A study on Ambulance Response Time in Kuala Lumpur, Malaysia

by

DR. AHMAD FADZIL SUJAK

Dissertation Submitted In
Partial Fulfillment Of
The Requirements For The Degree Of
Masters Of Medicine (Emergency Medicine)

UNIVERSITI SAINS MALAYSIA
NOVEMBER 2008

ACKNOWLEDGEMENTS

I would like to convey my deepest gratitude and sincere appreciation to:

- Dr Nik Hisamuddin Nik Abdul Rahman, Head of Department, Emergency Department, Hospital Universiti Sains Malaysia who is the supervisor for this dissertation.
- Dr Mahathar Abdul Wahab, Emergency Physician of Hospital Kuala Lumpur who is also my supervisor who had given his strong support and courage throughout the period of completion of this dissertation.
- All the other Emergency Physicians of Hospital Kuala Lumpur and Hospital Universiti Sains Malaysia who had helped me throughout my stay during the course.
- All my colleagues and the Masters students of Emergency Medicine for their support and help during the course.
- Dr Faizal Amri Hamzah and Dr Chia Boon Yang whom had dedicated their time and energy in giving me assistance and valuable advice.
- To my dearest wife, Dr Azila Alias, thank you for all your support and understanding. To my two children, Sarah Irdina Fazila and sarah Qadisha Fazila, thank you for understanding the difficulties that both of you have to face for your parent to complete this course of post graduation. To my parents, the late Sujak Abu Shukor and Aishah Husin and my parent in-laws, Alias Ngah Ismail and Hamidah Mat Jamin, your prayer and hope has become a reality. May Allah bless our family, InsyaAllah.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

ACLS	Advanced Cardiac Life Support
AED	Automated External Defibrillator
AHA	American Heart Association
ALS	Advanced Life Support
AMI	Acute myocardial infarction
AMPDS	Advanced Medical Priority Dispatch System
BLS	Basic Life Support
BLS-D	Basic Life Support with Defibrillator
CAD	Computer Aided Dispatch
CPR	Cardiopulmonary Resuscitation
ED	Emergency Department
EMD	Emergency Medical Dispatcher
EMS	Emergency Medical Service
EMT	Emergency Medical Technician
HKL	Hospital Kuala Lumpur

MCCU	Mobile Coronary Care Unit
MECC	Medical Emergency Coordinating Centre
MOH	Ministry of Health
NGO	Non Governmental Organization
PSAP	Public Safety Answering Point
ROSC	Return of Spontaneous Circulation
VF/VT	Ventricular Fibrillation/Ventricular Tachycardia

LIST OF TABLES

LIST OF FIGURES

ABSTRAK

KAJIAN TERHADAP MASA RESPON

AMBULAN DI KUALA LUMPUR, MALAYSIA

Pengenalan: Perkhidmatan ambulan merupakan komponen penting didalam memberikan perawatan prahospital. Masa yang diambil untuk ambulan respon kepada panggilan kecemasan diketahui memberi impak kepada "chain of survival" keatas pesakit. Kementerian Kesihatan Malaysia telah menetapkan 95% daripada panggilan kecemasan mencapai masa ambulan respon dalam tempoh 30 minit.

Objektif: Untuk mengkaji prestasi perkhidmatan ambulan kecemasan berdasarkan kepada masa tindakan ambulan di Kuala Lumpur, Malaysia dengan cara menganalisa masa pemprosesan panggilan dan masa Penghantaran-ke-tempat kejadian.

Kaedah: Satu kajian retrospektif telah dijalankan di Pusat Panggilan Kecemasan (MECC), Hospital Kuala Lumpur (HKL) daripada 1 hb Oktober 2007 sehingga 31 hb April 2008. Kajian ini telah dihantar ke Pendaftaran Kajian Perubatan Kebangsaan, Kementerian Kesihatan Malaysia untuk kelulusan. Panggilan kecemasan untuk perkhidmatan ambulan dikendalikan oleh penyambut panggilan di MECC, HKL. Penyambut panggilan kemudiannya mengumpulkan

semua maklumat penting daripada pemanggil melalui set soalan yang telah ditentukan seperti di dalam borang dispatch kecemasan dan butiran maklumat diisi secara manual ke dalam borang. Penyambut panggilan menentukan jenis triage panggilan berdasarkan maklumat yang diterima. Segala maklumat yang diperolehi daripada pemanggil kemudiannya disalurkan kepada Penghantar panggilan di MECC, HKL dan waktu pada masa ini juga dicatatkan. Penghantar panggilan kemudiannya menghubungi responder untuk mengarahkan penghantaran ambulan, dan pada masa ini waktu dicatatkan. Responder menentukan jenis pasukan ambulan yang perlu dihantar (Basik atau Advan).. Penghantar panggilan kemudian mencatatkan masa ambulan sampai ke lokasi. Selepas lengkap borang dispatch kecemasan diisi, borang dikumpul dan disimpan di bilik MECC, HKL.

Keputusan: Sejumlah 525 panggilan terlibat di dalam kajian dan dimasukkan untuk analisa maklumat. 327 panggilan melibatkan kes bukan trauma dan selebihnya 198 panggilan adalah kes trauma. Kajian ini menunjukkan 87.8% (n=461) daripada panggilan yang diterima, pengambilan maklumat, triage panggilan dilakukan dan sehingga masa responder diaktifkan mengambil masa 5 minit atau kurang. Sementara itu 12.2% (n=64) daripada kes memerlukan masa lebih dari 5 minit. Kajian ini mendapati masa Penghantaran-ke-tempat kejadian mempunyai mean 21.9 minit dengan "standard deviation" 14.9. Walaupun kes trauma hanya merupakan 37.7% daripada kajian, tetapi ianya menunjukkan peratusan yang lebih tinggi (86.4%) pencapaian ART dibawah 30 minit berbanding dengan kes bukan trauma mencakupi 62.3% daripada kes, hanya 78.3% ART dibawah 30 minit tercapai. Perbezaan 8.1% yang diperolehi adalah signifikan.

Kesimpulan: Kajian ini menunjukkan prestasi perkhidmatan ambulan di Kuala Lumpur masih dibawah tahap garispanduan yang ditetapkan oleh kementerian kesihatan Malaysia. Pencapaian untuk masa pemprosesan panggilan adalah 87.8% dan masa penghantaran-ke-tempat kejadian (panggilan trauma) adalah 86.4%. Lokasi pesakit atau tempat kejadian memainkan peranan dalam mempengaruhi hasil masa respon ambulan. Jaringan jalanraya yang baik di Kuala lumpur membantu responder kecemasan ke tempat kemalangan dengan lebih pantas. Penggunaan pekhidmatan ambulan samada hospital atau badan bukan kerajaan (NGO) tidak mempengaruhi masa respon ambulan secara signifikan.

ABSTRACT

A STUDY ON AMBULANCE RESPONSE TIME

IN KUALA LUMPUR, MALAYSIA

Introduction: Ambulance service is a main part of pre hospital treatment. Time taken to response to emergency call is known to impact on the chain of survival. Ministry of health (MOH), Malaysia targeted 95% of the ambulances arrive at the scene of the incident within 30 minutes of received of the emergency call.

Objectives: To study the performance of emergency ambulance service based on ambulance response time in Kuala Lumpur, by analyzing the call processing time and dispatch-to-scene time.

Methodology: A retrospective study was conducted at the Medical Emergency Call centre (MECC), Hospital Kuala Lumpur (HKL) from October 1st 2007 until April 31st 2008. The study was sent to National Medical Research Registration MOH Malaysia for approval. All emergency calls for ambulance service were handled by call taker in MECC, HKL. The call taker would interact with the caller to gather critical medical information through an algorithmic set of questions as depicted in Emergency dispatch form and would manually filled up the form.

The call taker would determined appropriate medical call triage according to the information collected. With all the gathered information from caller, then the call taker pass it to the call dispatcher in MECC, HKL with the exact time being recorded. Then the call dispatcher ordered the responder for ambulance deployment, and the time the responder receiving order from the call dispatcher recorded. The responder would make a decision of the appropriate type (Basic or Advanced) of ambulance team to be deployed. Subsequently, the call dispatcher would obtain from the responder the time of ambulance arrival at the scene or incident site. After completion, the 'Emergency Dispatch Form' was then collected and was kept in the MECC room at HKL.

Results: A total of 525 calls were included in the study and entered for data analysis. 327 of cases involved non trauma patients and the remaining 198 numbers of cases comprised of trauma patients. In this study it was demonstrated that 87.8% (n=461) of the cases had a time period of being less than 5 minutes from when the calls were picked up, information obtained and phone triage done until the time responders were activated. Meanwhile 12.2% (64) of cases had registered times of more than 5 minutes. In this study, the dispatch-to-scene time has a mean of 21.9 minutes with standard deviation of 14.9. Although trauma-type calls formed only 37.7% of the calls studied, they showed higher percentages (86.4%) of achieving ART within 30 minutes as compared with non trauma-type of calls which formed 62.3% of cases and yet only 78.3% achieved ART within 30 minutes. The difference of 8.1% was observed and it was statistically significant.

Conclusion: This study shows that the performance of ambulance service in Kuala Lumpur was still below than expected by the MOH Malaysia Guideline standard. The achievements by components were for 'call processing time' was 87.8% and 86.4% for the 'dispatch-to-scene time' was 86.4% (trauma calls). Location of patients or incident site did play a significant role in determining the outcome of the ambulance response time. Well link roadways in Kuala Lumpur help emergency responders to attend motor vehicle accidents promptly. The use of either hospital based or NGO based emergency services did not affect the ambulance response time significantly.

1. INTRODUCTION

Ambulance service is the main part of pre hospital care. Ambulance service started evolving in times of war. During the Crusades of the 11th Century, the Knights of St John received instruction in first-aid treatment from Arab and Greek doctors. The Knights of St John then acted as the first emergency workers, treating soldiers on both sides of the war of the battlefield and bringing in the wounded to nearby tents for further treatment.

The concept of ambulance service started in Europe with the Knights of St John's, at the same time it had also become common practice for small rewards being paid to soldiers who carried the wounded soldiers in for medical treatment. The Surgeon-in-Chief of the French Grand Army, "Baron Dominiquie Larrey" created the first official army medical corp in 1792. He recognized the importance of reducing time to definitive surgery. Napoleon's armies used carts called "ambulance volantes" (flying dressing wagons) to evacuate wounded soldiers from the battlefield to aid stations. Trained attendants with equipment moved out from the field hospitals to give first-aid to the wounded army on the battlefield and/or carried them back by using stretcher, hand-carts and wagons to the field hospitals.

In United States of America, the subsequent practice of evacuating the wounded to aid stations principally began during the Civil War. Subsequently, using these same concepts, civilian ambulance services were first established in the United States in the late 1860s in Cincinnati and New York City. These ambulance services were initially hospital-based and were limited to transportation of patients to hospitals. Motorized ambulance vehicles have been in use

since the beginning of the 20th century. In the 1950s the United States pioneered helicopter-ambulances during the Korean War. This helicopter evacuated the wounded army to the field hospital not far from the battlefield where he would receive definitive surgery. The decrease in the amount of time to the definitive care and the advances in medical procedures significantly reduced mortality rates. Until the 1960s, civilian out-of-hospital care was limited to the transport of the sick and injured to the hospital.

In 1966, Dr. Frank Pantridge of the Royal Victoria Hospital in Belfast, Northern Ireland established an advanced out-of-hospital therapeutic intervention, a mobile coronary care unit (MCCU) using a milk truck converted for the purpose of picking up patients at their home and bringing them to the hospital. He focused only those patients whom were having chest pain and presumed myocardial infarction. In addition, the treatment began at home rather than delaying it until the patient had arrived at the cardiac care unit. The MCCU was equipped with a monitor, defibrillator, drugs, oxygen tank, and was staffed by a physician. His observation that most sudden cardiac death was associated with ventricular arrhythmias had lead to defibrillation which is an effective treatment of out-of-hospital sudden cardiac death. The MCCU's crews had the ability to monitor the cardiac rhythm of patients with chest pain and to defibrillate any shockable arrhythmia. Pantridge and colleagues were able to demonstrate the benefits of early intervention during acute myocardial infarction (AMI), specifically early defibrillation. Most patients who had sudden cardiac death in the MCCU were successfully resuscitated (Pantridge JF et al, 1967).

This European experienced had then influenced the American investigators including Keller in Ohio, Nagel in Florida, Graf in California, Grace in New York City, and Cobb in Washington who had applied this concept to patients in the United States. Miami, Florida was

the first American program to report their experience with pre-hospital monitoring and intervention in 1970. These pioneers of the American Emergency Medical Services (EMS) developed their systems to treat out-of-hospital cardiac arrest and used non-physicians to provide the care; thus, a new breed of healthcare technician was developed: paramedic. Each of these systems reported early success with the treatment of cardiac arrest in the out-of-hospital environment. They shared a common thread in that not all healthcare providers were trained to the paramedic level. Rather, only a select few individuals were trained to this higher level. Thus, each paramedic was experienced as fewer personnel handled the small number of calls that actually required their specialized training (Cobb LA, 1976; McManus WF et al, 1977).

While American investigators were developing EMS to treat cardiac arrest, a parallel movement was underway in America to treat trauma in the out-of-hospital setting. The 1968 publication of a paper from the National Academy of Sciences National Research Council, entitled Accidental Death and Disability: The Neglected Disease of Modern Society addressed not only out-of-hospital emergency care but also emergency department care, particularly trauma care. This paper cited a diversity of standards, poor equipment, inadequate supplies, no training standards, poor communications, and inadequate hospital emergency facilities. Thus, this paper set a mandate to improve trauma care in United States of America. Eventually, the EMS systems proliferated and incorporated increasingly sophisticated treatment regimens for disease processes with etiologies other than cardiac and trauma. System design became more sophisticated with the introduction of priority dispatch, targeted responses, multiple levels of providers, and hospital centers that specialize in trauma, pediatrics, cardiac disease, and now even strokes (Key CB et al, 2002).

2. OBJECTIVES

2.1 General:

To study the performance of emergency ambulance service based on the ambulance response time in Kuala Lumpur, Malaysia.

2.2 Specific:

1. To determine the call processing time.

2. To determine the dispatch-to-scene time and factors affecting it.

3. LITERATURE REVIEW

3.1 A Brief Overview

Modern EMS systems are composed of multiple links beginning with the patient, family member or bystander calling for assistance and continuing through to rehabilitation in the community setting. The concept of a "chain-of-survival," for cardiac arrest applied to the entire EMS systems. Much like a chain with links, each component forms one of the links in a chain of events necessary to provide each patient with the best care. Each component must perform optimally to allow the best outcome for the patient suffering any life-threatening event. If any component of links is weak, the entire system does not perform optimally (Cummins RO et al, 1991).

In Advance Cardiac Life Support (ACLS) guidelines 2005 by The American Heart Association (AHA) stated that in a cardiac arrest patient, if no CPR is attempted within 4 minutes, the patient will have an irreversible brain damage and an ideal call to defibrillation time is 5 minutes for pre-hospital. Without defibrillation, survival rate from cardiac arrest caused by VF declines by approximately 7% -10% for each minute. If more than 12 minutes has elapsed and no defibrillation was given, the cardiac arrest survival rate only 2% - 5%.

Patients who experience cardiac arrest rely on the next critical component, bystanders who perform CPR. Cardiac arrest patients who receive bystander CPR have the survival rate that

is double than that of patients who do not receive CPR until a professional rescuer arrives on the scene (Cobb LA et al, 1982; Eisenberg MS et al, 1979).

Recognizing that not every EMS response involves a patient who requires an advanced level of care, some systems chose a targeted approach to system design by using first responders, basic emergency medical technicians (EMTs), and paramedics in a system designed to channel the appropriate resources to each call. A targeted approach has the advantage of sparing highly trained, experienced paramedics for those calls requiring their skills, while sending basic level providers to patients who have a lower acuity (Key CB et al, 2002).

Calls placed to 911 accesses the next component of the system, the dispatch centre. Many sophisticated EMS systems use priority dispatch centers that interrogate callers based on a script and a protocol allowing the call taker to determine a priority for the emergency (Roush WR et al, 1989; Kuehl AE et al, 1989). These dispatch protocols may also provide "pre-arrival instructions" to allow family members, bystanders or the patient to implement initial treatment before the arrival of professional rescuers. Instructions may be given for simple procedures like controlling peripheral hemorrhage or even more complicated instructions, such as doing CPR on patients in cardiac arrest (Eisenberg MS et al, 1985). Telephone cardiopulmonary resuscitation (CPR) advice aims to increase the quality and quantity of bystander CPR, one of the few interventions shown to improve outcome in cardiac arrest. O'Neill JF and colleagues evaluated a telephone protocol (based on 2000 ILCOR guidelines) to assess the effectiveness of verbal CPR instructions to assess the effectiveness of verbal CPR instructions. This study analyzed retrospectively an emergency calls over period of seven months, and the time taken to perform interventions calculated. This study showed telephone-CPR instructions significantly improve

the numbers of patients in whom bystander CPR is attempted, but delays and poor quality CPR are likely to limit any benefits (O'neill JF et al, 2007).

Priority dispatch is now used by most ambulance services in prioritizing emergency calls. Until priority dispatch was introduced crews were dispatched simply in the order that calls were received. This important development increases the likelihood of a timely response to the sickest patients. The National Health Service (NHS) of United Kingdom (UK) has classified ambulance calls into a few categories. Ambulance calls were classified into three categories:

A: If the presenting condition may be immediately life threatening.

B: If the presenting condition is serious but not immediately life threatening.

C: If the condition is neither immediately life threatening nor serious.

This classification of ambulance calls is determined by using the Advanced Medical Priority Dispatch System (AMPDS) software used at the time of the emergency call receipt by ambulance control room staff. The UK government has set a standard for Ambulance National Health Service (NHS) that 75% of category A calls should be responded to within 8 min of the incident location having been established, and that 95% of category B and C calls should have a response within 14 min (urban areas) and 19 min (rural areas) in 95% of calls. These ambulance response time targets are used by the UK government as an important performance indicator for UK ambulance services. In 2002–2003, in England 74.6% of category A-emergency calls resulted in an emergency response in 8 min. This was achieved by 18 out of 33 Ambulances Services in England (Ambulance Services, Department of Health, England: 2002-2003).

One study related with the pre-arrival instructions for cardio-pulmonary resuscitation was performed to determine whether any problems exist on the telephone protocol which may compromise guidance for pre-arrival instructions for cardio-pulmonary resuscitation in the Vienna emergency medical system dispatch centre. A retrospective analysis of 114 cases of patients suffering from non-trauma cardiac arrest calls was performed, to evaluate the feasibility of pre-arrival instructions in this EMS dispatch centre. Analysis showed that in 59 cases the arrest occurred in the victim's home. The telephone and the patient were either in the same or in adjoining rooms in 55% of the calls. No technical or language difficulties encountered from this study. The callers were completely calm in 77% and fairly calm in an additional 15%. Not one caller was distraught (Meron G et al, 1996).

By prioritizing calls for assistance, appropriate resources may be dispatched to each request for service. In a system with multiple levels of providers, such as first responders, basic EMTs, and paramedics, an appropriate response may be tailored for each call. Requests for service deemed to be life threatening might require a first responder, paramedics, supervisors, and a transport vehicle. Other less serious incidents may only require a first responder to triage the call and determine if there is even a patient needing hospital transport present. Priority dispatch is the cornerstone on which a sophisticated, multilevel, EMS system that targets the response for each emergency is constructed.

Well trained first responders who are capable of beginning life saving treatment quickly constitute a further link in the system. Typically, most EMS systems have far more fire response apparatus than ambulances in the system. By using fire apparatus or even police in some areas, a

faster initial response is achieved to calls that are serious (Hoekstra JW et al, 1993; White RD et al, 1996).

The paramedic provider is supplemented with EMTs trained at the basic level. Basic EMT staffed ambulances are used to transport most EMS patients who require hospital evaluation but do not require advanced care in the pre-hospital phase of their treatment. These patients require only basic treatment, such as spinal immobilization, fracture splinting, external hemorrhage control, and comfort. In one study showed first responders may be used for less serious calls not likely to result in patient transport to triage the situation and request additional resources as needed (Key CB et al, 2000).

Well trained, experienced paramedics have the critical skills to resuscitate cardiac arrest patients, manage airways, establish intravenous access, and administer a wide range of drugs. They compose the last link in the out-of-hospital phase of the EMS system. A small cadre of these providers as been highlighted by Pepe and colleagues in his studies, is essential to the successful resuscitation of out-of-hospital patients with life threatening emergencies that would otherwise expire before arrival at the hospital (Pepe PE et al, 1993; Pepe PE et al, 1995).

Kuisma and colleagues has conducted a community based cohort study including an expert panel evaluation of the pre-hospital deaths record between 1 January 1999 and 31 December 2002 in four medical priority categories (A, B, C and D) and to evaluate if deaths in lower urgency categories C and D (target response times 20 and 90 min) could have been avoided by a faster ambulance response in the Emergency Medical Services in Helsinki, Finland. Pre-hospital mortality and avoidability of pre-hospital deaths by a faster ambulance response

(maximum 8 min) were used as main outcome measures. They found that pre-hospital death occurred 451 times in category A, 468 times in category B, 73 times in category C and 8 times in category D calls respectively and the pre-hospital death rates per 1000 calls were 52.0 (A), 11.4 (B), 1.0 (C) and 0.3 (D) ($P<0.0001$). The expert panel judged that 1 (1.3%) of category C deaths would have been avoidable, 24 (32.9%) potentially avoidable and 48 (65.8%) not avoidable by a more rapid ambulance response. The corresponding figures for category D deaths were 0 (0%), 5 (62.5%) and 3 (37.5%), respectively. Kuisma concluded from this study, the use of medical priority dispatching was associated with very low pre-hospital mortality in lower urgency categories C and D. Approximately, one-third of those deaths could probably be prevented by a faster ambulance response but the price would be a three-fold increase in calls with blue lights and siren (Kuisma M et al, 2004).

At present, there are few studies focusing on the patient and his/her experiences of pre-hospital care. However, Palazzo in his study had interviewed 300 patients about the reason for calling an ambulance. According to the criterion set by the study, i.e., having used ambulance care within the past three months, 50% of the patients were considered to have been in need of an ambulance. Approximately 60% of these patients believed that they were in a serious or life-threatening condition; 16% did not know whom to call when they needed help and a further 16% were not aware of any other way of getting to a hospital (Palazzo FF et al, 1998). The remaining 8% decided to call an ambulance because they wanted to avoid having to wait at the emergency department. One study was conducted to determine the Nursing home staff attitudes to ethical conflicts with respect to patient autonomy and paternalism. They found that staff attitudes to patient autonomy are crucial for patients' ability to act autonomously and take responsibility for

their own decisions. Hence, it was obvious that medical staff play a key role in supporting or limiting patients' rights in health care (Mattiasson AC et al, 1995).

One descriptive study was conducted to determine factors related to time delays in patients with suspected acute myocardial infarction involving 403 Swedish patients. From the survey, 84% of the patients suspected that the symptoms emanated from the heart. Despite this fact, 59% delayed going to the hospital more than 1 hour after the onset of symptoms. In the multiple regression analysis, factors involving a "dull pain", the patients' belief that it was nothing serious, and been in contact with the general practitioner were associated with prolonged delay. The conclusion is that the patient's subjective feeling of the severity of symptoms is an important predictor for time delays. There is still a need for public awareness of the appropriate responses to AMI symptoms, that is, to call for an ambulance instead of contacting the general practitioner. The decision to contact the emergency service shortened the delay time (Johansson I et al, 2004).

One study on lay public's expectations of pre-arrival instructions when dialing 9-1-1 was conducted. One thousand twenty-four individuals were successfully contacted; and 524 (51%) were at least 18 years of age and agreed to participate. Seventy-six percent (95% CI: 73%-80%) expected pre-arrival instructions for all four medical conditions. Specifically, pre-arrival instructions were expected by: 88% for choking (95% CI: 85%-90%), 87% for not breathing (95% CI: 84%-90%), 89% for bleeding (95% CI: 86%-91%), and 88% for childbirth (95% CI: 86%-91%). Ninety-nine of 117 respondents (81%) served by a PSAP that did not provide pre-arrival instructions expected to receive phone instructions for all four emergencies. Billittier

concluded that the lay public expects pre-arrival instructions when calling 9-1-1, although they may not currently receive this service (Billittier AJ et al, 2000).

Once the critically ill patient is delivered to the hospital, the EMS system does not end. Without equally expert care in the emergency department, intensive care unit, step-down unit, and rehabilitation facility, the overall survival and morbidity of the patient may be jeopardized at any point in this emergency care system.

3.2 Effects of Reducing Ambulance Response Time on Patient outcome

Much emphasis is placed on EMS response times. The often quoted "standard" of an eight-minute ALS response time comes from literature that investigated cardiac arrests (Cobb LA et al, 1982). Cardiac arrests compose a fraction of the responses made by EMS each year. There is no literature to support the idea that ALS response times of eight minutes or less are required for most EMS responses. Is a highly trained ALS paramedic needed on the scene in less than eight minutes for motor vehicle accidents, lacerations, trouble breathing, fever, sick, or fracture calls? The answer is no, and the paramedic was probably not needed at all for 85% of all EMS responses (Eisenberg MS et al, 1979; Pepe PE et al, 1989). Patients with simple lacerations, fractures, injuries from motor vehicle accidents, fevers, feeling ill, and many other complaints can be treated appropriately and effectively by EMTs trained to the basic level (Key CB et al, 2000).

Another study had observed the effect of paramedic's ambulance response time on patient survival. After controlling for several important confounders, including level of illness severity, they concluded, paramedic response time within 8 minutes was not associated with improved survival to hospital discharge. However, a survival benefit was identified when the response time was within 4 minutes for patients with intermediate or high risk of mortality. This study found adherence to the 8-minute response time guideline in most patients who access out-of-hospital emergency services is not supported by these results (Pons PT et al, 2005).

Several studies have attempted to evaluate the effect of pre-hospital times on outcome from trauma. Pepe in his study looked at total pre-hospital time and outcome of hypotensive

patients with penetrating trauma and reported that there did not appear to be any correlation with increasing pre-hospital times and mortality (Pepe PE et al, 1987). One study, using a computer model to simulate ambulance response times, could not demonstrate any association of ambulance response time with mortality. These studies showed response time of 8 minutes was not associated with improvement of patient survival to hospital discharged in trauma cases (Jones AP et al, 1995).

A cumulative meta-analysis was conducted to determine the relative effectiveness of differences in the defibrillation response time interval, proportion of bystander CPR, and type of EMS system on survival after out-of-hospital cardiac arrest. A comprehensive literature search was performed using priority exclusion criteria. They considered EMS systems that provided BLS-D, ALS, BLS plus ALS, or BLS-D plus ALS care, resulting thirty-seven eligible articles described 39 EMS systems and included 33, 124 patients. Their conclusion was confirmed that greater survival after sudden cardiac arrest is associated with provision of bystander CPR, early defibrillation and ALS. They also suggest more research is required to evaluate the relative benefit of early defibrillation versus early ALS (Nichol G et al, 1999).

3.3 Factors Affecting the Ambulance Response Time

3.3.1 Communication and Dispatch system

In the United States of America, a citizen initiates the EMS system by calling 911. This call is typically routed to a public safety answering point (PSAP) where the call is triaged as a police, fire, EMS, or combination response. PSAP call takers follow protocols to triage each call and pass the information to a dispatcher who interacts with the appropriate responders. Once the call is triaged to EMS, there is EMD personnel who interacts with the caller to gather critical medical information through an algorithmic set of questions and provides pre-arrival instructions (Pepe PE et al, 1989). A report from Central Lane 9-1-1 United States of America in 2003 found that 94% of appropriate information is requested by the call takers and 94% the information is accurately relayed to responder and caller. Pennsylvania Emergency Management Agency Commonwealth of Pennsylvania audited the performance of call taker monthly with a proper and objective way of measurement. Higgins in his study found that 26.3% of ambulance calls associated with a communications problems that may delay ambulance dispatch (Higgins J et al, 2001). The UK Department of Health has reported that only 10% of patients phoning 999 have a life-threatening condition and considers that 50% of patients transported to hospital could be cared for on-scene.

Griggs and colleagues studied an impact of medical training on ambulance dispatching. This study was designed to assess the ability of trained individuals to screen calls for emergency medical services to allow for safer or more appropriate responses. The degree of urgency of calls, as judged by dispatchers and a panel of physicians, was compared to estimates of the severity of the patient's illness or injury. Physicians were more likely to designate calls as

emergencies than were dispatchers. Neither physicians nor dispatchers were able to discriminate between the severely ill or injured and those without severe problems. The emergency medical technicians were better able to assess severity and degree of urgency than were physicians or dispatchers. A tentative conclusion is that rapid response by an emergency medical services system will be based upon the caller's description of the situation rather than medical assessment of patient condition (Griggs TR et al, 1977).

The problems of emergency department (ED) crowding, ambulance diversion, and increasing health care costs have been widely documented in the medical literature. A common factor contributing to all these problems is the increasing number of patients being transported to EDs by ambulance. A study by Michael had showed that significant proportions of patients arriving at the ED by ambulance have non-emergent medical conditions. The United State of America economic burden of transporting patients with non-emergent conditions is estimated to cost well over $1.32 billion annually. The results of this study emphasize the need to better assess the cost-effectiveness of EMS systems, to better educate the public on the appropriate use of ambulance transportation, and to develop field or dispatch triage tools that could be used to reduce the frequency of unnecessary ambulance utilization (Michael GE, 2007).

3.3.2 Ambulance

Jermyn had conducted a study to determine whether the call-response interval for an emergency medical services (EMS) system would be decreased through the introduction of ambulance base paging. This study community included a mixture of urban and rural areas in Canada with a total population of approximately 400,000. The EMS system is composed of two ambulance services and one central ambulance communication center with computer-aided dispatching capabilities. Approximately 30,000 calls are responded to yearly by the combined ambulance services. A before-and-after study design was used. In a retrospective review of one ambulance service, there were 224 calls collected in the period before base paging and 200 calls collected in the period after base paging was introduced. In the other ambulance service, there were 571 calls captured in the period before base paging and 515 calls captured in the period after base paging. The study concluded that the introduction of ambulance base paging reduced components of the call-response interval in this EMS system. Overall, the reduction in time was approximately 30 seconds, which was found to be statistically significant (Jermyn BD, 2000).

In an EMS system, response time is an important factor in determining the prognosis of a victim (Pons PT et al, 2005). Because pre-hospital emergency care is required to be efficient and swift, alternative measures to achieve this goal should be addressed. Soares-Oliveira and colleagues reported their experience with a medical emergency motorcycle (MEM) which was operated during hours of greater traffic congestion in 2 biggest cities in Portugal, that is, from 8 am to 12 pm on working days since July 2004. They found that the average time of arrival of 1972 calls attended by MEM at destination was 4.4 ± 2.5 minutes. The main action consisted of administration of oxygen (n = 626), immobilization (n = 118), and control of hemorrhage (n =

101). In 63% of cases, MEM arrived before other emergency vehicles. In 355 cases (18%), there was no need for transport. From this study, they concluded the MEM can intervene in a wide variety of clinical situations and a quick response is guaranteed. Moreover, in specific situations, MEM safely and efficiently permits better management of emergency vehicles. They propose that MEM should be dispatched mainly in the following situations: true life-threatening cases and uncertain need for an ambulance (Soares-Oliveira M et al, 2007).

3.3.3 Personnel

Most EMS systems in the United States are developed along two different lines of thought. The first, a strategy that attempts to maximize the number of paramedics in the system, has the goal of getting a paramedic to every emergency as quickly as possible. Such a strategy is termed a "uniform response" system, because a paramedic is dispatched on every call. Many systems use the uniform response strategy, some using paramedics on all ambulances; others also deploy paramedics with first responder crews such as those found on fire apparatus. Uniform deployment strategies are promoted as being particularly economically efficient and easier to administer. Proponents believe that no critical emergency will ever go unattended by a paramedic trained to provide ALS care (Curka PA et al, 1993).

Many such systems, with a uniform paramedic response to every call, have reported deterioration in their cardiac arrest survival rates and paramedic performance of such critical skills as endotracheal intubation (Becker LB et al, 1991 and Lombardi G et al, 1994). One system, using a uniform response, evaluated the endotracheal intubation skills of the paramedics

in their system. Investigators were alarmed to found that 25% of patients intubated in that system arrived at the hospital with the endotracheal tube misplaced (Katz SH et al, 2001).

Successful implementation of a priority medical dispatch system requires special education for dispatchers, call takers, and their supervisors. Careful attentions to detail in following the call screening scripted-protocol to the letter are essential to a working prioritization system. Further, quality improvement is integral to assuring that the scripts are followed and for continuing research to improve the protocols. Call takers were screened by listening to their call taking on a randomized basis, assessing up to 3% of all calls to the 911 dispatch center. Information gleaned from the quality assurance process was given to the individual call takers, dispatchers, and their supervisors. Quality improvement data were also used to find areas of weakness in the system and to target continuing education at those deficiencies (Roush WR et al, 1989; Kuehl AE et al, 1989).

Resources are assigned to a call once it is prioritized and they are dispatched based on priority. Higher level calls, such as suspected cardiac arrest, are dispatched before lower level calls. A typical resource assignment for cardiac arrest could include a first responder, basic EMTs, paramedics, and a paramedic supervisor. Lower priority calls, such as simple fractures, may need only a basic EMT ambulance for splinting and transportation to the hospital. These lower level responses may not even need to be dispatched with a light and siren response. Emergency calls that were unlikely to require advanced care or even transportation to a hospital (Key CB et al, 2000).

There was a 4 year audit of in-hospital cardiac arrest within an adult patient group between January 1993 and December 1996. The total sample consisted of 367 separate arrests where the initial rhythm was documented as either ventricular fibrillation (VF)/ventricular tachycardia (VT) (58.3%), asystole (21.7%), electromechanical dissociation (EMD) (7.0%) and other (13.0%). The primary outcome was return of spontaneous circulation (ROSC). This was achieved in 75.0% of all resuscitation attempts. Within the VF/VT group, successful outcome remained consistent over the 4-year period with an ROSC of 85%. Successful outcome remained consistent in the EMD group. However, the number of arrests was small. Within the asystole group, initial survival increased from 47.5% in 1993–1994 to 67.5% in 1995–1996. These results suggest that BLS and ALS training may only have an impact on initial survival from cardiac arrest (Pottle A et al, 2000).

First responders were the backbone of the targeted response EMS system. By training these crews to the basic EMT level and equipping them with automatic external defibrillators and basic first aid supplies, they were able to quickly respond to emergencies and provide initial stabilization before paramedic arrival. Even when dispatched from the same station as the paramedic units, these first responders perform basic functions allowing the paramedics to move quickly to more advanced assessments and skills such as intravenous access, drug administration, and endotracheal intubation. Typically these responders were based on fire apparatus such as pumper engines and ladder trucks, though other schemes using police personnel. Because these personnel were available in larger numbers than ambulances, they were able to respond more quickly to emergencies. Their turnaround time was also less than that of an ambulance because they were available for the next call as soon as they leave each scene. There was no

transportation of the patient to the hospital, few supplies to be restocked, and the report was brief, so they were rapidly available for the next emergency. Ambulance crews take longer to become available for the next call; therefore, adding enough ambulances to the system to improved response times would require far more ambulances than fire apparatus (Hoekstra JW et al, 1993; Pepe PE et al, 1993; White RD et al, 1996).

First responder systems were also cost effective. Fire apparatus crews were already in place in most urban and suburban settings. Additional personnel do not have to be hired to staff first responders. There was additional cost to the EMS system to operate these first responders in additional fuel usage, wear and tear, maintenance, and supplies. Overall, the cost was inconsequential when compared with the cost of adding enough ambulances to the system to achieve reasonable response times. One study found the cost of operating the first responder program for an urban fire department was roughly equivalent to the cost of operating a single paramedic ambulance for a year (Pepe PE et al, 1993).

First responders were typically used for several purposes. First, and most important, was to provide initial care quickly for patients with life-threatening emergencies. Second was to provide a rapid response when ambulance response delays are anticipated based on a computerized dispatch system. Third, they provide additional personnel necessary for managing complicated patients. Finally, they were used as a triage mechanism for calls unlikely to result in patient transportation. Each of these roles allows the system to operate with fewer, more experienced paramedics (Key CB, 2002).

3.3.4 Patient Contact Interval

Previously, the arrival of an ambulance at the site of emergency has been taken as the standard in assessing the effectiveness of emergency medical response. The current thinking is that even if the ambulance arrived early at the scene, the initiation of emergency care might still be delayed due to unforeseen circumstances. To determine the time between ambulance arrival at the scene to paramedic arrival at the patient (arrival to patient contact) and the effect of barriers to paramedic movement on this time interval, Campbell and colleagues was conducted prospective, observational study. This study showed barriers significantly. The median arrival-to-patient contact interval was 2.29 minutes (1.01 to 4.82 minutes) for 122 runs with barriers and 0.82 minutes (0.37 to 1.96 minutes) for 94 runs without barriers. They concluded from this study that the arrival-to-patient contact interval adds a variable and potentially lengthy amount of time to the total pre-hospital response time interval, and barriers impeding paramedic movement to the patient prolong this time interval. In 25% of all observed paramedic calls, the arrival-to-patient contact interval was more than four minutes. Measurement of the time from ambulance arrival on the scene to paramedic arrival at the patient was necessary to appropriately determine the relationship among total pre-hospital response time, paramedic interventions, and patient outcome (Campbell JP et al, 1993).

An obvious cause of delayed patient contact, especially in a city undergoing rapid development, would be high-rise buildings. To determine the impact of high-rise buildings on ambulance arrival to patient contact interval, a study was conducted in Singapore. Singapore is a highly urbanized country where livings in high-rise buildings are common. More than 80% of the population lived in high-rise apartments. This poses unique problems and challenges for

emergency ambulance services personnel in the access and evacuation of patients. The objective of this study was to estimate the arrival-to-patient contact delay when accessing patients in high-rise buildings and from the time of leaving the building with the patient to the time when the ambulance turned its engine on to start its journey to the hospital, compared with patients in ground-level. In conclusion, there were significant delays present when accessing patients in high-rise buildings and evacuating them to the hospital. Modification of buildings, increasing public awareness and education were suggested to help minimize these delays (Lateef F et al, 2000)

Kuala Lumpur is the capital and the largest city of Malaysia. The city proper, making up an area of 244KM^2, has an estimated population of 1.89 million with a population density of 7,388/KM^2 in year 2007. At the present time, according to Malaysian Emergency Response System (MERS) 999 MOH Operational Process, Malaysia practices deployment of an ambulance crew according to Primary responder territories, regardless of priority of call because of lack of manpower and training.

There are various ways to measure performance of ambulance service. Most of the measurement looks into the timeframe of the service from receiving ambulance call to delivery of patients to hospital. Average ambulance response time varies from one location to another. Guidelines on Ministry of Health (MOH) of Malaysia Ambulance Service Provision 2007 had set the service standards of the ambulance service shall be determined by the Response Time and Call Taking Time. Response Time is defined by as the time required for the ambulance to arrive at the incident site to provide on-site management and transportation. The standard response time for MOH Ambulance is ranging from 10 to 30 minutes for geographical area of within 5 KM

radius from the dispatching units. The guidelines targeted the Key Performance Index (KPI) for the ambulance service in Malaysia is defined as 95% of the ambulances arriving at the scene of the incident within 30 minutes of receipt of the emergency call, for incidents occur within 5 km radius from the ambulance dispatching hospitals/ facilities.

This fact was proven in one local study recently, which had demonstrated faster response from tertiary referral centre partly due to adequate manpower and better communication as illustrated in the Table 3.3.4 below. In this study, the author had concluded that effectiveness of response time depends on three components, namely, emergency response processing time, crew mobilization time and travel time to the scene (Hisamuddin NA et al, 2007).

Table 3.3.4: Mean Ambulance Response Time at Tertiary Hospitals in Three Different Cities in Malaysia (reproduced with permission from Hisamuddin NA et al, 2007)

Cities	Mean Call Processing Time (CPT)	Mean Time Taken to Prepare Team (TTP)	Mean Time Taken To Arrive At Scene (TTTS)	Mean Ambulance Response Time (ART)
Kota Bharu	117.67	117.00	676.83	911.50
Penang	154.07	218.56	896.33	1268.96
Kuala Lumpur	135.48	196.22	1208.08	1539.78

Hence, this study was undertaken at a tertiary referral centre in Hospital Kuala Lumpur to analyze both call processing time and ambulance response time and to identify factors which affected delays. In previous study of 'Pre hospital emergency medical services in Malaysia' by Hisamuddin and colleagues, the emergency call numbers were not standardized among the emergency ambulance providers (Hisamuddin NA et al, 2007). However, the usage of single