Addis Ababa University

College of Health Sciences

School of Medicine

Department of Emergency Medicine

Assessment of oxygenation status, prehospital communication, and transportation modality up on arrival to the Emergency Department among critically ill patients presented to two Addis Ababa governmental hospitals: Prospective cross-sectional study

Investigator: Mayet Endale (MD, Candidate of ECCM physician)

Advisors: Dr Merahi Kefyalew (MD, ECCM consultant)

Dr Tigist Worku (MD, ECCM consultant)

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Abbreviations and acronyms

AAFEPCA: Addis Ababa Fire and Emergency Prevention and Control Authority

AAU: Addis Ababa University

ABCDE: Airway Breathing Circulation Disability Exposure

COPD: Chronic obstructive lung disease

ECCM: Emergency and Critical Care Medicine

ED: Emergency Department

EMS: Emergency medical service

HSTP-II: Ethiopian Health Sector Transformation Plane II

PI: Principal Investigator

TASH: Tikur Anbessa Specialized Hospital

ZMH: Zewditu Memorial Hospital

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Abstract

Background: Any sickness and injury characterized by the failure of important organs and a high risk of life-threatening conditions that necessitate prompt action beginning on the scene to preserve life and minimize morbidity is considered a critical illness. It is becoming more common, and the need for acute care is rising, facing a time-sensitive challenge to the healthcare system. In both prehospital and in-hospital settings, airway resuscitation is the cornerstone for the early care of critically ill patients. In addition to prehospital airway management, interfacility communication and continuity care during ambulance transferring are always demanding substantial tasks for all EMS workers from on the scene to treatment centers, anywhere in the globe. Still, Hypoxic agitation, hypoxic disability, peri intubation arrest, death on arrival, and dead body at arrival are poor clinical outcomes resulting from patients arriving with hypoxia at the ED too late as adversely affect. However, this prehospital insufficient care is being rushed to the ED. Real-time care and pre-arrival contact should be implemented to provide escalation of care according to evolving updated clinical practice for better patient outcomes.

Objective: This study was intended to assess critically sick and injured patients' actual oxygenation state, prehospital communication, and mode of transportation upon arrival at the emergency department and to explain any gaps in prehospital treatment or in the ED.

Methodology: TASH and ZMH ED hosted a prospective cross-sectional study design for two consecutive months, from August to October over 2 months. A total of 202 samples were recruited using a convenient sampling method. The data has been cleaned and analyzed using the SPSS version 27. Descriptive and chi-square tests were used.

Result: Significant hypoxia (86.1%) and poor prehospital communication (16.8%) were seen in the results. Ambulance usage was also 46%. The chi-square test showed that the relation between mode of arrival and airway status was not statistically significant. Overall findings revealed that oxygen therapy was not based on respiratory support requirements during interfacility transferring; Ambulance transportation was not organized with resuscitation equipment and experts to optimize compromised airway; lack of clear communication on patients' clinical status between the prehospital system and the treating staff.

Conclusion and recommendation: The study identified that there was suboptimal prehospital airway management in all modes of arrival. In addition to this, pre-arrival contact was loose between the treating team and the prehospital system to facilitate preparations for the receiving hospital. Based on the study findings, the recommendation would be to have a well-organized and equipped EMS to have optimal airway status at ED arrival by delivering sufficient prehospital care. EMS system should be the point of first medical contact to have better clinical outcomes for time-sensitive critical illness and injury. Ambulance mode of transferring should be given along with advanced resuscitation to address continuity of care during transportation and decrease time to intervention. A critically ill patient from any referring hospital or catchment health center should have been notified to the on-call treating team by the liaison officer beforehand.

Introduction

Background

Any sickness and injury characterized by the failure of important organs and a high risk of life-threatening conditions that necessitate prompt action beginning on the scene to preserve life and minimize morbidity is considered a critical illness(1). It is the ultimate fate of all mortal cases and something that every living person will experience at least once in their lifetime. The topic of critical sickness and injury has gained a lot of attention in industrialized nations where sophisticated emergency medical services have been set up to provide the best prehospital care from the scene to reduce mortality and morbidity(2). However, little has changed in developing countries despite increased urbanization, the appearance of new diseases, higher life expectancies, and greater access to hospitals(3–6). In addition, non-communicable diseases, trauma, human-made disasters, and poisonings are more common in sub-Saharan African nations like Ethiopia, leading to a high number of preventable premature deaths and disabilities(7–12).

Because of this, the number of ED visits requiring critical care is periodically rising at a rate that is disproportionate to the overall number of ED visits, necessitating the provision of prehospital care to reduce outcome disparities(13,14). The ABCDE approach principle states that airway resuscitation is the cornerstone of initial care for critically ill patients in prehospital and in-hospital settings. It ensures the patency of the airway in patients who are airway compromised by providing optimal ventilation and oxygenation(15). Because EMS optimizes prehospital treatment provision, it has been linked to a decrease in morbidity and premature death related to emergency circumstances of impaired airway, making it a preventive core value of any health system(16,17).

However, prehospital care in Ethiopia remains immature and is not well established due to substantial barriers which are a combination of multifactorial (18,19). Due to suboptimal EMS provision, emergency patients are arriving at medical facilities with poor outcomes (20,21). There is the growing provision of prehospital care through EMS which has only been made in the nation's capital, Addis Ababa, which has one AAFEPCA dispatch center with a toll-free "939" contact center and a few private businesses (Tebta and Estnfas ambulances) that provide the service all around the city(22).

EMS and prehospital treatment have been the subject of extensive research. However, only one related small-scale, single-center study, was carried out on the airway state of critically sick patients in southern India. It found that many of these patients had poor outcomes because they were hypoxic when they arrived at the emergency department(25).

All EMS providers globally are expected to offer prehospital care, including airway control, interfacility communication, and ambulance transfer with advanced resuscitation, at the scene to treatment centers for critically ill patients(23,24). However, the inadequate prehospital treatment resulted in hypoxia and airway mishandling being pushed to the ED. The level of contemporary avoidable hypoxia, which was anticipated to be addressed in the prehospital setup, was not examined in any study. Therefore, this study was intended to assess critically sick patients' actual oxygenation status, prehospital communication, and mode of transportation upon arrival at the emergency department and to explain any gap whether in prehospital setup and/or ED.

Statement of problem

In an ideal world, given the state of the world today, Ethiopia would provide prehospital treatment that includes emergency medical services with well-trained people, and emergency resuscitation equipment in order to reduce unanticipated morbidity and mortality for critically sick patients. However, prehospital care provision still remained a concern to deliver high quality in acute care treatment.

Unfortunately, the inadequate prehospital treatment we provided resulted in loose prehospital communication, more airway compromise, and the use of public and police vehicles upon ED presentation. Critically ill individuals experienced hypoxia agitation and poor outcomes when they arrived at the ED. Prehospital airway mismanagement thus led to an increase in the number of dead bodies, arrival deaths, peri-intubation arrests, and hypoxic-induced disabilities in the ED. This study aimed to quantify the true extent of the care gap between emergency department and prehospital treatment.

Significance of study

This study examined the critical illness resuscitation gap that occasionally widens significantly between prehospital treatment and emergency department services. Early recognition and management of time sensitive hypoxia which improve critical care outcomes. Prehospital notice to the ED allows for early and efficient communication with the treatment

team. It also allows for on-site optimization, reduces the time between the incident and intervention, alerts the accepting ED to prepare necessary logistics, and allows for an evaluation of the benefits of transfer-based prognosis. It gave input for HSTP-II which aimed to have improved health emergency and disaster risk management. It would also decrease dead body, death at arrival, peri intubation arrest, hypoxic-induced agitation, and disability in the ED by giving input to health policymakers to revise their protocol and training program which will fill the gap in prehospital care by establishing well-organized EMS i.e., well-equipped emergency resuscitation material with trained personnel. It would also alert the ED to have an organized triage system for emergency resuscitation for those patients presented with already compromised airways. It may also give input to researchers and teach the community to use EMS.

Literature review

Globally

Even though much research has been conducted in prehospital care, limited papers are available on this topic. According to a prospective observational study done in the ED of South India Christian Medical College for 2 months between August 2017 and September 2017, a total of 450 critically ill patients with convenient sampling were recruited to assess airway status at arrival to the ED(25). Male patients accounted for 65.3%, and trauma victim was 9.8%. Up on ED presentation, 31% of critically ill patients' transportation was brought through ambulance mode of arrival. The extent of hypoxia was 63.1% for ambulances and 51% for private transportation. During prehospital transport, oxygen therapy was administered to 20.9% (94/450) of patients by nasal prongs (0.9%), oxygen mask (16%), bag-mask ventilation (1.3%), and endotracheal intubation (2.7%). When patients arrived at the emergency department (ED) via ambulance, invasive ventilation was necessary due to their increased hypoxia [(OR 1.63 (95% CI: 1.08–2.46); P value: 0.01] (OR 2.36 (95% CI: 1.46–3.80) P value: < 0.001). ED outcome of the patient was discharged 21% (95/450), admission 55.7% (248/450), left against medical advice 20.2% (91/450), and death 2.8% (13/450). Even though this is the first related study on this topic, it has limitations being a single center and poor Prehospital assessment of communication.

Africa

Emergency Medical Services (EMS) systems are prevalent in most industrialized nations; but, in Africa, these formalized systems are very uncommon and still in their early stages of development.(4,5). Even though health promotion, disease, and injury prevention are the main principles in the health system, developing countries are not focused on emergency medical care which will halt the large burden of death and disability(26). there was no study on evaluation of critically sick patients with a life-threatening condition's oxygenation state, prehospital communication, and mode of transportation upon arrival to the emergency department for triaging in Africa. However, a qualitative study was conducted on Perceptions of emergency care in Kenyan communities lacking access to formalized emergency medical systems(27). This study includes 59 focus groups with 528 participants in the eight Kenyan provinces. The outcome demonstrates the role that socioeconomic and cultural factors have in obtaining emergency medical care. People in the community deal with a variety of medical

emergencies. Numerous medical emergencies affect the community's residents. Nevertheless, there are several obstacles to receiving prehospital care, including a deficiency in the resources, system structure, transportation, skilled medical personnel, and early on-site care.

Ethiopia

Interview-based qualitative prehospital study study on the obstacles to receiving prehospital care was carried out in Jimma City, Ethiopia's Oromia Region(18). The study participated in 68 samples. This study showed poor prehospital care provision.

Similar studies with the above have been done in Mekell and Addis Ababa(19). In Mekelle City, Tigray, Ethiopia, a Community-Based Cross-Sectional Study on the Utilizations, Barriers, and Determinants of Emergency Medical Services was also carried out. The majority of respondents (88.1%) were unaware of an ambulance's EMS access phone number.

Patients who attended five public hospitals in Addis Ababa with specified emergency situations were the subjects of a cross-sectional quantitative and qualitative study on the trends and obstacles of emergency medical service utilisation in Ethiopia. The study comprised 429 individuals in total. The home (n = 222, 51.8%) was the most frequent emergency scene, followed by the roadside (n = 159, 37.1%). Out of all the patients, only 87 patients (20.3%) arrived via ambulance. Participants were more likely to think that ambulance transport is generally faster (n = 298, 69.5%) and safer (n = 341, 78.5%) than private care or taxi emergency transport. Per respondent impression, the median acceptable time to call for an ambulance was 16 minutes; however, the perceived ambulance waiting time was 40 minutes.

Objectives

General

To assess oxygenation status, prehospital communication, and transportation modality up on arrival to the ED among critically sick patients with high risk of life-threatening conditions

Specific

To assess oxygen saturation level and prehospital care provision of airway managment for critically sick patients upon ED arrival

To assess the prehospital communication status between the treating team and prehospital system about the clinical condition of critical patients upon ED arrival

To assess the mode of arrival for critically ill patients on ED arrival

Methodology

Study period and design

A prospective cross-sectional study design based in a hospital has been employed and data was collected on critically sick patients among ED visits of TASH and ZMH. Data collection has been carried out from August 20 to October 20/2023 over 2 months.

Study setting

The study has been conducted at 2 hospitals at TASH and ZMH in Addis Ababa. TASH has 600 doctors in total and is situated in the Lideta sub-city. It was first opened in 1972, and since 1998, AAU has used it as its university teaching hospital. It's the country's biggest tertiary hospital. There are numerous clinical departments in the hospital[29].

Population

Population source

Every patient seen during the study period at the adult emergency departments of TASH and ZMH

Population of study

Every critical ill patient seen in the study period at the adult ED

Sample population

All critically ill patients who were selected and participated in the study during data collection

Inclusion and exclusion

Inclusion

All adult (age>14) patients who presented to emergency departments and were critically ill to be triaged as red zone during the study period have been included

Exclusion criteria

Terminal patient with poor prognosis (only if the patient had compromised airway and definitive air had been deferred up on arrival to ED) and COPD so as to minimize cofounding factors patients

Determination of sample Size

Sample size has been calculated by using the formula for cross sectional study design.

$n= z^2p\ (1-p)/d^2$

Where: n= size of sample from an infinite population

Z=standard deviations corresponding to the 95% confidence interval =1.96

P=proportion among the study population =0.05

d=degree of accuracy required or desired precision (maximum allowable error of the estimate) =0.03

n= (1.96)2 *0.05 (1-0.05)/0.03*0.03=202

Since the sampling frame is <10000, i.e., 5,118, we use the adjustment formula

$n_{adj.}$= n/((1+(n/N))

where and= Adjusted sample

n= Calculated sample size

N= Study population

$\mathbf{n_{adj.}}$ = 202/ (1+(202/5000))

=194

N= (1/(1-NR))*n=(1/(1-0.05))*194 (non-response rate)

=204

Sampling method

During the study period, all adult critically ill patients who met the inclusion criteria were included in the sample using a convenient sampling approach

Collection of data

After preparing a structured questionnaire in English, which was prepared using prior literature based on study objectives, data was collected up on patient ED arrival on a prospective base. The structured format has been filled by trained data collectors and reviewed by the principal investigator (PI).

Assurance of data quality

Accuracy and consistency of data has been checked by the PI daily during data collection

Analysis of data

Data taken from patients has been coded, and the registry has been entered into the computer using Epi info 7.2.4 and then transferred to the SPSS version 27 software program for further analysis. The chi-square test and simple descriptive statistics such as frequencies, percentages, and mean have been employed to characterize the variables.

Variables

Independent variables

A. Socio-demographic characteristics

- Age
- Sex
- Religion
- Educational status
- Level of income
- Marital status
- Place of residence

B. Site of scene

C. Comorbid illness

D. Pre-hospital treatment provision

E. Mode of arrival

F. Communication

G. Referral

Dependent variables

A. Extent of patients presenting to the ED with hypoxia in Percentage

B. Prehospital communication status in frequencies

C. Percentage of ambulance mode of transportation upon ED arrival

Ethical considerations

The department IRB granted ethical approval before the study could begin. The documentation department staff has been briefed on the purpose of the study. Confidential records and information have been maintained for each educational course.

Dissemination of result

The Department of Emergency Medicine at AAU has been informed of the study's findings. A copy of the research article was then sent to the emergency medicine and critical care department of the AAU College of Health Science. Journals will publish it.

Operation definition

Critical ill -

Patient with serious head injuries(GCS < 8) or compromised respiration, circulation, or airwa y (25), TEWS >/=7

oxygenation status oxygenation saturation level in which < 94% is taken as hypoxia(25)

Result

In the two-month study period, 5,118 individuals were seen in the hospital EDs, with 9.9% (or 509) of those patients receiving a red triage. Convenient sampling was used to enrol 202 critically sick individuals for the trial. Sampling shown in [Figure 1]. Males made up the majority (57.9%). Most patients who presented with a critical illness were between the ages of 50 and 70. Of the seriously ill patients, about half (46.5%) were transported in ambulances after receiving a reminder via different channels. Of patients in critical. Comorbidity is illustrated in Figure 2.

The baseline characteristics upon Emergency department arrival were shown in Table 1.

Table 1 Baselines characteristics

Characteristics	**Number (%)**
Male	117 (57.9%)
Female	85 (42.1%)
Trauma victims	23 (11.4%)
Non-trauma victims	179 (88.6%)
Prehospital oxygen support status	
No oxygen treatment was given	138 (68.3%)
Oxygen therapy during pre-hospital transfer	63 (29.7%)
INO2	52 (25.7%)
Facemask	6 (3%)
Facemask with reservoir	2 (1%)
intubation	3 (1.5%)
Mode of transportation to the ED	
Ambulance	94 (46.5%)

Taxi	95 (47%)
Police car	2 (1%)
Man supported	3 (1.5%)
On foot	8 (4%)
Oxygen saturation status	
93-100%	28 (13.9%)
<93%	174 (86.1%)
TEWS	Minimum 5, maximum 14, mean 7.5
Chronic illness	
No comorbidity	51 (25.2%)
Comorbidity	151 (74.8%)
Status of Referral	
Home	84 (41.6%)
Police	3 (1.5%)
Health center	80 (39.6%)
Hospital	35 (17.3%)

The majority of critically ill patients (86.1% (174/202)) were desaturating on ED arrival. During the prehospital transfer, 31.2% (63/202) received oxygen therapy through endotracheal intubation 1.5% (3/202), facemask 2.5% (5/202), FM with reservoir 1% (2/202), and nasal prongs 25.7% (52/202). Up on ED arrival, 21.3% (43/202) of patients require invasive ventilation. Emergency care at the ED was employed according to the airway management requirement as shown below in figure 3. Communication between the treating team and the prehospital system about the clinical condition of the patients accounted for only 16.8% (34/202). It is mentioned in the figure 4**.** A chi-square test of independence was

performed to evaluate the relationship between the mode of arrival and vital signs (level of saturation). The relationship between these variables was not significant, x2(1, N=202) =2.520, P=0.112). Ambulance mode of arrival (44.1%) was less likely to be hypoxic than other means of transportation (55.9%) up on ED arrival from the cross-tabulation table.

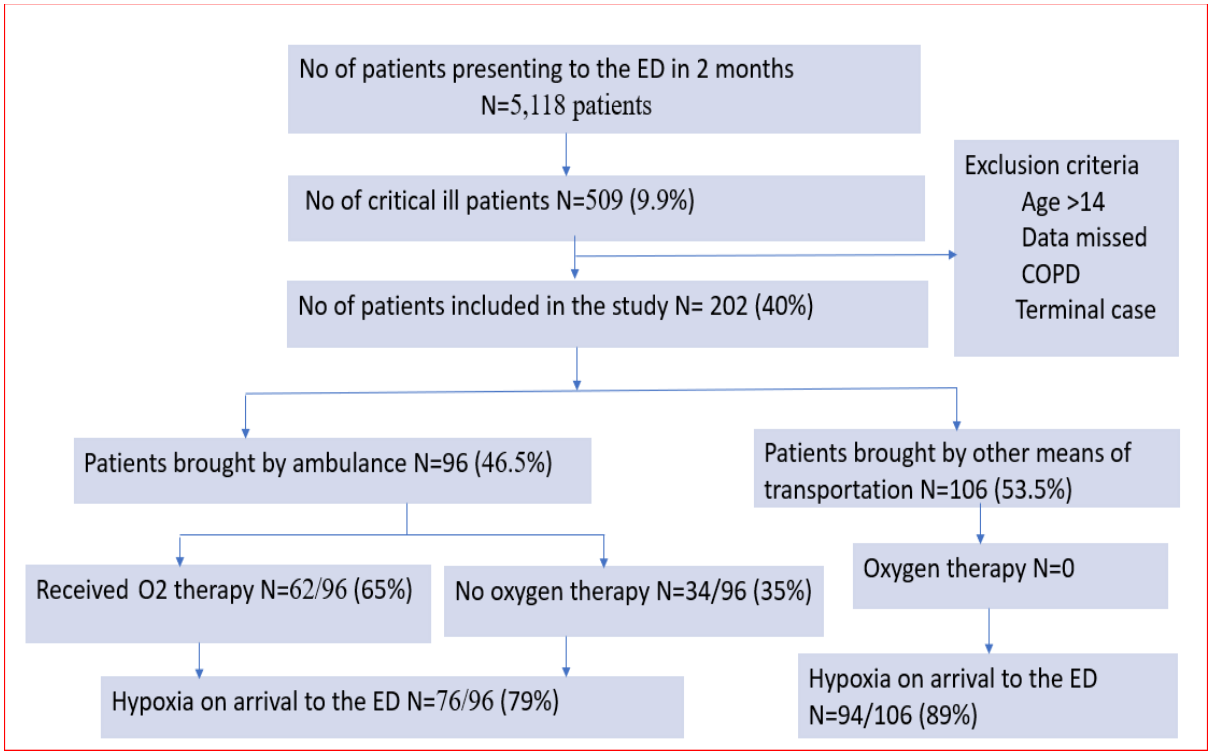

Figure 1

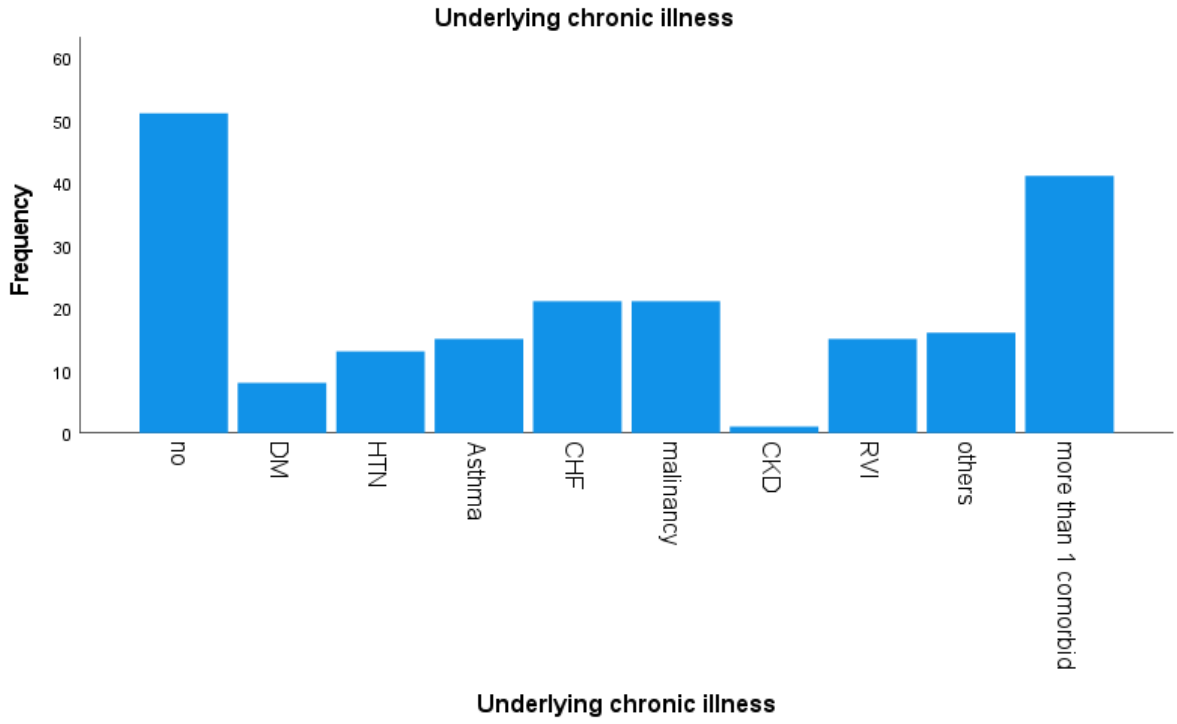
Underlying chronic illness
Frequency
60
50
40
30
20
10
0
no
DM
HTN
Asthma
CHF
malinancy
CKD
RVI
others
more than 1 comorbid
Underlying chronic illness

Figure 2

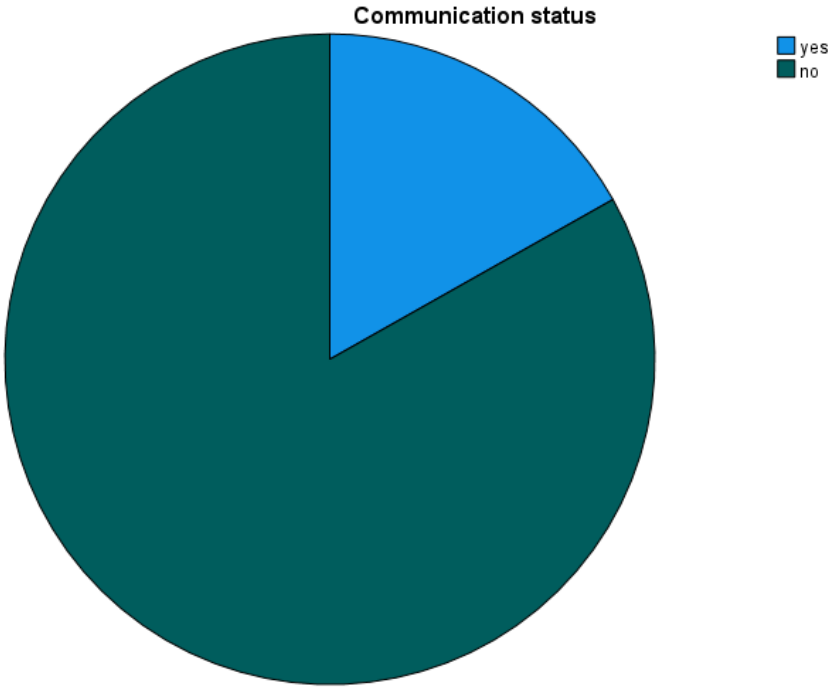

Figure 4

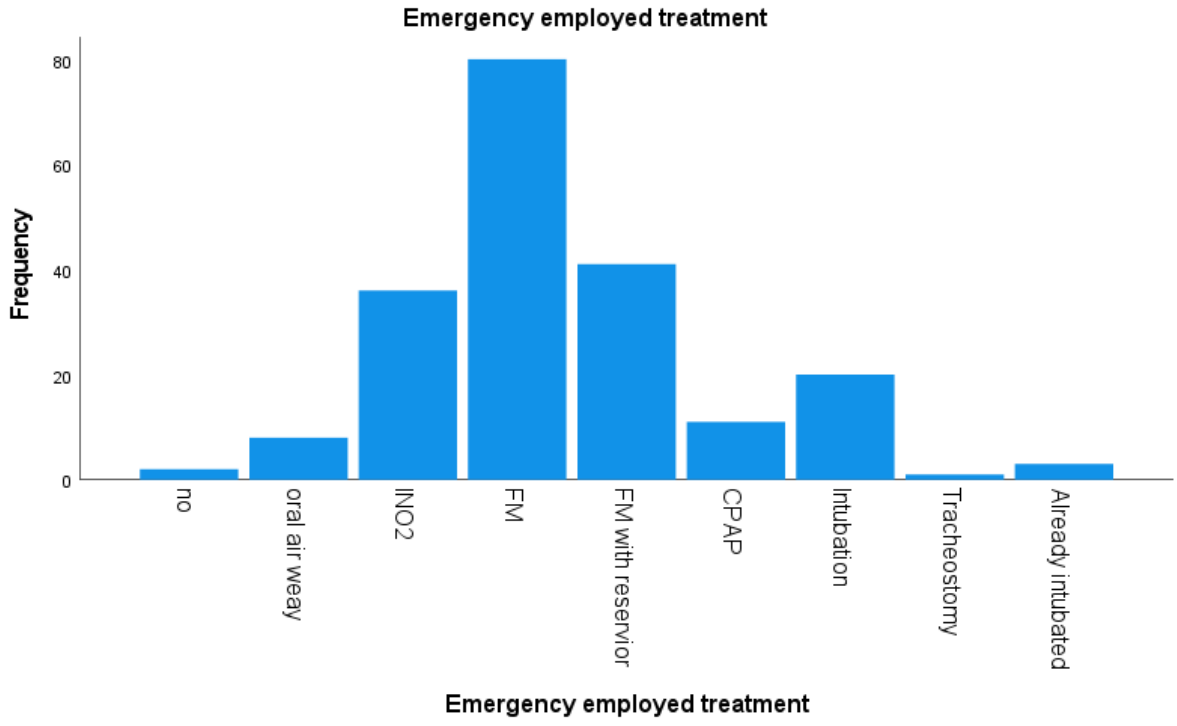

Figure 3

Discussion

Critically sick patients brought to the treatment center were evaluated for oxygenation status, prehospital communication, and mode of transportation upon presentation at the emergency department. Findings revealed that even though 31.2% (63/202) of the critically sick patients received oxygen therapy in a prehospital setting, the bulk of them (86.1% [174/202)) were still hypoxic when they arrived at the ED. Of the patients who were desaturating during their journey, 68.3% (138/202) had not started oxygen therapy, according to the study. Up on ED arrival, 21.3% (43/202) of patients had compromised airways requiring invasive ventilation.

This suggested that oxygen therapy was not based on respiratory support requirements. Prehospital oxygen therapy was administered without first making sure the airway was open and without first deciding on the best ventilation and oxygen delivery strategy. In addition to this, the other explanation for hypoxia was self-referral coming from home directly to the hospital.

There was a lack of clear communication on patients' clinical conditions between the prehospital system and the treating staff within the facility. Of the 202 critical cases, effective communication accounted only for 16.8% (34/202). The lack of a robust liaison office and an organized EMS establishment would be the possible explanation for this very large gap.

Less than half (46.5%) of the critically ill patients were transported in ambulances with a reminder using different modes of transportation, according to their mode of transportation, as indicated in Table1. Similar to the previous study(25), Of the patients transported by ambulance, approximately 62% (62/96) got oxygen therapy. Nevertheless, a large number of individuals (76/96) remained hypoxic because oxygen was given without first making sure the airway was open, demonstrating a lack of knowledge about when ventilation is necessary to protect a compromised airway. Furthermore, 34 out of 96 patients who were hypoxic throughout the ambulance ride were not started on oxygen treatment. Among the patients transported by ambulance, about 21% (20/96) had a compromised airway and required intubation only upon arrival at the emergency department.

Comparing the current study to a related one done in India, the latter found that patients were less desaturated upon arriving at the ED(25). Out of all patients, only 55% were desaturating. Moreover, oxygen therapy during pre-hospital transfer was only 20.9%, lower than in the current investigation. One reason for this could be that our observational study focused on a group of patients who were especially sicker than those in other studies. A superior

ambulance mode of arrival was observed in the current study (46.5%). Nevertheless, in the prior study, just 31% of patients were transported in ambulances with a reminder using different modes of transportation(25). According to this previous study, patients who arrived at the ED in ambulances had a higher chance of being hypoxic upon arrival than patients who arrived in other mode of transportation. The current study did reveal reduced hypoxia, though. This explains why, in this study, the more critically ill patient was transferred by means other than ambulance. Another factor is prehospital-supported oxygen therapy.

The provision of prehospital care for critically sick patients should be addressed to maintain optimal airway status to prevent hypoxia, facilitate effective communication with the treatment team for improved dispatch, and provide a better means of transportation via ambulance. Improving clinical outcomes for critically sick patients in prehospital care still largely depends on addressing time-sensitive airway management. By promptly dispatching severely sick patients from the scene to a higher center where services will be available for advanced medical care, early notification will shorten the time between the incident and intervention. Furthermore, it influences the course of care for critically ill patients by allowing for on-site optimization, streamlining interfacility transit, directing destination based on the availability of service and warning to prepare essential logistics at the accepting ED.

The current observation study has several strengths. It has been conducted prospectively at 2 large governmental hospitals which allowed for comprehensive analyses. It provided valuable information on critically ill patients' airway status, prehospital communication, and mode of arrival at the ED in our setup**.**

Limitation

This study had also limitations including those of inadequate sample size for generalization, and the outcome was not included in the study. One of the biases to be considered in the study was the focus given only to two hospitals which might have not a sense of representativeness of other hospitals. The selection of this hospital and sampling method were also convenient. Terminal palliative patients were also excluded from the study.

Conclusion

Most of critically sick patients were hypoxic upon Emergency Department triage arrival. Upon arriving at the emergency department, critical ill patients who had been transported by

ambulances were still hypoxic. Approximately 1 in 5 developed an airway impairment that required invasive ventilation. As a result, the study illustrated suboptimal prehospital airway management which was time-sensitive and expected to be addressed starting at the instant of occurrence everywhere to maximize patient outcomes. Self-transported Patients were too high. Prehospital communication was also loose between the treating team and the prehospital system about the clinical status of the patient.

Recommendation

Health officials should concentrate on EMS institutions that are well-organized and equipped to provide the best prehospital treatment possible to collapsed victims at the site and until they arrive at the hospital, as this will improve their chances of survival and clinical outcomes. Oxygen administration should be based on the requirements of the patient to institute life preserving therapy during ambulance transferring. Since the majority of the patients came straight from their houses though Self-transport to the ED for triage, the community needs to be made aware of and encouraged to use EMS. It is mandatory to thrill and teach in highly populated area about promotion of EMS so as to deeply embedded in the public. Before accepting a critically ill patient from any referral health institution or catchment health center, the liaison officer has to notify the on-call treatment team to mobilize the response. The determinants of prehospital communication and its association with critical ill patient outcome require another research.

Reference

1. Kayambankadzanja RK, Schell CO, Gerdin Wärnberg M, Tamras T, Mollazadegan H, Holmberg M, et al. Towards definitions of critical illness and critical care using concept analysis. BMJ Open. 2022 Sep 5;12(9):e060972.

2. Jacobs P, Grabinsky A. Advances in prehospital airway management. Int J Crit Illn Inj Sci. 2014 Jan;4(1):57–64.

3. Intensive care unit implementation guideline March 2018.pdf., http://repository.iifphc.org/bitstream/handle/123456789/intensive

4. Nielsen K, Mock C, Joshipura M, Rubiano AM, Zakariah A, Rivara F. Assessment of the status of prehospital care in 13 low- and middle-income countries. Prehosp Emerg Care. 2012;16(3):381–9.

5. Roudsari BS, Nathens AB, Arreola-Risa C, Cameron P, Civil I, Grigoriou G, et al. Emergency Medical Service (EMS) systems in developed and developing countries. Injury. 2007 Sep;38(9):1001–13.

6. World Health Statistics 2022 [Internet]. [cited 2023 Jun 1]. Available from: https://www.who.int/news/item/20-05-2022-world-health-statistics-2022

7. Global status report on road safety 2018 [Internet]. [cited 2023 Jun 1]. Available from: https://www.who.int/publications-detail-redirect/9789241565684

8. Injuries: the neglected burden in developing countries - PMC [Internet]. [cited 2023 Jun 1]. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2672580/

9. Gosselin R. The Increasing Burden of Injuries in Developing Countries. Tech Orthop. 2009 Dec 1;24:230–2.

10. Trauma burden in Tanzania: a one-day survey of all district and regional public hospitals | BMC Emergency Medicine | Full Text [Internet]. [cited 2023 Jun 1]. Available from: https://bmcemergmed.biomedcentral.com/articles/10.1186/s12873-017-0141-6

11. Ugare GU, Bassey IE, Udosen JE, Ndifon W, Ndoma-Egba R, Asuquo M, et al. Trauma death in a resource-constrained setting: mechanisms and contributory factors, the result of analyzing 147 cases. Niger J Clin Pract. 2014;17(4):397–402.

12. Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. PLoS Med. 2006 Nov;3(11):e442.

13. Mullins PM, Goyal M, Pines JM. National growth in intensive care unit admissions from emergency departments in the United States from 2002 to 2009. Acad Emerg Med Off J Soc Acad Emerg Med. 2013 May;20(5):479–86.

14. Herring AA, Ginde AA, Fahimi J, Alter HJ, Maselli JH, Espinola JA, et al. Increasing critical care admissions from U.S. emergency departments, 2001-2009. Crit Care Med. 2013 May;41(5):1197–204.

15. MD RW, MD RH, FAAP MGHMF. Rosen's Emergency Medicine: Concepts and Clinical Practice: Volume - 1&2, 9e. 9th edition. Philadelphia, PA: Elsevier; 2017. 2688 p.

16. Sasser S, Varghese M, Kellermann A, Lormand JD. Prehospital Trauma Care Systems. Geneva: World Health Organization; 2005 - Google Search [Internet]. [cited 2023 Jun 1].

17. Mahama MN, Kenu E, Bandoh DA, Zakariah AN. Emergency response time and pre-hospital trauma survival rate of the national ambulance service, Greater Accra (January - December 2014). BMC Emerg Med. 2018 Oct 3;18(1):33.

18. Shemsedin Amme Ibro, et al. January 31st, 2022; Perceived use of health care service: barriers to access prehospital care in Jimma City, Oromia Region of Ethiopia; research square DOI: https://doi.org/10.21203/rs.3.rs-897121/v2 - Google Search [Internet]. [cited 2023 Jun 1].

19. Menbeu Sultan, Yonas Abebe, Y. T, et al. Trends and barriers of emergency medical service use in Addis Ababa; Ethiopia. BMC Emergency Medicine. 2019;19.10.1186/s12873-019-0242-5 - Google Search [Internet]. [cited 2023 Jun 1].

20. Germa F, Balegh T, Kebede T, Bartholomeus K. Emergency medicine development in Ethiopia : Challenges, progress and possibilities. Afr J Emerg Med. 2013 Mar 1;

21. Sultan M, Abebe Y, Tsadik AW, Jennings CA, Mould-Millman NK. Epidemiology of ambulance-utilized patients in Addis Ababa, Ethiopia. BMC Health Serv Res [Internet]. 2018 Dec [cited 2023 Jun 2];18(1):1–7. Available from: https://bmchealthservres.biomedcentral.com/articles/10.1186/s12913-018-3820-4

22. Home | Tebita Ambulance [Internet]. [cited 2023 Jun 2]. Available from: https://www.tebitambulance.com/

23. Oxygen transport-2. Tissue hypoxia - PubMed [Internet]. [cited 2023 Jun 2]. Available from: https://pubmed.ncbi.nlm.nih.gov/9812940/

24. Berlac P, Hyldmo PK, Kongstad P, Kurola J, Nakstad AR, Sandberg M, et al. Pre-hospital airway management: guidelines from a task force from the Scandinavian Society for Anaesthesiology and Intensive Care Medicine. Acta Anaesthesiol Scand. 2008 Aug;52(7):897–907.

25. Murugan S, Kurien AS, Abhilash KPP. Airway status at arrival to the Emergency department among patients with life-threatening emergencies. J Fam Med Prim Care [Internet]. 2020 Dec 31 [cited 2023 Jun 2];9(12):6000. Available from: https://journals.lww.com/jfmpc/Fulltext/2020/09120/Airway_status_at_arrival_to_the_Emergency.32.aspx

26. Emergency medical care in developing countries: is it worthwhile? - PubMed [Internet]. [cited 2023 Jun 2]. Available from: https://pubmed.ncbi.nlm.nih.gov/12481213/

27. Perceptions of emergency care in Kenyan communities lacking access to formalized emergency medical systems: a qualitative study | BMJ Open [Internet]. [cited 2023 Jun 2]. Available from: https://bmjopen.bmj.com/content/5/11/e009208

28. Addis Ababa Population 2022 (Demographics, Maps, Graphs) [Internet]. [cited 2022 Sep 16]. Available from: https://worldpopulationreview.com/world-cities/addis-ababa-population

29. Addis Ababa - Wikipedia [Internet]. [cited 2023 Jun 2]. Available from: https://en.wikipedia.org/wiki/Addis_Ababa

Annex I Data collection tools

I. Socio-demographic questions

MRN _____

*Age*_____

Sex Male ☐ Female ☐

Religion

Muslim ☐

Orthodox ☐

Protestant ☐

Others (specify) _____

Educational status (specify)

Income level (specify)

Marital status

Single ☐

Married ☐

Divorced ☐

Widowed ☐

Place of residence

Urban-R☐ ☐

II. Critical illness characteristics

1.TEWS_____

2. Clinical presentation

General appearance _____

BP _____

PR_____

RR _____

T^0_____

SPO^2 _____

RBS _____

GCS _____

3. Site of scene

4. Referral yes no

If yes

Self

HC

Hospital

EMT

5. Mode of transfer communication Not communicated

6. Any Comorbid conditions

DM _____

HTN _____

CHF_____

CKD_____

Asthma

COPD _____

Malignancy _____

Mention if any other

7. Prehospital treatment given? (Specify if any) _____

Functional IV line _____

Fluid _____

Medication _____

Neck collar_____

40% glucose _____

Oral/nasopharyngeal airway _____

Others _____

O2 supplement yes/no_____

Requirements in liters

INO2 _____

Facemask _____

Facemask with reservoir _____

CPAP _____

LAM _____

Intubation _____

8. Mode of arrival

Ambulance

Private vehicle

Public vehicle

On foot

Man supported

9. Overall Diagnosis

10. Possible cause of RF

Oxygenation

Ventilation

Airway protection GCS<8

Anticipation

11. Invasive ventilation (intubation) requirement on arrival to the ED yes☐ no☐

12. Approaches employed in the management at ED upon arrival

Requirements in liters

INO2 _____

Facemask _____

Facemask with reservoir _____

CPAP _____

LAM _____

Intubation _____

II: Approval sheet Annex

Declaration

This is to certify that the thesis prepared by Dr. Mayet Endale, entitled as "**Assessment of oxygenation status, prehospital communication, and transportation modality upon arrival to the Emergency Department among critically ill patients presented to two Addis Ababa governmental hospitals",** and submitted to Addis Ababa University, College of Health Sciences, Department of Emergency Medicine in partial fulfilment of the requirement for a postgraduate specialty certificate in Emergency and Critical Care Medicine complies with the regulations of the university and meets the accepted standards concerning originality and quality.

Primary advisors:

_____

Dr Merahi Kefyalew Signature: _____Date:

Dr. Tigist Worku Signature: _____Date:

Examiner:

_____

Dr Temesgen Abicho Signature: _____Date:

_____

(Chairperson of the Department)