTA) was the leading cause of injury accounting for 75.2% of cases, this finding is comparable to studies done in developing countries such as Tanzania(2) and Nigeria(25), which accounted for 70.8% and 74.5% of cases respectively, and developed country like Turkey(14). RTA as a leading cause of injury may be explained by increased urbanization, motorization, destitute road conditions, and poor road maintenance..

In this study, more than half, 54.1% , of patients had a closed fracture, 23.8% had an open fracture, and a combination of open and closed was found in 22%, which was consistent with studies done in Egypt (18) and Nepal (20), who had more closed orthopedics injuries than open injury. The lower extremity fracture (77.1%) holds the dominance in the fracture site followed by the upper limb and pelvis & acetabulum, similarly, a study in Botswana(16) had a comparable finding with the common fracture site being the lower extremity (45.7%), followed by the upper extremity (21.6%) and pelvis (3.5%). Other studies (12,17) also show lower extremity was the commonly involved fracture site. In contrast, a study by Bidary et al(20) found upper limb fracture as the common site, the disparity of results may be a result of geographic and sociodemographic differences.

All except one patient had associated injuries. From the neurologic aspect, Traumatic Brain Injury (TBI) of different severity was present in 63.2% of the orthopedics patients admitted to the ICU, Respiratory failure from the medical condition was present in half of cases followed by Hemothorax from the surgical condition was present in 46.1% cases. The result from the current study shows, nearly all of neurosurgical cases were managed conservatively. Tube thoracostomy (chest tube) was the frequently done intervention by the general surgery. Similarly, studies done by(17–20) have shown that head injury is the most encountered associated organ injury..

In the current study, respiratory failure was the most frequent reason for admission, followed by monitoring purpose. A study by Gandham et al (12) showed that the main reason for ICU admission was for monitoring purposes in anticipation of postoperative complications. Again a study in West Africa (13) also showed postoperative monitoring as the main indication of ICU. The mean length of ICU stay in the current study was nearly 15 days, which again has a different result from the study done by Gandham et al(12), who found the average length of stay between 2 to 3 days. The reason for the discrepancy between the two results may be explained, by the reason that 45 (75%) of their patient were either elective cases or cases with single fractures, and the most prevalent reason for ICU admission was in the anticipation of postoperative complications. So once complications are ruled out patient will be discharged early and the length of stay within the ICU will be minimal. A similar study in Tanzania(2)showed overall ICU length of stay ranged from 1 to 59 days (median 8 days)..

The crude ICU mortality in the current study was 20.5%, the common reason being refractory septic shock (37.5%) followed by multi-organ failure and respiratory failure each accounting for 25%. The overall mortality was comparable to the study done by Gandham et al (12). The common reason for death being septic shock is also supported by studies done in Nigeria (19) and Brazil (26).

In this review, a lower Glasgow Coma Scale (GCS) was associated with increased mortality. Patients with severe TBI, GCS≤8 have higher odds of dying in ICU than those with higher GCS. In agreement with this, a study done in Tanzania(2) also showed that for those with GCS

<9, mortality risk was 4.72 times higher than the respective group, studies in Turkey(14) and Greece(26) also revealed the rate of mortality increased as the GCS values of the patient decreased. The current result is also supported by studies done in Ethiopia (22,24) which showed a reverse relationship between mortality and GCS. Those with low GCS have a high likelihood of having poly-trauma and high-energy injury, which may be the reason for increased mortality.

According to the study's findings, septic shock was a significant predictor of mortality. Those patients who had septic shock during their course of ICU stay have 10.5 times more odds of dying at ICU than those with out septic shock. The finding is consistent with the study done by Matthaios et al(26), which shows increased mortality by 6.2 times compared to patients without septic shock. A similar study in Nigeria(19) also ranked septicemia as the primary cause of death among orthopedics and trauma admissions.

The other factor identified in the study was length of stay in the ICU. Mortality was 4 times more likely in those who stayed less than 5 days, compared to patients who stayed more than 6 days. Studies in Jamaica(11) revealed survivors had a statistically significant longer period of stay in the ICU compared to the non-survivors, which also supports the idea that death occurs soon after ICU admission. A similar study in Nigeria(25) also revealed mortality was negatively correlated with length of stay, with more than half of the ICU trauma deaths occurring within 72 hours of admission. A study by Chalya et al(2) also showed that of the non-survivors who were admitted to the ICU, 66.7% of them died by the seventh ICU day. This result may be a result of different factors like severity of injury, admission of patients with poor prognosis, and delayed admission to ICU.

This study focused on orthopedic patients managed in the ICU, which makes it the first of its kind in Ethiopia, to assess specifically orthopedics patients in the ICU, and as a result could generate new ideas for further studies and act as baseline data. It also tried to identify determinants of outcome, which will be of great importance for quality improvement. This study had several limitations including the data source being secondary data, the small sample size, and the lack of a similar study for discussion.

Conclusion and Recommendation

Traumatic cases accounted for the largest proportion of Orthopedics patients to end up in AaBET ICU. From the traumatic admission, the Road traffic accident was the major cause of ICU admission. More than half of the patients were between the ages of 20 to 39. Fractures were present in the majority of patients, the common anatomic area being the lower limb followed by the upper limb. Isolated orthopedic injury was rare, bulk of the patients had an associated medical, surgical, or neurosurgical condition. The overall ICU mortality was substantial. GCS ≤8, septic shock, and ICU stay length ≤5 days were the major determinants of death at ICU.

To lower morbidity and mortality, coordinated efforts should target in reducing road traffic accidents. Health professionals involved in the management of orthopedic patients should keep in mind the three identified factors that may affect patient outcome which include GCS ≤8, septic shock and ICU length ≤5 days and therefore emphasize on these prognostic factors to help improve the outcome of patients.

Abbrevitions

AaBET……Addis Ababa Burn Emergency and Trauma.
BSF……...Basal Skull Fracture.
CNS…… Central Nervous System.
DAI……Diffuse Axonal Injury.
GCS……. Glasgow Coma Scale.
HAP……. Hospital Associated Pneumonia.
HIV……... Human Immunodeficiency virus.
HMIS…… Health Management Information System
ICU……...Intensive Care Unit.
IRB……Institutional Review Board.
I&D……... Irrigation and Debridement.
ISS……... Injury Severity Score.
PACU……Post-Anesthesia Care Unit.
SPHMMC……St.Paul's Hospital Millennium Medical College
PI……Principal investigator.
RTA……. Road Traffic Accident.
TBI……Traumatic Brain Injury.
WHO……... World Health Organization.

Declaration

Ethical Consideration:

Ethical approval and clearance were obtained for the study from the Institutional Review Board (IRB) of SPHMMC. Confidentiality of the information was guaranteed by not writing the name or anything that enables identification of the patient. In addition to that information gathered from the patients' card was solemnly used for this study only.

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Availability of Data and Materials

The datasets used in the current study or data collection tool are available from the corresponding author with a reasonable request.

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Disclosure

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

Authors' contributions

MB conceptualized the research problem, designed the study, conducted fieldwork and drafted the manuscript. MT,HM & GT were involved in conceptualization, preparing the research proposal, and revising the final manuscript. All authors of the manuscript have read and agreed to its content.

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