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Original Article

Effectiveness of Continuum of Trauma Care System in Trauma Centers in a Resource Limited Setup: A Multi-Center Mixed Method Study

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Abstract

Background *Trauma is the leading cause of death in Ethiopia, with a rate of 26.7 deaths per 100,000 popula- tion. Emergency care systems have been shown to reduce trauma deaths, but the effectiveness of the emergency care system in Addis Ababa is not studied well. The aim of the study was to assess the effectiveness of the continu- um of the trauma care system in selected emergency departments and trauma centers in Addis Ababa.*

Methods *A sequential explanatory mixed-methods approach was utilized, with in-depth interviews (N = 23) and focus group discussions (N = 17) with trauma team members, as well as a concurrently structured emergency care system assessment questionnaire (N = 333). The Chi-square test was used to show a significant association (P< 0.05) between the type and mechanism of trauma and patient condition categorization. The qualitative data were analyzed using Colaizzi's seven-step procedure.*

Results *The present study showed that Road Traffic Injury had been the most common cause of trauma (87.1%), with only 8.4% of trauma patients having received airway intervention during prehospital care. Out of 126 patients who had required emergency surgery, only 38.10% of injured patients received a prompt decision regarding the need for emergency surgery, and 78.7% couldn't have received rehabilitation service. The Chi- square test revealed a significant association (p < 0.05) between type and mechanism of trauma and patient condi-tion categorization. Five themes had emerged from the qualitative analysis, and hospitals had faced difficulties in providing trauma care due to a lack of leadership, coordination, cooperation, referral links, knowledge gaps, poor organization, and insufficient medications and medical equipment.*

Conclusion *This study found that the trauma care system in the city is ineffective due to systemic gaps in emer- gency departments, policies, Resources, documentation, referrals, and communication. These gaps contribute tothe high death and illness rates of trauma patients. To improve trauma care and reduce death and illness, the sys- tem needs to be improved and strategy has to be developed.*

Keywords*: Trauma Care System, Prehospital care, Continuum of Trauma Care and rehabilitation*

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Introduction

Road Traffic Injury (RTI) is the eighth leading cause of mortality worldwide, causing over 1.3 million deaths annually and injuring 20-50 million more. By 2030, it is predicted to become the fifth leading cause of death. RTI is particularly prevalent in poor and middle-income countries (1). The number of individuals killed in RTIs has increased dramatically in sub-Saharan Africa, with higher rates of 26.6, 20.7, and 26.7 deaths per 100,000 inhabitants in Western and Southern Africa, South-East Asia, Africa, and Ethiopia, respectively (1)

In 2018, Ethiopia's 2018 study revealed a 31.5% prevalence of RTI among trauma patients, with a higher rate

in the southern, nation, nationalities people's regions (58.3%), and Addis Ababa (33%). The time-trend analysis has shown an increasing burden of RTI in Ethiopian hospitals (2).

A ten-year study in Ethiopia's Emergency Department found that 53.4% of trauma cases were in Addis Ababa, followed by Gondar and Jimma. Major risk factors included severe traffic Injuries, occupational injuries, and surgical patients (3).

The UN 's 2020 Sustainable Development Goal 3.6 targets halving traffic-related fatalities and injuries. Despite stabilization, the goal has not been achieved. The WHO and Global Surgical Societies recommend developing a strong trauma care system to reduce traffic-related deaths by half by 2030(4,5).

A trauma care system is a coordinated effort to provide the best possible care to injured patients, from the time of injury to rehabilitation. The Trauma System Agenda for the Future outlines four fundamental components of a trauma care system: injury prevention, prehospital care, acute care facilities, and post-hospital care, emphasizing eight core infrastructure components (5).

Trauma continuum care is a holistic approach to caring for trauma victims from the moment of injury through recovery and rehabilitation (6). It involves a coordinated network of services that provide personalized care based on the individual's needs and the severity of their injuries.

Standardized trauma training, prehospital care, and trauma centers have improved RTI mortality in developed countries, but sub-Saharan Africa, particularly Ethiopia, faces increased mortality due to inadequate trauma systems (7).

Addis Ababa has the highest rate of RTI deaths and injuries in Ethiopia. Despite having several hospitals providing emergency care, the quality of care varies widely, and many patients die after admission. A study found that 604 out of 30,086 patients who visit-ed the emergency department died within 72 hours of presentation (8).

Many studies have found that factors such as transportation mode and referral channel contribute to poor hospital care outcomes for admitted RTI pa-tients. Post-trauma mortality was substantially associ-ated with poor physical and infrastructure, insuffi- cient resources, on-time monitoring of admitted pa- tients, provision of suitable medical and surgical care provider skill levels, and access to interventions. (9–19).

This study aims to provide insights into the challenges of providing effective trauma and emergency care in Addis Ababa, Ethiopia, to healthcare providers, administrators, and policymakers.

Materials and Methods

The study employed a mixed-methods approach. Quantitative data were collected from nine hospitals and patients' medical records (N = 333) and analyzed using the chi-square test, revealing a significant association ($p < 0.05$) between the type and mechanism of trauma. Qualitative data were gathered through in-depth interviews and focus group discussions to enrich the quantitative findings.

Study setting

According to the 2007 national census, Addis Abeba has 5,006,000 residents. It has 99 health centers, 14 state hospitals, and 42 private hospitals. Nine public hospitals were chosen for the study, including TASH, SPHMMC, Alert Hospital, Yekatit 12 Hospital, Mene- lik II Hospital, Zewditu Hospital, Ras Desta Hospital, and Tirunesh Beijing Hospital.

Study Participants

Three different approaches were used to sample and recruit participants for this study. 333 medical records from a one-year period were randomly selected from nine hospitals for document analysis. single proportion with corrective formula was used to determine the sample size. and purposive sampling was used to select 23 participants for in-depth interviews and 17 participants in 5 groups for focus group discussions. The final sample size for the in-depth interview was determined by the saturation of information during data collection.

Eligibility Criteria

This study examined two inclusion criteria; Medical records of RTI patients aged 18-60 who were admitted to the study hospitals and underwent trauma care were included in the study. Trauma team members and clinical personnel who had worked in the nine research institutions for more than six months were also included.

Data Analysis

The study analyzed quantitative data sequentially, followed by qualitative data analysis. The principal investigator revised data, computed descriptive statistics, The Chi-square test was used to show a significant association ($P< 0.05$) between type and mechanism of trauma and patient condition categorization, SPSS version 28 software used to make analysis.

The audio recordings of the interview and the FGD taken in Amharic were translated into English and checked by a professional researcher in qualitative re- search for accuracy. The descriptive phenomenology and the Colaizzi method were used in the analysis, sup-ported by ATLAS ti.23 software. During the qualitative phase, transcripts of in-depth interviews were prepared

to uncover recurring themes and build a coding scheme. The data were coded into 180 different codes, which were then sorted into 17 subthemes. From these categories, five overarching themes emerged. The study followed the concepts of credibility, transferabil-ity, dependability, and authenticity.

Ethical consideration

Ethical approval was obtained from the Addis Ababa University HSC ethical review committee (Protocol number 089/21), the Addis Ababa Regional Health Bureau (AA/HB/8501/227), and the study hospitals (PM 23/160, PO/14/22, PO/210/22, V409/24/1/2022). Before taking part in the study, all individuals provided written informed consent, and waiver consent was obtained for secondary data (protocol number 14/22).

Results

Quantitative findings

Continuum of Trauma care

The study assessed the continuity of trauma care for 333 patients in emergency departments and hospital wards, revealing that patients receiving the best possible care had improved outcomes and quality of life.

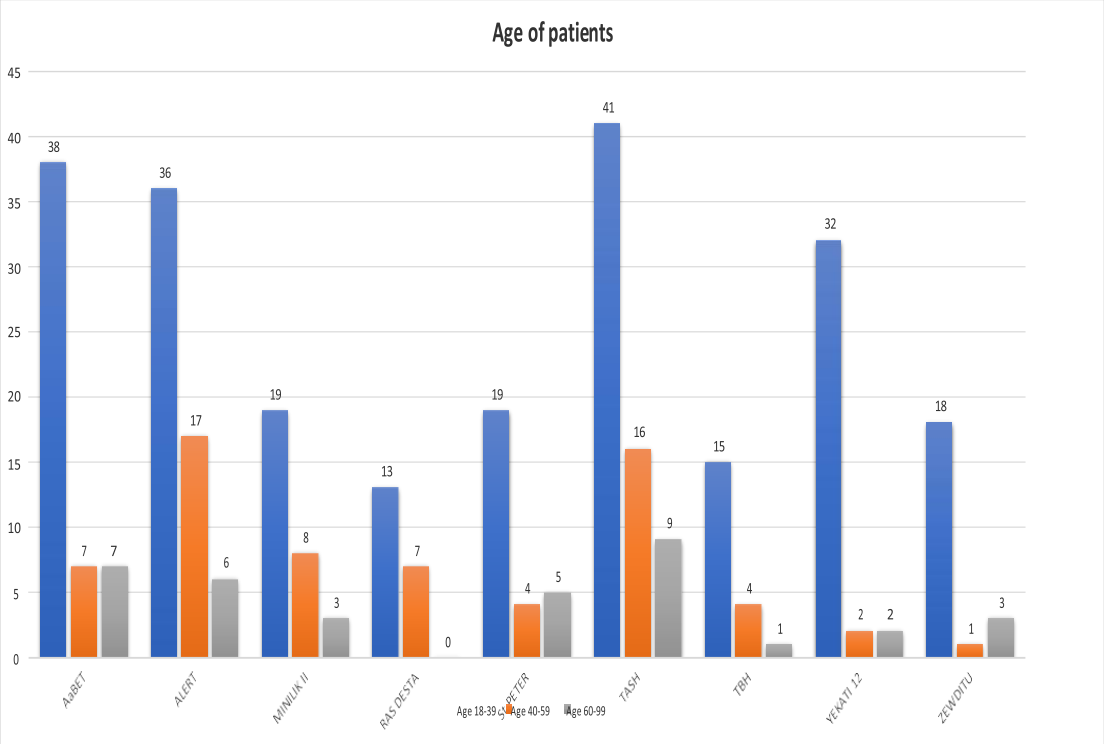

Figure 1: Age distribution based on reviewed patient records.

Demographic Characteristics of In-Depth Interview Participants

The study involved a diverse group of participants, with 23 members of the health workforce purposefully chosen from nine hospitals. From this 19 (82.6%) were men and 4 (17.4%) were women, with 65.2% of participants aged 30-39 were conducted, and 26.1% aged over 39 years. Their levels of education, were 10 (43.5%), 8 (34.5%), 3 (13%) , 2 (8.7%) first degree, specialty degrees, subspecialty degrees, and master-degree respectively. Furthermore, the participants included clinical nurses and chief residents in orthopedic surgery, as well as emergency and critical medicine specialists, emergency and critical nurses, public health officers, general surgeons, general orthopedic surgeons, general practitioners Leaders and coordinators.

Demographic Characteristics of Focused Group Discussions participants

The participants in the FGD were mostly aged 30-39 (70.6%), male (70.6%), and had a first-degree education (52.9%). They had a range of work experience as health care providers (6-10 years), with most being Emergency and Critical Nurse professionals or clinical nurses (29.4% each, and (58.8%) were Unit heads.

Patient referral status and Mode of transportation
Most patients (67.6%, N=225) admitted after RTIwere from Addis Ababa, followed by the Oromia Region (23.4%, N=78) and Amhara Region (4.8%, N=16). Transportation modes included ambulances (20.7%), taxis (55.3%), and private cars (15.3%).

The cause of trauma
This study found that RTIs were the most common cause of trauma for admitted patients, accounting for 87.1% of cases. Falling accidents accounted for 6.6% of cases, and gunshot injuries accounted for 3.3% of cases.

The pattern of Trauma death happened on arrival or after admission.
The tri-modal distribution of trauma deaths that occurred on arrival or after admission is presented on (Figure 2).

Demographic characteristics of the reviewed patient records.
Figure 1 presents the age distribution of patients admitted to emergency departments following road traffic accidents. Of the 333 patient medical records analyzed, 74.2% were male (N=247) and 25.8% were female (N=86).

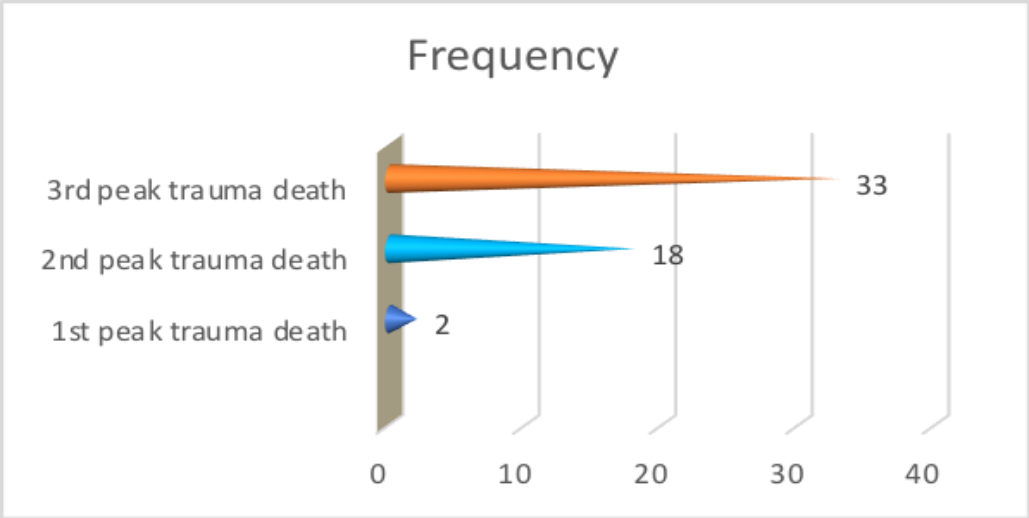

Figure 2 : Tri-modal Distribution of Trauma Deaths

Type of Trauma, Patient Condition at Admission, and Admission Pattern of Trauma Patients During Golden Hour
The study examined trauma types, patient conditions, admission patterns (Table-1).and time intervals during the Golden Hour (Table-2). Chi-square test showed a significant association between type and mechanism of trauma and patient condition categorization (p-value = 0.001).

Clinical characteristics of the study participants
The genitourinary system was the most frequently documented site of infection followed by the pulmonary system, wound site, and soft tissue. Blood stream infection was identified only in 4 patients.

More than two-thirds (88) of the study participants had at least one risk factor for the MDR pathogen, and among those patients, 69.3% (61) had more than one risk factor. The two most often found risk factors were hospitalization within the previous three months and usage of antibi- otics during the previous month. Forty-six (35.9%) research participants had imaging evi- dence of an abscess and the most frequent loca-tions were the liver, lung, and chest wall, fol- lowed by soft tissue and joint spaces. Clinical characteristics of study participants are shown in Table 2.

Table-1 Association of the type and mechanism of trauma patient condition categorization.

Type of trauma	Patient condition at admission				Total	P- value
	Immediate Category (red Zone)	Urgent Category (yellow)	Delayed Category (green)	Expectant category (black)		
Airway Injury	1	2	1	0	4	< 0.001
Head & Neck (TBI)	82	42	7	0	131	
Spine injury	3	3	0	0	6	
Thoracic/Chest injury	1	7	4	0	12	
Abdominal injury	1	3	1	0	5	
Orthopedic injury	29	62	30	0	121	
Other	20	15	18	1	54	
Total	137	134	61	1	333	

Table 2- The admission pattern of trauma patients during Golden Hour

Time duration	< 30 minutes		Not documented	
	(N)	Percent	(N)	Percent
Total duration of time between occurrence of trauma and getting prehospital trauma care	119	35.7%	214	64.3%
Total duration of time between occurrence of Trauma to admit in nearby hospital	127	38.1%	206	61.9%
Total duration of time between admission and getting trauma care at hospital	138	41.4%	195	58.6%
Total duration of time stays in the emergency department.	79	23.7%	254	76.3%

Delivery of pre-hospital emergency patient care

A study of 333 medical records revealed that only 8.4% of trauma patients received airway intervention during pre-hospital care, as shown in Table 3.

Table 3 - Delivery of pre-hospital emergency patient care

Prehospital emergency care given to the patient	Yes		Not Documented	
	f(N)	(%)	f(N)	(%)
Is air way intervention done to the patient?	28	8.4%	305	91.6%
Did chest drain placed to treat the tension. pneumothorax/haemothorax/?	31	9.3%	302	90.7%
Is pulse oximeter placed on functioning?	223	67.0%	110	33%
Is Large bore IV placed and fluid started?	232	69.7%	101	30.3%
Did full survey done for (and control of) external bleeding, including Scalp, perineum and back.	262	78.7%	71	21.3%
Assessed for Pelvic Fracture by physical Exam, X-ray, and CT	273	82.0%	60	18.05 %

Assessed for Internal bleeding by: Exam, Ultrasound, CT, and Diagnostic peritoneal Lavage.	**258**	**77.5%**	**75**	**22.5%**
was spinal immobilization needed?	81	24.3%	252	75.7%
Did Neurovascular status of all Limbs check?	277	83.2%	56	16.8%
was the patient Hypothermic?	28	8.4%	305	91.6%
Did the patient need (If not contraindication): Urinary Catheter, Chest Drain, Nasogastric tube and not indicated.	153	45.95%	180	54.05%
Has the patient been given Tetanus vaccine, Antibiotics and Analgesics?	262	78.7%	71	21.3%
Have all testes and imaging been reviewed?	263	79.0%	70	21.0%
Do Plan of care discussed with patient/family, Primary team, Receiving unit and other specialist.	7	2.1%	326	97.9%
Did Relevant trauma chart or form complete?	92	27.6%	241	72.4%

Review of Clinical care at admission and follow-up care

The clinical trauma care provided to patients during the admission period was evaluated as part of the continuum of trauma care. 52.0% of patients had all vital signs taken at admission. Primary and secondary trauma surveys were not documented in 54.4% and 55.0% of medical records, respectively. Management plans were not included in 29.7% of documented medical records.

Follow up trauma care.

Trauma care in the emergency department necessitates multisystem support and constant monitoring of the patient's condition. The analysis of the medical records shows on (table 4).

Table 4 : Follow up trauma care in emergency department and documentation.

Trauma care and documentation	**No**		**Yes**		**Not Available**	
	f (N)	**(%)**	**f (N)**	**(%)**	**f (N)**	**(%)**
Using of the minimum standard monitoring timely	47	14.1%	208	62.5%	78	23.4%
Pain control was done and documented	28	8.4%	276	82.9%	29	8.7%
Fluid management was done & documented	15	4.5%	198	59.5%	120	36.0%
the patient needed immediate surgery	70	21.0%	126	37.8%	137	41.1%
Any intraoperative surgical related incident	178	53.5%	1	0.3%	154	46.2%
Any intraoperative Anaesthesia related incident.	188	56.5%	2	0.6%	143	42.9%
Any complication detected at any stage of trauma care	30	9.0%	52	15.6%	251	75.4%
the patient managed in line with Advanced trauma care management for trauma related complications	25	7.5%	34	10.2%	274	82.3%

The decision, start and outcome of immediate surgery.

Nearly one-third of the 333 patients involved in RTI 126 patients required emergency surgery. Only 38.10% (N = 48) of injured patients received a prompt decision regarding the need for emergency surgery (Table 5 and Figure 3).

Table 5: The decision and start of immediate surgery.

	The recommendation for immediate surgery		**The immediate surgery starts.**	
	f (n)	(%)	f (n)	(%)
Less than 30 minutes.	1	0.80%	1	0.80%
From 30 minutes to 1 hr.	1	0.80%	1	0.80%
From 1hr to 2 hrs.	6	4.76%	7	5.60%
Greater than 2hr.	48	38.10%	47	37.30%
Not documented	70	56.56%	70	56.56%

The outcome of trauma care for the injured patient

The outcome of trauma care for injured patients in the study hospitals is Indicated on Table 6 below.

Table 6: The outcome of trauma care for the injured patient

The outcome of trauma care for the injured patient	**F(N)**	**(%)**
No major complication.	19	5.7%
Developed severe trauma related complication and managed at the same facility.	106	31.8%
Developed severe trauma related complication and referred to other facility.	7	2.1%
Died /death during the time of trauma care.	53	15.9%
Unknown/not documented.	148	44.4%

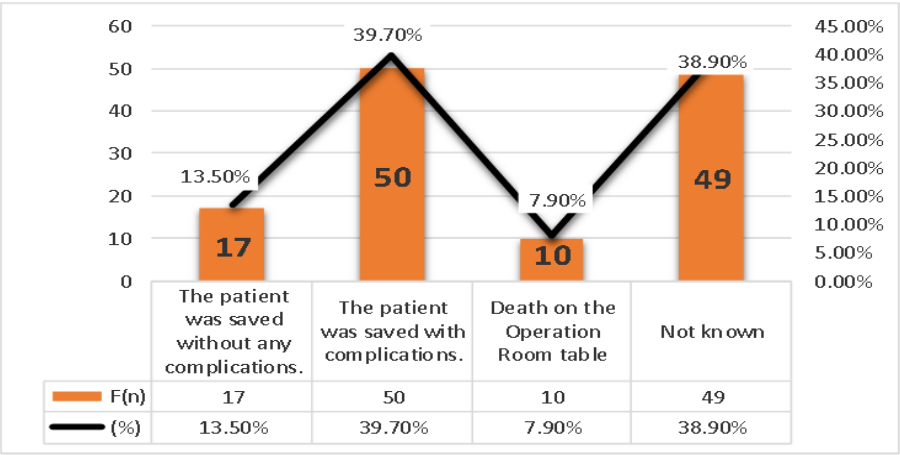

Figure 3: The outcome of the immediate surgery

Cause of death during the time of trauma care

The reasons of death during trauma care were,66% (N = 35) of all deaths occurred due to multiple organ failure, 22.7% (N=12) and 11.3% (N=6) of patients died due to delayed referral and trauma care, respectively, and direct vital organ harm from the RTI.

Rehabilitation service to the injured patient

The rehabilitation service provided to patients had also been evaluated, and the results shown on (table 7).

Table 7- Rehabilitation service

Rehabilitation service	**No**		**Yes**		**not Available/not documented**	
	F(N)	(%)	F(N)	(%)	F(N)	(%)
Did Physiotherapy for recovery of extremity injuries done?	261	78.4%	1	0.3%	71	21.3%
Did the patient received psychological counselling?	259	77.85%	2	0.6%	72	21.6%
Did the patient receive Specialized rehabilitative nursing?	262	78.7%	1	0.3%	70	21.0%
Was there Discharge planning?	258	77.5%	9	2.7%	66	19.8%

Qualitative findings

The continuum of trauma care in the study hospitals was also studied qualitatively to identify the lived experiences of trauma team members. Five themes were emerged from the qualitative analysis and Trauma care challenges in study hospitals were Lack of leadership, coordination, and teamwork, Insufficient communication and referral links, poor prehospital and continuum of Trauma care, Insufficient drug, and medical equipment and poor documentation.

Leadership, coordination, and teamwork

The outcomes of the study show a lack of effective leadership, coordination, and synergy within emergency trauma facilities. The following are the evidence stated by the study Participates.

> *"As an empathetic healthcare practitioner, you want to do more for trauma patients than merely treat their wounds. You're attempting to save their lives. In this context, finding the time and space to interact with them is difficult. You regularly feel overwhelmed and confused, and you wonder who is in charge. You have the impression that you are fighting a losing war due to poor leadership or a lack of coordination."*

Another highly respected superspecialist physician stated that:

"There is no practical leadership and coordination in the emergency department. Residents ask the seniors for assistance; however, the situation is not ideal for providing care for the patient who is in need ".

The researcher noted that a lack of excellent leadership, coordination, and team spirit threatened the provision of emergency trauma care.

Access to Trauma Care

In-depth interviews demonstrate that the overloading of Addis Abeba City hospitals by road traffic accident patients is related to a lack of trauma care in their local districts or communities. This topic was repeatedly mentioned by the participants as.

> *"Car accident victims from different regional states should receive better care in their communities, as hospitals in Addis Ababa are congested and under-resourced."*

The Participants also put their recommendations regarding access to trauma care.

"The government should prioritize improving hospitals in regions rather than overspending on Addis Ababa's overcrowded and resource-dense hospitals, as well as addressing the imbalance in doctor distribution, with half of Ethiopia's doctors working in Addis Ababa, to ensure better access to trauma care."

The research reveals that establishing trauma care centers across the country was a challenging task due to the high costs involved.

"... One such challenge is the issue of affordability - Trauma care comes at a high cost. This makes emergency medical services inaccessible to a large segment of society…"

Prehospital trauma care

In-depth interviews with trauma team members demonstrate that pre-hospital care for road traffic accident patients is deficient at the national level,with many causes identified. One of the in-depth in- terview participants expresses his emotions as fol- lows:

"*The lack of adequate pre-hospital care nationwide is a significant concern for medical practitioner working in this big Hospital. The lack of well-structured and organized treatment has led to the loss of patients involved in road traffic accidents."*

The other participant also describes his feelings as:

"*There is no coordination or continuity from prehospital care to rehabilitation service. Many lives could have been saved if there was a strong prehospital service. Many complications and disabilities could have been prevented ifthere was a good trauma care system."*

Ambulance service

In an interview, participants repeatedly criticized the pre-hospital ambulance service for providing insufficient care due to a lack of emergency medical supplies, life-saving medications, and poor equipment.

"There is no oxygen, pulse oximeter, or monitor in the ambulances or cars that transport patients to the hospital. Furthermore, the majority of patients arrive without the assistance of medical professionals because patients or families are unable to pay for their services. If a nurse is added to the ambulance, the patient or their family would be required to pay the nurse's allowance, which they are often unable to do. Because the sending institution cannot afford to pay the nurse's allowance, the nurse is left be- hind, and only the driver arrives."

Communication and Referral Linkage

The participants emphasized the inadequacies in the trauma care system, highlighting the need for improved communication and referral linkage for effective emergency trauma care.one of the participants in the interview said:

"……We have poor team spirit and communication…."

Health professionals discussed communication failure during refer-out and refer-in, highlighting that a communication gap leads to congestion in trauma centers, patient complications, and even death.

"Communication with other hospitals is difficult, especially when referring patients due to a lack of space and resources. The hospital's lack of Orthopedic surgery and a C-RM machine causes referral delays, which can lead to complications like DVT, wound healing, deformity, and even death."

The interviewee also stated on referral linkage among health facilities:

"The referral linkage coordination is too passive; patients frequently linger here for more than 10 days without receiving definitive trauma therapy. The city's liaison mechanism is becoming inefficient. When a referral request was submitted, all receiving hospitals responded that they were full of trauma patients."

Before patients are taken to the emergency room, the analysis's results show that there is a communication gap and disjointed referral connection.

Continuum of care (from acute care to rehabilitation)

The trauma care continuum assures high-quality care for injured patients from injury to recovery, however it is not effectively supported in study hospitals.

"The care for RTI patients is generally good once they are treated for an emergency life-threatening condition and linked to a specific department or specialty."

This quote was also supported by the participant from the orthopedic department.

"Regarding to continuum of trauma care particularly for Orthopedics trauma patients it is good. Once the RTI patients are transferred to orthopedics ward, the follow up care and definitive care is good "

The interview and FGD revealed that the city's ICU service, a crucial component of trauma care, is restricted and not easily accessible.

> *"The city faces a shortage of ICU care services, with public hospitals occupied and private hospitals expensive. Patients may struggle to afford ICU beds, and rehabilitation services are not available in the hospitals they work in. Physiotherapy is outdated and professional."*

Drug and medical equipment availability

The study found that the trauma department's shortage of pharmaceuticals and medical equipment is disappointing, with staff members expressing irritation about the lack of resources One of the emergency department's final-year chief resident students said:

> *"The department lacks government and hospital support, resulting in insufficient resources, medications, and supplies for patient care. This has resulted in trauma team members staying away from patients, which has led to complications and even death. The shortage of emergency medications and equipment is widespread."*

The other participant stressed out that:

> *"Uh The other challenge is extreme shortage of emergency medical supplies, it is difficult to get cervical collars, even gloves are not available. So, in an emergency situation how can a health professional give support without Gloves. There are no emergency drugs used for treatment of life threating condition."*

Participants emphasized the chronic shortage of medical drugs and equipment in their institution. They regularly see road traffic accident victims suffer due to this lack of resources. A young emergency and critical care nurse said:

> *"There are resource limitations. One of the crucial pieces of equipment we were unable to find for our RTI patient was a collar. A cervical collar is an essential piece of equipment for RTI patients who have suffered a cervical spine injury. It is, however, unavailable.*

A study found that an extreme shortage of emergency drugs and medical equipment makes it impossible to care for RTI patients.

Documentation in trauma care

Trauma team members frequently neglected to accurately record patient information and information produced during medication administration or procedural planning.

> *"The patient's documentation is unclear and not recorded in accordance with the WHO trauma registry, indicating poor quality."*

Another interviewee frequently mentioned the limitations on the documentation raised by the previous participant.

> *"The patient's incomplete medical record hinders access to treatment and management plans, potentially leading to repeated treatments or diagnostic tests by subsequent doctors."*

Some FGD participants noted responsible health professionals accurately documenting patient information despite the complexity of the WHO register form. A female participant mentioned this as :

> ***"****The registration form is quite comprehensive. It may be relevant to medicolegal issues; thus doctors fill it out. They are carefully filled. Throughout the trauma care procedure, it is simultaneously filled."*

In contrary to this a female FGD participant highlighted the issue of incomplete referral forms, which can hinder the provision of continuous trauma care.

> *"The referral paper for certain RTI patients isoften incomplete, with preceding actions not documented. For instance, an old man with rib fractures was arrested after an accident, but CPR was not noted on the referral page. "*

According to the research, trauma team members were not recording all relevant patient medical information or following the WHO trauma register format, which could have hampered the delivery of treatment.

Discussion

The study highlighted the strengths and weaknesses of the current trauma care system in Addis Abeba, Ethiopia, and provided a comprehensive overview of trauma and emergency care service delivery. It identified five key themes: 1) Basics of the trauma care system, 2) Prehospital trauma care service, 3) Trauma care continuum, 4) Competency of trauma team members, and 5) Trauma team member perceptions.

To begin with, the pattern of trauma patient flow into the ED was presented as follows: the study found that 67.6% of trauma patients were from Addis Abeba, followed by Oromia and Amhara Regions. This suggests that trauma care services were concentrated in metropolitan areas. Most patients used taxis or minibuses (55.3%) to travel to medical facilities. A similar study identified that in 46.2% of cases, care was not given at the scene, but the main reasons for this were lack of knowledge and equipment (20).

Many Similar studies also highlighted challenges in emergency trauma care due to information systems and poor communication in Addis Ababa (21–23).The study suggests the need for decentralized trauma care services, support for metropolitan trauma cen- ters, and improved communication and information systems.

The study discovered that Addis Ababa's trauma care referral linkage system is insufficient, with patients coming without warning. This makes it harder to refer people to emergency services and find ward beds.

Because the system is still dormant, patients will not receive definitive trauma therapy for several days. Similar problems existed in Cambodia and Sub-Saharan Africa. (11)(24)

This study found that RTIs are the most common cause of trauma among admitted patients, accounting for 87.1% of cases, followed by falling accidents and gunshot wounds. These findings are consistent with earlier research emphasizing RTIs as a major factor to trauma cases (25). Understanding the various causes of trauma can help guide preventive efforts and focused interventions to reduce the frequency of such episodes.

Furthermore, the study looked at the trimodal distribution of trauma deaths that happened before or after admission. The third peak trauma death accounted for 62.3% (N=33) of cases, followed by the second peak trauma death at 33.9% (N=18) and the first peak trauma death at 3.7% (N=2). This distribution pattern provides insights on the provision of continuum of trauma care that was ineffective and the severity of trauma-related fatalities, which can drive resource allocation and the development of trauma care procedures (26).

The study also examined the type of trauma, patient condition at admission, and admission pattern of trauma patients and admissions in the Golden Hour. Head and neck injuries were the most common type of trauma, accounting for 39.3% (N=131) of admitted patients. Among these patients, 62.6% were admitted as red category (immediate) and 32.06% as (Yellow category) urgent cases. Orthopedic injuries were the second most common type, accounting for 36.3% (N=121) of admitted patients. The varying admission patterns for different types of traumas highlighted the need for tailored approaches to patient management during the critical Golden Hour (26).

The researchers also found an association between the type and mechanism of trauma and the patient's condition (injury severity). Airway, head, neck, thoracic/chest, abdominal, and orthopedic injuries were the most serious with (P-0.001). This finding is consistent with a Korean study that revealed a significant relationship between injury sites and trauma mechanisms in severely damaged patients with trauma, with the head, neck, and chest being the most related (27).

According to the findings of this study, only 8.4% of trauma patients received airway help during prehospital care, while 91.6% were not documented. While the vast majority of injured patients underwent crucial procedures such as wide bore IV placement and hydration delivery, screening for external bleeding, and pelvic fracture diagnosis. The lack of recorded data and complete trauma charts raises concerns about care quality and continuity. Similar studies found that some sort of pre-hospital care was delivered at the scene in 46.2% of cases, but the most common reasons for not giving care were a lack of knowledge and equipment (20).

Prehospital care capabilities vary significantly in LMICs but are generally less developed in LICs and rural areas (28). Addis Ababa's prehospital care was inadequate due to lack of coordination and guidelines. Ambulances lacked essential supplies and trained personnel, forcing patients to rely on private cars or taxis to get to the hospital. Poor communication between departments and hospitals further complicated care, leading to delays in referrals and worsening injuries.in congruent to this study Nigeria lacks a national prehospital trauma care system, while other African countries have improved prehospital services (29,30).

The study found that emergency departments and trauma centers in Africa lack specialized policies, protocols, and practice guidelines, similar to Nigeria (29). Poor coordination in the trauma care system leads to unsatisfactory treatment services (30). Barriers include lack of funding, leadership, and regulation. The researcher recommends expanding prehospital care and improving organization and leadership to improve trauma care in Addis Ababa.

Trauma care coordination necessitates strong leadership, community engagement, and regional collaboration (31). Many hospitals lack a dedicated individual to handle emergency preparedness, response, and recovery, resulting in resource shortages, duplication of services, and low staff morale. Clear policies, protocols, and standards of practice guidelines are required to improve trauma care.

The continuum of trauma care is crucial for injured patients(32) The study highlights the inefficiency of hospitals in providing continuous trauma care, leading to delays and gaps in patient care. This can result in longer hospital stays, higher healthcare costs, and psychological impacts. In Ghana, delays in trauma care result in emergency surgeries being postponed by an average of 12 hours (29), increasing mortality and morbidity rates, longer hospital stays, higher healthcare costs, and psychological effects for pa-

tients. Addressing these issues is crucial for improving patient outcomes and overall healthcare delivery.

Trauma care quality in the study was low, with only 62.5% of patients monitored to minimum standards and 59.5% receiving good fluid management. Only 10.2% of patients received advanced trauma care management. Similar findings have been reported in Ghana and Tanzania(17,33). These findings highlight the need for more research to assess trauma care quality across Africa and to develop interventions to improve it. Possible interventions include promoting evidence based trauma care, improving resource access, and developing quality improvement programs.

Only 38.10% of patients obtained timely emergency surgery, and 37.30% underwent surgery within two hours of injury. Only 13.50% of patients survived without issues, while 39.70% survived with complications. These findings are similar to those of other studies conducted in (17,34,35), and they suggest that there was room for improvement in emergency surgery timeliness and quality. This could be accomplished by ATLS training, improving resource access, and addressing underlying causes of road traffic injuries.

The trauma care outcomes for injured patients were assessed and found that 15.9% died during care, 31.8% developed severe complications, and 44.4% lacked clear documentation. This is consistent with other Ethiopian studies, indicating a need for im- proved trauma care outcomes (36)). Interventions included training and implementing quality improve- ment programs. Addressing underlying trauma causessuch as road traffic accidents, violence, and occupa- tional accidents was also crucial.

The causes of trauma-related mortality were also investigated. Multiple organ failure accounted for 66% of deaths, while delayed referral and trauma care accounted for 22.7%, and direct critical organ injury accounted for 11.3%. There was no recorded proof in 88.6% of patients' medical records. A study conducted in Addis Ababa's Tikur Anbessa Hospital found similar results, with multiple organ failure (36.7%), respiratory conditions (30%), and sepsis (16.8%) being the three main causes of death for RTI patients. The researchers of this study suggest a need to im- prove trauma care by training healthcare workers, increasing resources, and reducing referral times.

The study found that 78.4% of trauma patients did not receive physiotherapy, 77.85% did not receive psychiatric counseling, 78.7% did not receive specialist rehabilitative nursing care, and 77.5% did not receive effective discharge planning. Almost 20% of patients' medical records contained no information on their rehabilitation service status. This is similar to other African studies (17,37). Lack of qualified healthcare staff, resources, inadequate coordination, and excessive expenses are all factors contributing to this shortage. The researchers of the study recommend additional research to examine the state of rehabilitation services throughout Ethiopia.

The study found that there is gap in the documentation of clinical care for trauma patients. Primary and secondary trauma surveys were not documented in 54.4% and 55.0% of cases, respectively. Factors contributing to inadequate documentation include lack of time, lack of training, poor coordination, and complex medical records systems. Interventions include developing standardized protocols, training healthcare providers, improving coordination, and simplifying medical records systems.

The study examined the prehospital care continuum of trauma care in Ethiopia, highlighting areas for improvement in leadership, coordination, resource availability, communication, referral links, and documentation. It highlighted the high number of trauma patients in Addis Ababa, and the challenges in emergency trauma care due to poor communication and information systems. The study recommended expanding prehospital care, improving organization and leadership, and promoting regional collaboration to enhance trauma care in Addis Ababa.

Limitation

The study has the following limitations, such as its limited applicability, reliance on self-reported data, and focus on public hospitals in Addis Ababa. It also did not consider patient satisfaction, treatment quality, or cultural factors' impact on care delivery, and did not assess implementation costs.

Recommendations

The researchers recommend the following to improve trauma care in Addis Ababa and Ethiopia: Establish responsive prehospital services, establish guidelines for trauma care, provide medical supplies for trauma care, Train healthcare workers in trauma care, Im-prove hospital care for trauma patients, Address the underlying causes of trauma. The researchers also call for further research to assess trauma care quality across Ethiopia.

Abbreviations

ATLS: Advanced trauma life support; **ATLAS.ti:** Archive of Technology, Life world and Language; **CPR**: Cardio Pulmonary Resuscitation; **CT** scan :Computerized Tomography; **DVT**: Deep vein thrombosis ; **ED**: Emergency Department; **FGD**: Focused Group Discussion; **ICU** :Intensive Care unit; **LIC:** Low Income Countries ; **LMIC**: Low- and Middle-Income Countries ; **IV**: Intravenous ; **RTI**: Road traffic Injury ; **SPSS**: Statistical Package for the Social Sciences **;TBI:** Traumatic Brain Injury**; TASH**: Tikur Anbessa specialized Hospital ;**TTM**: Trauma

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Ethics consideration
Ethical approval was obtained from the Addis Ababa University HSC ethical review committee, the Addis Ababa Regional Health Bureau, and the study hospitals. Before taking part in the study, all individuals provided written informed consent, and waiver consent was obtained for secondary data.

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AAU provided financial assistance for data collection. The founder was not involved in the study.

Data availability
The datasets used and analyzed during the current investigation are available upon reasonable request from the principal investigator.

Operational Definitions
Trauma: Refers to physical injuries that occur unexpectedly and need quick medical intervention.
Prehospital care: Pre-hospital care, also known as emergency medical services or ambulance care, involves providing medical care to patients before they reach a hospital.

Continuum of Trauma Care: is the highest quality of care to injured patients from the moment of injury through rehabilitation and recovery

Trauma care: Trauma care refers to the accessibility of a well-organized and coordinated effort in a defined hospital to provide the full spectrum of care to an in- jured patient, from the time of injury to transport to an acute care facility and rehabilitative care.

Trauma Team: describe a group of healthcare professionals including emergency medicine, orthopedic surgeons, neurosurgeons, anesthetists, intensive care, surgeons, nurses, allied health, and support staff.

Rehabilitation: is a set of interventions aiming to optimize functioning and reduce disability in individuals with health conditions.

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