VOL. 10, NO. 23, DECEMBER 2015 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences


www.arpnjournals.com

A PRE-HOSPITAL EMERGENCY RESPONSE FRAMEWORK FOR BETTER WORK COORDINATION

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ABSTRACT

Coordination is a significant factor for any emergency medical team in delivering an effective and efficient service to its community. Despite the perceived importance on coordination, there is a lack of studies on its role in most pre-hospital emergency responses. In this research, we observed and studied the process flow of an often-crowed medical center for about a year. Towards the end, we suggested a framework involving the paramedics, nurses and technicians. The framework is later tested if it could reduce the patient treatment time in emergency cases. Hence, a survey study involving paramedics and technicians was conducted to evaluate the feasibility of our proposed framework where authors studied the effect after applying the framework. Only responses completed with pre-hospital care time were analyzed for the total time differences. Interviews were extended to the experts to further confirming the validity of this framework. As a result, 400 dispatches for pre-hospital care treatment were analyzed. Among these, 200 pre-hospital cases were compared to the remaining 200 cases after grouping the data following N-X-O design. It is found that there are statistically significant differences between the two groups. Interview reviewed that the treatment time become better and better services deliver to the patients. It could be conclude that the proposed framework could help the paramedics to deliver a faster service to patients. This conformed to our earlier hypothesis about coordination. The coordination as suggested in the PRIER framework is rare but generally useful for any emergency medical center where paramedics aimed to take faster and appropriate actions on surviving patients. This helps to conclude that a framework based on Information and Communication Technology (ICT) could improve a service quality for better coordination.

Keywords: coordination, pre-hospital, emergency response, telemedicine, telecare, treatment time.

INTRODUCTION

Paramedics play an important role in hospital to deliver the best and fastest treatment to patients. They need to respond to an emergency quickly. In most situations, medical procedures are always followed and performed in seconds or minutes to save a patient. In real life, there are many cases where the patients are far away from a medical center and it is necessary to transport paramedics to the scene in order to provide the necessary pre-hospital diagnosis and care which include the use of drugs before they are hospitalized. In most cases, a patient would need to be further transported to the nearest hospital. The pre-hospital diagnosis would help doctors in the hospital for speedier analyses.

The response time for paramedics and emergency medical technicians includes (i) respond to a scene, (ii) diagnosing the medical conditions of a patient, (iii) to provide critical care if needed and (iv) the (to and fro) transport time ((AAOS), 2013). The time interval in diseases such as stroke, heart attack and thrombolysis are dominant. It has been shown that time interval between the beginning of symptoms and the start of a treatment is in proportion to the severity of these diseases (that is, the earlier the better) (Berg RA, 1995). In line with this, Berg suggested that by reducing the overall out-of-hospital time interval will have a positive effect on patient survival rate (Berg RA, 1995).

AIM OF THE STUDY

This study aims to develop an emergency response framework that could help paramedics in reducing the treatment time, which is directly related to the morbidity and mortality of patients. In developing this aim, four objectives have been identified as follows:

- To identify variables that delay pre-hospital treatment of a medical center.
- To suggest a framework that could better coordinate the activities of a medical center from ICT perspective.
- (We survey also the available wireless network technologies to be used in modern emergency medical response services.)
- To evaluate the proposed framework if it minimizes patient emergency treatment time.

LITERATURE REVIEW

Many people encounter health problems after accidents such as bleeding and stroke. In some situations, they must be treated as soon as possible to prevent from further suffering and injuries. This would be called as an emergency situation that posts an urgent risk to life, health, property or environment. In related to this, the use of Information and Communication Technology (ICT) in healthcare domain attracts much attention. Health Information System, for example, is used in recording data and organizing for a better treatment (Salkintzis, 2000).

EMERGENCY MEDICAL SERVICE (EMS)

Emergency Medical Services (EMS) are types of emergency services devoted to provide out-of-hospital discriminating and sensitive medical care with transport to authoritative care places, to patients with injuries or illnesses where the patient or technician judges comprise a medical emergency.

PREHOSPITAL DELIVERY OF CARE SYSTEM

A system of pre-hospital delivery of care is to be considered from several aspects: Cultural, Geographical, Political and Primary health care infrastructure. Although emergency care is considered to be a small part of public health but in modern and developed cities, people expect to have a good healthcare system; this ensures good services for the public. Emergency medical services work in different geographical areas and therefore the provided emergency services may vary in expected scope of practice and levels of care (Sikka & Margolis, 2005). Holliman *et al* believe that in considering an emergency medical service of a country, it is important to understand its current level of health care availability and infrastructure (Holliman *et al*., 2000).

PATINET DELIVERY

(Varshney, 2008) highlighted that one of the important requirements for better healthcare is patient-monitoring – during the transmission of patient to hospital, there might occurred significant fluctuations in a patient's vital sign. Such information must be communicated back to the center for better facilitation upon arrival. From ICT perspective, an effective transmission technique such as the Enhanced Data Rates for GSM Evolution (EGPRS) for emergency-use warrants further investigation.

In related to this, (Davis & Barach, 2000) highlighted taking a patient to the hospital following the shortest route and duration have been the important requirements for pre-hospital treatment.

In Japan, for solving the problem of transporting the patient in a haphazard fashion to the hospital, ambulances are staffed by three-crew member trained in rescue, stabilization, transport and advanced care of medical emergencies (Tanigawa & Tanaka, 2006). In this case, three level of care provided by ambulance personnel, including a basic-level ambulance crew (First Aid Class one, FAC-1), a second level (Standard First Aid Class, SFAC) and the highest level (Emergency life saving technician, ELST). In this case, ELSTs are able to perform most procedures relevant to pre-hospital emergency care (Tintinalli, Cameron, & Holliman, 2010).

PREHOSPITAL EMERGENCY MEDICAL SERVICE (PREHOSPITAL EMS)

Sikka highlighted that any delay in servicing patient in an emergency situation may cause in-morbidity or mortality. Therefore, a Pre-hospital EMS must consist of an integrated and coordinated chain of resources that:

1. Notifies authorities when an incident has occurred (notification by people)
2. Dispatches the appropriate resources to the scene of the incident
3. Provides rapid and appropriate care
4. Transports the patient to a facility that has the appropriate personnel and equipment necessary to manage the patient and to acknowledge, refer, or if not arrange the emergency case (Sikka & Margolis, 2005).

All these works must be done in a timely manner in order to come up with different emergency medical situations. Jelovsek *et al* mentioned seven problems for old-fashioned emergency medical service:

1. Paper information cannot be shared
2. Lack of availability for call taker
3. Lack of efficient control on mobile users
4. On terrain condition there is an inefficiency of paper documents
5. For further hospital treatment, in emergency department, information are poor and with delay
6. In different rescue stations there is not any collaboration among mobile users
7. To plan carefully and with great detail for accounting and statistics analysis manual retyping should be done (Jelovsek & Stern, 2007).

DELAYS IN PRE-HOSPITAL CARE AND DELAY FACTORS

In an emergency rescue mission, several organized units exist. These involve Dispatch center, mobile rescue unit and emergency department (ED). In Qazvin medical emergency center, there is a lack in fully automated communication between different units. Therefore, personnel need to deal with redundant work such as working with paper-based forms to fill. All these efforts in an emergency intervention take time while in patient survival; time is one of the most critical factors. To have a better performance, several processes could be set up. By reducing communication obstacles among actors in emergency mission an improvement could be observed (Jelovsek & Stern, 2007).

There are many factors in different aspects of socio-demographic, social, clinical and proximal that has been related with pre-hospital delay (Dracup *et al*., 1995). The entire pre-hospital delay period comprises of two components: the first being the decision time and the second is home-to-hospital delay. Decision time refers to the time captured by patients to distinguish their symptoms in order to determine whether the patients require serious and call for medical help. Home-to-hospital delay is the time that passes from requesting for help to hospital admission (Goldberg *et al*., 2009). Perkins-Porras suggest that in an emergency situation a direct call to emergency department must be done because previous researches show that if consultation with a paramedic or physician or a member of family happen, it may pilot to longer pre-hospital delay in a condition that they have a direct call and request for help from emergency medical service (Perkins-Porras, Whitehead,

Strike, & Steptoe, 2009). (Fukuoka, 2006) considered the total pre-hospital delay time as follows:

Table-1. Pre-hospital delay time.

Name	Definition
Total pre hospital delay time	The time interval from beginning of symptoms until arrival at a hospital which a cardiac catheterization laboratory exist and equipped in the hospital and having capability to afford 24 hours a day and 7 days a week cardiac care.
Pre-hospital delay time 1	Defined as time from starting of symptoms to entrance at a clinic that is not prepared with a cardiac catheterization laboratory and with no nonstop cardiac care.
Pre-hospital delay time 2	Defined as the time from entrance at a clinic to arrival at a hospital that is well prepared with a cardiac catheterization laboratory.

In addition, Fukuoka considered in-hospital time and classified it into two categories:

Table-2. In-hospital delay time.

Name	Definition
door-to-needle	Described as a time which passes from hospital arrival to initiation of thrombolytic therapy.
door-to-cath-lab-time	described as the time go by from hospital arrival to the time patient entered the cardiac catheterization laboratory (Fukuoka et al., 2005).

INFORMATION EXCHANGE METHOD AND ITS OBSTACLES

Exchanging information verbally could involve many problems such as unreliability, paper sharing problem and retyping of data from system to another system. All these processes could be removed via the following means: E-ordering by hospital staff from Health Information System, call taker to dispatcher in dispatch center and dispatcher to mobile unit and mobile unit to emergency department in hospital.

It is very useful to collect numerous data exchanged from concerned information systems and gathering to a central database for the needs of Emergency Medical Service, operation improvement management and EMS quality assurance management (Jelovsek & Stern, 2007).

While hospital staff would get informed about patients only on the arrival at Emergency Department, the development in communication devices such as voice become a mean that paramedics are currently capable to aware the emergency department of hospital verbally. Such verbal communication either by radio or cellular phone have had its own limitations such as voice transmission quality, requirement to make records of such communication and technical problems of capturing and transmitting data that paramedics want to obtain (Anantharaman & Han, 2001).

It should be noticed that miscommunications and delays happen in transferring data regarding patient's condition from paramedics to doctors in the emergency department. If the doctor received limited amounts of data about patient's condition, they could not be well prepared on how to help the patients. On the contrary, if all these data were sent to doctor before the arrival of patient, they would be more prepared to admit the patient. This shows the importance of exchanged information between emergency department and ambulances which carry the patients (Jelovsek & Stern, 2007).

Transmission of electro cardiogram to hospital was shown as a way to decrease treatment time in patients who had suffered from acute myocardial infarction (MI). New technologies enable transmission to a mobile unit directly therefore a care physician can react regardless of presence within or outside the hospital (Sejersten *et al.*, 2008).

Figure-1 shows how information flows among the different medical systems:

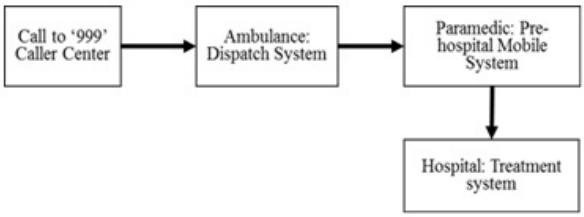

Figure-1. Structure of emergency medical service.

Table-3. An overview on significant factors influence on prehospital care treatment.

Miscommunication
Paramedics Knowledge
Socio-demographic
Primary healthcare availability and infrastructure
Clinical and proximal delay time

METHODOLOGY

This survey study on pre-hospital care treatment was conducted in an ambulance dispatch center in Qazvin city of Iran for a year. The designed questionnaire covers demographic information on patients including their vital signs. All information has been gathered from the paramedics. In addition to these information, the location where the accident occurred, the treatment time and dispatch time were appended to the questionnaire as provided in Appendix B. These consist of the time of emergency call, time of dispatch to the scene and time of arrival to the scene, time of transportation and returning back to the dispatch center. The most significant factors include the time of arrival to the scene and time of transportation and gathered for patients. The derived

treatment time for pre-hospital care were compared to understand the benefits for having a pre-hospital care emergency response framework.

DATA COLLECTION

In this study, data were collected at two different phases for each study. As mentioned, paramedics fill in the questionnaire and answer the questions. They are also responsible for entering the complete data of patients in a special paper containing all critical information about patient's signs and symptoms and patients' medical history provided by the center of emergency medical service. Before applying the framework, this information was delivered to the care center by hand when they arrived to the medical care center. After applying the framework, all the patient data were transmitted via wireless technology to the care center before delivering the patient to the care unit. A single data entry website provided easy access for paramedics to transmit the medical records electronically. Moreover, the data was transmitted to the specialist so they are able to send feedbacks to paramedics and deliver better care to patients during transportation. After gathering data, data would be analyzed with statistical methods. By comparing two different datasets gathered before and after applying the framework, it could be acknowledge that the framework would lead to reduce the patient treatment time compared with the previous procedure paramedics applied. Moreover, several interviews have held with specialist to acknowledge the correctness of the framework.

PROCESS OF PATIENT DELIVERY TO HOSPITAL

To ensure the delivery of high quality patient care the provision of pre-hospital care, as delivered by Emergency Medical Services (EMS), is an essential link in a comprehensive medical care framework or framework. Aside from providing a transport system, EMS enables us to reach out into the community so that medical assessment and care can begin prior to the arrival at a medical facility. It is truly a multi disciplinary approach as it involves public activation of the system through 115, dispatching through central ambulance communication centers, first response teams, tiered response with fire services, air ambulance paramedic services, land ambulance paramedic services and medical oversight/direction.

Figure-2 shows the process of taking a patient to emergency department or hospital where emergency occurs. It involves four points in an emergency mission. At point A, in case of an accident or injury after calling an emergency center, an ambulance will dispatch to the scene. It a common practice to arrive at scene in 5 minutes after call based on the world standard of arriving ambulance to the scene. This time in Qazvin emergency medical center is more than five minutes. Therefore, there is waste of time here. At point B, the ambulance is on the incident scene. The crews would achieve primary treatments for patient and then put him/her in the cot and carry it inside the ambulance. This time could vary base on the situation. If they choose scoop and run approach, the time period for doing such work would be less than two minutes. While, if they use stay and play approach, the time period that crews and paramedics spend in the scene for treatment would reach up to ten minutes. So, base on the different situations and kind of accidents paramedics should be able to understand which approach would be more appropriate to use. By removing the communication obstacles between emergency department and ambulance and create a better coordination between them, this time could be lessen up to two or three minutes. Point C is the most significant point for treatment in pre-hospital care. It requires more consideration as the major part of patient treatment and remedial actions in pre-hospital situation is perform on this point. After moving the patient inside the ambulance, the paramedics begin to check the vital signs by considering the different aspects of diseases. Then, they would use appropriate actions and drugs to cure the patient. Afterwards they will send the information to emergency department room and specialist who is sitting on the other side. Specialists would check their acts. In case of further actions or prescribing a drug for patient, specialist would send enough and appropriate feedback to the paramedics. This cycle would repeat until the ambulance arrives at the appropriate care point. All these works would happen in case of implementing the framework for emergency medical service.

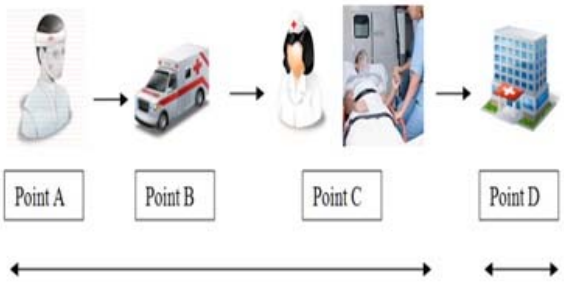

Figure-2. Process of taking patient to emergency department in an emergency situation.

RESEARCH RESULTS

A framework for emergency medical service, for patient treatment is designed based on the factors of emergency response and communication ways among paramedics, technicians and specialists. This framework consists of two phases (1) Preparation phase, and (2) Response phase.

a) Preparation phase (recognize 4W1H knowledge)

In this phase, we show the components that are missing from the current emergency medical system (See Figure-1). Our framework is shown in Figure-3, with respect to recognize the 4W1H knowledge of paramedics, nurse and technicians team in the preparation phase. The emergency medical service of Qazvin Hospital has been organized up-to-date drills each year for its community.

However, these drills won't lead paramedics to act autonomously. Selected paramedics gain advantages from specialist consultations and increase their knowledge in different aspects of pre-hospital treatment action. Regardless of emergency medical service drills which could be organized for different missions, this framework may support any other paramedics in decision making. Base on the 4W1H in Figure-3, the top management could conduct various exercises on 4W1H knowledge to paramedics, nurse and technicians' effectively.

Initially, the team could better understand their roles and responsibilities for an incident. To avoid misconception about an emergency medical service situation, specialists should educate paramedics, nurses and technicians to enable them to be well prepared to take appropriate actions. In this case, paramedics, nurses and technicians would be well aware and familiar with their role and responsibilities. Besides, response time plays a critical role in an emergency medical service rescue mission. Paramedics, nurses and technicians should ensure the timing of action taken is right and proper for the situation of incident as well as the availability of emergency resources.

b) Action phase

In this phase, a team of paramedics, nurses and technicians is ready for a faster response. As illustrated in action phase in Figure-2, medical team is positioned in the middle of triangle with a rectangle. At each corner of the triangle, a part for emergency medical service has been mentioned and all these parts have relation with an emergency rescue mission. In addition, the cycle of treatment of patient is situated in the small rectangle that has been surrounded by a triangle. Moreover, the big rectangle that covers the small rectangle is comprised of external factor (environmental factor, knowledge) that would have influence in an emergency rescue medical mission.

It is believed that paramedics, nurses and technicians would be more prepared to encounter an incident and manage it as well. Initially, paramedics should begin with recognizing vital signs of patient to understand the amount of injury. Base on the information that is gathered from each patient, they would decide what to do and make decision and take action base on their knowledge and experience. Moreover, specialists are always needed in each emergency medical rescue operation, even though paramedics have knowledge on rescue action. Also, we must notice that in every emergency mission, there is a need to have specialist. Actually, paramedics, nurses and technicians are not qualified as well as specialists in treatment and diagnosis of diseases; however they are capable to act a better and proper action to save patients from morbidity and mortality in advance of taking them to the emergency unit. Particularly, paramedics should have a great knowledge to be able to handle the situations and the more the knowledge; level of service would be better.

To enable more reliable communication between mobile unit and emergency department, a protocol has been applied, so it can ensure that data would send and receive between paramedics, nurses and technicians with specialist and paramedics can acquire necessary instructions from them in case that they made mistake or treatment encounter an human mistake. We consolidate all of these phases into a framework shown in Figure-3.

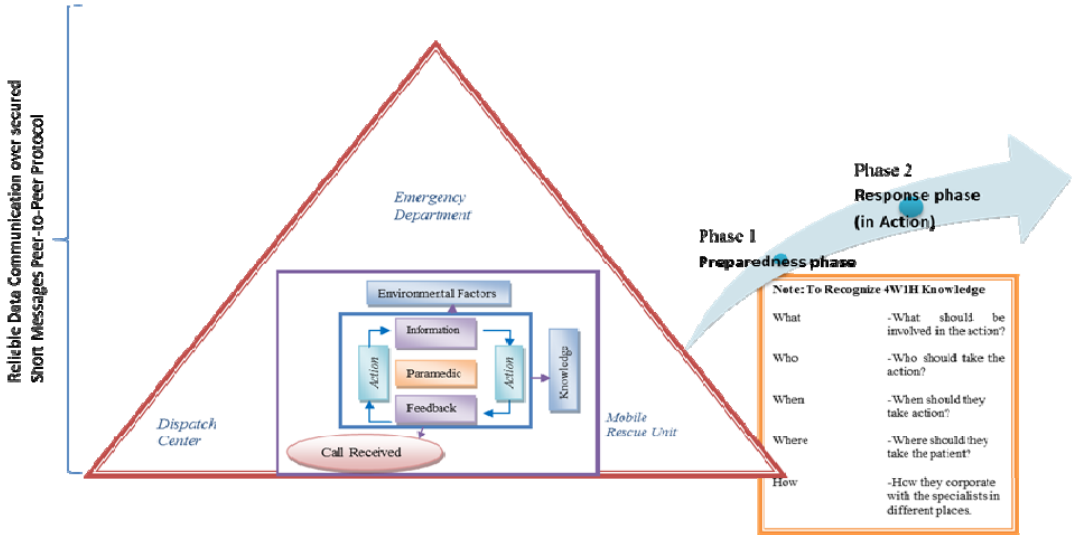

Figure-3. A pre-hospital emergency response framework (PER) for better coordination and patient treatment.

In summary, we have proposed and tested the framework depicted in Figure 3 having considered the main issue of coordination and five vital factors (as shown in Table-3) affecting the desire performance of emergency medical service at Qazvin. Our studies show, emergency medical service of Qazvin city has suffered from problems

such as long delays and inadequate feedback. As it has been depicted in Figure 3, paramedics have ideal and perfect action to respond throughout emergency medical service as long as they have received support and extra knowledge from specialists on each mission. Without support and feedback of specialist, paramedics would react based on their reasoning and logical thinking, knowledge and experience that would not be enough in different cases. Conversely, paramedics are able to manage their stress and treatment of patient in a better way. This is important to avoid any wrong decision and faster the treatment time. Consequently, they would not mar themselves even if they have deep knowledge on emergency. Meanwhile, paramedics will be always ready to manage emergency situations by communicating and cooperating with specialist by using this framework.

c) Comparison of time

Figure-4 shows the time difference before and after applying the framework in Qazvin emergency medical care unit. As it has been illustrated, the distance for presenting emergency medical service is between 2,000 meters and 20,000 meters that would cover the entire city. The red dots show the typical time that is obtained from the survey. For the red dots, no frameworks have been applied and there is not any coherent way for communication between paramedics, doctors and medical care unit. The only communication way for them is their own mobile phone, which is disallowed or cannot be used most of the times. The range of the time for the red dots is between 8 minutes to 48 minutes. On the other hand, the red dots shows the time related to the pre-hospital care treatment after applying the framework. The covered area is the same as the area covered by the red dots and the range of the time for treatment is between 6 minutes whereas the highest one is 44 minutes. As it can be seen in Figure 4, the treatment time in an emergency situation is less than the time without using the framework. Hence, this framework could help paramedics, doctors and medical care units to present better services to patients and morbidity and mortality rate would decrease subsequently.

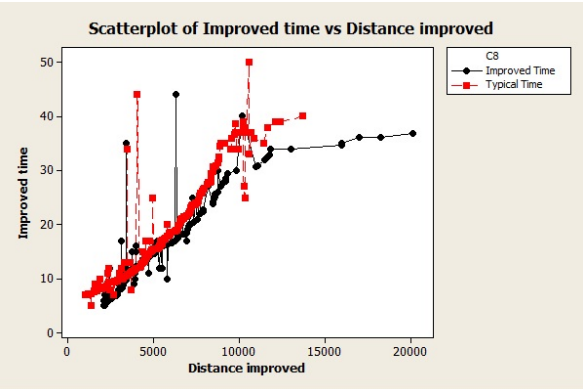

Figure-4. Comparison the time before and after applying the framework.

Based on the results obtained in this research, a T-Test was performed. The results showed that this framework reduced the treatment time in about 25 percent of incidents compared with ordinary treatment. As where treatment is a very time critical action, therefore, by applying this framework, it could be said that better treatment in quicker condition has been present to patients. Table-4 shows the results obtained from T-Test.

Table-4. Paired t-test comparison between improved time and typical time.

	N	Mean	StDev	SE Mean
Improved Time	200	19.284	9.226	0.652
Typical Time	200	19.069	9.516	0.673
Difference	200	0.215	10.613	0.750
20% CI for mean difference: (0.025, 0.405) T-Test of mean difference = 0 (vs. not = 0): T-Value = 0.29 P-Value = 0.775				

RESEARCH SIGNIFICANCE

This framework is planned for helping paramedics, nurses and technicians involved in an emergency rescue mission for better coordination, communication and faster actions throughout an emergency service situation. In light of the framework, paramedics, nurses and technicians are able to diagnose diseases and detect both the patients' primary and supplementary signs before compiling these information to the dispatch center specialists in more coordinated manner therefore faster. At such, paramedics are able to deliver better services and treatment to patients and the risk of morbidity and mortality would decrease. Moreover, the time spent in relief operation can be further shorten if paramedics, nurses and technicians has understood how to handle and work with new procedures as well as their cooperation with the specialists.

CONCLUSIONS

In this study, we proposed a pre-hospital care emergency response framework for an ambulance dispatch center in Qazvin. The framework was validated with its data collected by randomly distributing questionnaires to nurses, paramedics and doctors who were involved in the dispatch center. In addition, a comprehensive survey on data transmission technologies was performed from the literatures to select the best technology for data transmission. It would enable data transmission during rescue mission to be more reliable, confidential and integrated.

As mentioned earlier in the introduction, the purpose of this study was to develop a pre-hospital care emergency response framework in order to better treat patients who are in danger. The framework is prepared via conducting a survey with regards to Qazvin emergency

medical service experts and nurses, who are well informed about different situations that would happen in the city. Concurrently, in-depth interviews with the experts from Qazvin emergency medical service were conducted to fulfill supplementary criteria. Among the many advantages, this study leads us to have a framework that would help paramedics to:

1. Ease preparation for destination hospital before the arrival of ambulance
2. Simplify and expedite the communication process for the need of drug, and
3. Better manage and profile of incidents

The evidence from this research suggests that the 4W1H knowledge and response is needed for Qazvin emergency center in order to deliver a faster and better service to patients.

APPENDICES

APPENDIX A: COMMUNICATION TECHNOLOGIES

a) Sending packets via wireless ad-hoc cellular network

Sending patient information from ambulance to hospital is so important because the destination hospital must be informed of patient's condition to afford a better service for them. To process data and improve scoring system such as trauma a telephone could not be qualified. Health information systems, which are telephone base, will have need of a devoted phone at the Emergency Department with a doctor always standing by to answer it. Most communities also have changed from having doctors provide such direct medical control (Anantharaman & Han, 2001). GSM or "Global System for Mobile Communication" clearly describes a cellular, wide area, circuit switched, and digital mobile phone network architecture (Tisal, 1998). Circuit-switched networks such as GSM and IS-95, frequently indicated as CDMA (Code Division Multiple Access) in the United States, can afford wireless data connectivity, cover up a large area, and handle efficiency of mobile host handover (Ojanpera & Prasad, 2001). Radio data rate in GSM phase 2+ is between 9.6 Kbps and 14.4 Kbps while communication is full duplex. Always user throughput is slighter than nominal radio data rate (Bettstetter, Vogel, & Eberspacher, 2000). Table-5 summarizes WWANs main high level (Pentikousis, 2009).

Table-5. WWAN characteristics.

	Sending/Receiving	Rate *a	Rate *b	MTU (Byte)
Mobitex	Half duplex	8.0	<4.6	512
DataTAC	Half duplex	19.2	<10	2048
CDPD	Full bidirectional	19.2	<10	2048
GPRS	Full bidirectional	< 171	40 - 60	1500
EDGE	Full bidirectional	< 473	50 - 60	1500

*a: Rate of Radio Data (Kbps)
*b: User Transfer Rate (Kbps)

Nowadays GPRS is widely used among people and in many applications. Also, by having a quick look to the table we would understand that EGPRS or EDGE by having a good upload and download data link can have an important role in transmitting data. Whereas in an emergency service, both the speed of uplink and downlink must be well high, it can be conclude that EGPRS could be a good choice to do so.

b) Selected technology for packet transmission

As discussed earlier, there are many technologies over wireless networks that use for sending and receiving packets. As it had been shown, each technology has its own features and specification and is appropriate for a certain work. In addition, it uses its own protocol that is dedicated and written base on the technology and its needed infrastructure. By comparing these technologies, as it shown in Table-4, some technologies would be useful for doing such work. In an emergency situation, packets must be transmit to destination and receive feedback in the fastest way, EGPRS technology could be the best one among these technologies. As it had shown in the table, two types of EGPRS exist with different upload and download speed rate. As a matter of fact, in an emergency situation rate of sending is important as receiving. Moreover, it should have a balance between them. By referring to time slots it could be understand that which type would be more suitable for use. As it observed, EGPRS uses a five slot and a better sending and receiving would be exists for packets.

c) Communication protocol

Short Messages Peer-to-Peer protocol consists of two main parts in order to send and receive messages. These messages will send from a mobile sender, go through the GSM network and by certain routing algorithms would be delivered to its destination. As where emergency messages are so important and their reliability must be kept during message transactions, a hash function is extended to this protocol to warrant that messages will deliver at right time and without any problem. As it has been understand and analyzed, a hash function would contain 3 main parameters: ID, data, and message digest. At sender site, data would be encoded to MD5 and send to

the other side through network. Receiver will receive this message and with hashing techniques will decode data.

Table-6. Some possible configuration of gprs and circuit switched data services.

Techno-logy	Upload (Kbit/S)	Download (Kbit/S)	Allocated TDMA time slice
CSD	9.6	9.6	1 + 1
HSCSD	14.4	28.8	2 + 1
HSCSD	14.4	43.2	3 + 1
GPRS	20*	80	4 + 1
GPRS	40**	60	3 + 2
EDGE (EGPRS)	59.2#	236.8	4 + 1
EDGE (EGPRS)	118.4##	177.6	3 + 2

Note:
* Uses Class 8 & 10 and CS-4
** Uses Class 10 and CS-4
# Class 8, 10 and MCS-9
Class 10 and MCS-9

ACKNOWLEDGEMENTS

The author A.T.H. Sim would like to acknowledge in receipt of Research University Grant (vot.7128) and Fundamental Research Grant Scheme (vot.78628) from Universiti Teknologi Malaysia.

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