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2015
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OUT-OF-HOSPITAL CRITICAL CASE TIME INTERVALS OCCURING IN THE GREATER JOHANNESBURG METROPOLITAN AREA, GAUTENG, AS RECORDED IN A PARAMEDIC CLINICAL LEARNING DATABASE

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A research project presented to the Faculty of Health Sciences of the University of the Witwatersrand, submitted in partial fulfillment for the degree

of

Master of Science in Medicine

in

Emergency Medicine

Johannesburg, 2014

DECLARATION

I, Benjamin Simon van Nugteren, declare that this research project is my own work. It is being submitted for the degree of Master of Science in Medicine in Emergency Medicine at the University of Witwatersrand, Johannesburg. It has not been submitted for any degree or examination at this, or any other university.



Benjamin S. van Nugteren

25th day of November 2014.

DEDICATION

This research report is dedicated to all involved in the emergency care profession and ultimately all of those who will be impacted by the service which is delivered to them.

ABSTRACT

Background. Out-of-hospital time intervals are often used to assess Emergency Medical Service (EMS) system performance. In addition, these time intervals are linked to patient outcome in certain time-dependent pathologies such as stroke, out-of-hospital cardiac arrest (OHCA) and myocardial infarction. There are a number of variables that are thought to influence these time intervals such as the number of interventions performed and the transport distance to hospital. **Objective.** This Johannesburg-based study assessed out-of-hospital critical case time intervals as recorded in a paramedic student clinical learning database. **Methods.** This retrospective study analysed 19742 cases that were attended to by paramedic students and their clinical supervisors. Of the total number of cases, 1360 critical cases were deemed to meet inclusion criteria in the Greater Johannesburg Metropolitan (GJM) area over the eight-year period under review. **Results.** Eight hundred and fifty six “trauma” cases and 504 “medical” cases were analysed. The mean response time interval was 10.67 minutes (95% CI:10.48;10.86). Of the critical cases assessed, the mean on-scene time interval was 26.69 minutes (95% CI:26.23;27.15). Generally, critical cases in Johannesburg had longer total incident time intervals (53.53 minutes 95% CI:52.90;54.15) when compared to international data. **Conclusions.** This study found that when compared to international trends, patients who are critically-ill locally experience similar response time intervals when compared to certain data. On-scene time intervals are comparatively extended. In addition, it was also found that in increase in the number of on-scene interventions led to an increase in on-scene time intervals.

ACKNOWLEDGEMENTS

Acknowledgment must go out to my supervisors, Mr. Chris Stein who remains an academic and professional mentor for many of us in the emergency care domain and guided this research report. Thanks to Prof. E. Kramer who supported my efforts during the entire post-graduate process and acted as supervisor for this research report.

LIST OF ABBREVIATIONS

ALS:	Advanced Life Support
AMI:	Acute Myocardial Infarction
BLS:	Basic Life Support
CPR:	Cardiopulmonary Resuscitation
ED:	Emergency Department
EMC:	Emergency Medical Care
EMDATA:	Emergency Medical Database and Analysis System
EMS:	Emergency Medical Services
GCS:	Glasgow Coma Scale
GJM:	Greater Johannesburg Metropolitan
HEMS:	Helicopter Emergency Medical Service
ILS:	Intermediate Life Support
OHCA:	Out-of-Hospital Cardiac Arrest
PCR:	Patient Care Record
PCRID:	Patient Care Record Identifier
STEMI:	ST-Elevated Myocardial Infarction.
UJ:	University of Johannesburg
UK:	United Kingdom
USA:	United States of America

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CHAPTER 1: BACKGROUND, LITERATURE REVIEW, PROBLEM STATEMENT AND STUDY AIM

1.1 Introduction

The following background and literature review will detail the rationale for this local study. The literature review will discuss out-of-hospital time intervals and the role of Emergency Medical Service (EMS) intervention on these time intervals. The review will go on to describe the international experience with out-of-hospital time intervals as well highlight EMS performance indicators commonly described in relation to these time intervals.

1.2 Background

Emergency Medical Service performance assessment has become standard practice worldwide. This is commonly done by assessing out-of-hospital time intervals related to EMSs and less commonly patient morbidity and mortality. In the late 1970s, the “golden hour” concept was used as a rough guide for EMSs and practitioners with regard to acceptable out-of-hospital time intervals and patient outcome. Achieving the “golden hour” would mean transporting and handing over patients to definitive care within 60 minutes from the time that the medical emergency occurs. It was believed that achieving this “golden hour” improves patient outcome. The “golden hour” is said to be particularly relevant for a subset of patients who have experienced extensive trauma. Whether or not the “golden hour” is achieved may be influenced by a number of out-of-hospital time intervals.

Out-of-hospital time intervals include the activation time interval (time from call received by the EMS to activation of the first responder); response time interval (activation of the first responder to EMS arrival on the scene); on-scene time interval (from EMS arrival on-scene to departure to hospital); transport time interval (from departure from scene to arrival at an appropriate medical centre) and the total incident time interval (from activation of the first responder to handover at an appropriate medical centre).[1]

In recent years however, the relationship between time intervals and patient outcome has come under scrutiny.[1,2,3] Authors have debated whether or not the “golden hour” concept does actually contribute to patient outcome and whether or not the “golden hour” actually has scientific merit. As far back as 2001, Lerner and Moscati attempted to determine the scientific origin of the “golden hour” concept. These authors were unable to definitively answer this question.[3]

Besides traumatic pathologies however, other disease outcomes are time-dependant in terms of early identification and intervention. Earlier intervention in certain pathologies influences morbidity and mortality positively. Favourable stroke and Acute Myocardial Infarction (AMI) outcomes have been seen where the time of onset of symptoms to definitive treatment has been 90 minutes and less.[2] In addition, out-of-hospital cardiac arrest (OHCA) outcomes are improved with early identification and intervention.[2]

Despite current debate around time intervals and their influence on patient outcome, historically out-of-hospital time intervals are used to assess EMS system performance. Currently, these time intervals are one of few quantifiable measures in the out-of-hospital environment. These time intervals are used as performance indicators internationally as well as locally. The science behind determining the suggested out-of-hospital time intervals has enjoyed much attention lately as EMSs endeavor to provide an efficient, reliable and cost-effective service.[1-6]

The background to this study provided conflicting data related to whether or not out-of-hospital time intervals (either individually or collectively) do contribute to patient outcome. In addition to patient outcome, out-of-hospital time intervals serve as important EMS system performance indicators. As such, in many countries, these out-of-hospital time intervals remain important and are assessed. Before this study, there was no literature describing local (Johannesburg, South Africa) out-of-hospital time intervals experienced by critically-ill patients.

Based on this lack of research, there was no evidence documenting the time that critically-ill patients were spending out-of-hospital from the time of the incident and thus, the need for this type of research was supported. Although the relationship between the out-of-hospital time intervals and patient outcome was beyond the scope of this study, this research may serve as a foundation for future local studies in this area.

1.3 Literature Review

1.3.1 Introduction

Emergency Medical Services are primarily tasked with transporting the ill and injured from the scene where injury or illness took place to an appropriate hospital. Depending on the level of expertise involved in this transport, certain out-of-hospital interventions could also take place en-route to hospital. The time taken to perform these interventions and subsequently transport patients to hospital therefore highlights EMS influence out-of-hospital time intervals. To discuss the relevance of these out-of-hospital time intervals, this literature review will begin by describing EMS impact on certain diseases that have been identified to be time-dependent in terms of patient outcome. The literature review will also go on to explore EMS out-of-hospital time intervals as a measurement of system performance.

By way of refreshment, the following time intervals are important: the activation time interval (time from call received to activation of the first responder); response time interval (activation to time on-scene); on-scene time interval (from arrival on-scene to departure to hospital); transport time interval (from departure from scene to arrival at an appropriate medical centre) and the total incident time interval (from activation to handover at the appropriate medical centre.

1.3.2 Emergency Medical Service impact on Morbidity and Mortality

For many years now, the impact of EMS regarding patient outcome has been studied. Literature has identified that in certain circumstances there may be an improvement in patient outcome when using the EMS in relation to interventions by EMS personnel.

However, certain studies have shown that EMS use, in fact, compromises patient outcome. These outcomes may possibly relate to the out-of-hospital time intervals incurred and the number of interventions performed by EMS. Below, different pathologies and the role that the EMS has in their outcomes are discussed.

1.3.2.1 Emergency Medical Services and Acute Myocardial Infarction (AMI)

Early identification and intervention in AMI leads to improved patient outcome. A 13-month prospective, cross-sectional study conducted in Beijing by Song *et al.,* investigated whether or not patients experiencing ST-Segment Elevation Myocardial Infarction (STEMI) were arriving at hospital more rapidly when using private transport in comparison to using the EMS.

Song and colleagues performed the study to determine whether using an ambulance to get to the Emergency Department (ED) after STEMI improved out-of-hospital time intervals when compared to using patients using private transport. Their study found that patients were arriving at hospital more rapidly when using private transport than by ambulance.

In this study the median time taken from making a decision to seek medical care, to arrival at the ED door for the two groups was 35 minutes in the private transport group versus 50 minutes ($p<0.001$) in the ambulance transport group. This rapid arrival to the ED, however, did not lead to more rapid intervention in hospital.

The ambulance transport group led to definitive intervention more rapidly than the private transport group (173 minutes versus 193 minutes; $p=0.049$). Despite the delay in ED arrival when using the ambulance service, the authors in this study speculated

that ambulance transport may lead to improved patient outcome as ambulance personnel may be able to effectively deal with life-threatening complications such as cardiac arrest. This was not tested.[2]

Similarly, the American College of Cardiology (ACC) and American Heart Association (AHA) suggest that the time of first medical contact to Percutaneous Coronary Intervention (PCI) in STEMI should be ≤90 minutes. Although there is scant evidence documenting ideal out-of-hospital time intervals that should make up these 90 minutes, Studnek and colleagues found in their study performed in North Carolina that 67% of patients received PCI within 90 minutes from time of EMS activation.

In the study, it was found that patients who had on-scene times of ≤15 minutes had an increased likelihood of achieving the ≤90 minute PCI time. Besides time intervals, the authors suggest EMS use in STEMI scenarios as EMS personnel may be able to identify and intervene during life-threatening consequences associated with STEMI.[6]

1.3.2.2 Emergency Medical Services and Trauma

Emergency Medical Service out-of-hospital time intervals and the number of interventions that occur on-scene in trauma aetiology has been investigated. Literature has associated poorer patient outcomes in trauma scenarios where out-of-hospital interventions by EMS personnel were initiated as these resulted in prolonged out-of-hospital time intervals. The Ontario Prehospital Advanced Life Support (OPALS) Major Trauma Study, compared trauma patients in a Basic Life Support (BLS) group (with limited capabilities) to an Advanced Life Support (ALS) group (with the ability to perform an array of interventions).

The study showed that in certain instances, patients experienced greater mortality when ALS measures (increased number of interventions) were implemented in the out-of-hospital environment. In particular, this was associated with patients who presented with a Glasgow Coma Scale (GCS) of less than 9/15. Besides the group who presented with a GCS of less than 9, there was no difference in survival to discharge between the BLS group and the ALS group. The study highlights that EMS use and the implementation of ALS interventions may not always be beneficial regarding patient outcome as these may prolong out-of-hospital time intervals.[4]

In contrast, a trauma-based study conducted in New York by Lerner *et al.,* showed that the total out-of-hospital time interval did not influence ultimate patient outcome. In their study, the authors identified that the mean time spent on-scene by survivors was longer than non-survivors. However, the authors acknowledge that there may have been an element of bias as practitioners may have transported acutely ill-looking patients more rapidly than those that did not appear as critical. Further research is needed to identify which trauma related incidents are time-dependant.[5]

In relation to time intervals, an assumption could be made that the number of out-of-hospital interventions could influence the out-of-hospital time interval. van der Velden *et al.,* conducted a study to determine whether or not the number of out-of-hospital interventions would influence the on-scene time interval of patients who had undergone trauma. Patients who sustained trauma were divided into two groups where the first group was treated by EMS personnel and transported to hospital, and the second group was treated and airlifted by Helicopter Emergency Medical Service (HEMS) personnel.

According to their data, an increase in the number of out-of-hospital interventions led to significant increase in the on-scene time intervals in the EMS group but did not lead to an increase in on-scene time in the HEMS group. Despite this the increase in on-scene time in the EMS group, however, did not influence the patient's hospital stay duration.[7]

Out-of-hospital time intervals in trauma were investigated by Carr *et al.* In his meta-analysis, a 30-year period was reviewed to find median ambulance intervals extending from time of activation to total incident time. Comparative data and valuable insight was obtained over a vast time period. Ambulance services were divided into urban, suburban and rural ambulance services, and the median times reflected these categories. In-line with other literature, the mean times for on-scene intervals ranged from 13.5 minutes for urban ambulances to 15 minutes for rural ambulances. The mean total incident time intervals ranged from 31 minutes for urban ambulance services and 43 minutes for rural ambulance services.[11]

1.3.2.3 Emergency Medical Services and Stroke

As mentioned earlier, certain conditions such as stroke and AMI seem to have improved patient outcomes when out-of-hospital time intervals are decreased.[2,8] Currently, the recommended time from onset of symptoms to the administration of thrombolytic therapy for ischaemic stroke is ≤3 hours.

Ramanujam *et al.,* in a retrospective study conducted in San Diego found that the average EMS total incident time interval (from time of call logging to hand over at the receiving facility) for patients with confirmed stroke was 39 minutes. Although informative, the authors acknowledge that in addition to minimising EMS out-of-hospital

intervals, it also important for early stroke recognition by patients themselves as well as members of the public which could lead to earlier EMS activation. In the study, there was a decreased total incident time (median value of 2.5 minutes) when there was concordance in diagnosis between dispatchers and the attending crew. The authors did highlight the fact that an increased awareness of stroke recognition in EMS dispatchers is absolutely critical. The median response time interval in the study was six minutes, and the median scene time interval was 19 minutes.[8]

In a prospective study by Faiz and colleagues in Norway, out-of-hospital time intervals in 440 stroke patients were examined. The study found that using an ambulance led to shorter out-of-hospital delays for stroke patients. Patients who had experienced stroke were transported to the ED in ≤3 hours from time of onset of symptoms in 50% of cases. The authors go on to explain that the severity of the stroke symptoms also possibly contributed to shorter out-of-hospital time delays. Delay to contacting either the EMS or other healthcare professional after symptom onset seemed to make up the longest delay in the out-of-hospital time interval.[9]

1.3.2.4 Emergency Medical Services and Respiratory Distress

In a similar study to the OPALS Major Trauma Study, the OPALS Respiratory Distress Study compared whether or not ALS intervention improved respiratory distress patient outcome. The study, conducted over a 12-month period, involved a multiphase approach where the 12-month period was divided into a BLS phase which was conducted over a six-month period and an additional six-month ALS phase. With the study showing a 1.9% improvement in outcomes in the ALS phase, time intervals for each component of the incident were also identified. Most notable, similar median scene

time intervals of 13.5 minutes were encountered in both phases of the study. Median response time was approximately seven minutes for both phases of the study. Despite having similar time intervals, there seemed to be an improvement in patient outcome in the ALS group.[10]

These findings were supported by a large study conducted across four European countries comparing EMS systems. Although time intervals were not reported on, ambulances staffed with personnel with higher qualifications seemed to improve the out-of-hospital condition of patients that presented with respiratory distress. The study showed that of the 3152 patients who presented with poor arterial oxygen saturations, 75% of patients across the EMS systems experienced a normalisation of saturations after EMS intervention. The study also found that of the "highest priority calls", response times of ≤8 minutes were achieved 66%-88% of the time.[12]

1.3.2.5 Emergency Medical Services and Out-of-Hospital Cardiac Arrest

Eisenberg and colleagues, in 1979, showed that patients who underwent OHCA had improved survival rates if Cardiopulmonary Resuscitation (CPR) was initiated within four minutes (Basic Life Support [BLS] – interventions) from the time of cardiac arrest, as well as if definitive care (defibrillation – Advanced Life Support [ALS] interventions at the time) was initiated within ≤8 minutes.[13] Many EMS systems have subsequently based their system performance on this response time interval. It must be noted, however, that when compared to the Eisenberg study, BLS providers now have the ability to perform defibrillation. Subsequent studies have investigated outcomes with regard to OHCA and out-of-hospital time intervals.

In one of the largest OHCA studies performed to date, 109350 OHCA cases were examined regarding out-of-hospital time intervals in Japan. The study, performed over a four-year period, showed that the mean ambulance response time interval from time of activation of the first responder was 7.4 minutes. The main aim of the study was to assess the relationship between collapse-to-EMS CPR interval and outcome. Data were reviewed retrospectively from a national OHCA registry, where patients who underwent bystander- witnessed cardiac arrest were enrolled in the study.

In the study, one of the variables measured was the time interval from witnessed collapse to hospital arrival. The time intervals that make up this total out-of-hospital interval were also documented. These times were then compared to one-month neurologically favourable outcomes. The study concluded that shorter collapse-to-EMS CPR intervals were associated with better outcomes. There was however, no definitive time interval proposed. The authors go on to state that better public education regarding OHCA needs to be made a priority in an attempt to shorten this interval.[14]

A study by Spaite and colleagues in Arizona set out to determine whether additional interventions such as therapeutic hypothermia improved outcomes after the return of spontaneous circulation in OHCA (keeping in mind that this may increase the out-of-hospital time intervals). In determining this, one of the main objectives of the study was to determine whether prolonging out-of-hospital time intervals to transport patients to specialised facilities capable of implementing these interventions affected outcome. The study determined that prolonged intervals as a result of transporting to specialised care did not adversely influence outcome. Of relevance, was the mean response time interval (from receipt of call from bystanders) which was shown to be 5.4 minutes, the

on-scene time interval of 18.3minutes and a total out-of-hospital interval of 30.6 minutes. Overall OHCA survival was shown to be 5.9%.[15]

1.3.3 International Practice related to Performance Measurement and Time Intervals

Much attention has been shifted to evaluating EMS system performance with regards to various time intervals during an emergency. This attention has been around creating realistic minimum time intervals that are thought to improve patient survival. The most commonly used time interval to measure EMS performance is the response time interval (from receiving the initial call to the first medical unit arrival). Typically, the eight minute timeframe is used when assessing response time interval performance.

In relation to the on-scene time interval, Tintinalli and colleagues in their EMS global guidebook make reference to an American College of Surgeons Committee on Trauma (ASCOT) suggestion that ambulances should have an on-scene time interval of less than 20 minutes in cases involving trauma to achieve acceptable time intervals to achieve definitive care. Despite the guidebook being a relatively recent publication, the actual ASCOT suggestion within the text dates back to 1987 with seemingly no recent update to this time interval.[16] There does not seem to be any literature regarding timelines for the other components that make up the total out-of-hospital time interval, both locally and internationally.

The term Response-Time-Threshold (RTT) is used regularly to determine EMS system performance and typically refers to the number (or fraction) of incidents that can be reached in a designated timeframe. In the United States of America (USA) the American Ambulance Association and the National Fire Protection Agency (NFPA) states that

urban ambulance services should provide a response time of less than four minutes for a BLS unit and less than eight minutes for an ALS unit. These guidelines were established after the findings of the Eisenberg study (conducted in 1979) where non-traumatic cardiac arrest patients seemed to have improved survival statistics when these timelines were adhered to as described earlier.[13,17,18]

This eight minute timeline was challenged by Pons *et al.,* in 2002. The authors of the paper acknowledged that although providing an ambulance service within these guidelines would improve “medical effectiveness” it would decrease EMS system efficiency in general as the number of resources would have to be increased dramatically which would lead to an increase in costs and thus make the EMS system unsustainable.

Pons *et al.,* go on to notion that shorter response time intervals may lead to improved overall patient satisfaction but the evidence supporting the true benefit in terms of patient survival using these timelines is lacking. In their paper, the authors conclude that there was no statistical difference in patient survival based on the response time interval. To note, this paper only included patients who were involved in a traumatic incident.[18]

In 2002 Blackwell and Kaufman, however showed that by decreasing the response time interval an improvement in patient survival could be seen. Intervals of less than five minutes led to an improvement in patient survival. The authors however were also of the opinion that sustaining this level of service would be at an extraordinary cost.

They were unsure as to whether this would be at all possible in the majority of life-threatening emergencies. In their paper, the mean response time for the study period was 6.97 minutes.[19]

In their 2012 study, Blanchard and colleagues went on to dispute the eight minute response time interval further. Their study found that after adjusting for type of injury, gender and age, there was only a small beneficial effect in the risk of mortality for those patients who experienced an under eight minute response time interval. In their paper, they call into question the clinical effectiveness of a dichotomous eight minute response time interval.[20]

1.3.4 Local Practice related to Performance Measurement and Time Intervals

In Gauteng, ambulance services are provided by both the private healthcare sector as well as the provincial authority. The provincial authority provides these services either themselves, or through an agent such as the City of Johannesburg.[21,22,23] Within the province, ambulance services are governed by the Gauteng Ambulance Services Act of 2002. In this Act, there are no stipulations or guidelines regarding out-of-hospital time intervals or expected response time intervals.[21]

However, the Gauteng Department of Health and Social Development (GDHSD) does report on a number of “Performance Indicators (PIs)” to determine the performance of the ambulance services which the GDHSD manage. Figures obtained from the GDHSD 2011/12 – 2013/14 Annual Performance Plan indicate that for 2010/11 critical cases (“Code Red/Priority 1”), a response time of less than 15 minutes within an urban environment was estimated to be 57%.[22]

The GDHSD 2012/13 Annual Report indicates that actual figures report critical cases ("Code Red/Priority 1") responded to within 15 minutes in an urban environment is 52%. The report indicates that all calls (all "priorities") had a response time of within 60minutes, 77% of the time.[22]

The report does not indicate average times for any of the out-of-hospital time intervals. Of the different out-of-hospital time intervals, the GDHSD only measures the response time interval when reporting on EMS performance indicators in relation to out-of-hospital time intervals. Data related to mean out-of-hospital time intervals in Gauteng is lacking. In a 2008 study conducted by van Hoving *et al.,* in the Western Cape, it was found that the mean on-scene time for critically-ill patients transported by road was 25 minutes. Other out-of-hospital intervals for the ground ambulances were not determined.[24] There do not seem to be any comparative figures for the Gauteng province.

With no local (Gauteng) literature available regarding out-of-hospital time intervals to compare to international data, the need to determine these out-of-hospital intervals became important.

1.3.5 Summary of the Literature Review

The role of out-of-hospital time intervals and interventions on patient outcome has not been absolutely determined. Outcomes related to disease processes such as stroke and AMI have however shown improvement if these time intervals are decreased. Other authors propose that out-of-hospital time intervals do not ultimately influence patient outcome.

Despite this controversy, EMS system performance is still judged on various out-of-hospital time intervals. The RTT is a commonly used measure utilising the response time interval as an indicator to determine whether an EMS is providing services efficiently and effectively. With the increased costs associated with providing an effective EMS, many authors have contested the sustainability of providing such a resource within the current guidelines.

There was no literature documenting the out-of hospital time intervals that critical cases in Johannesburg, Gauteng were experiencing. Without this knowledge, it remained difficult to determine whether or not patients utilising these resources are in-fact benefiting from such a service.

1.4 Problem Statement

Assessing local critical case out-of-hospital time-intervals is important as this is commonly performed internationally. If it was found that critical cases are spending inappropriately lengthy times before being transported to hospital, investigation into those reasons may be warranted both from a teaching as well from an EMS system performance perspective.

University of Johannesburg students are involved in clinical learning across all years of study. Whilst involved in this clinical learning, these students are exposed to critical cases under the guidance of supervising practitioners. We were unaware of how long these critical cases remained in the out-of-hospital environment (from time of activation to time of arrival at the ED).

1.5 Study Aim and Research Objectives

1.5.1 Study Aim

The aim of this study was to describe critical case out-of-hospital time intervals from an existing electronic database of clinical learning Patient Care Records (PCRs – APPENDIX A) known as the Emergency Medical Data and Analysis System (*EMDATA*) at the University of Johannesburg (UJ)[+]. Data from 1 January 2001 to 31 December 2008 (eight-year period) were extracted. These out-of-of hospital time intervals included the response time interval, on-scene time interval, transport time interval and total incident time interval.

A detailed description of the database will follow below. In addition to the time-intervals, the researcher investigated whether the number of interventions played any significant role in determining the on-scene time interval. The researcher also determined whether the transport distance to hospital impacted the total incident time interval.

1.5.2 Research Objectives

i. Determined and described the critically-ill (Priority 1 - P1) patients (as defined by the treating practitioner) that paramedic students were exposed to during an eight (8) year period in the Greater Johannesburg Metropolitan area. This will include the demographic details of these critically-ill patients.

ii. Determined the time intervals that these patients spent in the out-of-hospital environment. These intervals included the response time interval, on-scene time interval and the transport time interval.

[+] The University of Johannesburg is a Higher Education Institution (HEI) which was established after the merger of the Technikon Witwatersrand, Rand Afrikaans University and part of Vista University in 2005.

iii. Determined the category of registration (BLS, ILS and ALS) of the supervising practitioner that was present during these incidents.

iv. Determined the number of interventions performed during the critical cases. Interventions were grouped as follows:

a) Advanced airway placement or intervention.

b) Establishing intravenous access.

c) Drug administration.

d) Packaging and cervical-spine immobilisation.

e) Stabilisation and immobilisation of fractures.

f) Any form of cardiopulmonary resuscitation where the patient is transported to a receiving facility and not declared deceased on-scene.

g) Advanced cardiac life support measures such as defibrillation, vagal manoeuvres, cardioversion or transcutaneous pacing.

v. After determining the number of interventions that were performed, determined whether or not there was a predictive relationship between the number of interventions and the on-scene time interval.

vi. Determined the distance from the receiving facility that these critical cases occurred. Once established, determined whether or not there was a predictive relationship between the distance from the receiving hospital and the total out-of-hospital time interval for the critical case.

1.6 Conclusion

This chapter provided insight about study rationale. International and local data was presented to contextualise the nature and reason for the study. With much international attention being given to EMS system performance with regard to out-of-hospital time intervals, it is logical that locally, similar studies are conducted. This served as the foundation for the problem statement.

With the role of out-of-hospital time intervals on patient outcome remaining controversial, this local study focused primarily on describing critical case out-of-hospital time intervals. With this in mind, the aim and objectives for the study were described in this chapter. The following chapter will describe the methodology and data extraction method employed in this study.

CHAPTER 2: MATERIALS AND METHODS

2.1 Introduction

This chapter will discuss the data extraction techniques employed for the study. In addition, the data analysis techniques will be discussed as well as the ethical considerations and approval obtained to conduct the study.

2.2 Sources of Study Data

2.2.1 Background and Purpose

The source of the data was the Emergency Medical Database and Analysis System (*EMDATA*). This electronic clinical learning information system database was introduced to students at the University of Johannesburg: Department of Emergency Medical Care (EMC) in 2001.

As part of their studies, paramedic students at the UJ are engaged in clinical learning across all years of study. During their clinical learning, students are expected to complete a paper-based PCR for every patient encounter that they have.

Once the student has access to *EMDATA*, via internet connection, the PCR is transferred to the electronic platform by the students themselves. Only once all of the required fields have been populated into the electronic database are students able to save and generate an electronic record of the paper-based PCR.

At the end of every academic year, the database is accessed by the relevant lecturers to ensure that the required number of skills and patient encounters for each student has occurred. A student must complete the required number of skills and patient encounters for that particular academic year. If the requisites are not met, the student does not progress to the following academic year with regard to clinical learning.

EMDATA was designed, implemented and is supported by one of the lecturing staff within the Department of EMC. This electronic database was designed on an Active Pages 3.0 (Microsoft Corporation, Washington, USA) platform and is accessed by students from any computer with an internet browser and internet connectivity.

2.2.2 Data Reliability and Validity

As is widely known, one of the disadvantages of a retrospective study design using patient records is the potential for incorrect data to be recorded on the PCR or the incorrect transfer of information into the electronic database. At the end of each study year, lecturers in the Department perform a random audit of PCRs in relation to the data which was captured by the student.

Further to this, the clinical supervisors ensure that all patient encounters are completely documented on a PCR. In this way, the database should contain all critical cases which were attended to by the students and their supervising practitioners. The required parameters of the PCR are verified by the student's supervising practitioner. The PCR is only accepted as a record if the supervising practitioner's signature is clearly identified on the PCR. The PCR duplicates the information captured on the supervising practitioner's service specific patient report form. Although there is a possibility that

students do not capture each and every patient encounter, this should be a rare event. This possibility is further restricted considering that critical cases provide an opportunity for skill acquisition, and students require a certain number of skills each year for clinical learning progression.

One of the limitations of this local study is the fact that the students work with a multitude of services during their clinical learning time, and thus, access to the activation intervals (as described above) was not possible. Services use different dispatch systems. Consequently, the activation intervals were not investigated in the scope of this study.

2.3 Data extraction

This retrospective, descriptive study made use of an already existent database at the UJ's Department of EMC. All electronic records from 1 January 2001 to 31 December 2008 were accessed and assessed for inclusion in the study. Critical cases entered into the database during this period were assessed for eligibility. Only records that were entirely complete were eligible.

Critical cases were entered into the database as Priority One (P1) cases by students. The EMDATA database does not list the final diagnosis of the critical cases analysed, but during data extraction, cases were able to be categorised into two broad categories based on the aetiology.

These categories were identified as “trauma” and “medical” aetiologies. Traumatic aetiologies were defined as those critical cases where patients sustained physical injury as a result of blunt or penetrating trauma. Medical aetiologies were defined as those critical cases where patients acquired and displayed signs of disease.

With regards to data extraction, each PCR is represented by one line in the database table. Each individual PCR has a Patient Care Record Identifier (PCRID). Linked to the PCRID are all of the relevant incident details such as the incident date, incident location, patient age, incident times, clinical findings, interventions and transport details.

Structured Query Language (SQL) statements were used to access and identify the critical cases within the specified study period. Structured Query Language statements are commonly used to extract and isolate data in relational database management systems. Once the critical cases were isolated, data was further manipulated using Microsoft Access® (Microsoft Corporation, Washington, USA) and Microsoft Excel® (Microsoft Corporation, Washington, USA). In addition to this data manipulation, aggregate queries were performed in Microsoft Access® (Microsoft Corporation, Washington, USA) to group and count certain parameters as identified in the research aim and objectives in Chapter 1.

For the purposes of this study, the out-of-hospital time intervals examined were defined as follows:

- Response time interval (activation of the vehicle to time on-scene)
- On-scene time interval (from arrival on-scene to departure to hospital)
- Transport time interval (from departure from scene to arrival at an appropriate medical facility)
- Total incident time interval (from activation to handover at an appropriate medical facility)

Critical case incident locations were obtained from the database. The location (address) was plotted on a map. The transport distances were calculated using the “distance calculator” function on Google Earth® (Google Incorporated, California, USA). As the detailed routing of the ambulance was not known, distances (in kilometers) from the scene to the receiving medical facility were calculated using the “as-the-crow-flies” methodology (ACFM). This technique to calculate distances in an urban setting are supported by Doumouras and peers in a 2012 Academic Emergency Medicine study.[25]

2.4 Data Analysis

All data analysis and statistical tests were performed using a commercially available statistical package, SPSS (version 21.0; IBM Corporation, New York, USA). For most of the research objectives, simple descriptive statistics were used to represent data. Tables and charts were used to graphically display this data where appropriate.

To determine whether or not predictive relationships existed between the number of out-of-hospital interventions and out-of-hospital time intervals linear regression analysis was used. This technique was repeated when determining whether or not there was a predictive relationship between the transport distance to hospital and the total incident time interval.

2.5 Ethical Considerations

Ethical approval was obtained from the Human Ethics Research Committee (Medical) at the University of the Witwatersrand with the submission of this protocol (Ethics Clearance Certificate Number – M110247, APPENDIX B). Permission to utilise the existing data on the *EMDATA* database was obtained from the Department of EMC at the UJ (APPENDIX C).

Due to the design of the study, it was not possible to obtain consent from the patients identified from the *EMDATA* database. However, at no stage was any identifying data used in the write-up of the research project or any possible subsequent publications of the research findings. All raw data remained strictly confidential and remained password protected at all times. Only the researcher and supervisor had access to the data.

2.6 Conclusion

This chapter described the data source, extraction and analysis techniques used in this local study. A brief explanation was provided regarding the structure of the database and the way in which the critical cases were isolated, manipulated and analysed. In addition to the data extraction and analysis techniques, ethical considerations and approval were provided.

Chapter 3 presents the data using the techniques described in Chapter 2.

CHAPTER 3: RESULTS

3.1 Introduction

This chapter presents the data extracted and analysed from the *EMDATA* database. Initially, demographic details for the critical cases will be presented using simple descriptive techniques. Subsequently, the results of regression analysis described on page 18 of Chapter 1 will be displayed.

3.1.1 Overview and Demographics of Critical Cases

A total of 19742 cases were entered into the clinical learning database between 1 January 2001 and 31 December 2008. Of these cases, 3186 (16.1%) were categorised as critical cases according to paramedic students and corroborated by their supervising practitioners. The reasons why these patients were categorised as critical cases were beyond the scope of this study. Because the database contains critical cases recorded by students throughout all of their clinical learning areas, further data extraction took place to isolate cases that occurred Greater Johannesburg Metropolitan (GJM) area. Critical cases that died on-scene, those that were entrapped and those with incomplete details were not used during data analysis. Table 3.1 below provides an overview of the critical cases assessed.

Table 3.1: OVERVIEW OF CRITICAL CASES

TOTAL NUMBER OF CASES	TOTAL NUMBER OF CRITICAL CASES	NUMBER OF CASES IN GJM AREA	CRITICAL CASES WHO DIED ON-SCENE	CRITICAL CASES WITH INCOMPLETE DETAILS	CRITICAL CASES FINALLY ASSESSED
19 742	3 186 (16.1%ˈ)	1 906 (9.6%ˈ)	320 (16.8%*)	226 (11.8%*)	1360 (71.3%*)

GJMC = Greater Johannesburg Metropolitan; ˈ = expressed as a percentage of the total number of critical cases; * = expressed as a percentage of the number of cases occurring in the GJMC area.

Although the number of interventions and out-of-hospital time intervals were not linked to critical case gender and age, it remained important to display this demographic detail. Table 3.2 below displays the gender and average age of critical cases that formed part of the sample.

Table 3.2: GENDER AND AVERAGE AGE OF CRITICAL CASES

GENDER	COUNT	NO OF CASES WHERE AGE WAS NOT RECORDED	AVERAGE AGE (YEARS)
MALE	690 (50.8%)	56	29
FEMALE	670 (49.2%)	63	43
	1360* (100%)	119	

*TOTAL NUMBER OF CRITICAL CASES OCCURRING IN GREATER JOHANNESBURG METROPOLITAN AREA

The average age of males experiencing critical illness, was lower than that of the female population. Figure 3.1 below provides aetiological information on the critical cases based on gender.

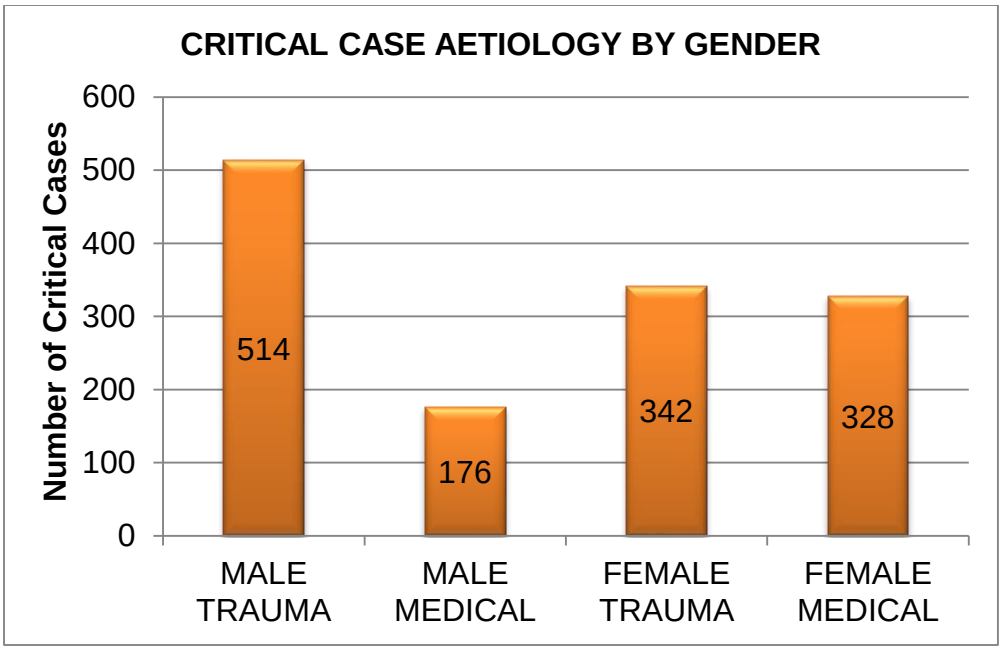

Figure 3.1: CRITICAL CASE AETIOLOGY BY GENDER

According to the data most critical cases were categorised as male trauma cases (37.8%). The average age of patients in the male trauma and male medical critical case categories was 29 years. As can be seen in Figure 3.1 there is fairly even distribution of female trauma and female medical critical cases. The average age of the patients in these two combined categories was 43 years of age.

Table 3.3 below provides a more detailed description of the critical case trauma and medical categories.

Table 3.3: CRITICAL CASE CATEGORY

CRITICAL CASE CATEGORY	COUNT	%
GENERAL TRAUMA[1]	560	41%
HEAD TRAUMA	296	22%
RESPIRATORY[2]	206	15%
CARDIAC	118	9%
ENDOCRINE	74	5%
GENERAL[3]	63	5%
NEUROLOGICAL (NON-TRAUMA)	43	3%
	1360	100%

[1] =Includes polytrauma, burns and trauma other than head trauma; [2] =Includes conditions where primary condition was respiratory in nature such as pneumonia or Chronic Obstructive Pulmonary Disease but may be complicated by a cardiac condition; [3] =General conditions such as poisoning and drowning as well as unknown conditions.

Sixty-three percent of critical cases were categorised as trauma. This included both general as well as head trauma. The “general” category (5%) grouped a number of conditions such as poisoning, drowning and in addition, those conditions where the student and supervising practitioner were unable to use an existing category.

3.1.2 Critical Case Out-of-Hospital Time Intervals

The aim of this local study was to describe out-of-hospital time intervals experienced by critical cases in the GJM area. Table 3.4 below shows the average of the out-of-hospital time intervals described in Chapter 1.

Table 3.4: CRITICAL CASE TIME INTERVALS

CRITICAL CASE TIME INTERVALS	AVERAGE[1] IN MINUTES (% OF TOTAL INCIDENT TIME)	95% CONFIDENCE INTERVAL
RESPONSE TIME INTERVAL	10.67 (19.9%)	10.48;10.86
ON-SCENE TIME INTERVAL	26.69 (49.8%)	26.23;27.15
TRANSPORT TIME INTERVAL	16.24 (30.3%)	15.92;16.56
TOTAL INCIDENT TIME INTERVAL	53.53	52.90;54.15

[1]=Average over 8-year period

Table 3.4 shows that for the critical cases assessed in the GJM area during the period under review, half of the total incident time was spent on-scene. Data obtained from the total incident time intervals appeared to have greater variance when compared to the other out-of-hospital time intervals.

3.1.3 Category of Registration of Supervising Practitioner

During clinical learning, students work with supervising practitioners. The category of registration may vary depending on the academic year that the student was currently engaged in at the time of clinical learning. Below, in Table 3.5, a breakdown of the category of registration of the attending supervising practitioner is given.

Table 3.5: CATEGORY OF REGISTRATION - SUPERVISING PRACTITIONER

CATEGORY OF REGISTRATION - SUPERVISING PRACTITIONER	NUMBER OF CRITICAL CASES (% OF TOTAL NUMBER CRITICAL CASES)	
ADVANCED LIFE SUPPORT (ALS)	893	65.7%
INTERMEDIATE LIFE SUPPORT (ILS)	270	19.9%
BASIC LIFE SUPPORT (BLS)	197	14.4%
	1360	100%

As can be seen from the results, in almost two thirds of cases, students attending critical cases were supervised by ALS practitioners. In terms of clinical learning supervision, this would be the ideal scenario for students and this is ultimately the category in which they will practice once graduated. It is likely though, considering resource constraints that students could end up working with BLS practitioners, as can be seen in Table 3.5. This will only be the case for first-year students as these students are generally only taught BLS interventions.

3.1.4 Number of Interventions Performed and the Relationship with the On-Scene Time Interval

As part of this study, it was important to investigate the number of interventions performed whilst engaged with the critical cases. After determining the number of interventions performed, it was determined whether there was a predictive relationship between the on-scene time interval and the number of interventions performed.

The time taken to perform each intervention depends on the student and/or supervising practitioner level of proficiency as well as the complexity of the intervention. In terms of the dataset, the times for individual interventions were not obtainable, thus, interventions were grouped in categories before the final count was performed. It was assumed that although the complexity of the interventions varied, the time to perform the interventions were similar. This was similar to previously performed studies in this arena. A list of these categories is provided on page 18 under section *1.5.2.* On average 1.96 ≈2 (Confidence Interval [CI] - 0.06; CI Upper Limit – 1.99 CI Lower Limit – 1.92) interventions per critical case were performed over the eight-year period.

To determine whether or not there was a relationship between the number of interventions performed and the on-scene time interval, data was analysed using linear regression. Below, in Figure 3.2, is the scatter plot for the number of interventions and on-scene time interval. The scatter plot also shows the regression line and equation.

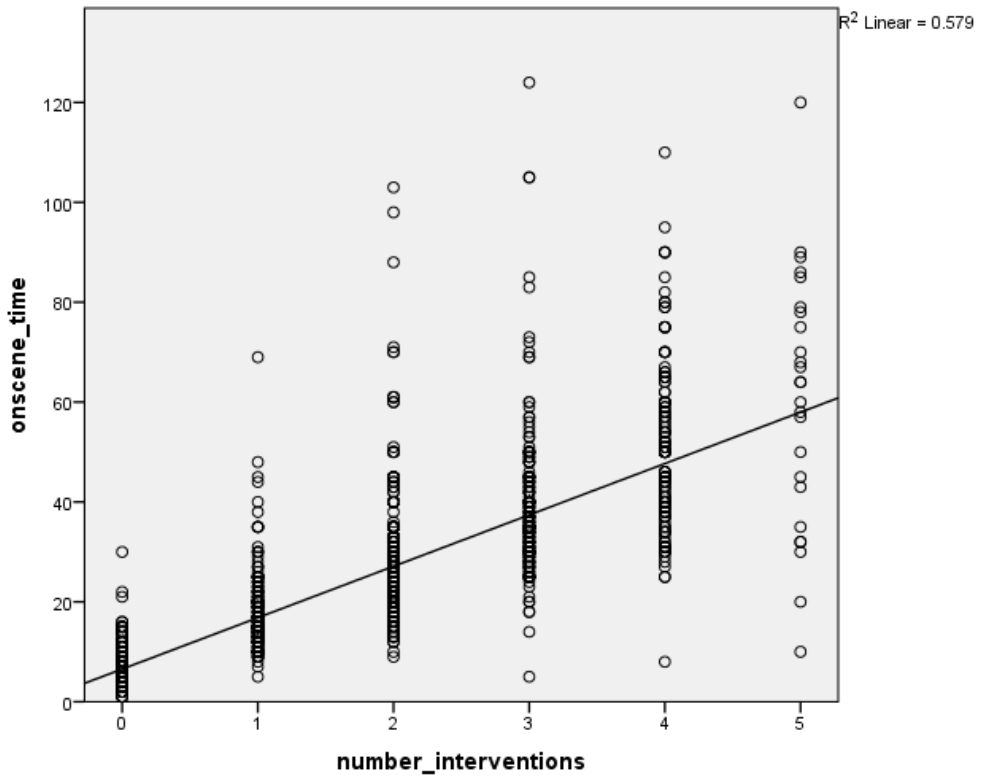

Figure 3.2: SCATTER PLOT OF ON-SCENE TIME INTERVALS AND NUMBER OF INTERVENTIONS

Adequate fit of the regression model was demonstrated. In addition to the significant F-Statistic (F=1866.522) the following results were observed supporting the model fit: R^2=0.579; p<0.001.

These findings support the notion that the number of on-scene time interventions were associated with an increase in the on-scene time interval. The equation y=6.55+10.29*x can be used to approximate on-scene time intervals (y) when replacing x with the number of on-scene interventions.

3.1.5 Transport Distance to Hospital and the Relationship with the Total Incident Time Interval

The last research objective in this local study was to determine whether there was a relationship between the distance (in kilometers) to the receiving medical facility and the total incident time interval. Distances were calculated using the “as-the-crow-flies” methodology (ACFM) as described in Chapter 2. Below, in Figure 3.3, a scatter plot shows the distance to hospital in kilometers (x-axis) plotted against the total incident time interval in minutes (y-axis).

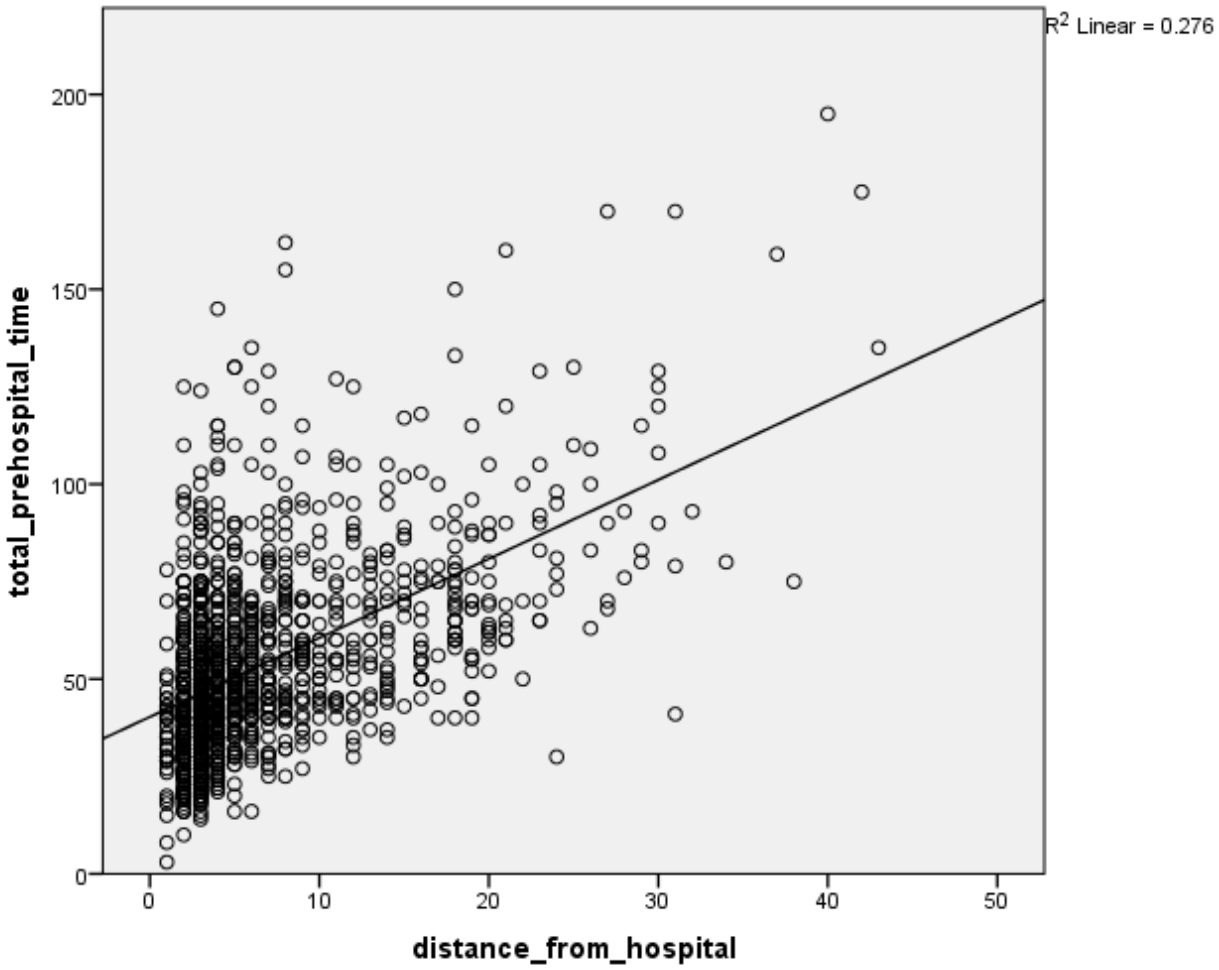

Figure 3.3: SCATTER PLOT OF DISTANCE TO HOSPITAL AND TOTAL INCIDENT TIME INTERVAL

As with the previous relationship between the number of interventions performed and the on-scene time interval, the regression model demonstrated adequate fit. In addition to the regression line and equation shown above, additional significant findings included a $p<0.001$ and an F-Statistic of 517.22. The adjusted R^2 value of 0.275, was not as high as in Figure 3.2. The equation $y=40.28+2.03*x$ can be used to approximately calculate the total incident time interval (y) by substituting "x" with the distance from hospital.

With the distance to hospital being further, it would be logical to expect the transport time interval to be longer, it was however important to determine whether or not the total incident time interval would be affected by this distance. It could be argued, that the further away a critical case occurs from hospital, more time would be spent "stabilising" the patient on-scene, or less time would be spent on-scene as the patient may be loaded into the ambulance sooner. The results showed that the further the critical case occurs from the receiving hospital, the longer the total incident time interval.

3.2 Conclusion

This chapter conveyed the results of the data analysis using simple descriptive statistics and where necessary the results of various statistical tests. After analysis took place, it was found that there were more male trauma cases when compared with other critical case aetiologies. In addition, the four out-of-hospital time intervals were shown. The number of interventions, and the distance to hospital were then determined to have a relationship with the on-scene time interval and total incident time interval respectively. The following chapter will discuss the results.

CHAPTER 4: DISCUSSION

4.1 Introduction

The aim of this study determined critical case out-of-hospital time intervals that occurred in the GJM area. In the previous chapter, results and analysis were provided in line with the research objectives of this local study.

This chapter will contextualise the findings in relation to published literature where relevant and appropriate. This chapter will follow a similar order to the way in which the research objectives were laid out. Research objectives related to the number of interventions and the transport distance to hospital will be discussed with the associated timelines.

This chapter will also include the limitations of the study as well as recommendations related to certain points in the discussion. Finally, concluding remarks will end the chapter.

4.2 Critical Case Characteristics

Of the 19742 Patient Care Records (PCRs) entered into *EMDATA* by students over the eight year period, a total of 1906 (9.6%) were categorised as critical cases occurring in the GJM area. Reasons for why these cases were categorised as critical cases were not investigated in this study.

However, it is logical to suggest that despite the student and supervising practitioner's clinical reasoning behind the categorisation, these students and practitioners were determining the level of "urgency" and number of interventions required which in-turn determined the out-of-hospital time intervals. It could also be argued that cases that were incorrectly categorised as less acute may have experienced inappropriate out-of-hospital time intervals. The extent of this, however, is not known.

Adhikari and colleagues, in their 2010 paper, made mention of the fact that defining critical illness is challenging. The authors suggest that critical illness cannot be diagnosed with one particular test such as in the case of malaria or the Human Immunodeficiency Virus (HIV). Usually, critical illness diagnosis is made by using a combination of clinical, laboratory, radiological and physiological findings. Even with these findings, critical illness definition is usually determined by consensus and constantly under scrutiny.[26] It is well known that out-of-hospital health care providers do not have the ability to perform many of these investigations which complicates the ability to identify critical illness. Often, identification of the critically-ill patient is based on suspicion in the out-of-hospital environment.

Comparing the incidence of critical cases in this local study to international data is not necessarily accurate. The reason for this is related to the way that clinical learning for EMC students is structured. Students are scheduled to work during certain times only, and as a result, student documented critical cases will only occur during the time that they are engaged in clinical learning. Therefore, the true incidence of critical cases cannot be commented on as the data is incomplete.

This local study showed that 63% of documented critical cases had a traumatic aetiology. In 2013, Hardcastle *et al.* commented on the impact that the trauma burden in South Africa EMS. Keeping in mind that our study in Gauteng only investigated a subset of trauma cases (critical cases), it still is important to acknowledge that the majority of critical cases assessed were also related to trauma.

Hardcastle and colleagues report ambulance call rates for trauma of approximately 11.6/1,000 population in the region compared to Norwegian and Welsh data which is 30/100,000 and 19/100,000 respectively.[27] The higher number of out-of-hospital trauma critical cases when compared to medical critical cases in this GJM study is therefore not a surprising finding.

Figure 3.1 shows that proportionately, male trauma critical cases seem to occur most frequently (37.8%) when compared to male medical, female trauma and female medical critical cases. These data are supported by evidence from Seedat *et al*.,that addresses issues around injury and violence prevention. In their paper, males aged between 15-29 years have “disproportionate” roles in violence both as perpetrators as well as victims. Males who die from homicide in South Africa outnumber those of women by more than 7:1.[28] This finding that most critical cases analysed in this local study involved male trauma is therefore expected.

4.3 Critical Case Out-of-Hospital Time Intervals

One of the main research objectives of this local study was to determine the out-of-hospital time intervals. These out-of-hospital time intervals included the response time interval, on-scene time interval, transport time interval and the total incident time interval.

As this was an important objective, it would be beneficial to revisit the definitions of these time intervals. The response time interval includes the elapsed time from activation of the first-responder to arrival on-scene; the on-scene time interval includes the elapsed time from arrival on-scene to departure to hospital; the transport time interval includes the elapsed time from departure from scene to arrival at an appropriate medical centre and finally the total incident time interval includes the total elapsed time from responder activation to handover at the appropriate medical centre.

Considering that these time intervals were obtained from a clinical learning database, there may be specific reasons as to why certain time intervals are comparatively different to international trends. By discussing each out-of-hospital time interval separately, an opportunity to comment on these differences was created.

4.3.1 Response Time Interval

4.3.1.1 Defining Response Time Intervals

Literature defines the response time interval differently.[1-11] The end-point of the response time interval historically occurs when the first-responder reports their arrival at the given case location. However, there are certain nuances related to the definition of response time interval. Myers and colleagues, in their paper on performance

measurement in EMS, commented on the fact that the response time interval should be based on a “physiological” point of view. Simply stated, it means that this time interval should be measured from the moment the “phone rings at the 9-1-1 call-centre” until the moment that the first-responder arrives at the patient’s side. This response time interval takes into account the fact that certain locations may actually be difficult to access.[29] Carr *et al*., terms the time interval from call receipt to activation of the first responder the “activation time interval”.[11]

As mentioned in *1.6.2* one of the limitations of this local study is that students work with different clinical learning service providers during their clinical learning. These services capture data differently in relation to the “activation time interval” and thus, these were not included in analysis or reporting. The response time interval discussed below refers to the time interval from the time that the first responder is activated to the arrival of the responder at the given location.

4.3.1.2 Comparing Local and International Response Time Intervals

The average response time interval for critical cases in the GJM area according to our data was 10.67 minutes (95% CI 10.48;10.86). This response time interval includes critical cases of both traumatic and medical aetiologies. When comparing this response time interval to published data, it is important to note that most literature reviewed comments on response time intervals in two distinct categories, namely: trauma cases and out-of-hospital cardiac arrest (OHCA) cases. As mentioned in Chapter 3 the OHCA cases declared dead on-scene were excluded in this study as they were not transported to hospital.

Carr *et al*., in their meta-analysis provided comparative data related to the response time interval as defined in this study. The authors categorised the out-of-hospital time intervals according the geographical location of the ambulance service. This included urban, suburban and rural ambulance services. In their review, average response time intervals for the urban ambulance services was 5.28 minutes and suburban ambulance services was 5.23 minutes.[11] In Beijing China, Zhang, Wang, Li and Zhao reported mean ambulance response times (from time of responder activation to arrival at incident location) of 11.9 minutes. This data was obtained from 51 918 ambulance cases.[30]

As the Carr study included a vast meta-analysis, their study reported on varying response time intervals previously reported. Currently, many EMSs use the eight-minute response time interval as one performance measure of their system. This eight-minute response time interval was proposed as far back as 1979 by Eisenberg and colleagues in their OHCA-related study.[13] To date, there have been no unequivocal data to either support of refute this suggested time interval.

Authors have suggested that this eight-minute target needs to be scrutinised as EMS systems have changed dramatically and access to defibrillation and cardiopulmonary resuscitation (CPR) has improved with public education and defibrillation programmes. As mentioned in the literature review, the 2012 article by Blanchard *et al.*, found no significant increase in the risk of mortality when response time (in minutes) was treated as a continuous variable.[20] This raises questions about the significance of the currently recommended eight-minute response time interval.

4.3.1.3 Importance and Contributors to Local Response Time Intervals

In Gauteng, the only out-of-hospital time interval that is performance measured is the response time interval. The Gauteng Department of Health and Social Development (GDHSD) has suggested a response time interval target for critical cases of less than 15 minutes.[23] According to data in our study, 77% (1047/1360) of critical cases had a response time interval of less than 15 minutes, but this must be viewed with caution. Data in our study is a combination of both private as well as public healthcare sector ambulance services and possibly more importantly, does not include the "activation interval" (time elapsed from the emergency dispatch centre receiving the call until dispatch of the first-responder). When combining the activation interval and response time interval, it may well be found that the 15 minute target may be met less consistently. The extent of this is not known.

When compared to certain international response time intervals, the reasons for longer local response time intervals should be examined. The concept of "urban sprawl" has been considered by Trowbridge *et al*. In their paper, urban sprawl has been defined as the hosting of major events, low-density construction, decreased suburb access, poor street connectivity and increased infrastructural development leading to increased congestion and a subsequent decrease in traffic flow. This has been seen as a contributing factor to increased EMS response time intervals.[31]

Considering that the City of Johannesburg undertook projects (in particular transport projects) in light of the 2010 Fédération Internationale de Football Association (FIFA) World Cup since 2005, this may have had an underestimated impact on response time intervals with many of the above challenges experienced by responding EMS personnel. The time of day and related traffic congestion were not assessed in this study.[32]

With the possible de-emphasis on the effect that response time interval has on morbidity and mortality, the question needs to be asked as to whether or not there are other benefits or risks associated with decreased response time intervals. Many authors have commented on the fact that decreased response time intervals lead to improved public perception of the EMS.[11,19,20,29] Although public perception remains a relatively subjective measure, it is important. Knowles and colleagues in the United Kingdom (UK) reported in a study on patient experiences and views on an emergency system that waiting times feature highly when assessing whether a patient is satisfied with a healthcare system. In their study, patients reported satisfactory waiting times when using the ambulance service.[33] Given the aims of this study it was unable to assess this variable.

4.3.1.4 Concerns around Decreasing Response Time Intervals

When assessing possible negative consequences of decreasing response time intervals, practitioner safety comes to mind. In January 2010, an ambulance safety conference hosted in Phoenix Arizona highlighted practitioner, patient and public safety in daily ambulance activity. Multiple sources reiterated the fact that increasing

ambulance speed did not necessarily decrease response time intervals but did indeed increase the risk of ambulances and personnel being involved in collisions.

Although, generally, ambulances are fitted with warning mechanisms such as lights and sirens, these mechanisms did not decrease the risk of being involved in a collision if disproportionate speed was used whilst responding to the case.

The authors summarise the conference proceedings by stressing the fact that EMS managers should not see response time intervals as the only indicator in performance management with regards to time intervals.[34]

Although public perception is important, authors have also commented on the fact decreasing response time intervals (up to a certain extent) may require additional resources. This includes human, equipment and vehicle infrastructure. With increased financial pressures on healthcare systems globally, careful consideration must be given to increasing financial expenditure to increase infrastructure without assessing the true benefit.[17,27] This also applies to the local healthcare system in Gauteng.

Data from this study showed similar response time intervals to those internationally. The value of decreasing the response time interval remains controversial. Achieving a balance between satisfactory patient expectations, acceptable safety standards and arriving at the patient's side within an acceptable timeline during time-dependant pathologies remains a challenge for EMSs and managers.

4.3.2 The On-Scene Time Interval and the Number of Interventions Performed

Literature often describes on-scene time intervals in relation to specific pathologies. These conditions include stroke, ST-Elevated Myocardial Infarction (STEMI) and pathologies related to trauma. Inclusive of these conditions, as discussed in the literature review, there are certain time-dependent conditions that once diagnosed (or suspected), the sooner transport and definitive intervention is initiated, patient prognosis is improved.

4.3.2.1 Comparing Local and International Practice

This Gauteng study found that average on-scene times for critical cases in the GJM area was 26.69 minutes (95% CI 26.23;27.15). When comparing this to time intervals that international services are spending on-scene, GJM-based practitioners have extended on-scene times. International on-scene time intervals vary, but in the Carr *et al.,* review the mean on-scene time interval for urban ambulance services was 13.5 minutes [1,4,5,8,11] It was also found that local EMS practitioners are spending half of the total incident time interval on-scene when managing critical cases (Table 3.4).

Our data however, was comparable to on-scene times in the Western Cape. van Hoving *et al.*, found that crews in that region had mean on-scene times of 27.90 minutes when dealing with critical cases. The authors comment that this time on-scene is taken up by performing “essential tasks”. Reasons for local practitioners spending time on-scene longer than international colleagues should be sought.

4.3.2.2 Redefining the term "On-Scene"

A realistic contributor to the differences seen in on-scene time intervals when comparing local and international data may be as a result of the actual definition of "on-scene". As mentioned in section *4.3.1.1.* certain texts refer to the point of being "on-scene" as the point where the first responder arrives at the patient's side. In July 2007, the Inner City Regeneration Charter published by the City of Johannesburg made mention of the fact that there was an alarming rate of urban decay within the City's confines. This decay included the neglect of high-rise, high-populous residential areas. This decay of infrastructure included elevators, stairwells and fire-escapes.[35]

In relation to this point, a 2007 paper, in Academic Emergency Medicine, coined the term "vertical response times", authors described the multiple challenges faced by EMS personnel in gaining access to patients in different urban environments despite reporting "on-scene" at the given location. Variables such as "wrong entrance to building", "locked doors" and "poor building access" contributed to an increase in on-scene time intervals. In the article, on-scene times were increased by as much as 28 minutes in certain scenarios. This was based on the fact, that arrival "on-scene" did not necessarily mean arrival at the patient's side.[36] With this and considering the high number of informal settlements within the city's confines, this could well be a contributor to the increased on-scene time intervals experienced by patients who were critically-ill in the GJM area.

4.3.2.3 The Role of Students in Influencing On-Scene Time Intervals

It must be acknowledged that the critical case out-of-hospital time intervals reported on in the study, are from a clinical learning database. Having said this, it must also be accepted that students would be performing certain skills which they have been taught theoretically and practiced on a simulator or manikin. However, this does not guarantee immediate proficiency in the clinical environment.

Schroedl and colleagues, in their simulation-based learning paper, make mention of the fact that this type of learning is effective in improving clinical skill proficiency but does not guarantee “first-time” success in the clinical environment.[37] As a result, when students repeat clinical skills such as inserting an intravenous line, this may increase the on-scene time interval.

In their study, Gonzalez and peers reported on the increase in the on-scene time interval when practitioners insert an intravenous line successfully on the second or third attempts. In the paper, the writers report mean on-scene time interval increases by approximately three minutes per intravenous line attempt. This increase in on-scene time is for an isolated skill. The total increase in time for multiple skills that are repeated is not known.[38]

Although not ideal, it is reasonable to expect, that this could be a realistic contributor to the increased on-scene time interval in this study when compared to international data. In addition to multiple attempts for isolated procedures, it could be considered that students are performing interventions purely in the interests of clinical learning. This practice is not supported by the UJ and this is emphasised with supervisors and it is

believed that this is not a major contributor. Further comment on the on-scene time interval and number of interventions performed will be provided below.

4.3.2.4 The Effect of Team Dynamics on the On-Scene Time Interval

As described earlier, data from this study was obtained from a clinical learning database. These critical case time intervals come from a combination of cases from ambulance services from both the private and public healthcare sector. In the GJM, the possibility exists that multiple resources are sent to the same incident as currently there is no single emergency dispatch centre managing both human and vehicle resources.[23] As a result, it is likely that personnel from different services attend the same critical case. Caldwell *et al*., and Castelao *et al*., reflect on team dynamics in the healthcare environment.

The authors of these papers suggest that when healthcare personnel that are not familiar with working with each other are expected to perform together in a team, role definition may become blurred. As a result, aspects of patient care timelines, quality, effectiveness and safety may be compromised. This is particularly evident in the critical care environment, according to Castelao.[39,40] Although not likely an isolated contributor to extended on-scene time intervals, this is a consideration in this GJM study.

4.3.3 The Relationship between Interventions and On-Scene Time Intervals

In addition to commenting on local on-scene time intervals in this study, an important research objective was to determine whether or not there was a relationship between the number of interventions performed and the on-scene time interval. After data analysis, the linear regression model indicated that in this study, critical case on-scene

time intervals increase when additional interventions were performed. With relative accuracy, the model was able to predict the on-scene time interval based on the number of interventions performed.

The relationship between on-scene time intervals, interventions and patient outcome remains unclear. As mentioned earlier, depending on the pathology, bodies of knowledge support either the “scoop and scoot” principle or alternatively the “stay and play” principle. When contextualising these principles in terms of time, Kulla and colleagues added an extra time interval to those already discussed above. In their paper, based on a German trauma registry, the “trauma resuscitation time (TRT)” interval was introduced and assessed.

This TRT was the elapsed time from the time of the incident to the time when ED treatment ended. According to their findings patients who underwent multiple out-of-hospital interventions had increased total out-of-hospital time intervals, but had the same TRT intervals when compared to those patients who received the interventions in the ED.[41]

This paper highlighted the importance of the continuum of care in the emergency care environment and is relatively novel when reporting on data. Historically, authors create two very separate healthcare environments for patients requiring emergency care. These separate environments include the prehospital and the in-hospital environment. Although each environment is unique and has individual time intervals, the continuum of care as well as total time extends across both environments.

Naturally, prehospital and in-hospital timelines are reported on differently. However, as pointed out by the Kulla study, whether the intervention took place in the out-of-hospital environment, or in the ED, there was no difference to TRT.[41] In some instances, initiating early intervention in the out-of-hospital environment may lead to improved patient prognosis. An acceptable example of this includes the early administration of analgesia.

In Australia, Jennings emphasised the fact that early, sufficient out-of-hospital analgesia administration has two important reasons. Firstly, because healthcare practitioners should subscribe to a humanitarian ideology, this becomes an essential part of relieving human suffering. Secondly and scientifically supported, this strategy could prevent the transition from acute pain to chronic pain syndromes.

Early analgesia promotes recovery from traumatic injury and also enhances mental health in relation to the pain.[42] Beyond the realm of critical cases, Smit and Boyle defended prolonged on-scene time intervals to establish intravenous access and provide analgesia to simple ankle fractures for the same reasons outlined above.[43]

Further to this, the author of this local study notes the findings of the French Intensive care Recorded in Severe Trauma (FIRST) study with interest. With some authors supporting the “scoop and scoot” principle [4,16], this European study found that performing additional interventions in the out-of-hospital environment decreased 30-day mortality in patients who underwent blunt trauma. The sample that underwent interventions performed by Emergency Physicians (EPs) included endotracheal intubation, mechanical ventilation, post-induction sedation, vasopressor support and fluid resuscitation had longer on-scene time intervals than those who were transported by a Basic Life Support (BLS) service.

In addition, their hospital admission time was longer but the study end-point showed an improvement in 30-day mortality (*p=0.03*) after correcting for initial clinical status and the Injury Severity Score (ISS). South African Advanced Life Support (ALS) practitioners have the ability to perform the interventions listed above.[44] Further developments related to this study should be followed with interest.

The effect of an extended on-scene time to establish intravenous access on patient outcome was investigated by Seymour and colleagues, in 2012. In the American study, the authors reported on decreased mortality (odds ratio=0.68) in high acuity, non-injured, critically-ill patients, where on-scene time was extended whilst establishing

intravenous access. On-scene time intervals in the study were extended by six minutes on average. Mortality was decreased after correction for illness severity, demographics, dispatch and transport characteristics. Our local study did not investigate patient outcomes and therefore were not able compare our findings to the Seymour study. The relationship between increased on-scene time intervals and the number of interventions performed was important though.[45]

In Gauteng, the public healthcare sector provides a two-tiered emergency medical response service. Advanced Life Support practitioners in a Primary Response Vehicle (PRV), if available, are dispatched to suspected high-acuity calls, followed by an ambulance staffed with ILS and/or BLS practitioners when one becomes available. Most private healthcare emergency medical service providers operate similarly.

Although this study did not determine whether the student was on the PRV or ambulance, it could be suggested that on-scene time intervals in this local study could be extended because ALS practitioners could be waiting on-scene for an ambulance. The extent of this is not known. However, in the Fischer *et al*., study mentioned in the literature review, authors found that despite slightly extended on-scene time intervals (predominantly because of the increased number of interventions), a two-tiered emergency medical service (BLS followed by ALS response) seemed to improve patient condition with relation to cardiac chest pain, respiratory distress and OHCA.[12]

The results of this local study have shown that local practitioners have longer on-scene time intervals with critical cases when compared to data internationally. Possible reasons for this longer on-scene time interval were explored. This study has also shown

that the on-scene time interval is increased when additional interventions are performed on-scene. Based on different bodies of evidence, the role of increased interventions in the out-of-hospital environment remains under investigation.

4.3.4 Transport Time Interval

The transport time interval is defined as the elapsed time from the departure from scene to arrival at the receiving medical facility. In our study, average transport time for critical cases in the GJM area was 16.24 minutes (95% CI 15.92;16.56). The area that formed part of the GJM area was approximately 1650.00km^2 during the period of data review with a population of approximately 7,151,450.[45] In this area, six public health receiving medical facilities and 16 private health receiving facilities have the capacity to receive critical cases depending on the case aetiology.[47,48]

The results of this local study showed that the average transport time interval was longer than the response time interval reported on earlier. The transport time interval is seldom used as a performance indicator when assessing EMS performance and the impact of the transport time interval on patient outcome even less so. When compared to international data, it was found that various transport time intervals were experienced in international EMS systems. Carr and colleagues presented transport time intervals of 10.78 minutes in their meta-analysis.[11]

Although not routinely commented on, it is important to note that that the transport time interval forms part of the total incident time interval and the fact that the patient still requires on-going care during this period. In the 2011 Gonzalez study performed in a rural environment, authors found that intravenous access en-route to hospital was more

successful than intravenous access success on-scene. Although the GJM area data was obtained from an urban environment, our average transport time interval was similar to those transport time intervals experienced in other studies in rural settings. Practitioners should be reminded that interventions that take place on-scene can be effectively performed whilst transporting a critically-ill patient to hospital.[11,36]

In 2007, the Myers *et al*., statement on evidence-based performance management in the EMS briefly made reference to “ALS transport intervals”, where slightly better survivability was experienced by Return of Spontaneous Circulation (ROSC) patients who had suffered OHCA. In this paper, the authors made mention of the fact that the transport time interval could be extended if appropriate care was being given during this time.[28] Although not entirely represented from this data, considering that a high number of critical cases in the GJM were being attended to by students supervised by ALS practitioners (65.7% - Table 3.5), this is a consideration.

However, despite having highlighted the importance of the transport time interval above, the Arizona ambulance safety conference mentioned in *4.3.1* above, also stated that the transport time interval is another area that requires attention regarding safety and risk awareness. During the transport time interval, treating practitioners are often providing care under adverse conditions and increased speeds during this period increased the risk of injury to both practitioners and patients. These increased speeds did not improve transport time intervals but, like the response time interval discussion, increased risk of injury.[34]

In recent times, the use of Helicopter Emergency Medical Services (HEMSs) to transport critically-ill patients has become commonplace in established EMS systems, both internationally and locally. According to van Hoving and colleagues in the Western Cape one of the perceived primary benefits of using HEMS is to minimise time to definitive care.[24] This is possible as HEMSs are not affected by traffic congestion, road closures and typical urban sprawl activity. It must however be stressed that this is generally in relation to the transport time interval.

Authors have found that HEMS use does not significantly shorten the total incident time interval as on-scene time intervals in this group are usually prolonged.[7,23] Myers and peers support this and mention that the transport time interval should not be considered in isolation when using air transport as the on-scene time intervals and the transport time interval could be longer than when using ground transport.[29]

4.3.5 Total Incident Time Interval and the Transport Distance to Hospital

This study focused on the out-of-hospital time intervals that critical cases were experiencing in the GJM area. In the literature review, the “golden hour” was used as a reference term to contextualise the relevance, interest and importance that international EMSs have placed on investigating out-of-hospital time intervals. Locally, little data existed describing these time intervals. This study showed that the average total incident time interval experienced by critical cases in the GJM area was 53.53 minutes (95% CI 52.90;54.15).

Although the impact of achieving the “golden hour” has been debated, it would appear that on average, data obtained from this local database, critical cases were reaching definitive care within this specified time period. Despite this, it must also be noted that this total incident time interval does not include the “activation interval” mentioned earlier. Further investigation of this interval may indicate significantly increased out-of-hospital time intervals. The extent of this is not known.

Varying data exists when comparing these local total incident time intervals to those internationally. In one large meta-analysis in the US, Carr found that out-of-hospital time intervals over a 30-year period were approximately 30 minutes. This, however, was in cases involving only trauma.[11] In a large retrospective German study, it was found that mean out-of-hospital time intervals for trauma were approximately 70 minutes. This study, however, included the out-of-hospital intervals from the time of the incident (“physiological” point of view).[49]

As mentioned with the transport time interval above, the total incident time interval is seldom used as an indicator when assessing overall EMS performance. The total incident time interval is more commonly used when assessing EMS performance in relation to time-dependent conditions. This is relevant in conditions such as STEMI. The American College of Cardiology and the American Heart Association recommend that patients experiencing STEMI should receive Percutaneous Coronary Intervention (PCI) within 90 minutes from the time of first medical contact. If this first medical contact is EMS, then the total incident time interval can contribute to a major portion of this 90 minute period. Decision-making by EMS practitioners in relation to urgent transport then becomes important.[6]

Ramanujam and colleagues also commented on the importance of the total incident time interval in relation to stroke intervention. In their San Diego study, it was found that total incident time intervals for ischaemic stroke patients was 39 minutes. Currently, it is suggested that intervention for ischaemic stroke patients should occur within 3 hours from the onset of signs/symptoms. Again, the out-of-hospital time intervals could be significantly affected by EMS practitioner decision-making and performance.[8]

In fulfilling the research objectives of this study, data showed that an increase in the distance to the receiving medical facility would increase the total incident time interval. At face value, this seems indeed logical. However, this finding requires further comment in a broader context.

With certain pathologies being time-dependent, it is important that local EMS managers take this distance and the impact on the total incident time interval into account when planning vehicle and human resources. Papers by Myers *et al*., as well as Tissier *et al*., made reference to the fact that ALS intervention, earlier on improved survivability. Considering the vast distances/areas that rural South African EMSs cover may mean that emphasis should rather be on placing ALS in these rural areas as opposed to concentrating this resource in the urban environment as time spent with the patient will be longer based on the distance from receiving medical care.[24,27,42,44]

4.4 Conclusion

This chapter contextualised and rationalised the results from Chapter 3 where possible. Possible reasons for the comparative difference to international data in out-of-hospital time intervals were suggested. These suggestions were only considered as possibilities as the true reasons for the comparative differences were assessed in this study.

In addition to reflecting on the critical case out-of-hospital time intervals, reasons for an increase in the on-scene time interval in relation to the number of interventions performed was also discussed. Chapter 5 below presents the recommendations and future research, limitations and the conclusion of the study.

CHAPTER 5: RECOMMENDATIONS AND FUTURE RESEARCH, LIMITATIONS AND CONCLUSION

5.1 Recommendations and Future Research

Patients who experience critical illness may use EMSs to transport them to definitive care. However, as emergency care has progressed through the decades, certain interventions that were performed exclusively in-hospital, are now being performed out-of-hospital. This local study, supported by international studies, has shown that these interventions prolong the on-scene time interval but not necessarily the total incident time interval. Evidence has also found that bar certain time-dependent conditions, the impact of out-of-hospital time intervals remains unknown. Based on these comments, this local study would like to recommend the following in two distinct categories:

5.1.1 Improving Performance pre-Emergency Medical Service Arrival

Currently, the only performance indicator assessed by public healthcare EMSs are the response time interval. Based on the lack of evidence supporting either a four-minute, eight-minute or 15 minute response time interval in relation to patient outcome in all conditions, it is recommended that response time interval performance indication is linked to specific clinical conditions.

Evidence has suggested that specific conditions such as respiratory distress, STEMI, stroke, status epilepticus, suspected sepsis, OHCA and penetrating trauma have better outcomes when identified and treated earlier. However, this is just not in relation to the response time interval but also, the total incident time interval.[29]

In order to do this, earlier identification of the specific clinical condition needs to occur. This includes better public awareness and earlier, better EMS access. Strategies to assess public knowledge on certain emergency medical conditions are being undertaken and should be used to inform public awareness campaigns.[50]

As suggested in the Kwazulu-Natal study by Hardcastle and colleagues a single, national telephonic entry point to EMS is essential for effective resource management. Once the EMS has been accessed effective triage with the assistance of Computer-Aided Dispatch (CAD) systems can lead to more effective condition prediction and resource allocation in terms of BLS or ALS requirements.[27,51]

Responding personnel need to be made aware of the patient signs and symptoms by EMS dispatchers as this heightens awareness around these time-dependent conditions.[8] Responders need to be made aware that currently, the response time interval impacts only a small subset of patients such as OHCA. In simple terms, despite increasing the financial and safety risks of decreasing response time intervals for all categories of patients, this may not ultimately improve all patient outcomes.[34]

5.1.2 Improving Performance post-Emergency Medical Service Arrival

On-scene time intervals and the number of interventions performed on-scene need to be contextualised appropriately. As mentioned above, certain conditions benefit from earlier identification and intervention.

Certain “treatment bundles” have shown to improve patient outcome when performed on-scene.[24,29,42,43,44] Emergency Medical Service systems require robust clinical governance and quality processes to ensure that EMS practitioners are aware and are implementing these “treatment bundles” when appropriate.

Both in-hospital and out-of-hospital practitioners are urged to consider the continuum of care concept as suggested by Kulla and colleagues. On some occasions, on-scene time intervals (and subsequently total incident time intervals) may be prolonged to perform certain interventions. This prolonged on-scene time interval may subsequently decrease the time spent in the ED where these interventions would have been performed. However, these interventions need to be carefully considered. Future research regarding these interventions and “treatment bundles” are required.[41]

It is also recommended that out-of-hospital practitioners “merge” the on-scene time interval and transport time interval in terms of performing interventions. Considering the fact that lighting, access to equipment and protection from weather elements is generally better in the ambulance than on the roadside, authors support performance of interventions whilst en-route to receiving medical care as opposed to performing these interventions at the scene. Additional care should be taken however, to minimise injury whilst performing these interventions.[34,36,44.]

In terms of the relationship of the total incident time interval and the distance to receiving care, it is suggested that South African EMS systems strongly consider their human resource model. As suggested by certain authors, it may be appropriate to initiate ALS interventions earlier on considering the distance to receiving medical care. South African EMSs in outlying and rural areas should urgently consider whether appropriate interventions and care is being provided during prolonged transport times. Research related to current EMS staffing models are required to investigate this.[29,36]

5.2 Limitations of the Study

This study highlighted the out-of-hospital time intervals experienced by critical cases in the GJM area. Although valuable insight was gained into these intervals, one of the limitations of this local study is that data was obtained from a clinical learning database. The influence of the student on the critical case time intervals cannot be quantified entirely. However, all students are supervised by registered practitioners and clinical decision-making regarding interventions and transport decisions are left up to these registered practitioners.

Another limitation of this study, again linked to the data source, is the fact that not all critical cases during this time period would have been reflected. This is because the critical cases assessed in this study would have only have been those where a Patient Care Record (PCR) was completed and submitted by the student attending to the critical case. Critical cases may have occurred without a student being present at the time. Those critical case time intervals were not assessed.

Internationally, standardised reporting of data in the out-of-hospital domain remains problematic. This is also a limitation of this study. Actual times were documented by students and signed off by supervising practitioners. However, as mentioned previously, the definition of “on-scene” may be interpreted differently, and thus, it is possible that various time intervals may be defined differently in certain cases. Future, prospective studies using automatic time capturing systems can prevent this.

International data regarding out-of-hospital time intervals is usually represented in two distinct categories; namely trauma and non-trauma cases. As described above, certain pathologies are time-dependent and patient outcome may improve in certain cases where out-of-hospital time intervals are shortened. This study did not analyse different pathologies in relation to time intervals but assessed all critical cases in totality. This is a limitation and could enjoy further research at a later stage.

Finally, but not exhaustively, another limitation of this study is that patient outcome in relation to out-of-hospital time intervals was not assessed in this study. Considering the number of receiving facilities and different ways of reporting data, this was considered beyond the scope of this study. Future studies in the GJM area could focus on this relationship.

5.3 Conclusion

This chapter discussed the results of this study in relation to international studies. Out-of-hospital time intervals were found to be similar to other studies published in this domain. Despite these findings and similarities, “ideal” out-of-hospital time intervals remain controversial.

An increase in the number of interventions performed were linked to an increase in the on-scene time interval as supported by international findings. This was rationalised in the greater context, where patient care in the emergent environment must be considered as a continuum, that does not end when the ambulance arrives at the hospital door.

In light of the debate around “ideal” times and interventions performed, it is has become evident that EMS systems are under increasing pressure to deliver a service that is cost-effective, clinically effective and safe that may well be linked to quantitative measures. In the same breath, considering the nature of EMS work, the qualitative measures such as patient experience and satisfaction cannot be dismissed.

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APPENDIX A – PATIENT CARE RECORD

UJ EMERGENCY MEDICAL CARE
PATIENT CARE RECORD

Date : dd_____mm_____yy_____

Name :

Address :

Tel No:

Gender ☐ Race ☐

Age ☐ If exact age unknown:
Adult ☐ Child ☐
Infant ☐ Neonate ☐

Incident Location

Student 1 : _____

Student 2 : _____

Crew : _____ ☐

EMS: INC No:

Transported By:

Transported To:

	HRS	MINS
Call Received :		
On Scene :		
Left Scene :		
At Hospital :		

Vehicle Reg. No: ☐

Priority: 1 2 3 4

HISTORY / CLINICAL FINDINGS:

DO NOT LEAVE BLANK

MECHANISM:

MVA: ☐
- ☐ Front Impact
- ☐ Rear Impact
- ☐ Right Side Impact
- ☐ Left Side Impact
- ☐ Rollover
- ☐ Pt. Ejected
- ☐ Entrapment

Entrapment Duration:_____min.
Approx. Speed:_____ km/h

Pedestrian: ☐
- ☐ Front Impact
- ☐ Rear Impact
- ☐ Left Side Impact
- ☐ Right Side Impact

Approx. Speed:_____ km/h

Fall: ☐
Approx. Height: _____m

Shooting: ☐
Approx. Range: _____ m
Calibre: _____

Stabbing: ☐

Other Assault: ☐

Crush Injury: ☐
Crush Duration:_____min.

Burns: ☐
- ☐ Thermal
- ☐ Chemical
- ☐ Electrical

PRIMARY SURVEY:

Neuro Status
- ☐ Alert
- ☐ Responding -verbal
- ☐ Responding - painful
- ☐ Unresponsive

Airway
- ☐ Patent
- ☐ Threatened - LOC
- ☐ Threatened – Foreign Body
- ☐ Threatened – Blood/Vomitus
- ☐ Threatened – Inflammation
- ☐ Threatened – Facial Trauma

Breathing
- ☐ Normal
- ☐ Tachypnea
- ☐ Bradypnea
- ☐ Respiratory Distress
- ☐ Central Cyanosis
- ☐ Apnea

Circulation
- ☐ Peripheral Pulses Present
- ☐ Peripheral Pulses Absent
- ☐ Central Pulses Present
- ☐ Central Pulses Absent
- ☐ Exsanguinating Haemorrhage

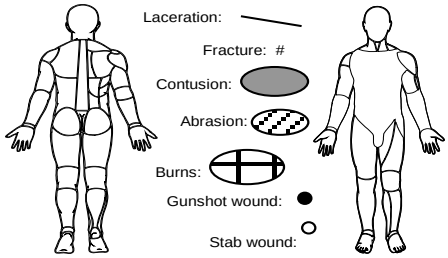
TIME										
Blood Pressure										
Pulse/min										
Resps/min										
Skin										
Pupil Reaction	L	R	L	R	L	R	L	R	L	R
Pupil Size										
GCS										
$Sa0_2$										
HGT mmol/l										
ECG Rhythm										
APGAR Score										

DO NOT LEAVE BLANK

O_2 Delivery Device_____ @ _____ **l/min**

TIME	DRUG/FLUID	DOSE	ROUTE

DO NOT LEAVE BLANK



PROCEDURES:

ET Intubation: ☐

☐ Oral ☐ Nasal
No. Attempts: ____
☐ Successful ☐ Failed
Sedation Required ☐

Cricothyroidotomy: ☐

Technique/Ventilation:
☐ Needle
☐ Surgical
☐ Jet Insufflation
☐ BVM Ventilation

Reason for Cric.:
☐ Failed Intubation-no Facial Trauma
☐ Facial Trauma
☐ Upper Airway Obst.-Foreign Body
☐ Upper Airway Obst.-Inflammation

Intravenous Access: ☐

No. Attempts: ____
No. Successful: ____
IV Started: ☐ On Scene ☐ In Vehicle ☐ At Destination

Full Spinal Immobilisation: ☐

OTHER TREATMENT / PROCEDURES:

DO NOT LEAVE BLANK

SKILLS PERFORMED:

Crew Signature

CREW COMMENTS:

Signature

I hereby release _____, the emergency care provider and UNIVERSITY OF JOHANNESBURG from any liability of medical claims resulting from my refusal of emergency care and/or transportation to the nearest recommended medical facility. I further understand that I have been directed to contact my personal doctor with regard to my present condition as soon as possible. I have received an explanation of the potential consequences of my refusal of emergency care and/or transportation which I understand.

_____ _____
Patient Signature Emergency Care Provider Signature

Date: dd_____**mm**_____**yy**_____ **Time:**_____**:**_____

I hereby declare that the following valuables, belonging to the patient whose name appears on this data form, were handed over to me by _____, the emergency care provider.

1. _____
2. _____
3. _____
4. _____

Signature: _____
Name: _____

Patient handed over to: _____

Signature

Student Signature

SURVIVAL
(PRIORITY ONE PATIENTS)

Hospital: _____

Hospital Number: _____ Hospital Stay: _____ Days.

Survival:
☐ Died Pre-hospital
☐ Died in Casualty
☐ Died in ICU/Ward
☐ Discharged with Disability
☐ Discharged without Disability

EMDATA
Emergency Medical Database and Analysis System
Revised January 2007
Copyright ©2000-2008 UJ

Date Captured: dd_____**mm**_____**yy**_____
PCRID:_____

APPENDIX B – ETHICAL CLEARANCE CERTIFICATE

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Benjamin S van Nugteren

CLEARANCE CERTIFICATE	**M110247**
PROJECT	Out-of-Hospital Critical Case Time Intervals Occuring in the Greater Johannesburg Metropolitan Area, Gauteng, as Recorded in a Paramedic Clinical Learning Database
INVESTIGATORS	Benjamin S van Nugteren
DEPARTMENT	Department of Family Medicine Medical School
DATE CONSIDERED	25/02/2011
DECISION OF THE COMMITTEE*	Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 25/02/2011 **CHAIRPERSON** .....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable
cc: Supervisor : Mr C Stein

DECLARATION OF INVESTIGATOR(S)
To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**
PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

APPENDIX C – LETTER OF PERMISSION

UNIVERSITY OF JOHANNESBURG

26 January 2011

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL) – UNIVERSITY OF WITWATERSRAND

As the owners of the data contained within the Department of Emergency Medical Care and Podiatry: Emergency Medical Database and Analysis System (*EMDATA*), permission is hereby granted to Mr. Benjamin S. Van Nugteren (Student no: 519330) to access and analyse data to assist in the completion of his Master's research project entitled "OUT-OF HOSPITAL CRITICAL CASE TIME INTERVALS OCCURING IN JOHANNESBURG, GAUTENG AS RECORDED IN A PARAMEDIC CLINICAL LEARNING DATABASE". Mr. van Nugteren may access all the relevant recorded patient care records and associated data ranging from 1 January 2001 to 31 December 2008. The specific data includes age, location, gender, mechanism of injury/disease, level of intervention and the supervising crew category of registration.

If you have any queries regarding the above, please do not hesitate to contact me 082 653-2125 or at clambert@uj.ac.za

Mr. C. Lambert

Head of Department: Emergency Medical Care and Podiatry

Faculty of Health Sciences

University of Johannesburg.