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Pre-Hospital Medical Emergency Service Systems Models for Ethiopia

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Abstract

Background: Pre-hospital emergency medicine also referred to as pre-hospital care, immediate care, or emergency medical services medicine is a medical subspecialty which focuses on caring for seriously ill or injured patients before they reach hospital, and during emergency transfer to hospital or between hospitals to providing timely care to victims of sudden and life-threatening injuries or emergencies in order to prevent needless mortality or long-term morbidity. Therefore, the aim of this paper to review the available pre-hospital emergency system model in relation to the contexts of Ethiopia with implication of selecting the model suits to the country.

Methods: Initial search of PubMed, Scopus, and Web of Science were systematically searched for studies of Pre-Hospital Medical Emergency Service Systems Models from 2005 until January 30, 2021. Studies evaluating Pre-Hospital Medical Emergency Service systems with evidence of widespread adoption (Anglo-American, Franco-German, Dutch, Sarajevo and the Japanese models and uniform and tiered response). This approach began from the philosophical perspective that prehospital services should be performed and reported in adherence to Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines.

Results: The result of this study showed that resource constraints and cost-efficient emergency medical service affecting the utilization of pre-hospital services.

Conclusion: Given resource constraints, considerations and cost-efficient emergency medical service our finding suggest that Anglo- American model and two-tiered pre-hospital ambulance system consisting of semi advanced and basic life support for emergency and nonemergency patient care that support by trained Emergency Medical Technicians were effective for resource less developed country including Ethiopia.

Keyword: - Pre-hospital, emergency medical system, Ethiopia.

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Background

Pre-hospital emergency medicine also referred to as pre-hospital care, immediate care, or emergency medical services medicine is a medical subspecialty which focuses on caring for seriously ill or injured patients before they reach hospital, and during emergency transfer to hospital or between hospitals. Emergency medical service system is a network of resources to

deliver emergency care to the community out of health facility and in health care facilities. According to Moore (2), emergency medical service (EMS) is often defined as "a comprehensive system which provides the arrangements of personnel, facilities and equipment for the effective, coordinated and timely delivery of health and safety services to victims of sudden illness or injury."

The aim of EMS focuses on providing timely care to victims of sudden and life-threatening injuries or emergencies in order to prevent needless mortality or long-term morbidity (Al-Shaqsi 2010). The function of EMS can be simplified into four main components; accessing emergency care, care in the community, care end route, and care upon arrival to receiving care at the health care facility (Razzak and Kellermann 2002). The rapid development of medical technology has also reformed the global EMS systems with the introduction of multifunctional compact monitoring systems making the task of monitoring patients manageable in an uncontrolled atmosphere of pre-hospital contexts.

Globally, there are five models of EMS in the world. These are Anglo-American, Franco-German, Dutch, Sarajevo and the Japanese models (Revue 2016). Generally, the way of emergency health care delivery in pre-hospital environment evolved around two well-known main models of EMS with distinct features. These are the Anglo-American and the Franco-German model. These categorical distinctions were obvious during the 1970s until the end of the 20^{th} century. Today, most EMS systems around the world have varied compositions from each model. Table 1 presents the comparison between Franco-German model and Anglo-American model. Another method of EMS category is according to the level of care provided into Basic Life Support and Advanced Life Support according to the level of care provided (Moore 1999).

The Franco-German model of EMS delivery is based on the "stay and stabilize" philosophy (Mehmood et al. 2018). The rationale of this model is to bring the hospital to patients. It is usually run by physicians and they have extensive scope of practice with very advanced technology. The model employs more of other methods of transportations together with land ambulance such as helicopters and coastal ambulances (Revue 2016). Therefore in Europe, pre-hospital emergency care is almost always provided by emergency physicians. The attending emergency doctors in the field have the authority to make complex clinical judgment and treat patients in their homes or at the scene. This results in many EMS users being treated at the spot of incident and less being transported to hospitals. The very few transported patients are usually directly admitted to hospital wards by the attending field emergency medicine physician bypassing the emergency department. Countries such as Germany, France, Greece, Malta, Russia, Ukraine, Italy, Spain, Poland, Estonia, Croatia, Slovenia, Switzerland, Hungary, Czech Republic, Slovakia, Portugal and Austria have well-developed Franco- German EMS systems (Davison, Karpinski, and Strobel 2016; Gomes et al. 2004; Langhelle et al. 2004; Revue 2016; Strobel et al. 2016; Widyaningsih et al. 2020).

In contrast to the Franco-German model, the Anglo- American model is based around "scoop and run" philosophy (Revue 2016). The aim of this model is to rapidly bring patients to the hospital with less pre-hospital interventions. It is usually allied with public safety services such as police or fire departments rather than public health services and hospitals (Pozner et al. 2004). Trained paramedics and Emergency Medical Technicians (EMTs) run the system with a clinical oversight. It relies heavily on land ambulance and less so on aero-medical evacuation or coastal ambulance. In countries following this model, emergency medicine is well-developed and generally recognized as a separate medical specialty. Almost all patients in the Anglo-American model are transported by EMS personnel to developed Emergency Departments rather than hospital wards. Countries which use this model of EMS delivery include the United States, United Kingdom, Ireland, Hong Kong, Mexico, South Korea, Iran, Canada, New Zealand, Sultanate of Oman and Australia (Bull 1996; Jensen and Dobson 2011; Pozner et al. 2004; Suryanto, Plummer, and Boyle 2017).

Table 2: *Comparison between Franco-German and Anglo-American model Davison S, Karpinski E, Strobel C. 2016;160.*

No	Model	Franco-German model	Anglo-American model
1	Interventions	"Stay and Play" ''delay and treat''	"Scoop and Run" ''load and go''
2	No. of patients	*More treated on scene * few transported to hospitals	*Few treated on scene *More transported to hospitals
3	Provider of care	Prehospital care by Emergency physicians	Prehospital care by paramedics
4	Main motive	Brings the hospital to the patient	Brings the patient to the hospital
5	Destination for transported patients	Direct transport to hospital wards i.e.: by passing EDs	Direct transport to EDs
6	Overarching organization	EMS is a part of public health organization	EMS is a part of public safety organization
7	Patients	doctor is brought to the patient	Patient is brought to the doctor

While both systems have the same principal mission when delivering emergency care for trauma and life-threatening illnesses. They differ when delivering non-life threatening care and scheduled transports of stable cases. The conventional European style uses primary care options other than transporting patients to Emergency Departments extensively more than the Anglo-American system. If to be transported, patients in Europe are usually escorted directly to a hospital floor where the attending field emergency physician believes condition will benefit more by direct admission unlike the American model where all admissions have to go through emergency department(Suryanto, Plummer, and Boyle 2017)

Emergency medical services (EMS) has evolved greatly since its inception. The model has gone from a load-and-go philosophy to one that integrates high-level medical knowledge and techniques. EMS response can be grouped into two categories: uniform and tiered response. Uniform response means an advanced life support (ALS) unit is always dispatched. A tiered response sends first responders, basic life support (BLS) units, and/or ALS units depending on how the caller answers a series of questions asked by the dispatcher.

The uniform response (one that includes a paramedic) provides some advantages, most notably that there is always an advanced practitioner available on scene. It is also easy to implement, and has been shown to be economically efficient (David Persse 2015; Time n.d.).

A two-tiered ambulance system, consisting of advanced and basic life support for emergency and nonemergency patient care can provide a cost-efficient emergency medical service. However, such a system requires accurate classification of patient severity to avoid complications. A tiered response model calls for basic life support (BLS), ALS, and/or other EMS resources to be dispatched, depending on the information provided by the caller. Supporters of this model argue that paramedics are in fact not necessary for a majority of calls. Because this decreases paramedic usage, they are available to respond quickly to more complicate emergency situations. Evidence suggests that this model allows paramedics to keep their skill set current, as mentioned above (Widyaningsih et al. 2020).

One of the main differences between Advance Life Support and Basic life Support is that a BLS cannot use needles and other devices that makes cuts in the skin. The BLS providers cannot administer medicines. On the other hand, An ALS provider can give injection and even administer medication to a patient. An ALS can give basic treatment in case of cuts or injuries whereas a BLS person does not have the right to do it. Unlike the BLS unit, an ALS unit will be equipped with airway equipment, cardiac life support, cardiac monitors and glucose testing device. A person with an ALS unit has to undergo more training than a person in the BLS unit.

Basic life Support can be called as the first step of treatment. A person who has taken BLS lessons know how to give assistance to a patient. Every person can take BLS lessons, which does not last for many months. The Advance Life Support lessons are generally preferred by doctors, nurses and the paramedic staff. On the other hand Basic Life Support (BLS) is an emergency transport provided by certified Emergency Medical Technicians (EMTs). Advanced Life Support (ALS) is provided when a patient is in more critical condition and a paramedic is required to assist in the treatment of the patient before and/or during transport to the emergency facility.

Materials and methods

Search Strategy

The literature search was conducted from the following databases: PubMed, Scopus, and Web of Science. To explore the grey literature, we made a search from the Internet by using Google

Scholar search engine. The review period covered the years 2005-2020. A guideline and review publications were excluded, as were publications unavailable in English and full text. We also searched bibliographies and contacted journals to find additional references. No restrictions were put on study design, but studies were included only if a comparison group was evaluated. All titles and abstracts were examined, and the relevant articles were obtained for review.

Inclusion criteria

Combinations of the following search terms were used: advanced life support, Anglo-American model, basic life support, developing country, emergency medical services, Franco-German model, prehospital, tiered response, low-and-middle-income countries, uniform response. We performed a related articles -search from the PubMed for all articles we included after reading the abstracts. We also checked the reference lists from all relevant articles. The search process is presented in Figure 1.

The search strategy was the same as that used in the literature search for the systematic review. Selection criteria Articles were included if they fulfilled at least one of the following criteria:

1. Anglo-American model was compared to the Franco-German model, or
2. Tiered response was compared to the uniform response model, or
3. ALS prehospital care was compared to the BLS prehospital care, or
4. Two different ALS systems were compared (e.g. physician-ALS compared to paramedic-ALS), or
5. ALS prehospital care was compared to any other treatment (e.g. ALS care compared to patient transport by laypersons).
6. A comparison between ALS and BLS was done virtually by an expert group.

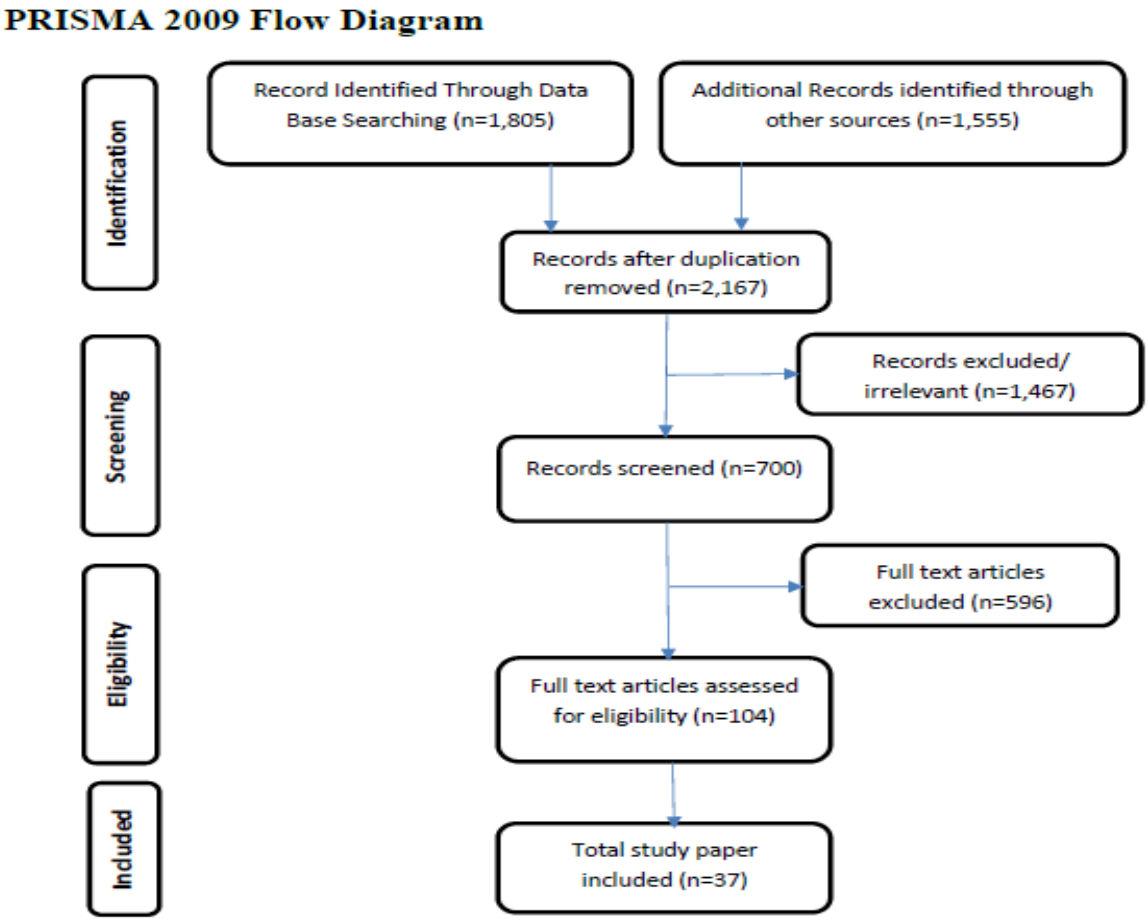

Figure 1: *Diagram of systematic search. Reproduced from Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group.*

This systematic review is focused on EMS, secondary response model. We accepted only the studies with a follow up period until hospital discharge or later. We considered that studies using survival until arrival to the hospital are sensitive to the transport system and distance.

We did not accept articles that only discussed treatment practices or treatment delays. Also we excluded articles using surrogate outcomes such as blood pressure or pain. Articles based on geographical epidemiology were also excluded.

Data extraction

The following data were gathered from all the included articles: Bibliographical data (author, title, journal, year, volume, issue, pages), research aim, research methods (prospective, retrospective), years of gathering data, place of research (state or other), description of the research population, professionals involved (physician, paramedic, EMT), transportation method, transportation time and distance, baseline differences in the research population, transferability of research population and treatments across jurisdictions, amount of drop-outs and blinded

measurement of outcome variables. Figure 2 presents number of studied conducted on the pre-Hospital Medical Emergency Service Systems over time.

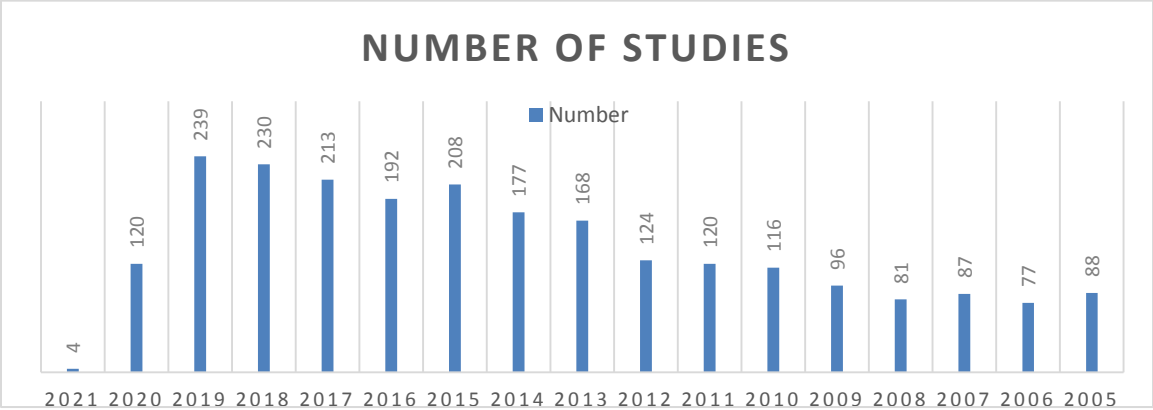

Figure 3: *Pre-Hospital Medical Emergency Service Systems over time* Cabral EL dos S, Castro WRS, Florentino DR de M, Viana D de A, Costa Junior JF Da, Souza RP, et al. 2018;33(12):1110–21.

Result

Globally, there are two well-known models of EMS care delivery: Anglo-American which is based on "load and go" and Franco-German which is based on "delay and treat." No model is better than the other and each community should decide on what suits them better according to their resources, targets and goals. However, patient outcomes should be the ultimate judging standard on which one is best.

Another way to classify emergency medical service systems is according to the level of service and scope of practice provided. A two-tiered ambulance system, consisting of advanced and basic life support for emergency and nonemergency patient care can provide a cost-efficient emergency medical service. However, such a system requires accurate classification of patient severity to avoid complications (Widyaningsih et al. 2020). These are usually classified as a Basic Life Support (BLS) level and Advanced Life Support (ALS) level.

The typical "all-Advanced Life Support" system operates as a one type fleet of ambulances managing urgent and non-urgent care of patients. All vehicles are staffed by ALS qualified personnel. This is in comparison to a tiered response system which utilizes both BLS and ALS crews, dispatching ALS to the most severe of events only and BLS services are used for non-urgent and scheduled transports of stable patients. The tiered system has the advantage of freeing up ALS units for the acute care of seriously ill patients (Kurz et al. 2018). Many studies have tried to advocate the efficacy of Advanced Life Support system over the Basic Life Support system. These studies suffer from multiple drawbacks such as small size populations and these studies are grossly confounded and biased (Koziol 2016). Furthermore, they tend to be descriptive studies rather than hypothesis testing studies. Some studies have gone further and claimed that ALS interventions in pre-hospital settings improves patient outcomes (Koziol

2016). This is only limited to trauma patients and is not yet established for medical emergencies. On the other hand, other studies have shown that a rapid transport of victims to a definitive health care facility rather than advanced interventions have major impact on patient outcomes (Demetriades and Velmahos 2002). In short terms, it all comes down to the discretion of the attending provider to decide whether field interventions or rapid transport is the best measure on a case-by-case basis.

The result of this study showed that resource constraints, human resource and cost-efficient emergency medical service affecting the utilization of pre-hospital services.

Conclusion

Ethiopia, as a low-income country, is receiving a huge number of ambulance donations and there are ongoing initiatives towards training of Emergency Medical Technicians (EMT) to promote pre-facility health care and to improve accessibility to health facilities for mothers and acutely ill or injured patients. In line with this, Federal Ministry of Health has introduced an initiative of medical emergency and critical care service on selected high load road traffic accident areas in Harar, Hawasa, Jimma, Bahar-Dar and Mekele cities in collaboration with mayors of the cities. Medical emergencies require a different approach than the classical trauma cases. Trauma outcomes are better managed by rapid transportation to definitive health care and less field interventions, while medical emergencies such as cardiac arrests benefit more from prompt field interventions and stabilization before transport. The EMS in Ethiopia is growing rapidly. Both government and private owned dispatch centers have to adapt to the change in the demands of emergency care in the society. The concept of Emergency Practitioners in the community is attractive and worth contemplating to reduce the burden of non-communicable disease and any disaster that humpers the life of the society to tertiary health care systems.

Given resource constraints, considerations and cost-efficient emergency medical service our finding suggest that Anglo- American model and two-tiered pre-hospital ambulance system consisting of semi advanced and basic life support for emergency and nonemergency patient care that support by trained Emergency Medical Technicians were effective for resource less developed country.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable

Availability of data and materials

All data and material are presented in this review.

Ethics approval and consent to participate

Not applicable.

Competing interests

The author declares that he has no competing interests.

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Authors' contributions

IM was responsible for the Conceptualization, Methodology and design, Analysis, write-up and Editing of manuscript. IM has read and agreed to the published version of the final manuscript.

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