AN ANALYSIS OF EMERGENCY RESPONSE TIMES WITHIN THE PUBLIC SECTOR EMERGENCY MEDICAL SERVICES IN KWAZULU-NATAL

A dissertation submitted in fulfilment of the requirements for the degree of Master of Health Sciences in Emergency Medical Care in the Faculty of Health Sciences at the Durban University of Technology

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DECLARATION OF ORIGINALITY

This is to certify that this work is entirely my own and not that of any other person, unless explicitly acknowledged (including citation of published and unpublished sources). The work has not previously been submitted in any form to the Durban University of Technology or to any other institution for assessment or for any other purpose.

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Signed _____

Date 01 August 2017

ETHICAL CLEARANCE

This is to certify that the research studies conducted for the purposes of this dissertation have the approval of the Institutional Research Ethics Committee (IREC) of the Durban University of Technology (DUT) in KwaZulu-Natal.

Institutional Research Ethics Clearance Number: REC 83/13

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ABSTRACT

Introduction: Response times are considered to be one of the oldest and most popular indicators which are used to measure the efficiency of Emergency Medical Services (EMS), particularly to cases in which the patient's condition is deemed to be life threatening.

Purpose: To analyse emergency response times within the public sector Emergency Medical Services in KwaZulu-Natal and to compare these to the national norms.

Methods: Using a mixed method approach, the study was conducted in two phases. The first phase involved collecting quantitative data for all the cases logged in the Umgungundlovu Health District Communications Centre over a period of one week (seven days). Phase Two involved the collection of qualitative data from focus group discussions which were conducted with three groups which had been identified. These groups included the communications centre staff, operational staff and supervisory staff. The aim of these focus group discussions was to identify factors that influenced response times as well as to propose strategies which would improve these response times. Content analysis was utilised to interpret the qualitative data which had been collected.

Results: Quantitative data was collected from a total of 1 503 cases of which 680 were categorised as priority 1 (P1), 270 as priority 2 (P2) and 553 as inter facility transfer (IFT). The majority of the cases (895) had occurred in urban areas. A total of 406 cases were exempted as no patient was transported. The number of these cases was greater on days when the total case load was higher as compared to days with a lower total case load. The mean response time to cases in rural areas was 129 minutes and 110 minutes to cases in urban areas. All the time intervals were found to be longer for cases in rural areas as compared to those for cases in urban areas but with the exception of the EMD response interval. P1 cases had the shortest mean response times for both urban area cases (33 minutes) and rural area cases (95 minutes) as compared to the other case categories. Nevertheless, the national norm of 15 minutes in urban areas and 40 minutes in rural areas was not achieved in the majority of the cases. The mean Emergency Medical Dispatch (EMD) response interval was 41 minutes for P1 cases, 56 minutes for P2 cases and 96 minutes for IFT cases.

The qualitative data revealed factors that impacted on the response times and helped to explain and account for the quantitative data results. Challenges regarding the availability of resources, including vehicles, staff and equipment, as well as the way in which such resources are managed, were highlighted. The high demand for services compared to the available resources was raised by the focus group participants with this high demand resulting in extended EMD response intervals. This was exacerbated by the overwhelming demand for IFT cases which are serviced by the same resources as emergency cases and which have a much longer mission time, thus delaying response times continuously. Exempt cases were also found to impact negatively on response times as, although operational vehicles are committed to these cases, services are not required. Inconsistencies with regards to case prioritisation and dispatch triage also emerged. External factors, including poor road infrastructure, lack of road names and house numbers, weather conditions and long distances between EMS bases, the patient or incident location and health care facilities were also identified as factors that resulted in extended response times. Strategies to improve the situation were explored. These strategies included the effective management of resources in order to ensure optimal availability, the introduction of a formal, computer aided, dispatch system, the adoption of demand pattern analysis and dynamic location/relocation models, standardised processes and procedures to guide all areas of EMS operations and the education of both the public and staff.

Conclusion: South African EMS response time national norms for both rural and urban areas are unachievable under the majority of circumstances and, thus, they may be said to be unrealistic. Until these national norms, against which the efficiency of EMS in South Africa is measured, are revised, the service will be deemed to be incompetent.

DEDICATION

This dissertation is dedicated to all the Emergency Medical Services personnel who tirelessly dedicate their lives to serving those in a time of need, as well as to our families and loved ones who provide the continuous support, sacrifice and love which enables us to deal with the heartache and devastation we witness on a daily basis.

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My mom and dad, Verity and Robert Finlayson, I thank you for always believing in me, supporting me through the difficult times, for never allowing me to give up and, most importantly, for the many sacrifices you have made to give me the very best opportunities in life – I owe everything I have achieved to you.

Finally, the success of this journey would not have been possible without God the Almighty. When I felt most alone, Your presence gave me comfort, strength and guidance and enabled me to persevere.

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Emergency Medical Services (EMS): The system that organises all aspects of the care provided to patients in the prehospital or out-of-hospital environment. The term 'EMS' in context may encompass or refer to local, regional, national or international systems for the delivery of patient care (Newton 2013; Stein 2014).

EMS Communications Centre: A communications centre which is available 24 hours a day via a toll free emergency number in order to provide access to the public and other agencies to Emergency Medical Services (KwaZulu-Natal Department of Health 2004). The command and control of available resources is coordinated by the dispatching of vehicles to incidents or patients requiring EMS.

Emergency Vehicle: A vehicle that is used as part of a response system to transport patients to hospital and/or respond to incidents. These vehicles are dedicated to EMS use and are custom built and equipped for this purpose (Stein 2014). This study makes reference to two categories of emergency vehicles, namely, an ambulance that responds to an incident and which may transport one or two recumbent patients to hospital and a response vehicle that responds to an incident but is not suited to the transportation of any patients.

Dispatch triage: The process of prioritising cases logged and based on the information provided by the caller during receipt of the call by the EMS communications centre.

Triage: The process for sorting injured people into groups based on their need for or the likelihood of their benefiting from immediate medical treatment (Newton 2013).

Priority One/Red Code: A life threatening injury, illness or condition which demands the highest priority from EMS (KwaZulu-Natal Department of Health 2004; Stein 2014).

Priority Two/Yellow Code: A serious injury requiring hospitalisation but not considered to be life threatening (KwaZulu-Natal Department of Health 2004; Stein 2014).

Priority Three/Green Code: Minor injuries not requiring urgent intervention (KwaZulu-Natal Department of Health 2004).

Response Time: The period from the receipt of a call by the EMS communications centre to the time the first EMS vehicle arrives on the scene (KwaZulu-Natal Department of Health 2004; Castrén *et al.* 2008; Stein 2014).

Emergency Medical Dispatch (EMD) Response Interval: The period from the receipt of the call by the EMS communications centre to the time the first EMS vehicle is dispatched (KwaZulu-Natal Department of Health 2004; Castrén *et al.* 2008).

EMS Unit Response Interval: The period from the time the first EMS vehicle is dispatched to the time the first EMS vehicle arrives on the scene (KwaZulu-Natal Department of Health 2004; Castrén *et al.* 2008).

Prehospital interval: The period from the time the call is received by the EMS communications centre to the time the transporting emergency vehicle arrives at the receiving health facility (Castrén *et al.* 2008).

Mission Time: The period from the receipt of the call by the EMS communications centre to the time the case is completed and the attending emergency vehicle is available for dispatch to the next case.

Dispatch: The process of activating and sending resources to the scene of an incident or patient (Mould-Millman *et al.* 2015).

Inter-facility transfer: The transportation of a patient from one health facility to another.

Emergency case: A request for EMS for a patient or incident not within a health facility.

Incident: An event associated with one or more patients experiencing some type of condition requiring EMS (Stein 2014).

Exempt case: A logged call which did not result in the transportation of a patient to hospital (KwaZulu-Natal Department of Health 2004; Stein 2014).

EMS base: A base from which operational duties are carried out in order to service a particular a geographical area as well as the surrounding areas (KwaZulu-Natal Department of Health 2004).

Satellite base: A base which is an extension of an EMS base and has been strategically decided upon in order to improve response times. Such a base is not fixed and, therefore, it may change based on demand (KwaZulu-Natal Department of Health 2004).

CHAPTER 1:
INTRODUCTION

1.1 Study Background

MacFarlane and Benn (2003) highlighted challenges within the Emergency Medical Service (EMS) system, including the fact that there are few validated indicators of effectiveness and quality, that there are no universally accepted methods for the measurement of EMS efficiency and that the adequate assessment of the EMS system is not currently possible due to the difficulties involved in developing appropriate indicators. In order to produce effective rules and guidelines for the prehospital EMS setting, appropriate indicators that require in depth audit, research and analysis are necessary (Spaite *et al*. 1995; Moore 1999; MacFarlane and Benn 2003).

One of the most widely accepted criteria norms used for measuring the effectiveness and efficiency of EMS is that of response times, particularly to cases in which the patient's condition is deemed to be life threatening (Gendreau, Laporte and Semet 2001; MacFarlane and Benn 2003; Carr *et al.* 2006; Schooley and Horan 2007; Budge, Ingolfsson and Zerom 2010). There is, however, currently no universally accepted response time norm in existence. The most widely used standard includes the eight minutes and 59 seconds which should be achieved in 90% of all responses (Neely, Moorhead and Schmidt 1997; Pons and Markovchick 2002; Fitch 2005). This standard was introduced in the early 1970s after a study conducted on cardiac arrest survival rates which concluded that, among other factors, response times of less than eight minutes increased survival rates (Baum, Alvarez III and Cobb 1974; Cobb *et al.* 1975). At a later date, the addition of the 59 seconds was introduced to accommodate the logging of calls before the use of sophisticated computerised systems (Eisenberg, Bergner and Hallstrom 1979; Fitch 2005).

Response times are measured from the time an emergency call is received to the time the first emergency vehicle arrives on the scene (Meislin *et al.* 1999; MacFarlane and Benn 2003; KwaZulu-Natal Department of Health 2004; Castrén *et al.* 2008). Nationally and, more specifically, in KwaZulu-Natal (KZN), in South Africa the national norm for response times to priority one (red code) cases in urban areas is within 15 minutes and in rural areas

within 40 minutes for public EMS (KwaZulu-Natal Department of Health 2004, 2009, 2010b, 2015b, 2016a, 2016b).

The majority of public EMS bases in KZN are situated in urban areas. These areas vary in nature with some neighbourhoods having clearly marked street names and house numbers while the complete lack of such in other areas often makes it extremely difficult to locate a patient. However, although emergency vehicles are based within the urban areas they are not confined to these urban areas and are required to attend to cases in both urban and rural areas. This may result in delayed responses to cases in urban areas as emergency vehicles are not always readily available. This appears to be a common scenario as the majority of cases attended to by the KZN public EMS are within areas which are classified as rural with the KZN Department of Health reporting a total of 162 760 priority one cases within urban areas and a total of 205 668 priority one cases within rural areas during the 2015/16 financial year (KwaZulu-Natal Department of Health 2016a). The areas that are classified as rural are usually vast with widely dispersed populations and very poor road infrastructure. This results in long distances having to be travelled and at a slow pace. These factors all contribute to delayed response times and make it difficult to achieve the response time national norm of 15 minutes in urban areas and 40 minutes in rural areas.

Anecdotal evidence as well as reports issued by the KZN Department of Health show that the current national norms for response times to priority one (red code) cases in both the rural and urban areas in KZN are not achievable as it has proved not to be possible to respond within these set timeframes from as far back as 2004 when the KwaZulu-Natal Department of Health started reporting on performance as measured against these national norms (KwaZulu-Natal Department of Health 2000, 2005a, 2005b, 2006, 2007, 2008, 2009, 2010a, 2010b, 2011, 2012a, 2012b, 2013, 2014, 2015b, 2015a). The finding that performance has, in fact, deteriorated over the years, which may be a result of improved data collection tools, data management and the reporting of a more accurate output than was previously the case. The reasons for poor performance have been cited broadly and include a lack of available emergency vehicles and an increase in demand for the service. This does not, however, provide either an in depth understanding of or an adequate explanation for the poor performance reported (KwaZulu-Natal Department of Health 2005a, 2006, 2009, 2010a, 2010b, 2011, 2012b, 2013, 2014, 2015b, 2015a). Although this information is available and has been reported, it was unclear how it is obtained and

analysed. This gives rise to questions about the reliability and validity of the available data and current reporting.

1.2 Research Purpose and Objectives

The purpose of this research study was to analyse emergency response times within the public sector Emergency Medical Services in KwaZulu-Natal.

The objectives of the research study included:

1. Analysing response times in both rural and urban areas in KZN and comparing them with the established South African national norms.

2. Exploring factors that influence response times in KZN.

3. Identifying strategies to improve response times.

1.3 Research Questions

The research study sought to answer the following research questions:

1. What are the actual response times currently being achieved in both rural and urban areas in KZN and how do these compare with the established South African national norms?

2. How do non-priority one cases impact on the priority one cases response times?

3. What factors contribute to the meeting/non-meeting of the response time national norms?

4. What recommendations may contribute to the improvement of response times in the future?

1.4 The Researcher's Interest in the Study

The researcher has a broad understanding of the EMS field, particularly the public EMS environment. She qualified as an Advanced Life Support paramedic in 2005 and has worked extensively at an operational level, supervisory level and, currently, middle management level performing monitoring and evaluation for the Emergency Medical Services in KZN at the provincial level.

It has always been evident to the researcher that response times, mainly to patients or incidents considered to be life threatening, have constituted a major challenge. At an operational level the community often voices its disgust and disappointment at the delays in response times while, at a management level, the researcher is continuously required to provide explanation and/or reasons for why response times are not in line with the national norms provided. The justifications given all appear to be similar, regardless of changes in resource allocation and the management of such resources.

Based on anecdotal evidence, discussion and first-hand experience, it became apparent to the researcher that the national norms in terms of which the efficiency of the public EMS service is measured were not suitable and, thus, that they warranted exploration.

1.5 Dissertation Structure

An overview of the chapters to follow is given below.

Chapter One introduces the study by providing the background to the study, presenting the research purpose, research objectives and research questions, highlighting the researcher's interest in the study topic, listing definitions of the terms used and summarising the dissertation structure.

Chapter Two presents the literature review which contributed a deeper insight into the research area as it explored response times at an international and national level as well as contributory factors to response times.

Chapter Three outlines the research methodology used in the study and includes a discussion of the research design, a description of the study setting and the techniques used to collect and analyse the requisite data as well as an explanation of ethical considerations taken into account in the study.

Chapter Four provides a detailed description of the findings of the study. This comprised two phases; namely phase one, which focused on the quantitative aspect, and phase two, which focused on the qualitative aspect of the study.

Chapter Five presents the discussion based on the study findings for the quantitative and qualitative data as well as the use of both the quantitative and qualitative methods in order to provide a broad, but in depth, perspective of the topic.

Chapter Six presents the summary, recommendations, limitations and researcher reflections as well as the conclusion to the study.

A list of references used and the annexures are included at the end of the dissertation.

CHAPTER 2:
LITERATURE REVIEW

2.1 Introduction

The Emergency Medical Service (EMS) system is faced with challenges including the fact that there are limited validated indicators to measure both the effectiveness and the quality of the service, there are no universally accepted methods for measuring EMS efficiency and an adequate assessment of the EMS system is not currently possible due to the difficulty experienced in developing appropriate indicators. In order to produce effective rules and guidelines for the prehospital EMS setting, appropriate indicators that require in depth audit, research and analysis are absolutely essential (Spaite *et al.* 1995; Moore 1999; MacFarlane and Benn 2003).

Response times are considered to be one of the oldest and most popular indicators used to measure EMS efficiency, particularly response times to cases where the patient's condition is deemed to be life threatening (Gendreau, Laporte and Semet 2001; MacFarlane and Benn 2003; Fitch 2005; Carr *et al.* 2006; Schooley and Horan 2007; Budge, Ingolfsson and Zerom 2010). The time taken to arrive at a patient's side and start administering care has been shown to directly impact patient outcome (Meislin *et al.* 1999; Gendreau, Laporte and Semet 2001; Carr *et al.* 2006; Budge, Ingolfsson and Zerom 2010; KwaZulu-Natal Department of Health 2010b). Similarly prolonged response times are likely to have adverse consequences for the outcomes for patients with life threatening conditions/injuries (Budge, Ingolfsson and Zerom 2010).

The framework in terms of which response times are defined, factors that influence response times and available response time criteria norms are explored further in this chapter.

2.2 Response Time Interval Framework

As indicated in numerous studies, there is no standard which is utilised for the start and end points used when measuring response time intervals. This makes it difficult to compare or

benchmark against/with other agencies or regions. Some literature defines the start point as the point at which the call is received and others the start point as the point at which the vehicle is dispatched. In order to ensure accurate reporting across the board, it is essential that the definitions used are both consistent and standardised. The most commonly used and widely accepted definition starts from the time at which the call is received until the time at which the responding vehicle arrives on the scene of the incident or at the patient (Meislin *et al.* 1999; MacFarlane and Benn 2003; Castrén *et al.* 2008).

At the Utstein Consensus Symposium in 2005 a group of emergency medical dispatch experts (Castrén *et al.* 2008) agreed that the fundamental stages in providing effective EMS to any patient commence at the time at which the incident occurs until the delivery of definitive care. This process, referred to as the 'patient journey' (figure 2.1), was initially described by the European Emergency Data (EED) project (Krafft *et al.* 2003). There are two intervals that make up the response time; namely, the EMD response interval which is from the time a call is received to the time the emergency vehicle is dispatched, and the EMS unit response interval which is from the time the emergency vehicle is dispatched to the time it arrives at the incident or patient.

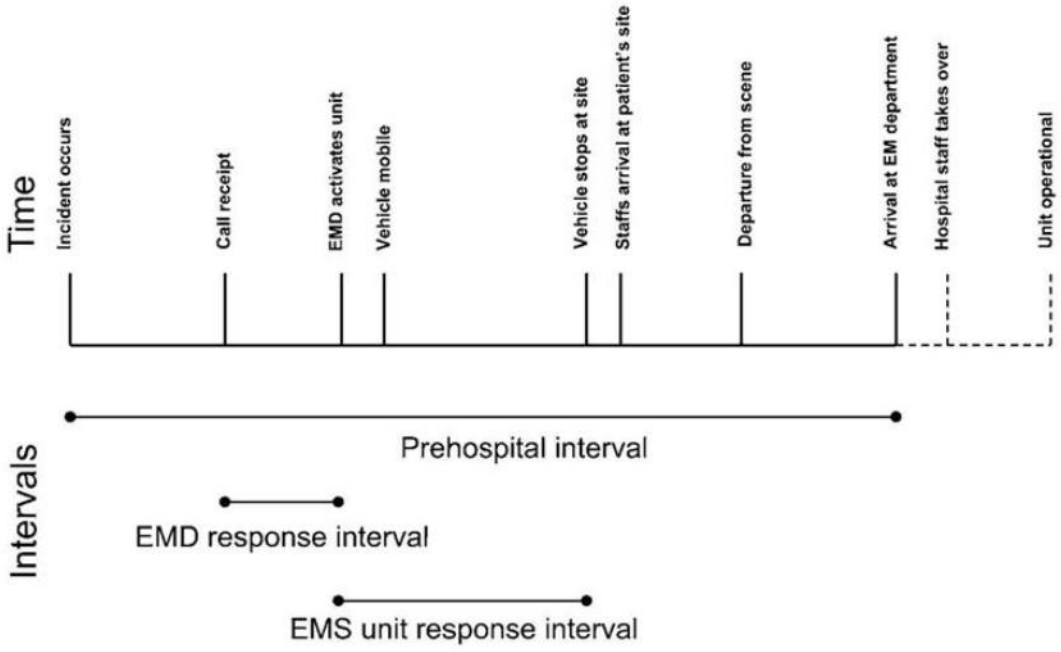

Figure 2.1: The patient journey (Castrén *et al.* 2008)

Budge, Ingolfsson and Zerom (2010) are of the opinion that the accurate prediction of response time performance indicators requires information on the two areas that make up the response time itself. These are termed the pre-travel time and the travel time with the start and end points for each defined in the same way as indicated above.

The KwaZulu-Natal (KZN) Department of Health have defined the response time as the period from when the call is received by the communications centre to the time the first emergency vehicle arrives on the scene (KwaZulu-Natal Department of Health 2000, 2004, 2005b).

2.3 Factors that Influence Response Times

The available literature highlights several factors that impact on the response times of Emergency Medical Services (EMS). The majority of these influencing factors differ for the two time intervals of the patient journey identified and make up the response time. Therefore these intervals are explored separately below.

2.3.1 EMD Response Interval

The command and control of EMS takes place within the communications centre. This is where all calls are received and prioritised and from where help is dispatched as well as where the management of all available resources takes place. An overview of the entire demand and delivery of services takes place in the communications centre. Studies conducted in KwaZulu-Natal, in the eThekwini district (Newton 2013) and in the Ugu district (Govender 2011) noted delays in the communication centres from the time the call was received until an emergency vehicle was dispatched and also that the time taken for an ambulance to arrive at the incident or patient increased considerably when the EMD interval increased, thus impacting directly on the response times achieved (Stein 2014). Possible reasons for this included limited available resources, a lack of EMS systems status management, poor dispatch decisions and the inappropriate use of EMS. These reasons are further explored below.

2.3.1.1 Available Resources

The KZN Department of Health EMS has repeatedly reported on an annual basis that they are unable to comply with the national response time norms. The main reasons highlighted include a lack of available emergency vehicles and an increase in demand for the service (KwaZulu-Natal Department of Health 2005a, 2006, 2009, 2010a, 2010b; Govender 2011; KwaZulu-Natal Department of Health 2011; Hardcastle et al. 2012; KwaZulu-Natal Department of Health 2012b, 2013; Newton 2013; KwaZulu-Natal Department of Health 2014, 2015a, 2016a). The total number of patients transported by EMS in 2004/05 was reported to be 483 122 and 564 529 during the 2014/15 financial year, thus indicating an increased demand for services (KwaZulu-Natal Department of Health 2005a, 2015a).

On the other hand, a study conducted in the Cape Town area in South Africa (Stein 2014), which explored response times using a computer simulation model, found that the response time national norms were never achieved regardless of increased numbers of ambulances while it was also not possible to establish an optimal number of operational ambulances. It was, nevertheless, found that a seven fold increase in the number of ambulances produced the best results. This study was, however, restricted to urban areas using computer modelling simulation and, therefore, outcomes in rural settings and in real-life situations may be different. A severe mismatch between the demand for services and the number of emergency vehicles available has also been reported in the eThekwini district (Newton 2013).

International studies have found that providing additional emergency vehicles to the original EMS bases resulted in an initial, although relatively small, improvement in response times. However, a plateau was soon reached, probably as a result of the reduced time required to allocate a call to a vehicle as there were more vehicles available. Nevertheless, the driving time remained the same and, thus, an increase in the number of vehicles and the strategic location of these vehicles were recommended for the best results (Savas 1968; Berlin and Liebman 1974; Ingolfsson, Erkut and Budge 2003; Peleg and Pliskin 2004).

2.3.1.2 EMS Systems Status Management

The available literature strongly supports the use of a strategy for the deployment and placement of resources which is based on the demand for services, namely, systems status management. This strategy has been used widely in EMS and has resulted in improved optimisation levels of resource management while containing the costs related to the system. The strategy includes the use of geographic information systems, demand pattern analysis and dynamic location/relocation models in an effort to improve travelling times to incidents or patients (Repede and Bernardo 1994; Brotcorne, Laporte and Semet 2003; Andersson and Varbrand 2007; Ong *et al.* 2009; Setzler, Saydam and Park 2009; Maxwell *et al.* 2010; Stein 2014).

There has been considerable progress reported with the implementation of systems status management in areas in which sufficient resources exist. This is essential as the continuous movement and deployment of vehicles based on demand are required. It has also been reported that inadequate resources is deemed to be a stumbling block to the proper implementation of systems status management and, thus, the proven benefits may not be realised (Repede and Bernardo 1994; Peters and Hall 1999; Rajagopalan, Saydam and Xiao 2008; Setzler, Saydam and Park 2009; Stein 2014). It has been suggested that improved response times in the EMS in South Africa will, in all likelihood, only be realised with the implementation of further decentralisation and deployment strategies which take into account the shifting demand patterns as the EMS in South Africa generally operates using a centralised approach. The use of satellite bases has also been shown to improve response times due to the emergency vehicles being closer to the patient or incident than would otherwise be the case (Stein 2014). Cham, Sundby and Vangen (2005) also found that response times were extended when communities were further away from ambulance bases in comparison to communities that are located closer to established EMS bases. It was also suggested by Young *et al.* (2003) that patients in areas considered as rural were 50% more likely to succumb to their injuries as compared to patients located in urban areas as a result of extended distances between the ambulance base and the patient or incident in rural areas.

The use of real time Geographic Information Systems (GIS) has been shown to assist in achieving optimal resource deployment which is based on the demand by area. This has

been demonstrated effectively in EMS systems throughout the world (Estochen, Souleyrette and Strauss 1998; Peleg and Pliskin 2004; Edelman 2007; Ong *et al.* 2008; Ong *et al.* 2009; Setzler, Saydam and Park 2009). A GIS consists of computer mapping software that identifies relationships between different data sets spatially. This generates a graphic display as well as the easy interpretation of relationships between the population and the environment in a specified geographical area. This system has been successfully utilised for the identification of injury and illness rates per area, thus facilitating the easy identification of high risk populations as well as the evaluation of public access to health care systems and develop and the measuring of the impact of preventative health care initiatives (Edelman 2007).

A study conducted on an EMS system in use in the Carmel and Lachish districts (Peleg and Pliskin 2004) compared response times before and after the implementation of a model-derived strategy for improving the deployment of ambulances based on GIS technology. Prior to the implementation of the model the study found mean response times in the two districts of 12.3 and 9.2 minutes respectively, with 34% and 62% of calls responded to within 8 minutes. However, after ambulances had been repositioned according to the model, more than 94% of cases achieved the 8-minute criterion norm. The study, thus, concluded that if the GIS simulation model is adopted, EMS resource deployment is more effective and this results in increased survival rates and improved cost efficiency.

However, although the use of GIS has proven its worth, it is open to human error in that the long string of numbers can easily be incorrectly typed/relayed. A new technology known as “what3words” has been introduced for easy reference in any area on earth which is divided into a grid of squares of 3 meters by 3 meters. Each box is allocated a code which is formulated using a process which consists of three familiar English words (Jones 2015; Gye 2016). This system is particularly useful in rural areas or in countries that do not have an organised network of street names and numbers, namely 75% of the countries in the world. This means that the majority of their populations are virtually invisible. If every person in the world had access to a simple, accurate and unambiguous address system, regardless of his/her whereabouts, this would significantly enhance timeous access to EMS.

2.3.1.3 Dispatch Decisions

The EMS communications centre is the first point of contact for anyone requiring EMS services, as it is the point at which emergency calls are received from the public and the call taker determines the severity of the incident and or patient's injuries/condition. This then results in each call being sorted/triaged accordingly and, ultimately, determines whether an immediate response is required or not. The triage involves the sorting of calls into order of apparent need, namely, Red Code/Priority One which refers to a life threatening injury, illness or condition which demands the highest priority, Yellow Code/Priority Two which is deemed to be a patient with serious illness/injury that requires hospitalisation but is not considered to be immediately life threating and Green Code/Priority Three which refers to a patient whose injuries do not necessarily require urgent intervention (KwaZulu-Natal Department of Health 2004; Castrén *et al.* 2008).

Traditionally, EMS systems were designed to provide services in response to all requests. It was assumed that every request referred to a patient with a serious illness or injury and ambulances were then dispatched on a first come first serve basis. The call taker simply had to obtain details of the nature of the illness or injury, the location of the patient and the telephone number of the caller. Unfortunately, this scenario has continued into the 21st century in certain industrialised areas (Thakore, Mcgugan and Morrison 2002). The problem with this method is that, currently, the demand far outweighs the available resources and this results in considerable delays in response times (Slovis *et al.* 1985).

A clear distinction is required between cases which are considered to be an emergency and cases which are considered to be non-emergency. Response time standards should be set and measured for emergency cases where the patient's condition is thought to be life threatening and, thus, requiring immediate intervention. However, if non-emergency cases are prioritised for response, this results in an increase in the number of cases requiring immediate intervention as well as heightened stress levels among the emergency personnel and, ultimately, delayed response times overall. In order to combat this situation, it is essential that effective systems are implemented in the communications centre to ensure that the dispatch triage is as accurate as possible based on the information provided to both the emergency medical call taker and the dispatcher (Frank and de Villiers 1995; Neely, Moorhead and Schmidt 1997; Price 2006).

A local study conducted by Newton (2013) found that the over-triaging of emergency cases is a major challenge in the eThekwini district where the majority of cases are deemed life threatening on receipt of a call. However, only 2.4% of these cases which had been triaged as priority one for dispatch were found to be priority one by the emergency care personnel on arrival (Newton, Naidoo and Brysiewicz 2015). International studies have also shown that the over-triage of cases to be a major challenge. However, it has also been noted that the implementation of protocol based priority dispatch systems has resulted in a marked improvement in the accuracy of triaging and, hence, improved response times due to the accurate prioritisation of cases (Slovis *et al.* 1985; Curka *et al.* 1993; Thakore, Mcgugan and Morrison 2002; Cone, Galante and Macmillan 2008).

The production and implementation of a formal, protocol based, priority dispatch system was first documented in the United States by Clawson (1981). This system included the use of ready-reference file cards which was utilised to guide a series of standardised questions and on the basis of which the most appropriate dispatch priority was determined. The study showed a decrease in the number of cases triaged as priority one as well as an improvement in the efficient utilisation of the available EMS resources.

Evidence based dispatch systems, including formal computer aided decision making methodology, have since been developed and are being successfully utilized around the world in the interests of effective EMS dispatch. The Medical Priority Dispatch System (MPDS) and the Advanced Medical Priority Dispatch System (AMPDS) have been successfully used widely to determine the appropriate priority for EMS cases and thereby informing the required resources and contributing to improved response times (Curka *et al.* 1993; Thakore, Mcgugan and Morrison 2002; Heward, Damiani and Hartley-Sharpe 2004; Flynn, Archer and Morgans 2006; Sporer, Youngblood and Rodriguez 2007; Cone, Galante and Macmillan 2008).

Where strict systems, including education and training policies, have been implemented in communications centres, and particularly when used in conjunction with a computer aided MPDS as well as the employment of suitably trained medical personnel, the successful optimisation of the emergency medical dispatch process has been realised. Such

achievements have been noted by the largest EMS system in the world, namely, the London Ambulance Service (Heward, Damiani and Hartley-Sharpe 2004).

Effective, continuous training combined with stringent quality assurance in respect of the personnel working in the EMS communication centre have been identified as vitally important in view of the challenges related to the implementation of processes and procedures for call taking, standardised triaging and emergency vehicle dispatch which have been identified as compromising efficiency (Heward, Damiani and Hartley-Sharpe 2004). The required level of training for optimal performance in this area has been questioned as far back as 1975 (Griggs *et al.* 1977), while the need for training in EMS priority dispatch systems was identified by Clawson (1981). It has been found that compliance with protocol when implementing priority dispatch systems may be accomplished through rigorous training and feedback (Clawson *et al.* 1998). In instances in which communication centre personnel are forced to make decisions based on subjectivity, anecdotal evidence and/or experience, inaccuracies and inconsistencies become more prevalent (Clawson *et al.* 2007).

2.3.1.4 Inappropriate Use of EMS

The inappropriate use of EMS has been identified as a worldwide challenge and is continuing to escalate. Studies have reported that as much as 30% to 52% of logged calls have been found to be non-emergency cases (Gibson 1977; Rademaker, Powell and Read 1987; Chen, Bullard and Liaw 1996; Gratton *et al.* 2003; Morris and Cross 1980). A study conducted by Snooks *et al.* (1998) reviewed ten studies which had been conducted in six different countries between 1977 and 1996. The study discovered similar trends in cases in which 11.3% to 51.7% of the responses had been found to be inappropriate. Both the African Federation of Emergency Medicine and the International Academy of Emergency Dispatch have also indicated that corrupt, prank or inappropriate calls are a cause of global concern (Mould-Millman *et al.* 2015).

Several studies conducted in South Africa have made similar findings. In the Overberg region of the Western Cape it was discovered that as many as 68% of the cases transported by the Caledon EMS had been found to be non-emergency cases (Frank and de Villiers 1995). A study conducted in the Ugu district of KwaZulu-Natal (Govender 2011)

found that the number of cases that did not result in the transportation of a patient, also referred to as exempt cases, was extremely high although it was not possible to establish reasons for this phenomenon. In a study conducted in KwaZulu-Natal, Hardcastle *et al.* (2012) found that the number of exempt cases was very high, particularly in the rural areas. A further study conducted in the eThekwini district of KwaZulu-Natal (Newton, Naidoo and Brysiewicz 2015) found that 30% of the cases responded to were found to be exempt cases, even after patients had received care from the attending personnel.

The reasons for the inappropriate use of EMS systems are understood to be both complex and varied and may include public ignorance or a misunderstanding of the use of EMS as well as the unavailability of public transport, inaccessible or distant primary healthcare facilities, deliberate misrepresentation of the need and hoax calls (Slovis *et al.* 1985). Further socioeconomic factors have also been suggested as reasons for the misuse and include age, gender, household income, type of health insurance of the patient, alcohol intoxication, drug abuse and the level of the patient's physical function (Rucker *et al.* 1997; Svenson 2000; Kawakami *et al.* 2007; Vardy, Mansbridge and Ireland 2009).

Unfortunately the misuse of EMS systems inevitably results in an increased demand for services and, where limited resources exist, this results in the unavailability of the emergency vehicles which are required to respond to life threatening emergencies and, therefore, extended response times (Slovis *et al.* 1985).

The current reality in South Africa that every patient, regardless of the severity of his/her injuries or illness, is transported to hospital constitutes a waste of the valuable and limited resources which are intended for life threatening emergencies. This increased demand not only places a strain on the EMS resources but also on the poorly resourced government health facilities (Schaefer *et al.* 2002).

However, there are alternatives to transporting every patient requesting EMS available and these have been successfully implemented. These alternatives result in shorter travelling distances, reduced job turnaround times, reduced waiting periods and a reduction in the total time that the patient spends within the system and include treatment on scene with patient discharge and EMS initiated refusal of transport. However, the latter should be used with great caution and in accordance with guidelines that have been properly researched,

developed and applied (Selden *et al.* 1991; Zacharia *et al.* 1992; Jaslow *et al.* 1998; Kamper *et al.* 2001; Schaefer *et al.* 2002; Knight *et al.* 2003; Snooks, Foster and Nicholl 2004; Snooks *et al.* 2004; Knapp *et al.* 2009).

Billittier, Moscati and Janicke (1996) discovered that 82% of patients deemed not to have required EMS transport would have gladly accepted an alternative means of transport had there been one available. Accordingly, alternative means of transportation may be considered for non-emergency cases such as the issuing of passes for scheduled public transport, including buses, mini-bus or taxi cab transport, or running scheduled, non-emergency, patient transport vehicles routinely with specified pick up points in all areas with wheelchair and stretcher access and on a daily basis in urban areas and perhaps less frequently in rural areas depending on demand (Newton 2013).

It must be noted, however, that the alternative systems described above should be implemented with great caution as possible litigation may occur should patients be incorrectly identified in cases in which they did, in fact, require emergency medical care (Goldberg *et al.* 1990; Snooks, Foster and Nicholl 2004).

2.3.2 EMS Unit Response Interval

In relation to EMS response times the KwaZulu-Natal Department of Health (2010b) noted that, in districts in which the kilometres travelled per ambulance were low, a better response time was observed while, in districts in which the kilometres travelled per ambulance were high, poor response times were observed. In addition, the districts that reported the poor response times when there was a high number of kilometres travelled per ambulance were, in the main, in deep rural areas with predominantly gravel roads. This highlights the following two very important aspects of rural/deep rural areas: firstly, the distances travelled in such areas in order to provide EMS are much further and, secondly, the road infrastructure is very poor. Both of these have a negative impact on, or delay, response times.

Both the KZN Department of Health as well as the literature available in South Africa and other African countries explain how poor road infrastructure, bad weather conditions, poor road signage, a lack of house/door numbers and topography all contribute to delayed

response times (Shehu, Ikeh and Kuna 1997; Cham *et al.* 2005; KwaZulu-Natal Department of Health 2005a, 2009, 2010a; Govender 2011; KwaZulu-Natal Department of Health 2011).

Some developing countries have resorted to innovative means for the transportation of obstetric patients ranging from canoes, bicycles, wheelbarrows, motorbikes, taxis and buses. All of these have a longer transport time as compared to more conventional means of transport with the longer transport time contributing to increased response times. However, these innovative means of transport are often the only means of transport available and, thus, they provide the only means of access to healthcare (Krasovec 2004).

Internationally studies have found varying methods of transporting patients. The developed countries have introduced specialist emergency transport teams as well as specialised ambulances and equipment, thus resulting in improved response times (Razzak and Kellermann 2002). In 2001 the Free State province in South Africa provided health facilities with 48 dedicated, inter-facility, maternity ambulances. This resulted in a reduction in maternal mortality from 279 to 153 and the percentage of vehicles dispatched within an hour increased from 84% to 91% while the mean EMD response interval was reduced from 32 to 23 minutes (Schoon 2013).

2.4 Response Time Criteria Norms

Although there is no universally accepted response time norm that exists, the most widely used standard stipulates that eight minutes and 59 seconds should be achieved in 90% of responses (Neely, Moorhead and Schmidt 1997; Pons and Markovchick 2002; Fitch 2005; National Fire Protection Association 2010). This standard was introduced in the early 1970s after a study conducted on cardiac arrest survival rates concluded that, among other factors, response times of less than eight minutes increased survival rates (Baum, Alvarez III and Cobb 1974; Cobb *et al.* 1975). The later addition of the 59 seconds was introduced to accommodate the logging of calls before the use of sophisticated computerised systems (Eisenberg, Bergner and Hallstrom 1979; Fitch 2005).

Studies have been conducted in order to establish whether the eight minute response time norm really does have a positive impact on patient outcomes in general as it has been

acknowledged that, although achieving this norm would, undoubtedly, improve medical effectiveness, it may also impact negatively on the EMS system efficiency as the resources required would have to be radically increased. This would increase cost and, therefore, prove to be unsustainable. Pons and Markovchick (2002) and Pons *et al.* (2005) concluded that it was not possible to find any statistical difference in patient survival based on the response time interval. In 2002 Blackwell and Kaufman (2002) found that a decrease in the response time intervals resulted in improved patient survival rates and also that intervals of less than five minutes definitely improved patient survival rates. It was, however, acknowledged that the cost of sustaining this level of service would be very high. Blanchard *et al.* (2012) went on to challenge the eight minute response time interval and found that depending on the type of injury and the gender and age of the patient, a slight benefit in the risk of mortality for patients who were responded to within eight minutes only was realised. The use of this norm for all case categories is, once again, questionable.

Fitch (2005) cited the response time norms implemented in various countries. These included North America which adopted the 8:59 benchmark in urban areas, 15 minutes in rural areas and 30 minutes in wilderness areas. It was indicated that these should be achieved for 90% of the life threatening emergency cases. The United Kingdom has had an established national standard since 2001 for both urban and rural areas for life threatening cases. This standard includes achieving a response time of eight minutes with 75% compliance, of which 95% must be within 14 minutes in urban areas and within 19 minutes in rural areas. Response times in Australia are measured at five, 10 and 15 minute intervals. It was reported that 50% of the cases are responded to within 10 minutes for both rural and urban areas. Hong Kong adopted what is known as a performance pledge which involves arriving within 12 minutes for 92% of all cases. The same response commitment has been made to both emergency and non-emergency cases. According to Kobusingye *et al.* (2005), in Monterrey, Mexico, the average response time achieved was 10 minutes while in Hanoi, Viet Nam the recorded average response was 30 minutes.

A descriptive study conducted by Langhelle *et al.* (2004) in Nordic countries, reported a response time average of less than five minutes to cases categorised as immediately life threatening in Copenhagen in Denmark. The Norwegian government required response time for patients in remote areas was 45 minutes and using predominantly service, rotor-wing ambulances manned by physicians.

London recently reported a deterioration in response times of up to 12% over a period of 12 months as compared to the target of eight minutes and with late arrivals to 42% of critically ill patients (DailyMail 2016). This is a clear indication that, as predicted by Blackwell and Kaufman (2002) and Pons and Markovchick (2002), the sustainability of the eight minute target is unrealistic.

The South African national response time standard for urban areas is less than 15 minutes and less than 40 minutes for rural areas. The KZN public EMS uses this benchmark to measure their responses to priority one (red code) cases in both urban and rural areas (KwaZulu-Natal Department of Health 2004; MacFarlane, Van Loggerenberg and Kloeck 2005; KwaZulu-Natal Department of Health 2009, 2010b, 2015b, 2016b). No standard or norm has been cited for non-priority one cases in South Africa (Stein 2014).

As MacFarlane, Van Loggerenberg and Kloeck (2005) highlighted, the only area in South Africa that has managed to achieve the national norm is the greater Johannesburg area. This does not, however, appear to be the case as reported in *The Star* newspaper (Chipangura 2013). Chipangura (2013) reported a noted decrease in the response times to priority one cases for public EMS achieved in the Gauteng Province, with 47.4% only of priority one cases in urban areas being responded to within 15 minutes and 75% of priority one cases in rural areas being responded to within 40 minutes. This represents a marked deterioration compared to the years preceding 2013.

A study conducted by Meents and Boyles (2010) reported that, according to the Eastern Cape Department of Health, its achievable response times were within one hour in rural areas and within 45 minutes in urban areas but that these response times were achieved only in 3.3% of cases with an average response time achieved of four hours while, in 16.7% of cases, the EMS did not arrive at all. Stein (2014) found that in Cape Town, South Africa, that even with decentralised emergency vehicle location strategies and a communications centre capable of handling priority one cases within a reasonably short time period, the national norms for response times were, in fact, unattainable, no matter the number of emergency vehicles available.

Studies conducted in KwaZulu-Natal showed similar results with the national norm not being achieved in the majority of responses. For example, in the eThekwini area the mean response time to P1 cases was reported to be 52 minutes (Newton 2013) and 101 minutes in the Ugu district to obstetric related P1 cases (Govender 2011).

Anecdotal evidence as well as reports issued by the KZN Department of Health show that the current national norms for response times to priority one (red code) cases in both the rural and urban areas in KZN are not realisable, particularly in view of the fact that the EMS have consistently failed to respond within these set timeframes from as far back as 2004 when the KZN Department of Health started reporting on performance as measured against these national norms (KwaZulu-Natal Department of Health 2000, 2005a, 2005b, 2006, 2007, 2008, 2009, 2010a, 2010b, 2011, 2012a, 2012b, 2013, 2014, 2015b, 2015a, 2016a, 2016b). In fact, there has been a significant decline in performance. However, this may be the result of improved data collection tools, data management and reporting and, thus, more accurate output.

2.5 Conclusion

It is essential that the establishment and adoption of response time norms are carefully and thoroughly explored as even the slightest reduction in response time targets results in major cost implication for tax payers as additional resources, including emergency vehicles, staff and equipment, are required while the benefits of these additional resources have not been established. Ensuring that targets are realistic and achievable will not only contribute to an improvement in internal systems but will also help to better inform the public, thereby preventing unrealistic expectations when the services of EMS are requested (Pons and Markovchick 2002; Carr *et al.* 2006).

Although information on the response times achieved as compared to the national norms has been reported by the KZN Department of Health, it is unclear how this information is obtained and analysed. This results in questions about the reliability and validity of such information. In addition, the information available does not provide an in depth explanation of the extent to which these response times are/are not being achieved and nor are the actual response times achieved explored and analysed. The report merely states the percentage of cases responded to within the national norms (KwaZulu-Natal Department of

Health 2014, 2015a, 2016a). According to Fitch (2005), such reporting often does not represent a clear and accurate picture of response times.

CHAPTER 3:
RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the research design and methodology used in the study and focuses on the study setting, population, data collection and data analysis procedures and ethical considerations.

3.2 Research Design

This research study was conducted in two phases, using the pragmatic paradigm. The study utilised a mixed methods methodology and was a descriptive study using prospective data.

In view of the complexity of response times in Emergency Medical Services (EMS), quantitative or qualitative methods individually would not have been adequate to capture the holistic insight required and, thus, these methods were mixed. This entailed the collection and analysis of the requisite data using, firstly, the quantitative method, secondly, the qualitative method and thereafter mixing both these methods. It is believed that these methods complement each other when used in conjunction, thus resulting in a more comprehensive analysis than may otherwise have been the case. A sequential explanatory approach was used for mixing of the methods (Morse 2003).

The patient journey, as outlined by Castrén *et al.* (2008), was utilised as a framework for analysing the time intervals during both phases one and two. This study focused on the intervals that make up the response time. These included the EMD response interval, which is from the time a call is received to the time the emergency vehicle is dispatched, and the EMS unit response interval, which is from the time the emergency vehicle is dispatched until the time it arrives at the incident or patient.

3.3 Study Setting

KwaZulu-Natal (KZN) is the second most populous province in South Africa, with an estimated 10.6 million people of which an estimated 9,504,000 do not have medical insurance. Geographically, the province occupies 7.6% or 92,100 sq. km of the total land surface in South Africa, thus giving a population density of 112.8 people per square kilometre. The province is divided into 11 health districts. It is estimated that 54% of the total population of the province live in rural areas while an estimated 10% of the urban population live in under-developed informal settlements. The public health sector is required to provide health services to all the citizens of the province, regardless of where they live (KwaZulu-Natal Department of Health 2012b).

The study was conducted in the Umgungundlovu Health District of KZN, one of the 11 health districts. The study was restricted to the public EMS only. This health district was deemed to be appropriate for the purposes of the study as a result of the urban and rural classification which provides a fair representation of the demographics of the province.

3.3.1 KwaZulu-Natal Emergency Medical Services

Emergency Medical Services (EMS) consists of administration, communications and operational divisions. The administration division deals with human resources, finance, fleet management and stores while the operational and communications divisions are directly responsible for the prehospital treatment and transportation of patients. This requires the efficient and effective utilisation of available resources. Both these divisions operate on a 24-hour basis. EMS in KwaZulu-Natal (KZN) provide services in all 11 health districts with each health district having its own communications centre where emergency calls are received and dispatched. At the time of the study five of the 11 communications centres were utilising a specialised computerised call taking and dispatch system, one of which was used in the study (Annexure A). The other six districts utilise a paper-based system for call taking and dispatch, with information being captured electronically in a spreadsheet for reporting purposes only once the case is completed. The standard operational procedures utilised in both the paper based and computerised centres are the same although the quality and availability of the data from the computerised centres are more reliable.

The EMS communications centre is the first point of contact for anyone requiring EMS. It is at this point that emergency calls are received from the public. The emergency medical dispatcher then determines the severity of the incident and/or the patient's injuries/condition. This results in each call being sorted/triaged accordingly. This sorting/triage ultimately determines whether an immediate response is required or not. In addition to emergency cases, requests for inter facility transfer (IFT) cases are received from health facilities. These are for patients who require a higher level of health care or intervention than is available at the requesting health facility. The emergency vehicles available are prioritised and dispatched to both emergency and inter facility transfer cases in accordance with the assigned codes.

An operational vehicle is described as a functional, roadworthy vehicle which is stocked with all the emergency equipment required as well as surgical sundries and which is manned by appropriately qualified personnel. An ambulance must be manned by a minimum of two personnel – one to drive the vehicle while the other treats the patient/s. A response unit is usually manned by an advanced life support qualified paramedic. The vehicle and staffing resources described above are deemed to be operational only when all required categories outlined above are present. Each district has numerous bases which cover areas considered to be rural and urban. The communications centre dispatches operational vehicles as they become available. This creates the possibility of cases waiting for a vehicle to become available and this may contribute to delayed response times during periods of high caseloads. Shifts currently run from 07h00 – 19h00 (day shift) and 19h00 – 07h00 (night shift) daily for both operations and the communications centres.

3.4 Phase One (Quantitative Phase)

Phase one included the collection of prospective data, where data was collected and captured on a daily basis for the day the cases occurred, in order to determine the response time per case achieved in both rural and urban areas.

3.4.1 Population and Sampling

For this phase of the study the Umgungundlovu Health District was used. This district communications centre utilises the computerised call taking and dispatch system. As mentioned earlier, the standard operational procedures used in both the paper based and computerised centres are the same although the quality and availability of the data from the computerised centres is more reliable than that from the paper based centres.

The study population for phase one included all cases and available resources in the district as indicated above for a period of one week from 23 February (Sunday) to 1 March 2014 (Saturday). The time period identified for the data collection process during this phase of the study included the end/start of the month as it was felt that this best represented every day operations throughout the year as well as providing for the inclusion of a wide variety of cases. Holiday periods were avoided as there is always an influx of holiday makers into KZN during these times, thus resulting in an increased caseload. In addition, the EMS also increases the resources available during holiday periods.

For the purpose of this study, the response time was broken down into two intervals – the first interval was from the time a call is received to the time the emergency vehicle is dispatched (referred to as the EMD response interval) and the second interval from the time the emergency vehicle is dispatched to the time it arrives on the scene (referred to as the EMS unit response interval) (Castrén *et al.* 2008). The reason for this decision was that the factors affecting the two intervals are different. These factors were explored further during the qualitative phase of the data collection.

The total quantitative data sample size comprised 1 503 cases. Of these 608 cases were in the rural areas and included 298 P1 cases, 130 P2 cases and 180 IFT cases, and 895 cases in the urban areas. The latter included 382 P1 cases, 140 P2 cases and 373 IFT cases.

3.4.2 Reliability and Validity of Data Captured by the Communications Centre

The information required per case is captured by the Umgungundlovu Health District communications centre using a specialised computerised system which was developed specifically for use in EMS call taking and dispatch. The information is captured by both the call taker and dispatch personnel throughout the duration of each case and, thus, there is always a risk of the human error element. There is, however, ongoing quality assurance in place which aims to ensure that accurate input is achieved, which includes the monitoring of both cases and the information captured by individuals. Those concerned are updated on the quality of their work and this informs continuous in-service training and improvement. Training is also conducted regularly to ensure that all call takers and dispatchers are well informed and aware of their responsibilities. In addition, the stringent quality assurance systems in place ensure that the manipulation of data is not possible retrospectively, thereby resulting in the availability of accurate and reliable data. Rural and urban areas are predetermined on the system and this ensures that all areas are correctly categorised consistently for all cases. Time is synchronised on all the computers in each centre, thus ensuring that accurate times are recorded for each case. In addition, when a case status is changed, the time is automatically captured on the system, thereby ensuring accuracy when the dispatcher indicates on the system that the emergency vehicle dispatched has arrived at the patient/incident. In other words, the on scene time for each case is automatically recorded. Annexures C, D, E and F include screenshots of the specialised call taking and dispatch system.

3.4.3 Data Collection

Once ethical clearance from the Durban University of Technology Institutional Research Ethics Committee (Annexure L) as well as approval from the KwaZulu-Natal Department of Health (Annexure H) had been granted to conduct the study, the requisite data was extracted from the Umgungundlovu Health District communications centre raw data files, which included information on all logged cases on a daily basis throughout the data collection period. The researcher captured the required information per case for each 24-hour period for seven days. This was done using the per case collection tool for Excel developed for collecting the quantitative data for this study (see Annexure B). This data

collection tool had been developed by the researcher and was based on the information required to carry out the study. The data was thoroughly checked by the researcher on a daily basis, thus ensuring that accurate data would be available for the data analysis once the data collection had been completed. Patient specific details were not collected and each case was identified by the use of a case number.

3.4.4 Reliability and Validity of the Data Collection Tool

The data collection tool (Annexure B) was presented to the Durban University of Technology Emergency Medical Care Department Research Committee (DRC), as well as to a statistician for their input and comment. A pilot study was conducted in order to test the data collection tool which was to be used. This pilot study took place over a 24-hour period on 28 January 2014, thus prior to the commencement of the actual data collection and included the capturing of data per case handled during that period from the Umgungundlovu Health District Communications Centre. The pilot study was conducted with the help of the statistician to ensure that it would be possible to carry out the required statistical tests with the available data after the data collection process. The data used in the pilot study was not used as part of the study itself.

3.4.5 Inclusion Criteria

- The study included all urban and rural area emergency and inter facility transfer cases within the Umgungundlovu Health District and to which an emergency vehicle had been dispatched and which had responded within the said district.
- The study included all the above cases which had been logged within the specified data collection period, regardless of when the case had been completed.

3.4.6 Exclusion Criteria

- The study excluded all planned patient transport referrals due to the fact that these referrals are managed and resourced independently and, therefore, they have no impact or influence on the emergency services.
- Cases that did not include all the times captured and required to determine the achieved response times were excluded as the required calculations would not have been possible without these times.
- This study included only cases received and attended to by the public EMS in KZN and, thus, cases received and attended to by private EMS were excluded.

3.4.7 Data Analysis

The Statistical Package for Social Sciences (SPSS) version 24.0 (IBM, Armonk, NY) software was used for the data analysis. In addition, the researcher made use of the expertise of a professional statistician for the quantitative phase of the study.

The statistical aspect of the study included the following:

- descriptive statistics using frequency and cross tabulation tables as well as various types of graphs (including bar charts).
- inferential statistics using correlations at a significance level of 0.05.
- testing of hypotheses using chi-square tests for both nominal and ordinal data at a significance level of 0.05.

3.5 Phase Two (Qualitative Phase)

Phase two comprised focus group discussions in order to explore the factors that influence response times in KZN and to identify strategies to improve response times based on the participants' perceptions.

3.5.1 Research Participants and Sampling

The study used purposive sampling by involving participants who were interested in taking part in the study and who had experience of the phenomenon being explored (Erlingsson and Brysiewicz 2013) to select participants from the following three categories of personnel:

1. Call taker and dispatcher staff working in the communications centre
2. Operational staff working in the ambulances and response units
3. Supervisory staff responsible for supervising both the communications centre and operations.

The focus group discussions were conducted separately for each group identified as it was anticipated that their level of involvement in and understanding of response times would be different. Group one above is directly involved in the first interval that comprises the response time known as the EMD response interval (from the time a call is received to the time the emergency vehicle is dispatched), group two above is directly involved in the second interval that makes up the response time known as the EMS unit response interval (from the time the emergency vehicle is dispatched to the time it arrives on the scene) and group three above is involved with and has a broad understanding of the entire response time (from the time the call is received to the time the first emergency vehicle arrives on the scene). Separating the three groups allowed for in depth discussions on the two intervals that make up the actual response time as well as an overview of both intervals from a supervisory perspective.

As indicated by Polit and Beck (2006), qualitative research sample sizing is based on the quality of the participants, the purpose of the inquiry and ensuring information saturation. Each focus group discussion included representatives from the Umgungundlovu Health District only. One session was conducted with each of the groups identified. However, the one session per group resulted in data saturation and, thus, no further rounds of discussions were conducted. Each focus group discussion was held with between five and six participants and was conducted by the researcher. Despite the fact that, at the time of the study, the researcher was employed by the KZN Department of Health EMS as a deputy manager, the participants were all at ease participating in the discussions and expressing their viewpoints freely.

3.5.2 Research Process

The focus group discussions were semi-structured, thus allowing for stimulating, unplanned discussion and ensuring that all the related information regarding the research topic was captured. This provided a broad understanding of the challenges experienced and the processes utilised during case management and dispatch which were linked to the findings of phase one. This also ensured methodological triangulation. Annexure G contains the schedule that was used for the focus group discussions with each of the groups identified. This schedule formed the basis on which the discussions were conducted although it did not restrict the discussions in any way.

All the focus group discussions were conducted in English – the primary medium of communication and language spoken in the KZN EMS. All documentation and correspondence are also in English, as well as all the patient report forms and vehicle control forms (both paper based and computerised). All the emergency personnel employed by the KZN EMS have had a minimum of basic life support training which is conducted in English only in South Africa and, thus, all the participants were able to express themselves comfortably in English.

Each focus group discussion was voice recorded. This allowed for the creation of electronic sound files that were labelled and which could be played back at any stage. These files were then transcribed verbatim by the researcher for data interpretation purposes.

The focus group discussions were conducted as follows:

- In a spacious, comfortable boardroom at Greys Hospital which is in Pietermaritzburg and which was the most convenient location for the participants.
- On arrival, each participant was given a letter of information outlining the focus group discussion process as well as a consent agreement (Annexures I, J and K). Annexure I contains the letter of information for the communications centre and operational personnel, Annexure J contains the letter of information for supervisory and management staff and Annexure K is the consent agreement. Refreshments were provided, thus allowing for time for the participants to go through these documents.
- The process was clearly explained to all the participants who were then given an opportunity to ask questions after which they completed the consent forms. This was

done prior to the commencement of the discussions, thus providing the participants with the opportunity to withdraw from the study should they so wish. However, all the participants signed the forms and were happy to participate in the study.

- A number was allocated to each participant in order to ensure that his/her input remained anonymous.
- The participants were asked whether they were prepared to participate in the focus group discussions with the researcher present and they all signified their willingness to do so.

3.5.3 Inclusion Criteria

- Participants who had worked in the communications, operations or supervisory areas in the Umgungundlovu Health District for 12 months or longer were included.
- Participants who had showed an interest in taking part in the study and also a willingness to share their experiences and viewpoints on the research topic were included.

3.5.4 Exclusion Criteria

- Any participant who requested to withdraw from the study would have been excluded from the study although no such requests were received.
- KZN EMS personnel employed in districts other than the Umgungundlovu Health District were excluded.
- Emergency Medical Services staff employed in the private sector were excluded.

3.5.5 Data Analysis

The study used content analysis, as outlined by Graneheim and Lundman (2004), for the interpretation of the qualitative data collected. This included the condensing of the transcriptions from the focus group discussions. Each statement was then grouped into categories and sub-categories and commonalities and variations were then identified and described (Graneheim and Lundman 2004; Erlingsson and Brysiewicz 2013).

3.5.6 Trustworthiness

The fundamental criteria used to ensure the trustworthiness of qualitative research includes credibility, transferability, dependability and confirmability (Graneheim and Lundman 2004; Shenton 2004; Polit and Beck 2006; Erlingsson and Brysiewicz 2013). The following outlines how these will be achieved.

3.5.6.1 Credibility

The credibility of the study was ensured in the following ways:

- Purposive sampling involving participants who were interested in taking part in the study and who had experience of the phenomenon under investigation.
- Triangulation which included the use of three different groups for the focus group discussions in the qualitative segment of the study and the mixed methodology used throughout the entire study.
- The findings were verified with some of the participants in order to ensure accurate interpretation. These participants were provided with the transcribed data and asked to confirm whether the discussions had been accurately captured.
- Scrutiny of the data collection process and data interpretation by the study supervisors.

3.5.6.2 Transferability

- The focus groups identified included individuals from three different areas within the EMS and all of whom had been involved in and had an understanding of response times. The focus group discussions were held separately with the three different groups which included:
    - individuals working in the communications centre where calls are received, sorted/triaged and dispatched
    - persons working on the emergency vehicles that are dispatched by the communications centre and which respond to the cases logged and
    - individuals supervising operations, including the management of both the communications centre and operations.

- Rich descriptions of the research setting and research design were provided.

3.5.6.3 Dependability and Confirmability

- The processes followed throughout the study were clearly documented in detail in order to ensure that readers understood and, if required, would be able to repeat the study. This detail included the planned research activities as well as the activities themselves, how the data was collected and a documented reflection of the entire research process.
- The results were obtained from the participants and did not emanate from the researcher. In addition, the results were verified with some of the participants in order to ensure their accuracy. These participants were given the transcribed data and asked to confirm whether the discussions had been accurately captured.
- A documented reflective journal and field notes were kept during the entire research process, thus ensuring the availability of an audit trail.

3.6 Integration of Qualitative and Quantitative Data

A sequential explanatory approach was applied for the mixed methodology utilised. The quantitative data, in the form of numeric information, and the qualitative data, in the form of texts, were combined by, reporting the results together (see discussion section of the study). The quantitative statistical results were outlined and this was then followed the qualitative quotes and/or themes that either supported or contested the quantitative results (Morse 2003).

3.7 Ethical Considerations

The ethical guidelines, as outlined in the Durban University of Technology, Faculty of Health Sciences policy documents, were adhered to throughout this study. Ethical clearance to conduct the study was obtained from the Durban University of Technology Institutional Research Ethics Committee (Annexure L). Subsequent to this approval being granted, a letter requesting permission from the KZN Department of Health to conduct the

study was submitted to the Department's ethics committee for approval (Annexure H). The latter was accompanied with the proposal for the study which had been approved.

Patient specific details were not used at all for the purpose of the study and each case was identified by means of a case number. During the data collection process, all the data captured was stored on a personal computer which was password protected. The researcher had sole administrator rights over this computer, thus rendering remote access by employees of the KZN Department of Health or others impossible. Only the researcher, the study supervisors and the appointed statistician had access to the raw data. Once the study had been completed, the data was stored in a password protected file for a period of 15 years after which the file would be destroyed.

The participants in the focus group discussions did so of their own will, no financial compensation was either offered or provided and all the details and opinions given remained anonymous. The participants were free to withdraw from the research study at any stage. In addition, they were all given a generic information sheet (Annexures I and J) as well as an informed consent form (Annexure K) which they signed prior to their participation in the study. The aim and purpose of the study and also any potential risks and benefits were fully disclosed to all the prospective participants in order to ensure that they would be in a position to make informed decisions regarding their participation in the study. All the prospective applicants were assured that all the information and data collected would be used for the purpose of this study only and would not be used against them. In addition, it would be managed in such a way that all the data remained confidential. In other words, the data was captured and stored in a way that ensured that it could not be traced back to any individual.

CHAPTER 4:
RESULTS

4.1 Introduction

The results of the data analysis are presented in this chapter. The results are also discussed in relation to the aim of the study, that is; to analyse emergency response times within the public sector Emergency Medical Services in KwaZulu-Natal. In view of the fact that the study used a mixed methodology, the reporting of the results comprised two phases with phase one covering the quantitative results and phase two the qualitative results.

4.2 Phase One Results (Quantitative Phase)

The first objective of the study provided the focal point of the reporting on the quantitative results and included analysing response times in both rural and urban areas in KZN and comparing these response times with the established national norms used in South Africa. The data was analysed using SPSS version 24.0 (IBM, Armonk, NY) and presented using tables, graphs and diagrams. Appropriate tests were conducted to verify the relationships that had emerged.

4.2.1 Properties of Time Differences

A test of normality was conducted to determine the shapes of the distributions. This testing procedure is necessary to determine the appropriate tests to be carried out. The results of the test of normality are presented in table 4.1.

Table 4.1: Test of Normality

Tests of Normality[b,c]

	URBAN/RURAL	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
L - K (PRE-TRAVEL TIME)	Rural	.210	532	.000	.757	532	.000
	Urban	.206	758	.000	.771	758	.000
M - L (TRAVEL TIME)	Rural	.150	532	.000	.827	532	.000
	Urban	.178	758	.000	.737	758	.000
M - K (RESPONSE TIME)	Rural	.105	532	.000	.898	532	.000
	Urban	.148	758	.000	.831	758	.000
TOTAL NUMBER OF OPERATIONAL EMERGENCY VEHICLES	Rural	.168	532	.000	.914	532	.000
	Urban	.172	758	.000	.911	758	.000
NUMBER OF OPERATIONAL AMBULANCES	Rural	.242	532	.000	.860	532	.000
	Urban	.244	758	.000	.858	758	.000
NUMBER OF OPERATIONAL RESPONSE UNITS	Rural	.346	532	.000	.725	532	.000
	Urban	.331	758	.000	.739	758	.000

a. Lilliefors Significance Correction

b. RESPONSE TIME NORM is constant when URBAN/RURAL = Rural. It has been omitted.

c. RESPONSE TIME NORM is constant when URBAN/RURAL = Urban. It has been omitted.

All of the significance values were less than the level of significance of 0.05. This implied that none of the distributions was normally distributed. Accordingly, appropriate non-parametric tests were applied for comparative purposes.

4.2.2 Case Load Overview

The tables and figures below present the overall summary of the results for the different variables.

4.2.2.1 Case Classification

During the one week period of the study 1 503 emergency cases were logged. All these cases were included in the study. The classification of the cases included inter facility transfers (IFT) which made up 37% (553) of all the cases, priority one (P1) primary cases which made up the majority of the cases at 45% (680) and priority two (P2) primary cases (270) which made up 18% of all the cases (Figure 4.1).

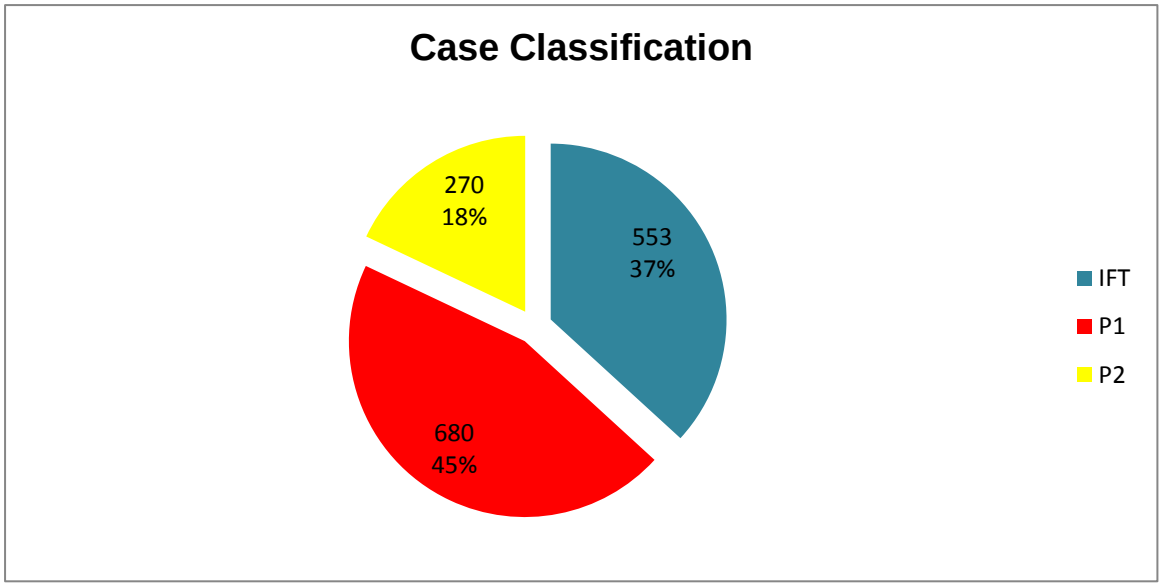

Figure 4.1: Case Type Classification

4.2.2.2 Rural/Urban Classification

The majority of the cases were within areas classified as urban areas (Figure 4.2). The breakdown of the case classification for both rural and urban areas is further depicted in Figure 4.3. The majority of the total cases were P1 cases of which 382 (56%) were within areas classified as urban areas and 298 (44%) within areas classified as rural areas. The IFT cases made up 37% of the total cases with 373 (67%) of these cases being in areas classified as urban areas and 180 (33%) within areas classified as rural areas. The P2 emergency cases made up the smallest portion of all the cases. Of these 140 (52%) were within areas classified as urban areas and 130 (48%) within areas classified as rural areas.

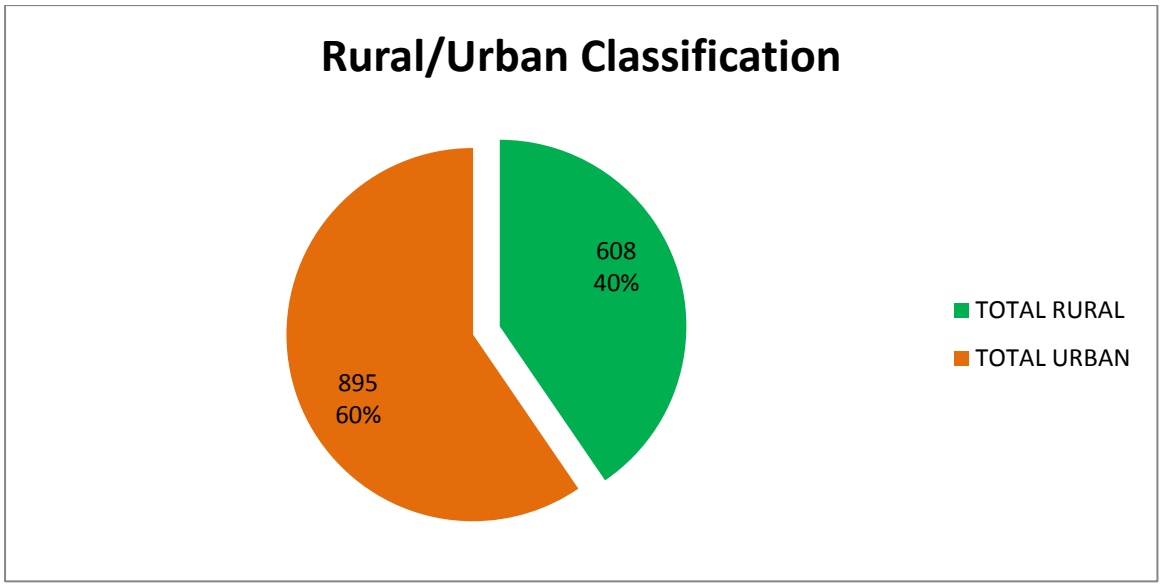

Figure 4.2: Rural Urban Classification of Logged Cases

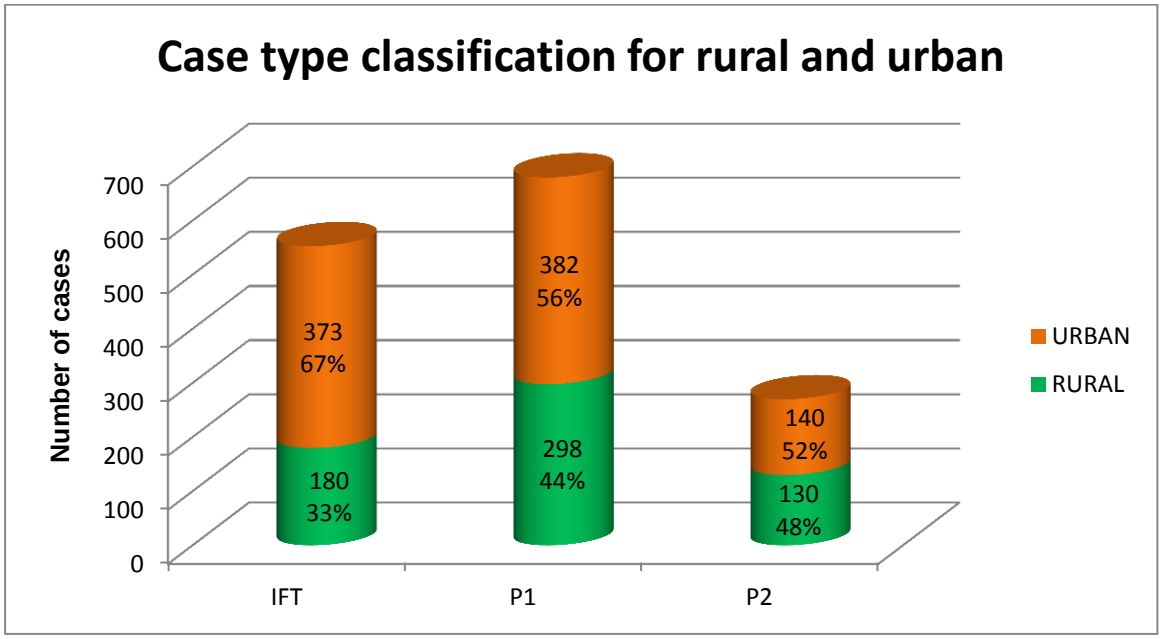

Figure 4.3: Case Type Classification Split per Rural and Urban

4.2.2.3 Case Load per Day

The study found a high case load on Monday at 221 (14.7%). The case load then increased on Thursday at 226 (15%) with a further increase on Friday to 235 (15.6%) and Saturday to 246 (16.4%). Figure 4.4 below illustrates the trend.

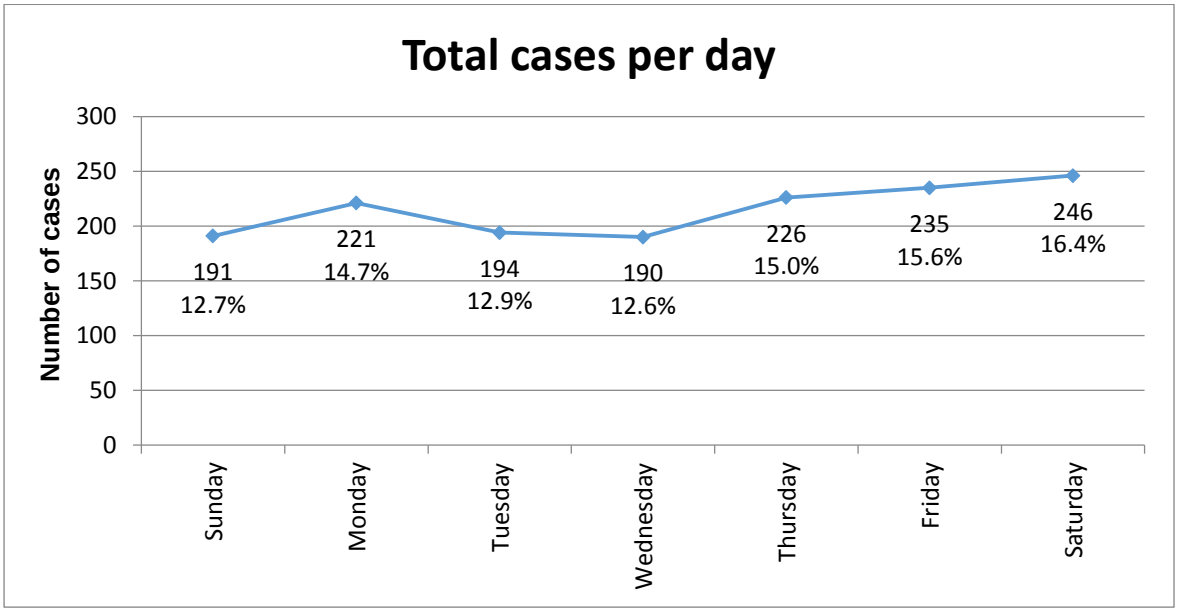

Figure 4.4: Cases Logged per Day

On weekdays, IFT cases made up the majority of cases with a total of 93 (49%) IFT cases on Wednesday. However, during the weekend the demand for IFT cases diminished drastically to less than a quarter of the total case load (Figure 4.5).

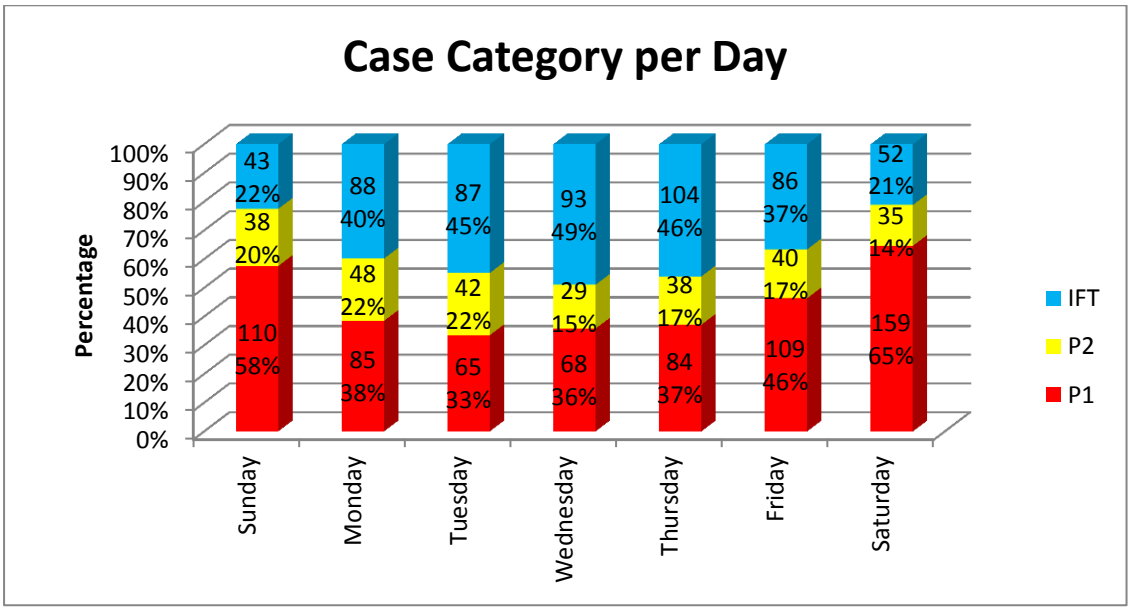

Figure 4.5: Case Category per Day of the Week

The study found a higher overall case load of 885 (59%) during the day shifts as compared to the night shifts (Figure 4.6). Figure 4.7 below depicts the case load for day and night shifts for each day of the week. It is worth noting that, during weekdays (Monday to Friday), the case load is consistently higher for day shifts than night shifts but during the weekend (Saturday and Sunday), the difference in case load for day and night shifts was minimal.

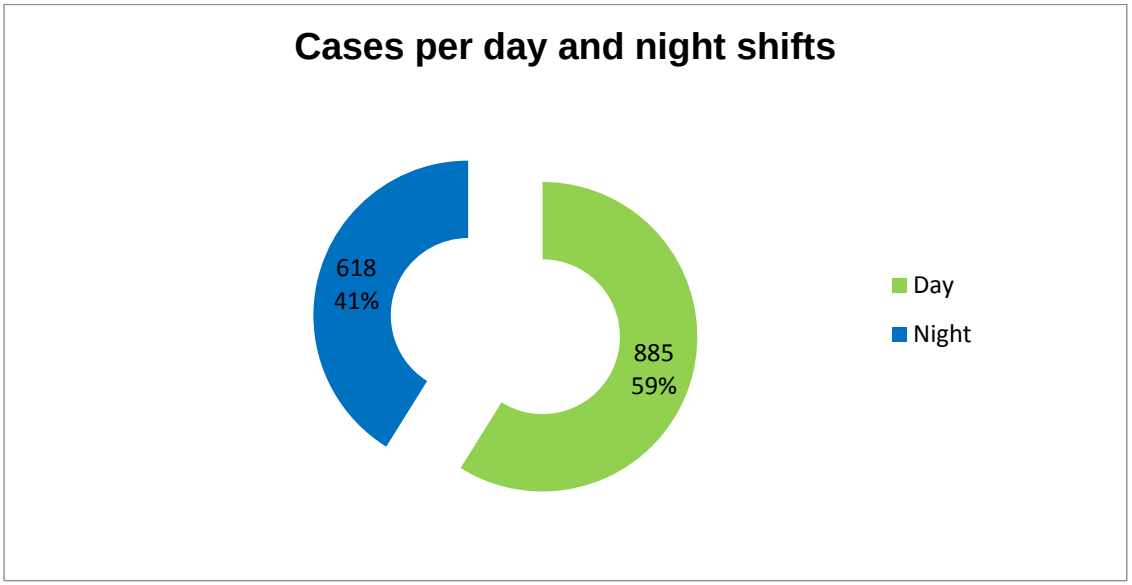

Figure 4.6: Cases for Both Day and Night Shifts

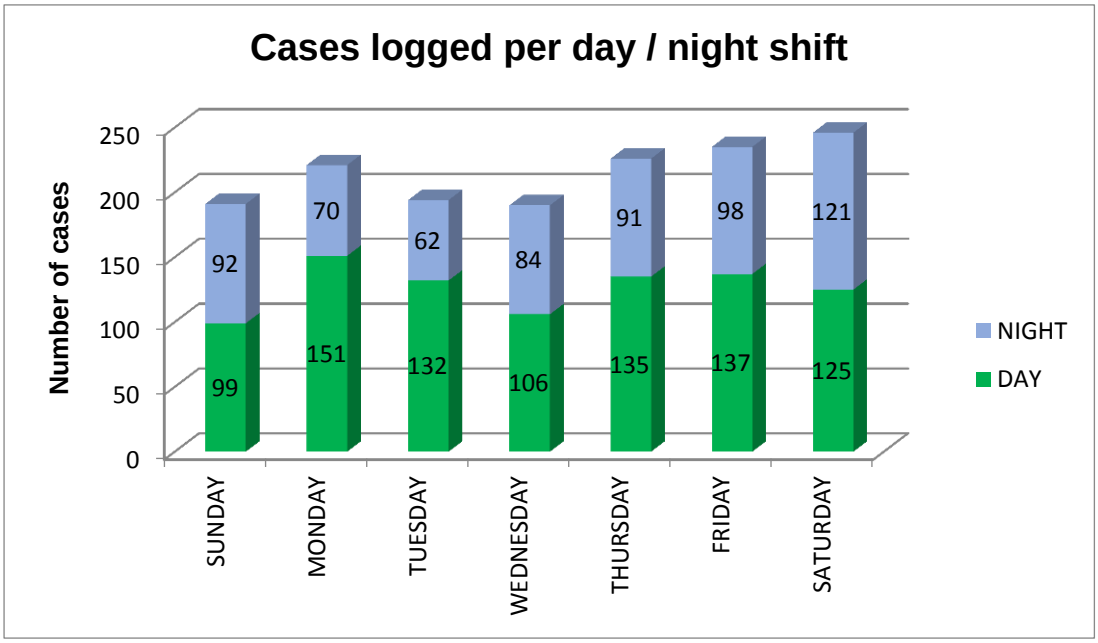

Figure 4.7: Cases per Day for Both Day and Night Shifts

Table 4.2 below indicates that there was a significant relationship between the day and the night shifts ($p < 0.001$). The chi square value was 26.25 with 6 degrees of freedom showing that higher frequencies occur during the day shift.

Table 4.2: Chi-Square Test for Day vs Night Shift Cases

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.250[a]	6	.000
Likelihood Ratio	26.542	6	.000
Linear-by-Linear Association	4.245	1	.039
N of Valid Cases	1503		

a. 0 cells (0.0%) have an expected count less than 5. The minimum expected count is 78.12

4.2.3 Operational Vehicles

The number of operational vehicles per shift fluctuated from a total of 19 operational vehicles for the night shifts on Monday and Friday as compared to a total of 25 operational vehicles for the day shift on Tuesday (Figure 4.8).

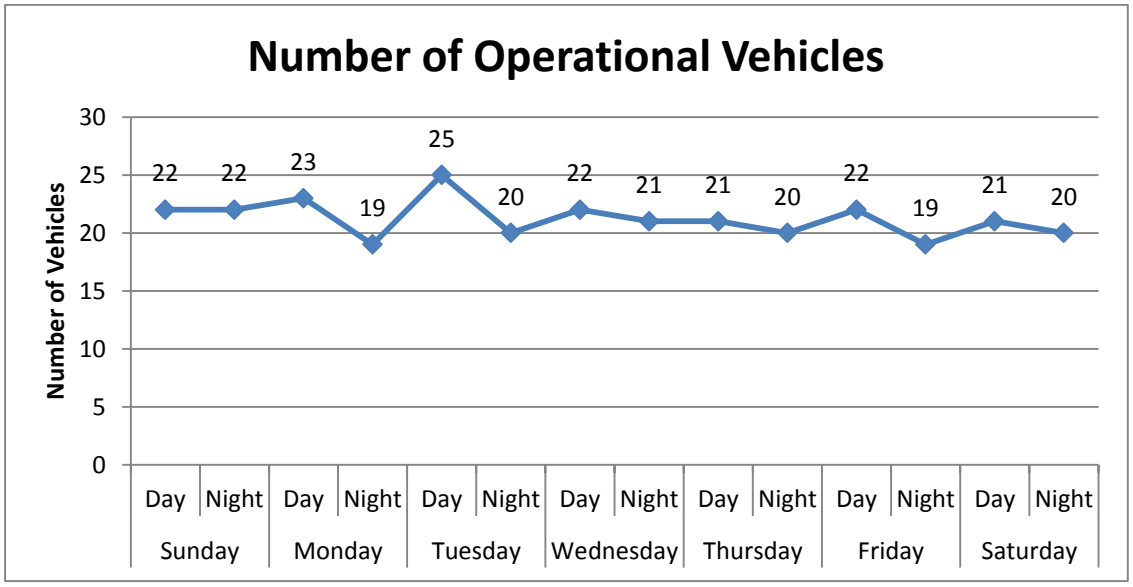

Figure 4.8: Number of Operational Vehicles per Shift

The number of operational vehicles was consistently higher for the day shifts with the largest difference between the day and night shifts on Tuesday with 25 operational vehicles during the day shift and 20 during the night shift. On Sunday there was a total of 22 vehicles for both the day and night shifts (Figure 4.9).

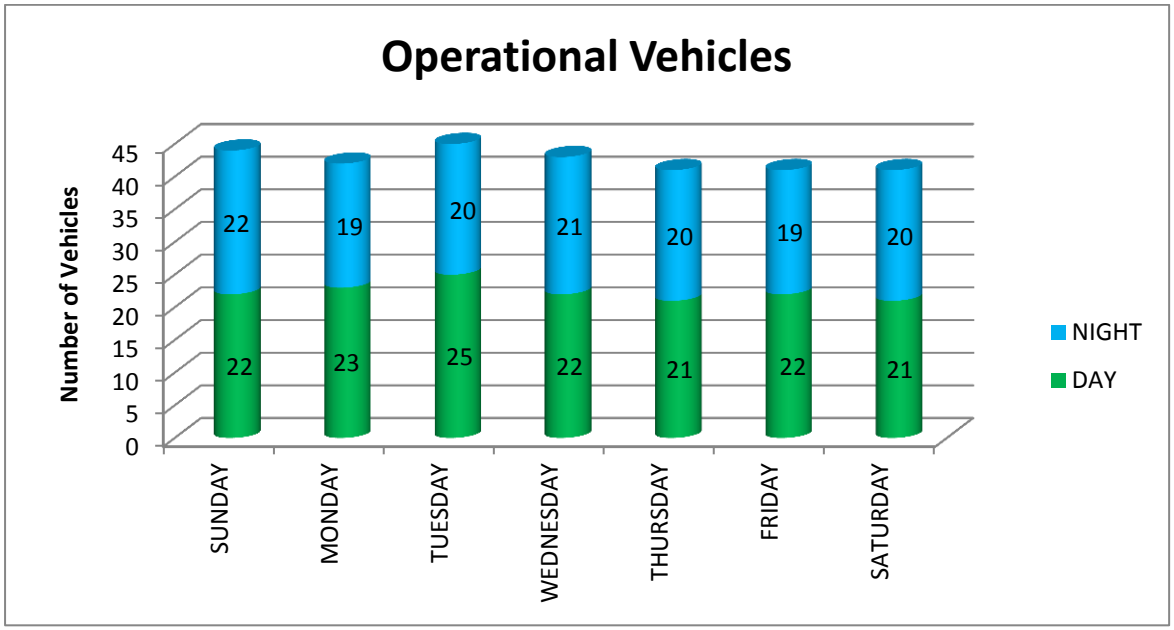

Figure 4.9: Number of Operational Vehicles per Day

4.2.4 Case Outcome

Nearly three quarters (73.0%) of the responses involved patients who were taken to a health institution. A total of 406 (27%) of the cases were exempt as, when the cases were responded to, it was found that services were not, in fact, required. The reasons for this included the cancellation of the case by the caller in 128 (8.5%) of the cases and also the inability to locate the patient or scene in 76 (5%) of the cases (Figure 4.10).

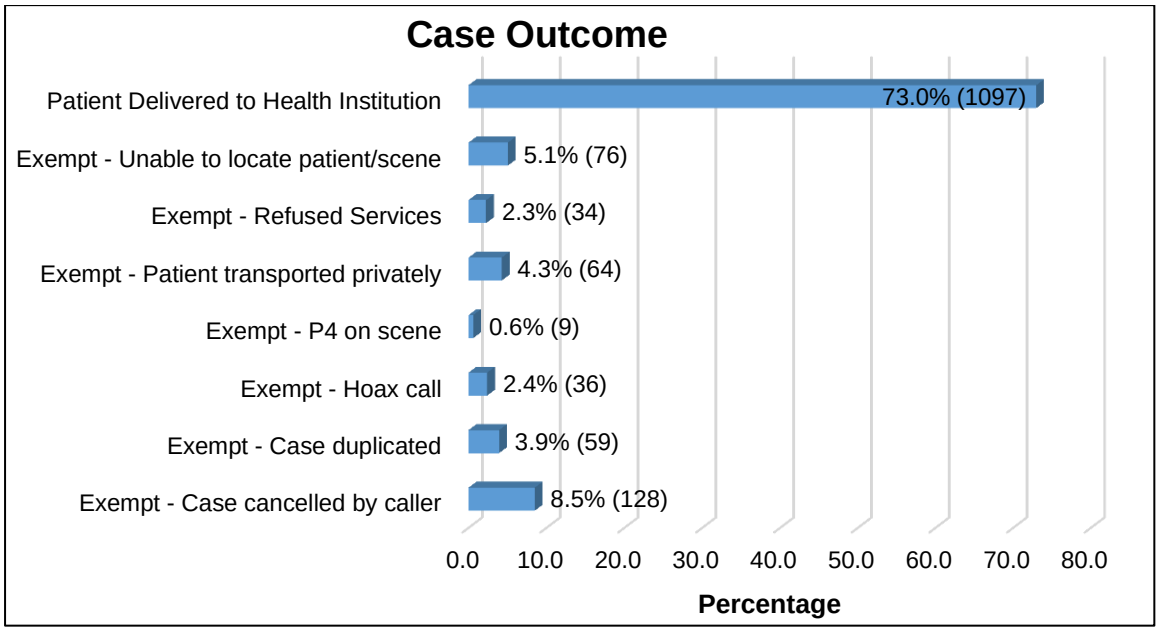

Figure 4.10: Outcome per Case

The study found the highest number of exempt cases on Friday with a total of 78 (33%) exempt cases and on Saturday with a total of 68 (28%) exempt cases. On weekdays the number of exempt cases was higher for the day shifts as compared to the night shifts. Of the exempt cases on Monday there were 49 (84%) exempt cases during the day shift and 35 (76%) exempt cases during the day shift on Tuesday. During the weekend the number of exempt cases was higher during the night shifts as compared to the day shifts with 29 (60%) exempt cases during the night shift on Sunday (Figure 4.11).

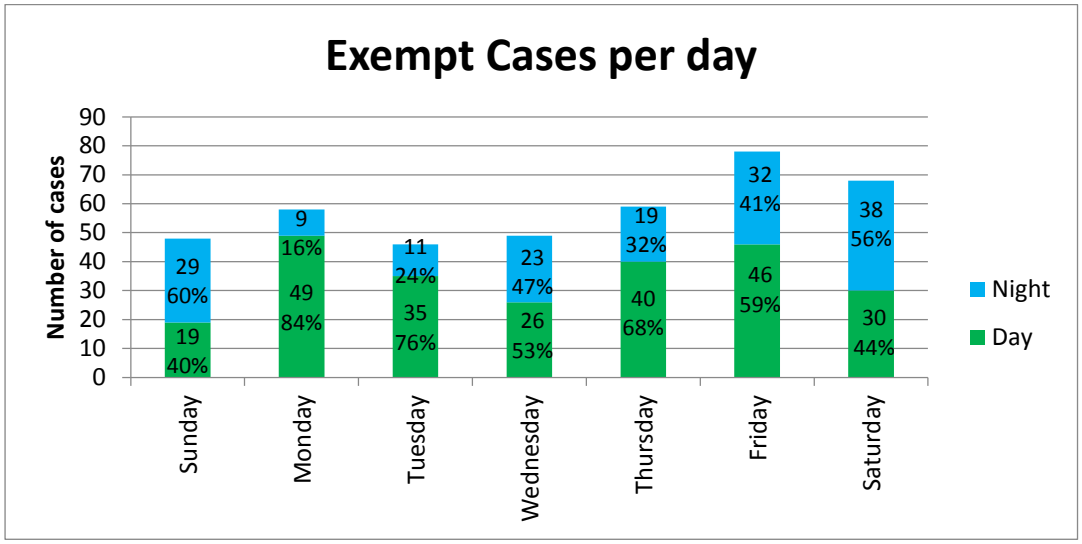

Figure 4.11: Exempt Cases per Day

4.2.5 Time Intervals

The time intervals for all 1 503 cases were included in the data. The mean mission time for all cases was 198 minutes, with a mean mission time of 216 minutes for cases in the rural areas and 181 minutes for cases in the urban areas. The mean mission time for P1 cases was 145 minutes, 174 minutes for P2 cases and 275 minutes for IFT cases (Table 4.3).

The mean response time to cases in rural areas was 129 minutes and 110 minutes to cases in urban areas. All the time intervals were longer for cases in the rural areas compared to those for cases in the urban areas with the exception of the EMD response interval. The mean response times to P1 cases were 84 minutes, 111 minutes to P2 cases and 164 minutes to IFT cases. All the time intervals were shorter for P1 cases and longer for IFT cases (Table 4.3).

Table 4.3: Mean Times Overview

	Total Cases Mean	Rural Area Cases Mean	Urban Area Cases Mean	P1 Cases Mean	P2 Cases Mean	IFT Cases Mean
EMD Response Interval	65	64	66	42	58	96
EMS Unit Response Interval	56	67	45	44	54	69
Response Time	120	129	110	84	111	164
Prehospital Interval	191	207	174	144	166	262
Mission Time	198	216	181	145	174	275

The study found the shortest mean response times for P1 cases in both urban area cases (72 minutes) and rural area cases (95 minutes) as compared to the mean response times for P2 and IFT cases. In addition, the mean response times in urban areas were shorter for all case categories as compared to those for cases in the rural areas (Table 4.4).

Table 4.4: Time Intervals per Case Category

Time Intervals							
			Mean	Standard Deviation	Median	IQR Percentile 25	IQR Percentile 75
P1	Rural	**EMD Response Interval**	43	54	18	7	60
		EMS Unit Response Interval	56	41			
		Response Time	95	65			
		Prehospital Interval	165	72			
		Mission Time	167	85			
	Urban	**EMD Response Interval**	41	50	20	7	55
		EMS Unit Response Interval	33	26			
		Response Time	72	55			
		Prehospital Interval	123	61			
		Mission Time	124	69			
			Mean	Standard Deviation	Median	IQR percentile 25	IQR percentile 75
P2	Rural	**EMD Response Interval**	60	66	32	9	86
		EMS Unit Response Interval	66	45			
		Response Time	124	77			
		Prehospital Interval	184	82			
		Mission Time	191	94			
	Urban	**EMD Response Interval**	57	57	41	12	82
		EMS Unit Response Interval	41	36			
		Response Time	97	67			
		Prehospital Interval	148	68			
		Mission Time	157	79			
			Mean	Standard Deviation	Median	IQR Percentile 25	IQR Percentile 75
IFT	Rural	**EMD Response Interval**	90	97	59	14	140
		EMS Unit Response Interval	78	73			
		Response Time	168	115			
		Prehospital Interval	272	204			
		Mission Time	290	214			
	Urban	**EMD Response Interval**	102	105	68	14	168
		EMS Unit Response Interval	60	63			
		Response Time	161	129			
		Prehospital Interval	252	209			
		Mission Time	261	200			

The mean EMD response interval was longer than the EMS unit response interval for all case categories except for P1 cases in rural areas where the mean EMD response interval was 43 minutes and the mean EMS unit response interval 56 minutes and P2 cases in the rural areas where the mean EMD response interval was 60 minutes and the mean EMS unit response interval 66 minutes. This indicated that the EMD response interval constituted the largest portion of the overall response time (Figure 4.12).

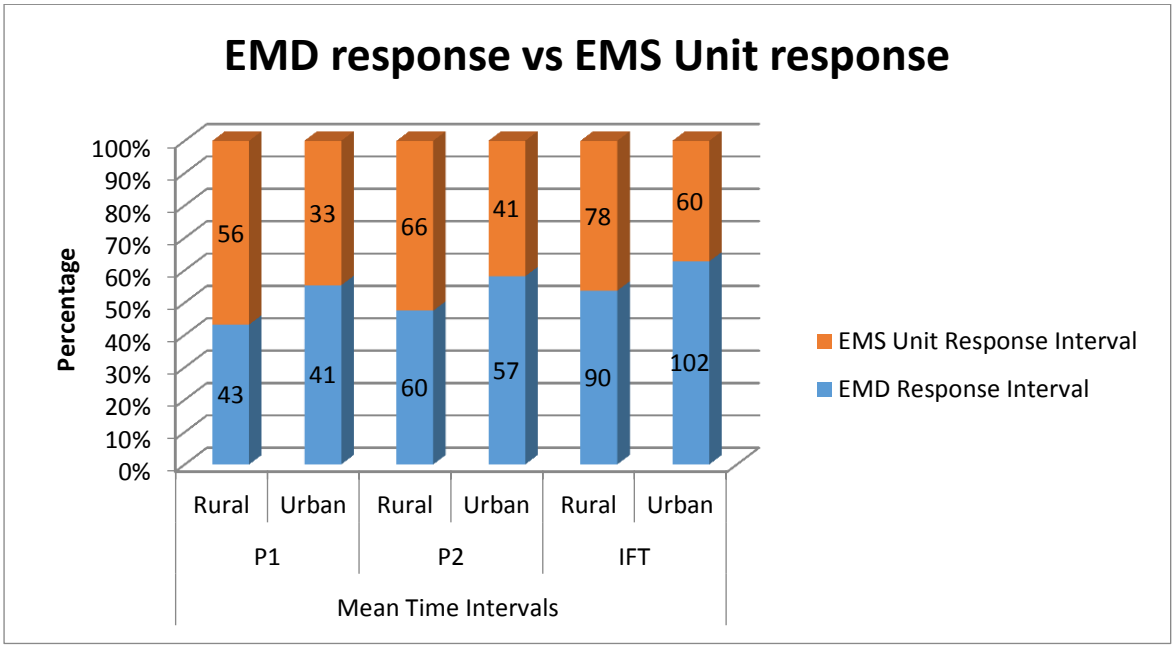

Figure 4.12: EMD Response Interval compared to EMS Unit Response Interval

The mean response time per day of the week ranged from 117 minutes on Friday to 133 minutes on Monday but was significantly lower during the weekend at 99 minutes on Saturday and 94 minutes on Sunday (Figure 4.13).

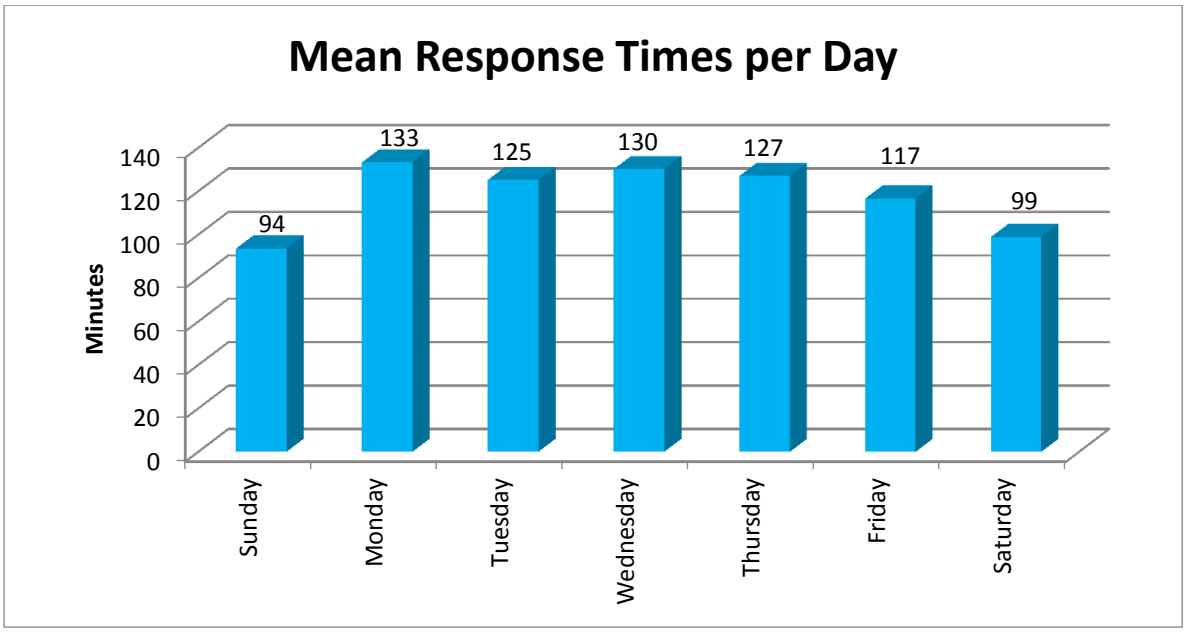

Figure 4.13: Mean Response Time per Day of the Week

The mean response time during the day shifts was higher for 4 of the 7 days, namely, Monday, Tuesday, Wednesday and Friday, all including weekdays. During the weekend the mean response time was higher during the night shifts (Figure 4.14).

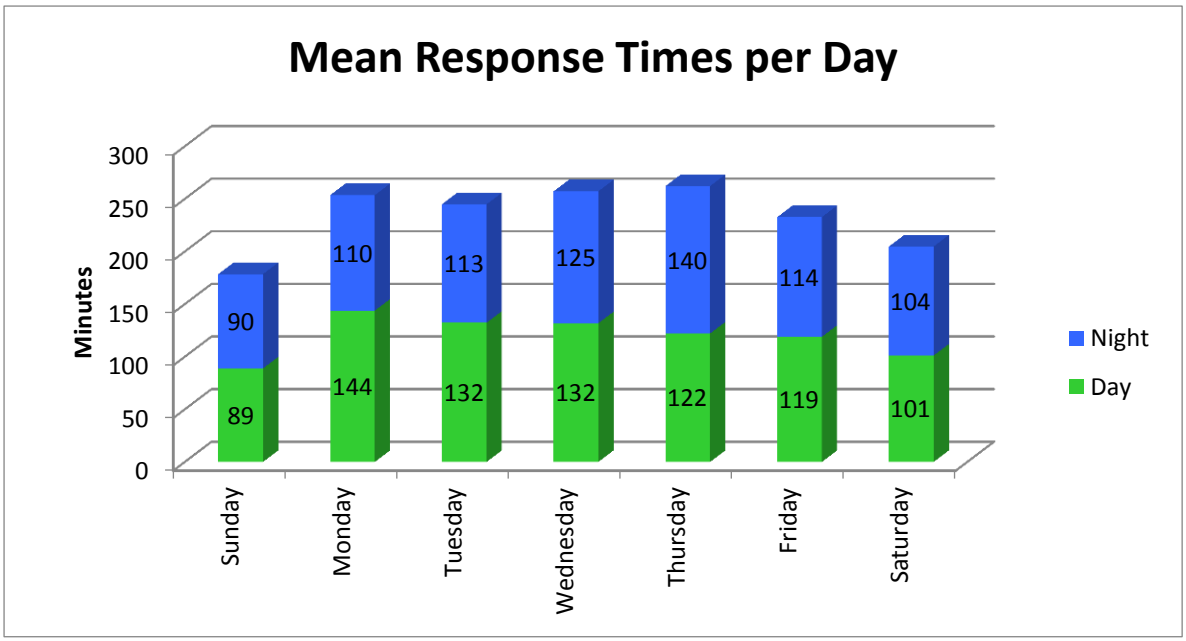

Figure 4.14: Mean Response Time per Shift per Day of the Week

4.2.6 Achieved Times as Compared to the National Norms

A total of 211 (14%) cases resulted in no response at all as they were deemed to be exempted before a vehicle was dispatched. These cases were excluded from this section. However, a total of 1 292 cases (86%) were included.

4.2.6.1 EMD Response Interval

The EMD response interval prescribed norm is 3 minutes (KwaZulu-Natal Department of Health 2004) while the study found the mean EMD response interval to be 41 minutes for P1 cases, 56 minutes for P2 cases and 96 minutes for IFT cases (Figure 4.15).

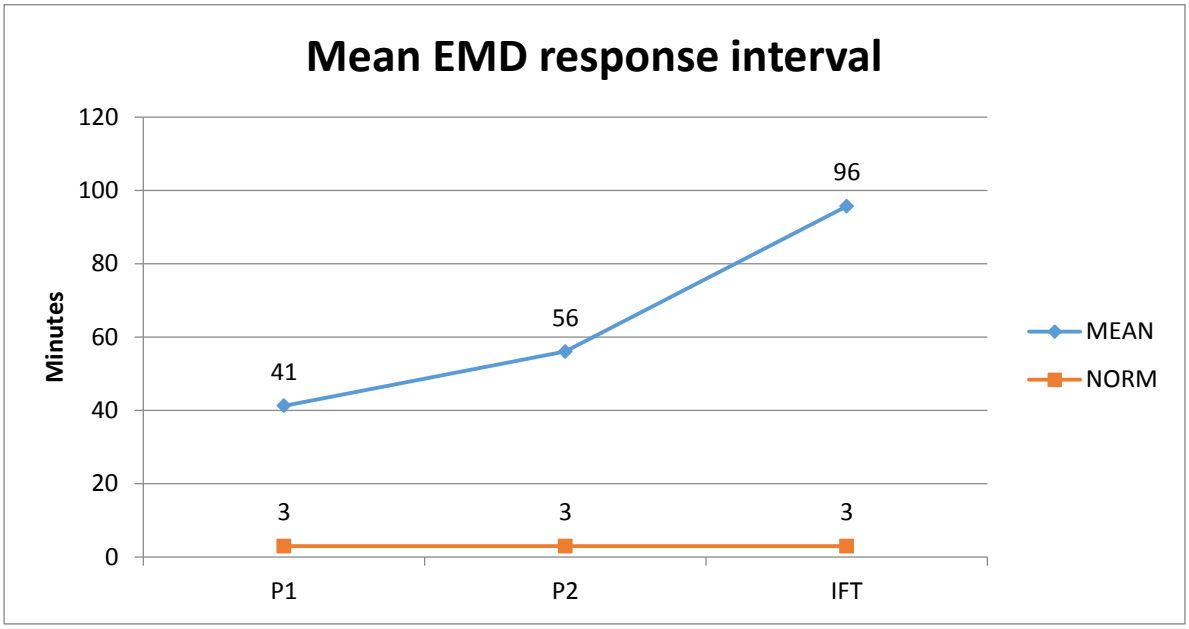

Figure 4.15: EMD Response Interval compared to the Prescribed Norm

Of the total cases for which a vehicle was dispatched, in 82 (6%) of the cases a vehicle was dispatched within the prescribed norm of 3 minutes (Figure 4.16). Of the cases with an EMD response interval within the prescribed norm (82), 26 (32%) cases cited an EMD response interval of 0 which is the situation when an emergency vehicle comes across a patient or incident, thus resulting in the case being captured after the emergency vehicle is on the scene.

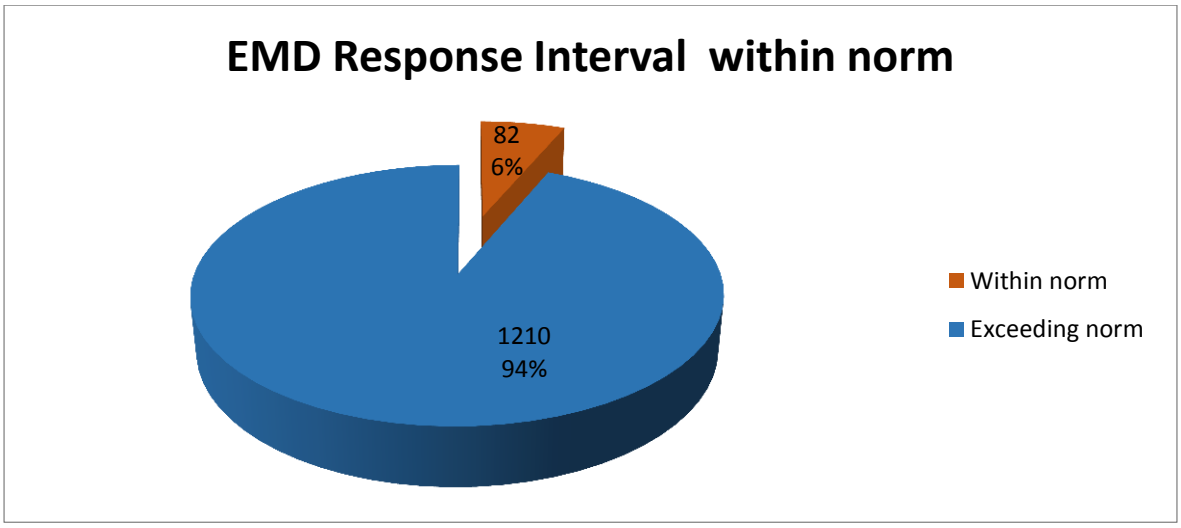

Figure 4.16: EMD Response Interval within the Prescribed Norm

4.2.6.2 Response Times to Cases in Rural Areas

The national norm for response times to P1 cases in rural areas is 40 minutes (KwaZulu-Natal Department of Health 2004, 2009, 2010b). The study found the mean response time for P1 cases was 95 minutes, 122 minutes for P2 cases and 162 minutes for IFT cases in rural areas (Figure 4.17). The difference between the national norm and the achieved response times in rural areas was significant for each case category ($p < 0.001$).

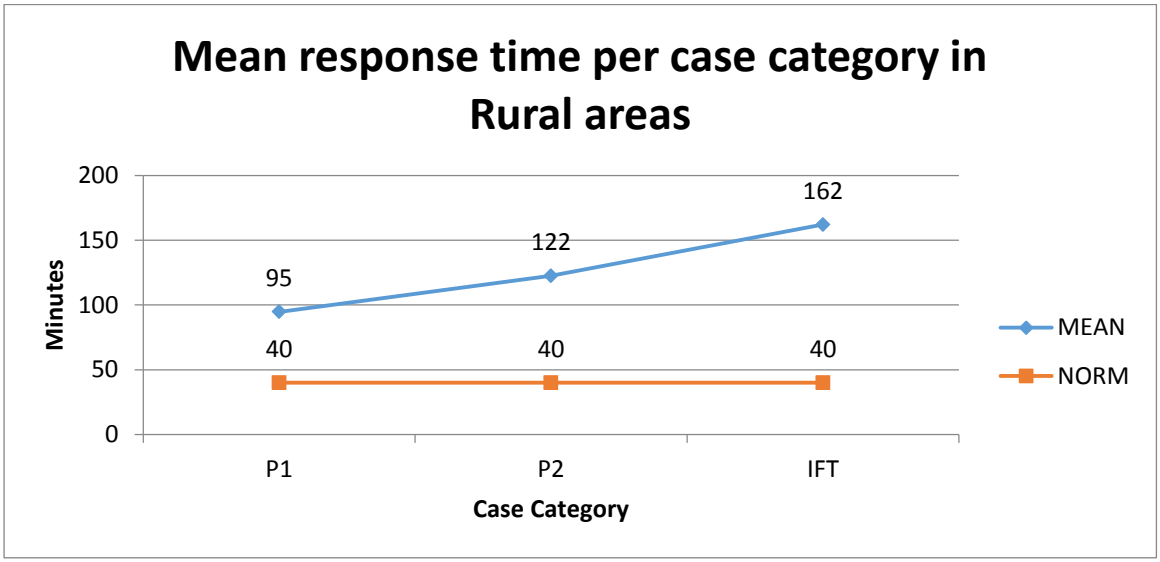

Figure 4.17: Response Times to Rural Area Cases compared to the National Norm

Regarding cases in rural areas (532) where a vehicle was dispatched and responded to the scene, 44 (17%) of the P1 cases were responded to within the national norm of 40 minutes, 9 (8%) of the P2 cases were responded to within the national norm of 40 minutes and 19 (11%) of the IFT cases were responded to within the national norm of 40 minutes (Figure 4.18).

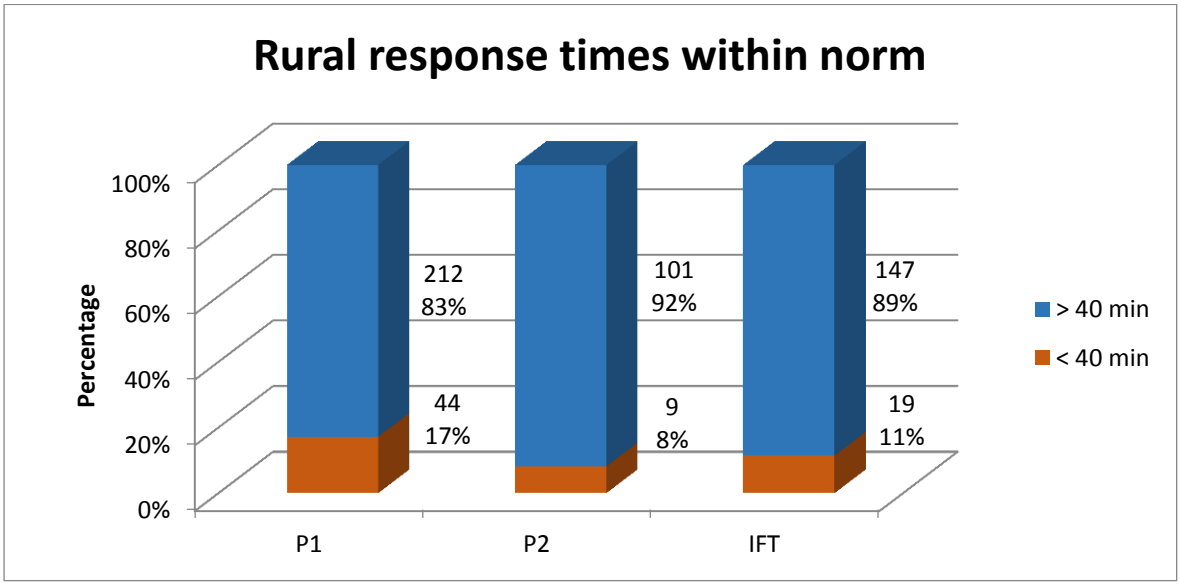

Figure 4.18: Response Times to Rural Area Cases within the National Norm

4.2.6.3 Response Times to Cases in Urban Areas

The national norm for response times to P1 cases in urban areas is 15 minutes (KwaZulu-Natal Department of Health 2004, 2009, 2010b). The study found the mean response time for P1 cases was 72 minutes, 94 minutes for P2 cases and 165 minutes for IFT cases in urban areas (Figure 4.19). The difference between the national norm and the achieved response times in urban areas was significant for each case category ($p < 0.001$).

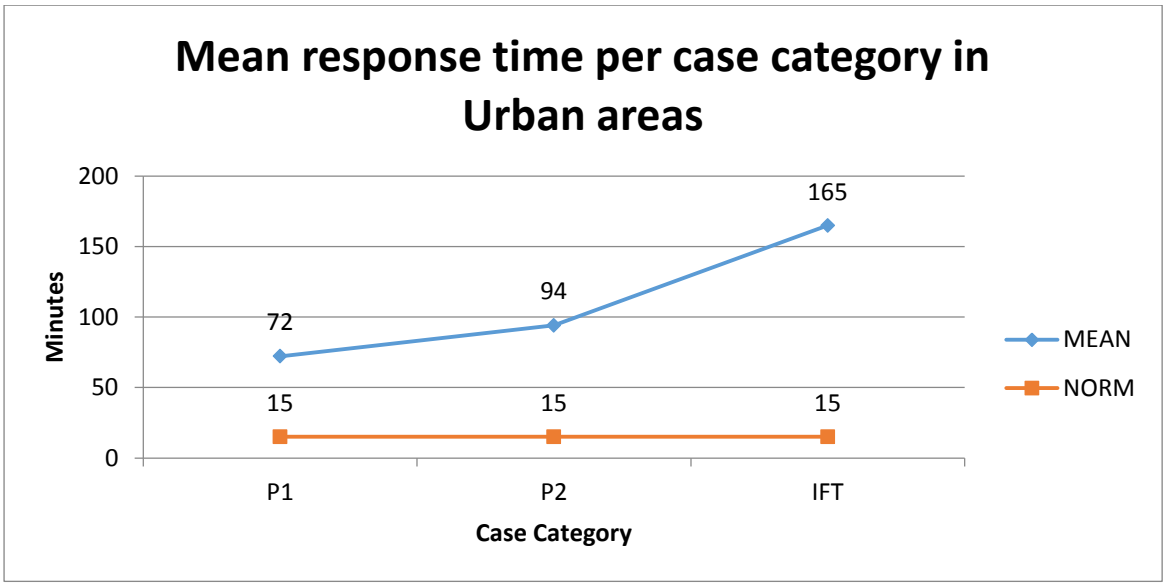

Figure 4.19: Response Times to Urban Area Cases compared to the National Norm

For cases in the urban areas (760) where a vehicle was dispatched and responded to the scene, 18 (6%) of the P1 cases were responded to within the national norm of 15 minutes, 1 (1%) of the P2 cases was responded to within the national norm of 15 minutes and 17 (5%) of the IFT cases were responded to within the national norm of 15 minutes (Figure 4.20).

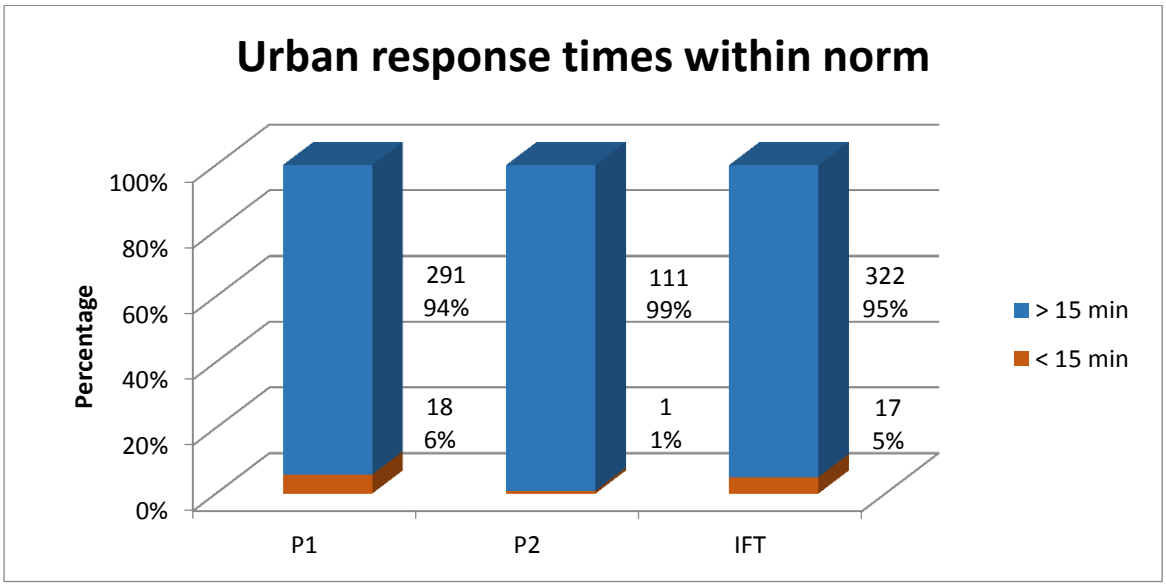

Figure 4.20: Response Times to Urban Area Cases within the National Norm

4.3 Phase Two Results (Qualitative Phase)

The second and third objectives of the study constituted the focal point of the reporting of the qualitative results. These objectives included exploring factors that influenced response times in KZN and identifying strategies aimed at improving response times.

The participants in the focus group discussions were selected based on both their availability and their willingness to participate in the discussions. All those invited to participate attended the session and agreed to participate in the discussion. In other words, none of those invited to participate was excluded from any of the groups. Each participant was allocated a number on arrival. For the purpose of the data analysis the operational staff group participant numbers started with “ops”, the communications centre staff group numbers started with “comms” and the supervisory group numbers started with “sup”, each followed by the respective number.

A Microsoft PowerPoint presentation was used to conduct the focus group discussions. This Microsoft PowerPoint presentation included the results from phase one of the study in order to provide insights and to promote discussion on these results. This approach was effective as the EMS is generally a structured environment, patterned on the military, and therefore the environment created was familiar to the participants and one in which they felt comfortable and were able to participate freely.

The focus group results were analysed by means of coding and were broken down into categories and sub categories. These categories and sub categories are presented in Table 4.5 below.

Table 4.5: Qualitative Data Coding Categories and Sub Categories

RESEARCH OBJECTIVES	CATEGORY	SUB CATEGORY
To explore factors that influence response times in KZN	Problems related to vehicles	Shortages and suitability of vehicles
		Poor maintenance of vehicles
	Problems related to staff	Shortages of staff
		Poor attitude and discipline of staff
	Challenges in the management of resources	Equipment availability and suitability
		Ineffective operational resource management
		Lack of resource management tools
	High demand for services and challenges experienced in dealing with cases	High caseload
		Difficulties related to inter facility transfer cases
		Factors resulting in exempt cases
		Inappropriate triage and prioritisation of cases
	External factors that contribute to the challenges experienced	
	Incorrect public perceptions	
To identify strategies to improve response times	Effective management of resources	Optimal resource availability and allocation
		Optimal operational resource management
	Systems overhaul for the improvement of services	Information and Communications Technology (ICT) solutions required to improve services
		Processes and procedures to standardise and improve services
	Effective and suitable education	Education of staff
		Education of the public

4.3.1 Problems related to Vehicles

The participants placed significant emphasis on the problems related to vehicles as a contributing factor to delayed response times. The Emergency Medical Services (EMS) is largely dependent on vehicles to provide a service due to the fact that it is a mobile service. This category was subdivided into two sub categories, namely, the shortages and suitability of vehicles and the poor maintenance of vehicles.

4.3.1.1 Shortages and Suitability of Vehicles

The shortage of vehicles, particularly ambulances, was discussed at length by the participants during all three focus groups discussions.

One participant expressed huge frustration due to the fact that that the work was never ending as there were always cases waiting to be dispatched. This made the shifts exhausting.

> *"There are just too many cases, the demand is high and there are too few ambulances"* (ops 3).

The participants in the communications centre group revealed the difficulties involved when there were no vehicles available to dispatch to a case immediately with the callers demanding to know the expected waiting times. It is often very difficult to determine these waiting times and cases that seemed to be non-emergency when logged, often have to be upgraded to an emergency case due to the extended waiting time. The participants also explained that, over the years, the number of operational vehicles and ambulances had not increased although the demand was continuously increasing.

> *"Response times are bad due to the shortage of vehicles and high caseloads received. Sometimes we are compelled to make a green code a red code case as the green code was sitting in the system for way too long as there were no vehicles available to be dispatched to that case which was received hours before. Sometimes when a vehicle is dispatched, it takes up to 45 minutes to arrive at a scene in an urban area. The dispatchers receive several calls from the caller*

requesting why the ambulance has not arrived as yet. The status of vehicles in the early 90s is the same as it is right now but the areas are growing and so is the population" (comms 1).

The participants from the supervisory group highlighted the national norm of 1 ambulance per 10 000 population and stated that the EMS is not even close to this national norm, thus making it virtually impossible to achieve the response times national norms.

"In terms of the national norms the response times were based on the population in an area for ambulances. In reality we are far away from this. This could be a realistic goal if there were more ambulances" (sup 1).

The suitability of vehicles was also expressed as an issue of concern by the participants in all the groups. They felt that the vehicles were not always suitable and this often had a negative impact on response times. Vehicles often became bogged down or broke down at regular intervals because they were not suitable for rural roads. This then caused delays in responding, not only to the case to which the vehicle itself was responding but to subsequent cases. If ambulances were suited to transport multiple patients they would be able to attend to multiple cases in an area before proceeding to hospital. This, in turn, would reduce response times. However, the majority of ambulances are able to transport only one patient at a time.

"They often use unsuitable vehicles for an area which causes breakdowns and delays. In urban areas where the road infrastructure is acceptable the Mercedes and crafters are suitable. Land cruisers are not suitable for urban areas but are suitable for rural areas" (ops 4).

"Patient transport services are using smaller vehicles for transfers. Only one stretcher patient can be transported at a time, sometimes there is more than one patient to be transported from the same institution and it has to be done separately, thereby increasing the number of trips and resources used for inter facility transfers" (sup 2).

4.3.1.2 Poor Maintenance of Vehicles

Participants expressed frustration when they voiced their concerns about the maintenance of vehicles. The delay in maintaining or repairing vehicles has a negative impact on response times as the majority of the available fleet are is often out of service. When vehicles return from being repaired there are often additional problems with the vehicles as the repairs were not carried out correctly or the service providers may be taking short cuts as they know their work is not closely inspected. Internal fleet management also appeared to be a challenge as roadworthy certificates were sometimes allowed to expire.

The participants expressed the following views:

> *"Some vehicles are not roadworthy, some even have expired license disks and the tyres are worn out. When vehicles are involved in accidents they are not repaired timeously"* (ops 4).

> *"Vehicles are breaking down too frequently. For example, lights are not working in the interior patient compartment so then, at night, that vehicle is stood down due to no lighting. When the vehicle is stood down, there is no replacement vehicle. Vehicles are not properly maintained"* (comms 1).

> *"Umgungundlovu has a fleet of 60 vehicles of which 40 are not operational because they need repairs. We do not have reputable mechanics working on our vehicles and repairs take three to four months. Even when they come back, you will find that there is something else wrong"* (sup 6).

4.3.2 Problems related to Staff

The participants expressed great concern about the problems related to staff as a major factor in the delay in response times. This category is subdivided into two sub categories, namely, shortages of staff and poor attitude and discipline on the part of staff.

4.3.2.1 Shortages of Staff

Staff shortages have a direct impact on the operational resources. This was raised as a concern by the participant ops 4.

> *"There is a shortage of staff and, when some staff are on family responsibility leave, sick leave and annual leave, then others are not permitted to work overtime because of no budget so the operational status is low"* (ops 4).

As revealed by the participants, staff shortages were also a problem in the communications centre as the available staff per shift at the time of the study was not able to answer all the incoming calls.

> *"The control centre is facing shortages of staff, we are unable to answer all the calls, management have been informed but nothing is done. We only have 3 call takers at the communications centre and they need to answer 110 lines. As a result, the communications centre staff don't take breaks, we eat and drink while we are working"* (comms 2).

As highlighted by the participants, although staff may be called in to work overtime, overtime is limited due to financial constraints as well as the limit in the number of overtime hours each staff member is allowed to work.

> *"Overtime is limited due to budget constraints. Once staff members have reached the maximum overtime allocated to them, then they are unable to work overtime for the rest of that month"* (sup 2).

4.3.2.2 Poor Attitude and Discipline of Staff

The participants expressed frustration because they felt that the operational staff were not disciplined. At the start of their shifts, the operational staff members often took a while to become operational and to become available for dispatch to cases, despite cases continually being logged during this time. In addition, they did not provide accurate information while attending cases during their shifts and, as a result, the communications

centre staff often did not know where they were or how much longer they would be. This made it difficult to prioritise the next dispatch and/or to provide accurate feedback to callers regarding expected delays. Communications centre staff also did not receive any support from the management structures as they were not available when attempts were made to contact them for guidance or when the staff required their intervention. This made it challenging for the communications centre staff to manage the available resources effectively during a shift, as it appeared that the operational staff members were able to do exactly as they wanted without any consequence.

> *"A demotivated staff can contribute to delays in response times, these staff intentionally delay cases, they take a long time to book available at the start of a shift, they don't update the communications centre at all and, when we try to dispatch them on cases, they argue with us. Vehicles become available after 1 hour from the start of a shift. Although we complain to the supervisor, nothing is being done. We, as the communications centre staff, find it difficult to get cooperation from an operational supervisor, it's as if we are undermining them. The supervisors are always busy when they are contacted. There is no support from management. When we have a challenge we are expected to deal with it ourselves, when we try to contact management to intervene, they are not available"* (comms 3).

The participants from the supervisory group highlighted ill-discipline on the part of both the operational and the communications centre staff. The operational staff intentionally delayed attending to cases and provided incorrect information on their whereabouts while communications centre staff members just did not answer the calls if they did not feel like doing so.

> *"We have ill-disciplined crews, they are intentionally damaging and vandalising the vehicles, no checklists are carried out on a vehicle before it is driven; staff don't check oil, water or tyre pressure when they refuel. There is poor supervision of staff. Forty motor vehicle accidents involving our own vehicles were recorded in one and half months but no discipline is taken against the staff members who cause the accidents. Drivers are not reporting damage caused to vehicles"* (sup 4).

"Previously EMS ran a few vehicles and achieved the desired response times. The attitude of staff is bad. As soon as a call is received it should be dispatched and the crew should be mobile shortly thereafter. Prior to 1994, although there were few vehicles, a case would never take up to 3 hours, however, now a case takes up to 6 hours. Staff was dedicated then but not anymore. To get through to the communication centre is challenging, staff just don't answer the calls when they feel like it" (sup 6).

4.3.3 Challenges with the Management of Resources

Although the availability of resources was highlighted as a major contributory factor to delayed response times, the use and management of the available resources was also highlighted as a concern. This category is subdivided into three sub categories, namely, equipment availability and suitability, ineffective operational resource management and lack of resource management tools.

4.3.3.1 Equipment Availability and Suitability

The participants from the operations group highlighted the unavailability of equipment as a challenge. When vehicles are not stocked with the required equipment and surgical sundries they are stood down (removed from service), thus reducing the available resources and thereby contributing to delayed response times.

"On arrival on duty at the start of our shift there are no resources in the ambulances and we are unable to leave base if vehicles are not stocked with surgical sundries, stock and equipment and this delays the response times" (ops 4).

According to the participants from the communications group, the computers used for call taking and dispatch in the communications centres were both slow and old, thus resulting in delays.

"The computers used in the communications centre are old and slow and this causes delays" (comms 3).

The participants from the supervisory group highlighted issues including the fact that the available equipment is not always suitable for the prehospital environment and, as a result, gets broken or damaged easily while either repairing or replacing of such broken or damaged equipment is often a difficult and lengthy process. Ordering new equipment as a replacement was said to be almost impossible. Issues regarding the storage and safekeeping of equipment were also raised as a concern as there were no security measures in place and, as a result, equipment was often stolen. In addition, it was difficult to investigate such incidents definitively and to institute disciplinary action in order to prevent it from reoccurring.

> *"Pool vehicles have no equipment, there is no proper asset management and often vehicles are also stood down due to a shortage of equipment because no one knows where the equipment is. The current supply chain management and finance systems are not supporting the EMS. Previously it was under our control and it worked. However, now it goes through district health and it is not very effective, it is a stumbling block"* (sup 4).

> *"There are problems with the infrastructure; there are no proper storage facilities and no system for the monitoring and tracking of equipment (sup 3).*

4.3.3.2 Ineffective Operational Resource Management

The participants expressed the view that operational resources were often managed ineffectively and that this contributed to the delays in response times.

As indicated by the operational participants, if there are multiple cases in an area, particularly the rural areas, an ambulance has to be dispatched per case. Particularly in the event of cases being found to be non-emergency, the ambulance should be able to attend to and transport multiple patients, thereby reducing the response times.

> *"Sometimes non-emergency transfers are done individually, rather use 1 vehicle to transport many patients at the same time, so there would be more vehicles left for emergency operations. Some cases are intentionally delayed until there are a number of cases in a particular area, especially in rural areas. We are requested to*

do local cases before taking on long distance cases no matter how long they have been outstanding for" (ops 2).

The participants from the communications group highlighted how on duty operational staff members were often used to perform duties other than responding to emergencies, for example, ferrying vehicles to and from service providers for the repair and maintenance of such vehicles or attending special events, thereby resulting in a reduction in the available resources. The communications participants also stated that pool vehicles were often not stocked and ready for use so, when a vehicle is stood down, it is not possible for the staff to be operational using the pool vehicle immediately as they are required to stock it first, thus causing delays. The use of specialised services, namely, aeromedical services, obstetric ambulances and inter facility transfer ambulances, was not clearly defined or understood, therefore resulting in the resource not being used effectively and not adding value.

"Ambulance staff are supposed to be used for emergency cases only but they are used to drop off and pick vehicles from merchants and they get used for special events which results in fewer ambulances being available to dispatch. Pool vehicles are not stocked so, when a vehicle needs to be changed over, then there are delays because the vehicle must be stocked first. If pool vehicles were stocked then the changeover would be immediate" (comms 1).

The supervisory participants highlighted that, during shift changes, there was often no sense of urgency and the service came to a standstill despite the fact cases continued to come in, thus resulting in a backlog and delayed response times.

"The service comes to a standstill at shift changeover because all vehicles in all areas have to stand down for the changeover at the same time. Advanced Life Support (ALS) work on responses vehicle only so they are not very productive. They go to a scene and have to wait there until an ambulance comes so it would be better if they worked on an ambulance" (sup 1).

4.3.3.3 Lack of Resource Management Tools

The study found that tools to assist in the management of resources were perceived to be unavailable, limited or non-functional. The entire EMS is provided with emergency vehicles and one of the most vital tools is the vehicle monitoring and tracking system which allows the communications centre to view the exact location of a vehicle at all times. This enables the communications centre to identify the vehicle closest to a particular patient, thus assisting in the dispatch of the closest vehicle and thereby reducing response times. In addition, the tool assists in providing accurate directions to the vehicle as well as enhancing the overall effective management of the available vehicles. However, as indicated by participants from both the operations and communications groups, this system was not functional and this impacted negatively on response times.

> *"The vehicle monitoring and tracking system that we have is a waste of time and money because it does not work in real time; it could assist us with accurate directions"* (ops 4).

> *"The vehicle monitoring and tracking system is useless as it does not provide real time. Tools that are accurate will assist in the managing of resources because we would be able to see where all the vehicles are"* (comms 3).

The participants from the supervisory group indicated that human resource management tools such as leave planning in order to ensure sufficient staff members were available for duty at all times were not used. This often resulted in an erratic number of staff arriving for duty, thus reducing the available resources and, in turn, negatively affecting response times.

> *"Not all scheduled ambulances are operational due to poor resource management, unplanned leave and night and day shift supervisors not working as a team. The day shift supervisor should plan and be getting staff to fill in for the night shift staff who are away. Sub district managers don't communicate – two Advanced Life Support (ALS) should not be given leave at the same time but it happens and the district then runs with no ALS"* (sup 1).

4.3.4 High Demand for Services and Challenges experienced in dealing with Cases

The participants expressed how the huge demand for services, including the nature of cases, played a significant role in the poor response times. This category was subdivided into four sub categories, including high caseload, difficulties related to inter facility transfer cases, factors resulting in exempt cases and the inappropriate triage and prioritisation of cases.

4.3.4.1 High Caseload

The participants all raised concerns over the high caseload which was continuously increasing while the available resources are remaining the same, thus resulting in a massive demand resource mismatch.

As indicated by the operations participants, by the time a case is dispatched the case has often already been outstanding for some time. Thus, even if their response is quick, the response time is not.

> *"Most of the cases are queued at the communications centre and, therefore, it takes longer to respond. When we get the case it has already been outstanding for hours. There are just too many cases, the demand is high and there are too few ambulances"* (ops 3).

As expressed by the communications participants, there were always outstanding cases waiting to be dispatched and this had a massive negative impact on response times.

> *"Delays are due to high case load. Cases are not completed within each shift and overflow into the next shift"* (comms 4).

4.3.4.2 Difficulties related to Inter Facility Transfer Cases

The participants raised concerns about the high demand for inter facility transfer (IFT) cases and how these cases contributed significantly to delayed response times. There were IFT ambulances but these were operational only during the day shift and, in many cases, there was a limited number of these ambulances only. Often not all the IFTs were completed during the day shift and, thus, the remainder had to be completed during the night shift. The same pool of ambulances are required to attend to all emergency cases then had to assist with the IFTs. In addition, it takes considerably longer to complete IFT cases as compared to emergency cases and, thus, this causes delays in the response times to all cases.

The following excerpts highlight the participants' viewpoints:

> *"Most ambulances are allocated for transfers because of the high number of such transfers. They go to Durban and are delayed, some transfers can take the whole 12 hour shift which leaves few ambulances for emergency cases"* (ops 4).

> *"Inter facility transfers are a lot, transfers are left behind from the day shift as there are no vehicles available and cases have to be prioritised. During a transfer, when they reach an institution, the crew will wait up to 2 hours for the doctor. The inter facility transfer case load is very high and, if you don't have inter facility transfer ambulances for the night shift, then the operational ambulances are used. Inter facility transfers take longer to complete which makes the case load increase and makes response times worse"* (comms 4).

The participants described how the doctors at the receiving hospitals often delayed completion of IFT cases as they examined the patient on the EMS stretcher before admitting the patient. If the information provided by the referring doctor did not match the condition of the patient, they would simply refuse to accept the patient and send the ambulance back to the referring facility with the patient.

> *"Crews sometimes wait hours at hospitals before a doctor accepts a patient. Although an ambulance is required for operations, it is kept behind in the hospital*

and is not available to the public while waiting for the doctor to accept the patients. Cases are delayed which affects and delays response times. The inter facility transfer cases demand is high" (sup 3).

4.3.4.3 Factors resulting in Exempt Cases

The participants mentioned the high number of exempt cases and stated that they felt that the delayed response times were a contributory factor to this high number. As expressed by the operations and communications participants, patients sometimes became frustrated with the delays and they made alternate arrangements to get to hospital. However, they did not inform the communications centre accordingly and, therefore, an ambulance was still dispatched and responded. This had a negative impact on the response times to all other cases. If the communications centre made contact with the caller prior to dispatching a vehicle they would know whether the patient had made alternative transport arrangements, thus enabling them to cancel the call and make the resource available for the next emergency.

"The biggest cause of exempt cases is the control centre. When we arrive for duty at 7pm, cases have already been logged 4 to 5 hours ago on the system. Call takers do not call those patients to find out if they still require the ambulance and, when we are dispatched to the patient, we arrive and are told that the patient has been taken to the hospital already" (ops 4).

"When the case load is high response times are longer and exempt cases increase. Callers wait for an ambulance for too long, and thereafter take the patient to hospital in a private vehicle. The call takers are unaware that the patient was taken to hospital privately and ambulances are dispatched. When crews arrive there they find out the patient has already been taken to hospital in a private vehicle" (comms 5).

According to the participants from the supervisory group sometimes a call is made to the emergency services but, when the ambulance arrives on the scene, the patient refuses to be taken to hospital and demands that the ambulance service takes his/her vital signs or that he/she be nebulised in the comfort of his/her own home.

"Some patients refuse to go to hospital. A family member calls for the ambulance and, once the ambulance arrives on the scene and assesses the patient, the patients refuse to go to hospital. Sometimes they even call because they want us to check their blood pressure or glucose or ECG at home. Others who are asthmatic will call us just to nebulise them at home and then they say they are ok after being nebulised" (sup 1).

4.3.4.4 Inappropriate Triage and Prioritisation of Cases

When a request for services is received by the communications centre the request is triaged based on the patient's condition. The participants expressed the view that the majority of cases are triaged as priority one (red code) and that this contributes to delayed response times.

As indicated by the participants in all the groups, real life threatening cases receive the same priority as non-emergency cases. Some patients merely require medical advice over the telephone and not transportation to hospital. However, it would appear that the communications centre staff just log every case rather than asking probing questions to determine exactly what is required. The participants stated that, if triaging were carried out correctly, then the response time target for priority one red code cases would be achievable.

"If the triaging of cases was correct, we might be able to meet the national norm but the information that the caller provides is incorrect so all cases are made a priority and this may affect response times. Currently a patient that has a stomach pain is receiving the same priority as a patient who is having seizures or a baby with a high temperature. Patients sometimes need only medical advice and not medical assistance and, if the communications centre staff asked the right questions, then they would know this and not send us there for something they could have done over the phone. Patients are triaged as red code but, when paramedics arrive on the scene, the patient is a green code. This happens most of the time" (ops 2).

At the time of the study the triaging of cases on receipt of a call was based on the opinion of the call taker. The participants from all the groups mentioned that there was no standardised system to assist with the effective triaging of cases.

> *"There is no standard system used for triaging each case so triaging depends on the call taker who is unable to diagnose a patient because callers provide incorrect information and the dispatcher has to search for the correct information from the caller"* (comms 5).

In some cases the call for emergency services is made by a neighbour or someone who is sent to the nearest public phone. As indicated by the participants, these people were often not given any information about the patient or the reason for the call. In addition, they were unable to provide a medical history or any information on the current condition of the patient, thus making it impossible to triage accurately.

> *"Sometimes the calls are received from a third party and it's difficult to assess the situations based on what information the caller gives. The third party is unable to answer the questions asked by the call taker and this makes it difficult to triage the case. Communications centre staff triage each case in their own way and don't ask enough questions to get a good idea of the condition of the patient"* (sup 2).

4.3.5 External Factors that contribute to the Challenges

The participants from all the groups cited external factors that have a negative impact on response times.

The experience of participants from the operational group was that most areas do not have road names or house numbers and this often makes it extremely difficult to locate the patient.

> *"We experience difficulty in finding areas as there are often no road names or house numbers available so we drive around the area asking for people who called the ambulance and switch our siren on to attract attention and this causes delays. Poor weather conditions also cause delays in response times"* (ops 1).

As alluded to by the participants, the driving time to many areas, particularly in the rural areas, was considerably longer than the response time national norm of 40 minutes and, thus, even if the emergency vehicle were dispatched at the time the call was received, it would still be impossible to achieve the national norm.

> *"I don't agree with the national norm as the driving time to some rural areas takes more than 40 minutes. Some rural areas are too far. Even if a vehicle is dispatched immediately, the driving time is more than 40 minutes" (*comms 3).

As cited by the participants from the communications and supervisory groups, the lengthy driving times resulting from the long distances between the EMS bases, health facilities and communities as well as the poor road infrastructure all contribute to delays in response times.

> *"The long driving time to patients and between health facilities, the poor road conditions in most areas and weather conditions have a negative impact on response times" (comms 5).*

> *"Response times depend on the distance or mileage of the area and the poor road condition. At night there is no one around in the areas to ask for directions. It negatively impacts on response times"* (sup 3).

4.3.6 Incorrect Public Perception

Public perception and the abuse of the EMS were discussed at length during all three focus groups. In some cases it appeared that the communities had been misled about the EMS, in other cases it appeared that there was abuse of the services by the public while, in others, there seemed to be public ignorance about the EMS.

As revealed by the participants, when new vehicles were purchased, the media released this information to the public and this raised expectations regarding improved response times due to the increase in resources. However, in view of the nature of the service, the

majority of the new resources were simply replacing old, written off resources and not increasing the available resources.

> *"The public is not properly educated on vehicles in the service, government is misleading the public about the fleet of ambulance and the public is informed only of new fleet not about the existing fleet that is involved in accidents or the aging fleet that has become obsolete. When they see that new vehicles have been purchased they expect to see an improvement but they are not told that these are replacing the old ones"* (ops 2).

It was clear from the experiences of the participants from the communications group that the public had realised the inaccurate nature of the information provided and, thus, when requesting an ambulance and being aware of the possible delays in the delivery of the service they often gave information which created the impression the situation was life threatening although it was not. This resulted in the call taker triaging the case as priority one. Only once the vehicle arrived on the scene did the real situation come to light. This often resulted in delayed responses to actual real life threatening cases. The participants also mentioned that the public appeared to be under the perception that, if they were taken to hospital by ambulance as opposed to a private vehicle, they would be attended to more quickly at the hospital than may otherwise have been the case, regardless of their condition.

> *"The communities are providing incorrect and misleading information when requesting an ambulance. The communities are under the impression that if they provide incorrect information, the ambulance will reach them faster. Sometime community members come to the control centre and threaten staff, our lives are at risk while sometimes community members come to the control centre and ask why there are so many ambulances that are parked outside but there is no available ambulance for when it is needed by the community. At times they drop the patient off at the control centre. Our lives are at risk because of the response times"* (comms 1).

> *"The callers have also become clever; they know what to tell us to make sure that an ambulance comes quicker, so they make the patients seem more critical than*

what they are. Some callers can't give any information about the patient because they will tell someone to go and call for an ambulance and, when you speak to that person, they just say they were told to call for the ambulance; they have no idea what the problem is. Some callers don't know their location and are unable to tell the dispatcher exactly where they are calling from. This makes it difficult for the ambulance to locate the scene. In some cases the ambulances drive around the area asking who called for the ambulance and they get no response. The case then becomes exempt only to find the same person will call again about the same case" (comms 5).

As highlighted by participants, the majority of the calls are made by a third party who has been requested to go and make the call for help. However, this third party is not given any information about the patient and his/her medical history, current condition or physical state. This makes it impossible to triage the case, thus forcing the call taker to make the case a priority.

"Sometimes the calls are received from a third party and it's difficult to assess the situations based on what information the caller gives. The third party is unable to answer the questions asked by the call taker and this makes it difficult to triage the case. Patients also abuse the service; they call the ambulance just to have their blood pressure checked" (sup 2).

4.3.7 Effective Management of Resources

The participants felt strongly that, if resources were managed effectively, there would be a marked improvement in response times. This category is subdivided into two sub categories, namely, optimal resource availability and allocation and optimal operational resource management.

4.3.7.1 Optimal Resource Availability and Allocation

It was apparent that all the participants in the three groups felt strongly about the availability and allocation of resources and whether optimal resource availability and allocation would contribute to improved response times. As highlighted by the participants from all the

groups, resource allocation should be based on population as well as the demand for services in each area. The participants also expressed the view that strategically placed satellite bases for emergency vehicles would assist in improving response times.

> *"Effective resource allocation should be done and this should be based on a case study about the number of cases in the different areas and the population. The higher the population the more vehicles are required to service the area"* (ops 4).

> *Expansion of the services is required. We need to place the service closer to the community but we must look at how often the community uses the service. We look at the demand in that area to determine where to place the satellite base"* (sup 1).

The number of pool ambulances available was suggested as an improvement strategy by the participants from the supervisory group. As a result of the high case load and the nature of the shifts, the operational staff members were are not always able to return to base at shift change times and, thus, oncoming staff had to sit and wait for the returns. However, if pool units were available they would be able to be operational at the start of their shifts and, therefore, attend to far more cases during their shifts than appeared to be the case.

> *"More vehicles are required; we also need to increase the pool units. Sometimes the day shift crews return much later to the base after a late case and the night shift crews have reported for duty. The night shift crew then have to wait for the ambulance to return and be stocked before they are mobile. If there were more pool vehicles available then the night shift crew would not have to wait for the vehicles to return and be restocked before being mobile again and they would be operational from the start of their shift"* (sup 3).

The participants also suggested the purchasing of new vehicles as an improvement strategy. Although the existing vehicles require replacing and additional vehicles are required to expand the services, whenever new vehicles are purchased they are regarded as being for expansion purposes despite the fact, most of the time, they are used for replacement purposes and there is no expansion of the services. However, if the purchasing of new vehicles were appropriately planned the new vehicles could serve both replacement and expansion purposes.

"Expansion of services is required. The new vehicles that get purchased are used for replacement of old vehicles. An EMS vehicle lifespan is about 150 000 km and vehicles should be replaced when the warranty expires. There needs to be a plan for both replacement and expansion" (sup 1).

The participants also expressed the fact that the use of support service staff to perform functions such as dropping off and fetching vehicles sent in for repairs would contribute to improved response times as operational staff would then be available to provide a service to the public for the full duration of their on duty time.

"If there were enough support services staff then the staff employed to perform operational duties would be able to work operationally and not be required to assist with other things such as taking vehicles for repairs" (sup 1).

4.3.7.2 Optimal Operational Resource Management

Ensuring the availability of resources would be the first step in improving response times although the way in which resources are utilised and managed is the deciding factor in respect of improved service delivery.

The participants from the supervisory group suggested the implementation of pick up points in each area or community. These pick up points should include a small shelter with access to a telephone which could be used to dial emergency call centres only, such as the Emergency Medical Services, Fire Department and South African Police Services. These pick up points would provide direct access to the services as well as serving as a pick up point as the vehicle would go to this point to pick up the patient. Alternatively, the participants suggested that a guide be sent to the pickup point, either a family member or neighbour, in cases where the patient is too ill to get to the pickup point him/herself, to assist with accurate directions to the patient's location, thereby reducing response times.

"We can build ambulance pick up points in every area. These should be central to each area and have a phone available that connects directly with the communications centre and SAPS using a speed dial. The ambulance crew would

know exactly where to go to because either the patient or the guide would wait at this point, thus allowing for easy access to the patient" (sup 2).

The participants felt that, if shift supervisors did not operate independently and, instead, worked together to plan ahead for subsequent shifts by assisting each other then there would be fewer delays in the vehicles becoming operational and, thus, improved response times.

"The supervisor on duty should arrange for overtime staff to fill in for staff who are on leave before the next shift starts. Supervisors need to work together to coordinate their shifts and plan properly for the next shift" (comms 5).

The participants highlighted the notion of combining non-emergency transfer cases rather than completing these cases individually as a strategy to improve response times.

"Sometimes non-emergency transfers are done individually; we should rather use 1 vehicle to transport several patients at the same time, so that there could be more vehicles available for emergency operations" (ops 2).

The participants alluded to the productivity of Advanced Life Support paramedics and suggested their working on an ambulance rather than a response vehicle in order to improve response times as this would reduce the waiting time on scene and optimise the availability of these paramedics.

"Advanced Life Support (ALS) paramedics work on a response vehicle only. They go to a scene and have to wait there until an ambulance comes before the patient can be transported, so it would be better if they worked on an ambulance" (sup 1).

4.3.8 Systems Overhaul for the Improvement of Services

The participants expressed the view the systems used within EMS required both a complete overhaul as well as standardisation in order to improve services and response times. This category is subdivided into two sub categories, namely, the Information and

Communications Technology (ICT) solutions required to improve services and the processes and procedures needed to standardise and improve the services.

4.3.8.1 Information and Communications Technology (ICT) Solutions required to Standardise and Improve Services

The availability of a system to assist with and standardise the triaging of calls received in the communications centre was suggested as an improvement strategy by the participants. If real emergency cases were identified on receipt of the call and dispatched as such then the response times target to priority one red code cases could be achieved.

> *"We require a triaging system to be installed in the communications centre so that the way calls are triaged is standardised and accurate"* (ops 1).

The communications centre is the hub of the service and, thus, all resources should be managed from the centre in order to best serve the community. At the time of the study the staff members working in the communications centre were unable to view the location of the operational vehicles and this made it extremely difficult to identify the most appropriate resource to dispatch to an emergency. The participants identified, inter alia, the need for a real time system that would allow them to view the location of vehicles as well as provide accurate directions to the patient. This would significantly assist in improving response times.

> *"A vehicle monitoring and tracking system that is accurate would assist us in the managing of resources because we would be able to see where all the vehicles are as well as give them accurate directions to the scene"* (comms 3).

The participants also identified the availability of security systems for the management of assets as an improvement strategy. These systems would assist in improving equipment availability and in overcoming the problems of theft and vandalism.

> *"Security and monitoring tools for effective asset management in EMS are desperately needed"* (sup 4).

4.3.8.2 Processes and Procedures to Standardise and Improve Services

In order to standardise services and ensure consistency there was an urgent need to put in place appropriate processes and procedures. The participants raised several concerns about this issue and stated that, if such processes and procedures were in place, this would contribute to improved response times. A participant from the supervisory group had this to say:

> *"We need a complete overhaul of the EMS, from the number of vehicles, to the number of human resources, to the communications centre, to the placement of the bases and even to infrastructure. We need to relook at the way things are done in all areas of our service and explore the best ways to provide a quality service and then implement it the same so that the way we do things is standardised. Until we do this we will not achieve good response times"* (sup 1).

The participants also highlighted the importance of quality assurance to allow for the identification of shortfalls as well as to operate as a tool for motivating staff and ensuring accountability for performance.

> *"If we bring in other aspects such as quality assurance, we will be able to identify gaps and improve response times. We should use a performance assessment as a concept to motivate staff and, at the same time, make them accountable. Response times should appear on their performance assessments"* (sup 1).

The participants expressed the view that consistent supervision and discipline would have a positive effect on response times.

> *"Supervision and discipline need to be consistent. If there are consequences then staff, supervisors and managers will do their work and they will do it properly" (sup 6).*

As articulated by participants, the presence of appropriate staff performing the required functions would contribute to improved response times. Vacant posts, particularly supervisory and management posts, should be filled and areas such as the

communications centre should cater for people who are interested in and qualified to perform the type of work required of them.

> *"We need to appoint people in all vacant supervisory posts rather than have people acting; they will then take their job seriously. Another problem is that some staff are operational but are placed in the communications centre. The communications centre should have a career path with its own structure. This will motivate staff as they will be doing what they have chosen as their career"* (sup 5).

The participants felt that a different shift system as compared to the existing shift system would contribute to improving response times. This would ensure that emergency vehicles were operational at all time without any substantial interruptions.

> *"Shifts should be staggered so that you don't have all your vehicles in all areas standing down for a shift change at the same time because the service comes to a standstill. If we have different vehicles that change shifts at different times then services would continue on a 24 hour basis"* (sup 1).

The participants stated that the standardisation of the information sought from callers when triaging cases would contribute to achieving better response times. In addition, it was recommended that the communications centre staff should also be more specific and honest with the information provided to the callers so that an informed decision could be made, reducing the number of wasted responses. It was also highlighted that, if patient transport services was effective, there would be a reduction in the inter facility transfer requests and this would certainly contribute to improved response times as the emergency vehicles would not be held up carrying out non-emergency transfers.

> *"Call takers should give callers information and inform them that they are busy at the moment and suggest options or alternatives. The comms centre also needs to call the caller to confirm before dispatching a vehicle. Calls could then be cancelled on the system, thereby preventing and avoiding unnecessary responses for exempt cases. The planned patient transport system needs to be more effective so that emergency ambulances can be left to attend to emergency cases. If they have*

vehicles that can carry stretcher patients as well as increase their capacity there would be far fewer inter facility transfer cases" (ops 3).

4.3.9 Effective and Suitable Education

The participants highlighted the importance of education for both staff within the EMS and the public in striving to improve response times. This category was subdivided into two sub categories, namely, the education of staff and the education of the public.

4.3.9.1 Education of Staff

The participants highlighted the importance of suitable staff training and, in particular, the lack of such training for staff working in the communications centre. Such training may facilitate telephonic medical advice that could be given in certain instances, if appropriate, and there would be no need to dispatch a resource. This would reduce the number of required responses and improve the overall response times.

> *"Control centres staff qualifications should be from ILS, ECT, ALS upwards. Call takers at communications centres can provide medical information to patient"* (ops 4).

The participants recommended as a strategy the training of the staff in the communications centre on what questions to ask in order to be able to triage accurately. They felt that no official training was available and staff who were trained to work on the ambulances were placed in the communications centre. It was then left up to the existing staff to orientate the new staff members and train them – a far from ideal situation.

> *"Staff at the communications centre need to be trained. The older staff are expected to orientate and teach the new staff and are unable to do so. New staff members are not sure of what questions to ask during triaging"* (comms 1).

The participants from the supervisory group expressed the view that the training of supervisors in the management and supervisory functions would contribute to improved response times. At the time of the study the supervisors and managers were required to

have a medical qualification but not necessarily a management qualification although they were expected to play the role of a supervisor or manager. Consequently, they often did not possess the required expertise.

> *"If we could improve the quality of supervisors there would be an improvement. Supervisors should have a medical qualification as well as management and supervisory qualifications to effectively manage their staff"* (sup 1).

The participants identified the importance of developing and implementing an effective orientation programme for new staff as a strategy for improving response times. It was felt that if staff members understood the service, knew what was expected of them as well as knew and understood the service targets, they would be better able to perform their duties.

> *"When staff are employed there should be effective orientation for them. They should fully understand the services and what is expected of them on a day-to-day basis. If staff are made aware of the national norms they may work harder to achieve them"* (sup 6).

4.3.9.2 Education of the Public

The participants from the operations and communications groups highlighted the fact that the public required education on both the EMS and also on how the entire health system and services available to them operated. This would assist in ensuring that the required information was provided when requesting emergency services as well as help them to understand the impact of abusing the service.

> *"The public need to be educated on when to call for the ambulance and what information is needed. We need to inform the public how the health system works"* (ops 2).

> *"The department should run an awareness campaign with the public, telling the public specifically how we work and the information that is required when calling for an ambulance. The public should be educated about the EMS and we are an emergency service and not a taxi service"* (comms 5).

The participants cited the need for the education of health facility staff as the inter facility transfer case demand was increasing and placing a huge strain on the emergency services. If these cases were coordinated appropriately then the time taken to complete these cases would be reduced, thereby resulting in improved response times overall.

> *"We need to educate the community as well as health facility staff on the EMS. The health facility staff members do not understand how to use EMS either and this impacts negatively on the EMS. The EMS does not have the capacity to deal with the influx of cases. Inter facility transfers are also increasing and there is a high demand for inter facility transfers"* (sup 1).

4.4 Conclusion

This chapter presented the results of the data analysis in relation to the study objectives. The results were presented in two phases, namely, phase one which covered the quantitative results and phase two which covered the qualitative results. Chapter five contains a discussion of the research findings.

CHAPTER 5:
DISCUSSION

5.1 Introduction

This chapter discusses the interpretation of the research results, including both the quantitative and qualitative results. The chapter also describes how these results complement and clarify the other, thus providing both a broader and more in depth understanding of response times than may otherwise have been case.

Specifically, the chapter aims to address the research objectives, namely, to analyse response times in both rural and urban areas in KZN and to compare these with the established national norms in South Africa, to explore factors that influence response times in KZN and to identify strategies to improve response times.

Each section in the chapter presents a discussion of the results relative to each of these objectives as stated above. This is followed by further interpretations and discussions.

5.2 Analysis of Response Times

Response times are considered to be one of the oldest and most popular performance indicators used to measure EMS efficiency and, in particular, to measure the response times to cases where the patient's condition is thought to be life threatening (Gendreau, Laporte and Semet 2001; MacFarlane and Benn 2003; Fitch 2005; Carr *et al.* 2006; Schooley and Horan 2007; Budge, Ingolfsson and Zerom 2010).

5.2.1 Introduction to Response Times

The framework used to measure response times in this study is described as the patient journey and was agreed upon by a group of Emergency Medical Dispatch experts at the Utstein Consensus Symposium in 2005 (Castrén *et al.* 2008). This study adopted only the intervals that make up the response time; namely, the EMD response interval (from the time

a call is received to the time the emergency vehicle is dispatched) and the EMS unit response interval (from the time the emergency vehicle is dispatched to the time it arrives on the scene).

The results of this study showed that the cases prioritised as Priority one (P1), thus thought to be life threatening at the time the call is received, make up 45% of the total demand for services. These are the cases that require a response which is within the national norm. However, the demand for Priority two (P2) cases and Inter Facility Transfer (IFT) cases also requires services which utilise the same available resources as Priority one (P1) cases. Studies conducted in other districts within the KwaZulu-Natal area have also found that cases categorised as P1 were in the majority (Govender 2011; Hardcastle *et al.* 2012; Newton 2013).

As shown by data collected during phase one of this study, the demand for services fluctuated from day to day. As depicted in Figure 4.5, during weekdays IFT cases make up the bulk of the cases by as much as 49% of the total case load on Wednesday. However, during the weekend the demand for IFT cases was drastically reduced to less than a quarter of the total number of cases. In fact, the majority of the cases (65%) were classified as P1 and occurred on Saturday. These results were supported by the qualitative data collected during phase two of this study with both the operational and the communications groups citing that the demand for IFT cases during the week was staggering. The supervisory group added that this was due to all the doctors being on duty during the week and that they performed their ward rounds routinely. It was explained that, during the weekends, the majority of doctors were only on standby duties and, thus, only emergency cases get transferred. However, the incidence of P1 cases was very high over the weekend due to increased traffic volumes, resulting in more motor vehicle collisions, incidents related to alcohol consumption and interpersonal violence as the majority of the population tended not to work over weekends and, thus, they often consumed more alcohol as compared to during the week. This was also coupled with an increase in domestic incident cases.

The quantitative data from the study revealed that the case load during the day shifts was consistently higher as compared to that of the night shifts with 59% of the total cases being logged during the day shift (Figures 4.6 and 4.7). This difference is true for all the weekdays but not during the weekend (Saturday and Sunday) when the difference was minimal (p =

0.039). It was highlighted during the focus group discussions held in the second phase of this study that the huge influx of IFT cases in working hours during the week were often not attended to during the day shift and were, thus, actually delayed and completed only during the subsequent night shift. However, as indicated above, this was not the case over the weekend. This supports the finding regarding the even split in the demand for services during both the day and the night shifts over the weekend. This finding was in line with the findings from other studies which showed a marked decline in the demand for EMS resources from the late night hours until early morning (Brown *et al.* 2007; Ong *et al.* 2009; Newton 2013).

In order to analyse the response times in depth it was necessary to investigate the two intervals that made up the response time independently in order to provide greater insight and understanding. These intervals included both the EMD response interval and the EMS unit response interval (KwaZulu-Natal Department of Health 2004; Castrén *et al.* 2008).

5.2.2 EMD Response Interval

The quantitative results of this study revealed that the mean EMD response interval was 41 minutes for P1 cases, 56 minutes for P2 cases and 96 minutes for IFT cases while the EMD response interval to 6% only of the cases were within the national norm of 3 minutes (KwaZulu-Natal Department of Health 2004). Of this 6%, 32% referred to emergency vehicles that had come across an incident or patient and, thus, the case was logged on the system only after their arrival on the scene. In the neighbouring eThekwini district, which is predominantly urban in nature, a similar scenario was found with a mean EMD response interval of 24 minutes for all cases and a slightly better mean EMD response interval for P1 cases of 21 minutes. However, the EMD response interval was still nowhere near the national norm (Newton 2013). Another study conducted in KwaZulu-Natal in the Ugu district found that the EMD response interval exceeded an hour for all obstetric cases which are always prioritised as P1 (Govender 2011).

The focus group discussions conducted during this study highlighted the delays experienced in the communications centre prior to the dispatch of an emergency vehicle. The discussions highlighted several contributing factors, of which a sufficient number of operational emergency vehicles to deal with the high demand for services was the most

prominent. The participants explained that there were always cases outstanding and waiting to be dispatched while, at the same time, additional cases were being logged. Despite the increased population and the increasing demand for services over the years, the number of operational emergency vehicles had not increased. It is only possible to attend to a case when there is an emergency vehicle available for dispatch. The participants from the communications group expressed how difficult it was to give answers to the callers on how long the emergency vehicle would take to respond and, as a result, they were often subjected to verbal abuse from the public as the callers felt the people working in the EMS were lazy and did not take them seriously. The KwaZulu-Natal Department of Health annual reports confirmed the increase in the demand for services of 14% over the years with a total of 483 122 patients transported by the EMS in the 2004/05 financial year and 564 529 during the 2014/15 financial year (KwaZulu-Natal Department of Health 2005a, 2015a).

In support of these reports, studies conducted in KwaZulu-Natal highlighted similar factors. In the Ugu district, Govender (2011) cited reasons for the extended EMD response intervals, including the high caseload which meant that all the available resources were busy on cases and, therefore, no resources were available for immediate dispatch as well as the time taken by the operational resources for refuelling, for taking a break to have refreshments and lunch, for returning to base to restock or to clean and for repairs. In the eThekwini district it was reported by Newton (2013) that the primary reason that the EMD response intervals extended beyond the entire response time national norm was the mismatch between public demand and the available resources. It is apparent that the 59 second rule prescribed by Eisenberg, Bergner and Hallstrom (1979) and adopted broadly in the United States (Fitch 2005; National Fire Protection Association 2010) is not attainable in the South African setting without a radical change in systems and resource allocation.

5.2.3 EMS Unit Response Interval

The results of this study have indicated that the mean EMD response interval was longer than the EMS unit response interval for all case categories with the exception of P1 and P2 cases in the rural areas (Figure 4.12). This demonstrated that, for the majority of cases, the largest portion of the response time is made up of the EMD response interval. The participants who provided the qualitative data collected during the second phase of this

study shared how they rushed to a scene or a patient when dispatched and were usually of the opinion that they had responded swiftly. However, on arrival, they were often faced with frustrated family members and patients as a result of the extended time taken to respond to their call of need. The participants stated they were often amazed to learn that some cases waited in the communication centre for hours before an emergency vehicle was dispatched. A study conducted by Govender (2011) explored the correlation between the EMD response interval and the response time. The study found a significant relationship between these two with the time taken for an ambulance to arrive at the patient increasing considerably when the EMD interval increased and, therefore, impacting directly on the response times achieved (Newton 2013).

Many of the factors that impact on response times are beyond the control of the public service and, therefore, addressing such factors is not always an option. Nevertheless, it is essential that ways in which to reduce their impact on the response times are carefully explored. During phase two of this current study, the participants from the operations group shared how they often struggled to find patients as a result of the fact that there were no road names and/or house numbers in most areas. Thus, although they managed to reach the area quickly they were forced to drive around looking for the patient and it is this that often significantly extends the response times.

The qualitative data collected during phase two of this study revealed that the response time national norms were not at all practical, particularly for rural areas. The participants stated that the driving time required to reach most areas often far exceeds 40 minutes and that vehicles are often unable to travel fast due to the poor road infrastructure and that this may be exacerbated by poor weather conditions. This causes further delays in the drive time and, thus, even if emergency vehicles were dispatched immediately on receipt of the call, they still would not achieve the prescribed national norm. Accordingly, the perception that purchasing additional emergency vehicles would assist in realising the national norm would not necessarily be the case for all incidents or for all patients. The available literature in South Africa and other African countries highlights that poor road infrastructure and bad weather conditions contribute to delayed response times (Shehu, Ikeh and Kuna 1997; Cham *et al*. 2005; Govender 2011; Newton 2013).

5.2.4 Response Time Interval

The results of this study have also shown that the mean response time per day is much lower over the weekend (94 minutes on Sunday) as compared to week days (133 minutes on Friday) (Figure 4.13). The mean response times are also longer for day shifts during the week but longer for the night shifts over the weekend (Figure 4.14). During phase two of this study, the participants from the communications and supervisory groups alluded to the fact that the case load during the day shift in the week was particularly high as a result of the influx of IFT cases which have a much longer mission time. This also explains the longer response times during the weekday shifts. The participants also explained that the night shifts during the week were generally quieter despite an overflow of cases which had not been attended to during the day shifts and which then had to be attended to during the night shifts.

The national norm for response times to P1 cases is 15 minutes in urban areas and 40 minutes in rural areas (KwaZulu-Natal Department of Health 2004, 2009, 2010b). The results of this study have shown that the Umgungundlovu Health District is not achieving this national norm. The mean response time to all P1 cases (rural and urban) was 84 minutes. This is twice as long as the required response time in rural areas and almost six times as long as the required response time in urban areas. During the qualitative data collection process, the participants from all focus groups indicated that they are not able to meet the national norm for response times and, in fact, some of them just laughed as if these national norms were unrealistic. Other studies conducted in KwaZulu-Natal have shown similar results with the national norm not being achieved in the majority of responses. For example, in the eThekwini area the mean response time to P1 cases was 52 minutes (Newton 2013) and 101 minutes in the Ugu district to obstetric related P1 cases (Govender 2011). Studies conducted in Cape Town, Johannesburg and the Eastern Cape of South Africa have also reported that the national norms for response times were not being achieved in the majority of responses (MacFarlane, Van Loggerenberg and Kloeck 2005; Meents and Boyles 2010; Chipangura 2013; Stein 2014). When compared to the international standard of an 8 minute response time to P1 cases, the South African national norms appear lenient although, in reality, even these are certainly not attainable (Baum, Alvarez III and Cobb 1974; Cobb *et al.* 1975; National Fire Protection Association 2010). Available media reports suggest that the ambulance services are under pressure and are

unable to meet the demands they face, even in first world countries. For example, London Ambulance Services reported a deterioration in response times of up to 12% over a period of 12 months when compared to their target of eight minutes and that they arrived late to 42% of critically ill patients (DailyMail 2016).

The quantitative data from phase one of this study revealed a mean response time to P1 cases in rural areas of 95 minutes (Figure 4.17), more than double the national norm with only 17% of the cases having a response time within the national norm (Figure 4.18). Due to the fact that there are no prescribed norms for response times for the other case categories (KwaZulu-Natal Department of Health 2004; Stein 2014) these case categories were compared with the same national norm. The mean response time to P2 cases in rural areas was 122 minutes, over three times the national norm with only 8% having responded within the national norm, and 162 minutes to IFT cases, over four times the national norm with 11% only being responded to within the national norm. The difference between the national norm and the achieved response times in rural areas was significant for each case category ($p < 0.001$). The participants from the operations group in phase two of this study highlighted that responding to cases in rural areas is very challenging as the areas differ greatly in terms of road infrastructure and signage (road names and house numbers) and this makes it very difficult to meet one set response time expectation. They indicated that, in several instances, the driving time to the scene or patient far exceeds 40 minutes, thus emphasising that this is an unrealistic goal that is, in fact, impossible to meet under many circumstances. Jones (2015) reported that 75% of countries in the world do not have an organised network of street names and numbers in place, thus rendering the majority of their populations virtually invisible, particularly in the rural areas.

The quantitative data from phase one revealed that, in urban areas, the mean response time to P1 cases was 72 minutes which is almost five times the national norm (Figure 4.19) with a mere 6% being responded to within the national norm (Figure 4.20). The mean response time to P2 cases in urban areas was 94 minutes, over six times the national norm with only 1% being responded to within the national norm and 165 minutes to IFT cases, over eleven times the national norm with 5% being responded to within the national norm. The difference between the national norm and the achieved response times in urban areas was significant for each case category ($p < 0.001$). The participants from all three of the focus groups explained that the same available resources respond to cases in both the

urban and rural areas and, therefore, they are often faced with the reality that a vehicle may only become available for dispatch hours after an urban area case has been logged.

In a study conducted in Cape Town, South Africa Stein (2014) concluded that, even with decentralised emergency vehicle location strategies and a communications centre capable of handling priority one cases in a reasonably short time period, the national norms for response times were simply unachievable no matter how many emergency vehicles were available.

5.3 Factors Influencing Achieving Response Times

There are many factors that impact response times. Some of these factors are within the control of the EMS but others not. The resources available and the way in which these resources are managed, service demand management, external influencing factors and public perception were identified as the factors which influence achieved response times.

5.3.1 Availability and Management of Resources

The services provided are dependent on the availability of suitable resources. In addition, these resources are often required in conjunction with one another in order to provide services. Such resources include vehicles, staff and equipment. Without a vehicle, staff is not able to provide a service and, without equipment and staff, a vehicle cannot provide a service. It is, therefore, imperative that resource requirements are in line with service delivery needs. Factors in respect of resource availability, management and maintenance were cited extensively during the focus group discussions conducted for the purposes of this study.

5.3.1.1 Vehicle Availability, Suitability and Maintenance

The EMS is a mobile health establishment service and, therefore, emergency vehicles play a vital role in service delivery. The issues raised during the focus group discussions included vehicle availability and suitability as well as vehicle maintenance concerns. The analysis of the quantitative data indicated that the number of operational emergency

vehicles per shift fluctuated from between 19 and 25 vehicles, with the majority of the shifts operating with fewer than 22 emergency vehicles (Figure 4.9). The number of operational vehicles was consistently higher for the day shifts when compared to that of the night shifts.

The participants from the communications focus group discussion held during the qualitative data collection process indicated that the schedule for operational vehicles was 26 but that it was very seldom met. They also highlighted that the operational resources had not been increased since the early 1990s despite the fact that both the population and the demand for services had increased considerably. The participants from all the groups explained that the number of operational vehicles was never sufficient enough to meet the demand and that there were always outstanding cases waiting to be dispatched. The supervisory group referred to the national norm of one ambulance to service 10 000 population and how far away from this they were. They maintained that, until this national norm was reached, it would be impossible to achieve the response time national norms.

The national norm for the number of operational ambulances in South Africa is one ambulance per 10 000 population (KwaZulu-Natal Department of Health 2004; Govender 2011; Hardcastle *et al.* 2012; Newton 2013; Stein 2014; van Nugteren 2014; Newton, Naidoo and Brysiewicz 2015). It is assumed that if this national norm is met, the response time national norm will be achievable. The KwaZulu-Natal Department of Health have continuously reported not having one ambulance per 10 000 population as a challenge which contributes significantly to the poor response times and also that purchasing additional ambulances would directly assist in overcoming this challenge (KwaZulu-Natal Department of Health 2005a, 2006, 2007, 2008, 2009, 2010a, 2010b; Govender 2011; KwaZulu-Natal Department of Health 2011; Hardcastle *et al.* 2012; KwaZulu-Natal Department of Health 2012a, 2012b, 2013; Newton 2013; KwaZulu-Natal Department of Health 2014, 2015b, 2015a, 2016a, 2016b). On the other hand, a study conducted in the Cape Town area of South Africa (Stein 2014) explored response times using a computer simulation model. The study discovered that the response time national norms were never achieved regardless of an increased number of ambulances. The study also found that it was not possible to establish an optimal number of operational ambulances although a seven fold increase in the number of ambulances had produced the best results. This study was, however, restricted to urban areas using a computer modelling simulation and, therefore, the outcome in a rural setting and in reality may be different. A mismatch

between the demand for services and the available emergency vehicles has also been reported in the eThekwini district (Newton 2013).

EMS services are provided far and wide and, regardless of where a patient is situated, the patient has the right to access EMS services. However, the suitability of the vehicles provided often poses a challenge in ensuring this. The qualitative data collected during phase two of this study highlighted concerns about the suitability of the vehicles for the rural areas with the participants explaining that the vehicles often broke down, became bogged down and/or had punctures. This resulted in delayed responses times to cases, as well as reducing the number of vehicles available. The majority of the ambulances are equipped to transport only one patient at a time and this was cited as challenge due to the fact that, in cases where the patients are not critical, an ambulance could attend to a second case before taking the patients to hospital, thereby reducing response times. Instead the ambulance has to transport the one patient all the way to hospital and then proceed back to the same area for the next patient. This clearly has a major impact on response times, particularly in rural areas and for non-emergency IFT cases. Similar challenges was also highlighted in a study conducted in the Ugu district (Govender 2011) where the ambulances were reported as becoming bogged down with this contributing directly to delaying the response times to obstetric cases.

The maintenance of vehicles was also raised as a concern by the participants in this study. The downtime of vehicles in for repairs and maintenance is often lengthy, thus resulting in the majority of the fleet being unserviceable. As a result, when a vehicle breaks down, there is no replacement vehicle to continue to provide services. The participants from all the groups expressed great frustration in this regard. They felt that the service providers contracted to work on the vehicles were not reputable, that they were often expected to use vehicles that were not roadworthy and also that they were expected to use old vehicles because the vehicles were very seldom replaced with new vehicles. In support of this finding a study conducted by Hardcastle *et al.* (2012) noted that 66% of the total ambulance fleet in KwaZulu-Natal public EMS had mileages of over 150 000 km.

5.3.1.2 Staff Availability, Attitude and Discipline

Issues related to staff were also cited as a challenge in all the focus groups and were thought to be a contributory factor to the poor response times. Shortages of staff in both operations and in the communication centre were highlighted. A shortage of staff in the communications centre automatically means that the command and control of available resources is strained. In addition, the number of operational vehicles is dependent on staff availability and, although the schedule for operational vehicles is 26, this was very seldom realised as no provision was made for staff taking leave, some of which was planned and others not. The study conducted by Newton (2013) confirmed that staff shortages in the communications centre posed a challenge in terms of the communications centre effectively performing its duties of call taking and dispatching. As reported in London (DailyMail 2016), ambulance services are faced with a desperate shortage of paramedics with an estimated 12% of vacant posts and this has contributed to one in three ambulances arriving late to critically ill patients.

The issues of discipline and a poor attitude on the part of staff were raised often during the focus groups conducted for the qualitative data collection required in this study. The participants from the communications and operations groups shared openly how they were frustrated and demotivated due to the extreme demands placed on them. The excessive workload was forcing them to take things slowly in order to prevent burnout. They felt that if they did not do this then the results could be fatal. In addition, they did not feel that they received any support at all from their management structures. Instead they were under pressure from management to work harder and they were also exposed to abuse from the public due to the poor services received. On the other hand, the participants from the supervisory group highlighted poor attitudes and the discipline of staff as a challenge. They shared how the staff in the communications centre simply did not answer calls if they did not feel like it and also how the operational staff intentionally delayed responding to cases and even vandalised vehicles and equipment so that they did not have to work. Both perceptions are clearly toxic for a productive working environment and were contributing to poor response times. Govender (2011) highlighted non-patient related factors that contributed to delays in response times in the Ugu district of KwaZulu-Natal. Govender (2011) found that the necessary tasks performed by the operational resources, including refuelling, refreshment breaks and returning to base, were extended far beyond an

acceptable timeframe. In addition, a category identified as “other” and in terms of which no reasons for trips or remaining idle were provided contributed to a mean delay of 44 minutes. These unnecessary delays impacted negatively on response times. London Ambulance Services reported that, due to staff shortages, the hardworking and dedicated ambulance staff were being pushed to their limits and beyond and that this was not sustainable (DailyMail 2016).

5.3.1.3 Management of Available Resources

Equipment is clearly a critical resource as optimal patient treatment and care are not possible without it. The participants from the operations group explained that the vehicles they were allocated to work on were often stood down due to a lack of, or non-functioning, equipment. In addition, the supervisory group raised concerns about the type of equipment purchased and how this equipment was often not the most suitable for the pre hospital environment and, as a result, was easily damaged and broken.

The way in which available resources are managed determines the value derived from such resources. It has been established that available resources are scarce. However, if managed optimally, service delivery would improve. The participants in this study alluded to the fact that operational resources were often managed ineffectively and that this contributed to delayed response times. The delays experienced at shift change, as highlighted by both the communications and supervisory groups, had an exacerbating effect as cases continued to be logged with the number of outstanding cases increasing due to the absence of responses during this period. Although the changeover should take a maximum of fifteen minutes it often exceeded an hour. The participants stated that, if all the vehicles were fully equipped and stocked at all times, there would be a limited delay when changeover was required. The study conducted by Govender (2011) in the Ugu district of KwaZulu-Natal supports this finding as it highlighted that, during the shift changeover periods, a minimum number of calls were attended to and that several cases were carried over to the oncoming shifts, thus contributing to delayed responses.

During the qualitative data collection phase in the current study, the participants from the communications group explained that they experienced intense frustration when the staff on duty, whose responsibility it is to be operational, were used for duties other than operations.

At the start of the shift they were reported as operational but were often used to attend special events or even to ferry vehicles to and from garages for repairs. This indicated that the available resources were not being used effectively and also resulted in prolonged response times. However, the supervisory group participants explained that they were forced to utilise operational staff for these functions as they did not have support staff to perform such duties. If vehicles were not taken for repairs then they would not have any operational vehicles. Thus, they were forced to utilise the staff available to them although they acknowledged the impact of doing so.

The phase two qualitative data from the operations and communications groups indicated that there were specialised areas of operations, including aeromedical services, obstetric ambulances, inter facility transfer ambulances and Advanced Life Support units. However, the use of these specialised areas of operations was not clearly defined and this often resulted in confusion and contributed to further delays. A study conducted by Newton (2013) in the eThekwini district highlighted that aeromedical services were used predominantly for inter facility transfers and were, therefore, not always available for responding to P1 emergencies. The same study found that Advanced Life Support intervention was required in only 1.4% of the cases while 61% of the cases to which they were dispatched required no intervention at all (Newton 2013). Thus, these findings support the findings of this study.

In order to assist with the effective management of resources there are tools available. However, the data from phase two of this study indicated that these tools were ineffective. The vehicle monitoring and tracking system was available in the communication centre and, ideally, should be used as an integrated system to identify the vehicle closest to a scene or patient, it should assist in obtaining accurate directions as well as identify vehicles delaying their response or travelling off route. However, the system that had been installed was not real time and, therefore, could not be used for these functions. According to Zetron International (2008), the intended operations of the computerised call taking and dispatch system, GEM (C3), should be fully integrated with a vehicle monitoring and tracking system which is real time to enable the location of emergency vehicles as well as the vehicle closest to an incident/patient to be identified (Newton 2013).

The supervisory group participants shared that leave planning was one of the tools available to be used to ensure maximum staff availability but that it was not being used effectively, thus resulting in an unbalanced spread of staff on annual leave. There were times when too many staff members were on leave at the same time and this impacted negatively on response times, because fewer operational vehicles were available than would otherwise have been the case. In addition, staff members with scarce skills, such as advanced life support skills, were often given leave at the same time, thus leaving either one or sometimes not even one such staff member to cover the entire district.

5.3.2 Service Demand Management

The demand for Emergency Medical Services is often unpredictable. Nevertheless, there are areas which require careful management in order to ensure that the available resources are optimally used to guarantee the greatest productivity possible. These areas include the high case load, inter facility transfer cases, exempt cases and case triage and prioritisation.

5.3.2.1 High Case Load

The quantitative data from phase one of this study revealed that the demand for services in the Umgungundlovu Health District over a period of one week (seven days) was 1 503, thus an average of 107 cases per 12 hour shift. The average number of operational emergency vehicles per shift was 21. This implied that, if cases were evenly split per vehicle, each vehicle would attend to an average of five cases per 12 hour shift, thus giving them each an average time of 144 minutes in which to complete each case. However, the results of the study indicated a mean mission time of 198 minutes for all cases – 216 minutes for cases in rural areas and 181 minutes for cases in urban areas (Table 4.3). This provides a clear indication of the prevalence of a resource availability-demand mismatch. Other studies conducted in South Africa and also internationally have found that the demand for services far outweighed the available resources, therefore posing a challenge in meeting the response time targets (Govender 2011; Newton 2013; Stein 2014; van Nugteren 2014).

During phase two of this study, the participants spoke extensively about the demand for services and how it was continuously increasing, making it almost impossible for them to provide effective services. They shared how there were always cases outstanding and

waiting to be dispatched. Although they were required to triage cases on receipt of the call, it was very difficult to dispatch such cases because all cases had to be attended to. If they prioritised all P1 cases over P2 and IFT cases then the latter would never be attended as there were always new cases being logged. This presented a major challenge to the dispatchers. Newton (2013) highlighted that, when it is not possible for the available resources to meet the demand, there is a build-up of cases and, as a direct result of this build up, further delays in response times are noted, particularly during peak demand period. A rise in the demand for ambulance services in London was reported as a major factor in their inability to meet their response time target of eight minutes to critically injured patients as the increasing demand meant fewer ambulances were available and ready to respond immediately (DailyMail 2016).

5.3.2.2 Inter Facility Transfer Cases

The quantitative data from phase one of this study showed that inter facility transfer (IFT) cases made up 37% of the total case load of which 67% was in areas classified as urban. As explained during the focus group discussions, these cases came with a host of challenges which impacted negatively on service delivery. IFT cases have a much longer mean mission time (290 minutes in rural areas and 261 minutes in urban areas) as compared to that of both P1 cases (167 minutes in rural areas and 124 minutes in urban areas) and P2 cases (191 minutes in rural areas and 157 minutes in urban areas) and this results in resources having to be committed to these cases for a large majority of the time. A study conducted in the neighbouring eThekwini district (Newton 2013) reported that IFT cases made up 27.8% of the total cases dispatched; because the non-emergency patient transport services were operational only during working hours, this significantly increased the demand for the available resources.

The qualitative data from this study indicated that, although there are inter facility transfer ambulances, there are very few of these and they are operational only during day shifts. They are not able to attend to all the IFT cases and this results in emergency ambulances being used. In addition, IFT cases often remain outstanding for long periods of time with the IFT cases logged during the day shift only being attended to during the night shift. The participants from the operations group explained that some long distance IFT cases may take the dispatched vehicle an entire 12 hour shift to complete. In addition to these

challenges, the receiving doctors often do not just accept the patient and release the vehicle and they make the ambulance wait until they have completed their examination and they are happy to accept the patient. This often takes hours as doctors are not always readily available as they may be in theatre or busy elsewhere when the patient arrives. A study conducted in the province of KwaZulu-Natal (Hardcastle *et al.* 2012) determined that the delivery of patients to an inappropriate health facility often resulted in an increased demand for IFT cases and that this impacted negatively on the availability of ambulances which was, in any case, extremely limited. The reasons cited for this included the fact that patients are often transported to the nearest health facility and not necessarily to the most appropriate health facility. However, if the health facilities at the local level are upgraded, the need to transfer patients would be substantially reduced. The delays experienced at hospitals have also been reported as a challenge in London (DailyMail 2016) where the time taken to hand over patients was often extended to such an extent that it resulted in ambulances queuing outside the accident and emergency departments and, thus, they were unable to respond to outstanding cases.

5.3.2.3 Exempt Cases

Cases known as exempt include those cases that are logged and responded to but the EMS services are found not to be required. The results of this study indicated that over a quarter (27%) of the total cases logged were deemed exempt. Of these cases 32% were due to the case being cancelled by the caller and 19% were due to the emergency vehicle being unable to locate the patient or scene. Exempt cases were found to be at their highest on Friday when they constituted 33% of the case load for the day and on Saturday when they constituted 28% of the case load for the day. During weekdays the number of exempt cases was higher for the day shifts as compared to night shifts although, over the weekend, the number of exempt cases was higher during the night shifts as compared to the day shifts. As discussed in previous paragraphs, mean response times were much longer during the week as compared to over the weekend and were also longer for the day shifts during the week as compared to night shifts. In addition, IFT cases were the highest during day shifts during the week. This provides a clear indication that, when the response times are the poorest, the number of exempt cases is the highest. A study conducted in Ugu district of KwaZulu-Natal (Govender 2011) found that the number of exempt cases was extremely high although the reasons for this could not be established. A study conducted in

KwaZulu-Natal by Hardcastle *et al.* (2012) found that the number of exempt cases was very high, particularly in the rural areas. This finding is similar to findings in other countries which have reported rates of exempt cases of between 30% (Hipskind, Gren and Barr 1997; Gratton *et al.* 2003) and 32% (Chen, Bullard and Liaw 1996). Both the African Federation of Emergency Medicine and the International Academy of Emergency Dispatch have indicated that corrupt, prank or inappropriate calls are an issue of global concern (Mould-Millman *et al.* 2015).

During the focus group discussions conducted in the second phase of this study it was established that exempt cases constitute a major problem due to poor response times. The majority of times when the vehicle arrives on the scene, the crew is informed that the patient has already been taken to hospital because of the lengthy delay before the ambulance arrived. The participants from the operations group felt that the communications centre staff did not remain in contact with the caller and update the operations staff and that they dispatched an emergency vehicle without even confirming if their service was still required when there had been a delay. This resulted in an increase in wasted responses which delayed response times for other patients who were waiting. The participants from the supervisory group explained how some patients use the EMS as a way of receiving health care. Such patients have no intention of going to hospital and, when the emergency vehicle arrives on the scene and the attending personnel commences treatment, the patient feels better and then decides to stay at home. These cases generally take longer to complete on the scene as compared to other cases and, thus, also contribute to delayed response times. In support of this finding, a study conducted in the eThekwini district of KwaZulu-Natal (Newton, Naidoo and Brysiewicz 2015) found that 30% of the cases responded to were exempted, some after patients had received care from the attending personnel.

5.3.2.4 Case Triage and Prioritisation

When a call is received in the communications centre, the case must be triaged in order to determine the required prioritisation. This process is known as the dispatch triage and is based on information provided by the caller regarding the severity of the incident or condition of the patient (Newton, Naidoo and Brysiewicz 2015). The quantitative data from the first phase of this study indicated that the majority of the cases received (45%) were

categorised as P1 and, therefore, required the highest priority for dispatch as these cases are presumed to be life threatening in nature. A similar scenario was found during a study conducted in the eThekwini district of KwaZulu-Natal where 56.2% of cases received were triaged as P1 for dispatch (Newton 2013). It has already been indicated that the demand for services is overwhelming and that all cases need to be attended to and, thus, if all P1 cases are prioritised over the P2 and IFT cases, the latter will never be attended to. The results of this study also indicated that all the time intervals were shorter for P1 cases and longer for IFT cases, thus highlighting that, although the demand is so great and all cases need to be attended to, regardless of their category, the P1 cases are receiving a higher priority as compared to the other cases. The over-triage of emergency cases has been reported as an issue of concern in the eThekwini district where the majority of cases are deemed life threatening on receipt of the call, although only 2.4% of the cases triaged as P1 were found to be P1 by the emergency care personnel on arrival at the patient or scene (Newton 2013; Newton, Naidoo and Brysiewicz 2015). When compared to studies conducted elsewhere, it is apparent that the over triage-rate is unacceptably high as other studies have noted an over-triage rate of only 10% (Lammers, Roth and Utecht 1995).

The participants from the focus groups conducted during the second phase of this study highlighted several challenges regarding the dispatch triage. The operations group stated that, if the dispatch triage were conducted effectively then meeting the national norm may be possible. However, the majority of the cases are simply triaged as P1 without suitable scrutiny, the call takers do not ask questions in order to gain a better understanding of the situation with which they are dealing and the large number of P1 cases results in non-emergency cases receiving the same priority as real life threatening emergency cases. The operations participants explained that being dispatched to a P1 case and arriving on the scene to a P3 patient was the situation in the majority of the cases to which they attend. However, the participants from the communications group explained that many of the calls received are from a family member or neighbour who has been sent to a public phone to make the call and do not have any details on the condition of the patient, the patient's medical history or the severity of the patient. This makes it impossible to triage such cases and they are therefore triaged as P1 by default. However, this compounds the challenges outlined above. The supervisory group explained that the process used to determine the dispatch triage is based on the call taker's observation and this may result in inconsistencies due to the fact that staff members have different levels of experience and

training on which to base their decisions. These concerns were supported by Newton (2013) who found that the strategies used in the eThekwini district for the triage of cases received and the allocation of resources were not effective and required review. He found that there were no procedures in place for the standardised scrutiny of the calls received in order to effectively inform the priority required (Newton, Naidoo and Brysiewicz 2015). This scenario differs substantially when compared with several other EMS systems throughout the world which follow a precise and systematically guided approach which is not based on individual opinion or perception (Pozner *et al.* 2004; Black and Davies 2005).

The high number of cases prioritised as P1 for dispatch, with only a small percentage of these actually requiring urgent transportation to hospital or lifesaving intervention by medical personal, results in the majority of the responses being found to be inappropriate. Inappropriate EMS responses have been reported in four studies conducted in South Africa. In the eThekwini district in KwaZulu-Natal it was found that only 1 in 10 patients dispatched as P1 were confirmed as P1 on scene (Newton, Naidoo and Brysiewicz 2015), in the Eastern Cape it has been reported that 16.7% of all EMS requests were never dispatched (Meents and Boyles 2010), in the greater Johannesburg area MacFarlane, Van Loggerenberg and Kloeck (2005) found that there was a high level of inappropriate use of EMS vehicles while, in the Western Cape, as many as 68% of the cases transported by the Caledon EMS in Overberg were not emergencies (Frank and de Villiers 1995). Studies conducted in developed countries have shown that as much as 52% of all requests for EMS are later deemed inappropriate and that this trend has been evident since the 1970s (Snooks *et al.* 1998).

5.3.3 Public Perception

The focus group discussions conducted highlighted that the perceptions of the public – the client – of EMS and the use thereof impact on response times. The members of the public are often misinformed and this tends to result in heightened expectations and often disappointment. As highlighted by the participants from the operations group during the qualitative data collection phase of this study, when new emergency vehicles are purchased to replace the old vehicles, the public believes that the response times will improve because there are more ambulances as the media release does not mention that the new vehicles are merely replacing older vehicles.

As explained earlier, cases are prioritised and dispatched based on the information provided by the caller. During the qualitative data collection phase of the study, the participants from the communications group explained that the public has become aware of this and often provides information that results in a P1 triage. However, when the emergency care personnel arrive on the scene the patient's condition does not correspond with the information provided and the patient is stable while his/her condition not life threatening at all. In addition, the service is often abused and often used for transportation to hospital only. In the neighbouring eThekwini district, it was found that majority of P1 responses were inappropriate. The reasons cited included public ignorance or misunderstanding of the EMS service as well as the unavailability of public transport and inaccessible or distant primary healthcare facilities (Newton, Naidoo and Brysiewicz 2015). Nevertheless, it would appear that this is not the case only in South Africa as it has been reported in London that the ambulances are often called to attend to and transport patients with minor injuries. It has even been mentioned that ambulances are used as a taxi service and that this results in delays when responding to real life threatening emergencies (Palazzo *et al.* 1998; DailyMail 2016). It has been found that many patients accessing the EMS do not have a clearly defined need for the service and, hence, the responses to these patients are considered to be inappropriate responses although the expectation of transportation to a medical facility still exists (Gratton *et al.* 2003; Newton, Naidoo and Brysiewicz 2015).

As alluded to by the supervisory group during the second phase of the data collection in the current study, the public are not aware that information regarding the patient's condition is of vital importance when making a call to the EMS. They often send a third party to make the call, sometimes this is a child or a neighbour who is told to go and call for the ambulance. However, these callers have absolutely no information regarding the patient's condition and, therefore, it is not possible to triage the case effectively.

5.4 Strategies to Improve Response Times

Several improvement strategies were highlighted during the second phase of this study by the focus groups. These included resource availability and the way in which resources are

managed, an overhaul of the systems used in the EMS and the education of both internal staff and the public at large.

5.4.1 Resource Availability and Effective Management

The first step in ensuring a service can be provided is to ensure that appropriate resources are available and the second is to utilise these resources efficiently.

5.4.1.1 Resource Availability and Allocation

In order to meet the demands for Emergency Medical Services (EMS) effectively, appropriate resources and the effective management of such resources are essential. The availability and allocation of resources was suggested as a strategy to improve response times by the participants from all the groups during the second phase of this study. They explained that resource availability should be based on the population served in the area and that resources should be allocated to the different areas based on demand. In addition, they recommended expanding the service with the establishment of more EMS bases in all communities as well as the inclusion of satellite bases. The expansion of services also requires additional vehicles and, thus, vehicles should be purchased on a regular basis both in order to replace old vehicles and to expand the services.

A study conducted in South Africa (Stein 2014) explored the optimal number of ambulances required in order to achieve the national norms. However, it was found not to be possible to establish this optimal number. This was ascribed to the deployment and redeployment policies applied which did not take into account of the number of available operational emergency vehicles. In the South African context it is definitely not possible to prescribe the optimal number of ambulances required as each area is unique and, therefore, requires careful, individual consideration.

The available literature strongly supports the strategy for effective resource allocation and is referred to as systems status management. This is a strategy that has been used widely in EMS to ensure better optimisation levels of resource management while maintaining system costs. This system includes the use of geographic information systems, demand pattern analysis and dynamic location/relocation models in order to improve the travelling

times to incidents or patients (Repede and Bernardo 1994; Brotcorne, Laporte and Semet 2003; Andersson and Varbrand 2007; Ong *et al.* 2009; Setzler, Saydam and Park 2009; Maxwell *et al.* 2010; Stein 2014). Substantial improvements have been reported with the implementation of systems status management in cases in which sufficient resources exist as the continuous movement and deployment of vehicles based on demand is required. It has also been reported that inadequate resources are deemed to be a stumbling block to the proper implementation of systems status management, thus hindering the realisation of the proven benefits thereof (Repede and Bernardo 1994; Peters and Hall 1999; Rajagopalan, Saydam and Xiao 2008; Setzler, Saydam and Park 2009; Stein 2014). It has been suggested by Stein (2014) that improved response times in South Africa would probably only be possible with the implementation of further decentralisation and deployment strategies and with careful consideration of the shifting demand patterns as EMS systems in South Africa generally use a centralised approach. The use of satellite bases in all areas has been found to improve response times due to the emergency vehicles being closer to the patients or incidents.

Community pick up points were suggested as an improvement strategy during the second phase of this study. This strategy would also include the establishment of an area in each community where members could make calls for services, including other emergency services such as the South African Police Services and the Fire Department. This would facilitate the making of calls as well as ensuring accurate pick up points for responding vehicles, thus reducing response times. There is no available literature showing that such a strategy has been implemented previously. However, in view of the challenges highlighted in this study in relation to achieving response time national norms, this strategy has the potential to impact positively on the attainment of these national norms.

Phase two of this study revealed that the availability of vehicles plays a vital role in providing Emergency Medical Services. However, this does not refer only to vehicles that are operational but also pool vehicles which are fully stocked and ready for use. Should a vehicle be stood down because of a breakdown or be involved in a collision, such pool vehicles would ensure that staff could still be operational immediately using a pool vehicle. In addition, during shift changes when a vehicle is out on a late case, the incoming staff would be able to use a pool vehicle and become operational at the start of the shift rather than waiting for the return of the vehicle which is out on a case. Other studies have also

identified this as an improvement strategy. Nevertheless, the strategy would require careful consideration because the expected number of additional ambulances needed in the health district under study is as much as ten times the number of vehicles that were available at the time of the study. This would come at a considerable cost which may not necessarily be sustainable. Additional staffing and medical equipment would also be required and this would require ongoing funding. Thus, although additional ambulances are required it must be emphasised that this should not be the primary focus and that a cautious approach should be adopted to ensure a balance between the costs of increasing resources with the simultaneous introduction of optimisation strategies for the optimal use of such resources (Stein 2014; Newton, Naidoo and Brysiewicz 2015).

In order to ensure that staff members who are employed for operations are not requested to perform other duties, it is essential that sufficient staff is employed for both the operations and support services. On the basis of the qualitative data collected in this study it is suggested that all staff members should have clearly defined roles and responsibilities and these are adhered to in order to ensure both optimal productivity as well as maximum use of operational vehicles.

5.4.1.2 Management of Resources

Resource availability is the first step in the right direction; however, if these are not managed and utilised correctly, then their value will never be realised. All the focus groups conducted in phase two of this study highlighted the urgent need for improved systems for the utilisation of resources. In view of the fact that EMS is a 24 hour service, it operates using a shift system. At the time of the study, the shifts were operating independently and this was resulting in staffing, equipment and vehicle issues for a particular shift being addressed only at the start of that shift. If all the logistics were planned and dealt with prior to commencement of a shift, there should be no delays. The participants from the communications group suggested that each shift should prepare for the subsequent shift and assist each other in order to ensure a smooth transition between shifts. The participants felt that if this were done then the accumulation of outstanding cases at shift change would be reduced and this would have an impact on improving response times.

Inter facility transfer (IFT) cases make up a large portion of the case load and place an enormous strain on emergency operations. Although many of the IFTs are considered to be non-emergency, they are completed using emergency ambulances. However, if the IFT cases are grouped and serviced in conjunction with each another this should help to reduce their impact on response times. Hardcastle *et al.* (2012) suggested that district hospitals be upgraded and improved in order to reduce the demand for inter facility transfer cases and also that appropriate referral systems be implemented to ensure that patients are taken directly to the most appropriate health facility, thus preventing the need to transfer the patient at a later stage.

This issue of the availability and use of advanced life support (ALS) practitioners was raised by the participants from the supervisory group during phase two of the current study. They maintained that, if ALS practitioners worked on an ambulance rather than a response vehicle, they could add more value as patients could be transported immediately rather than additional resources being allocated to just one patient. In support of this finding a study conducted by Newton, Naidoo and Brysiewicz (2015) revealed that, in up to 61% of the cases to which the ALS attended, no intervention other than transportation was required. In support of this, Stein (2014) reported that operational advanced life support vehicles did not have any positive impact on the response times achieved.

5.4.2 Improved Systems

A systematic approach to the functioning of an EMS service is vital for the standardisation of services to ensure that all individuals at all levels of the service have access to terms of reference regarding day-to-day operations.

5.4.2.1 Information and Communications Technology (ICT) Solutions

Accurate and standardised methods for the screening and triaging of received calls for prioritisation purposes would result in cases receiving the responses required based on either the condition of the patient or the severity of the incident. The participants expressed the view that the best option would be implementation of a computerised system for determining the dispatch triage as this would ensure that every case were screened using exactly the same method. This would help to prevent inconsistencies.

Evidence based dispatch systems, including formal computer aided decision making methodology, have been developed and utilised successfully around the world in respect of effective EMS dispatch. Both the Medical Priority Dispatch System (MPDS) and the Advanced Medical Priority Dispatch System (AMPDS) have been widely and successfully used to determine the appropriate priority for EMS cases and, thus, the required resources (Curka *et al.* 1993; Thakore, Mcgugan and Morrison 2002; Heward, Damiani and Hartley-Sharpe 2004; Flynn, Archer and Morgans 2006; Sporer, Youngblood and Rodriguez 2007; Cone, Galante and Macmillan 2008). These systems help to reduce the number of inappropriate responses by assisting in identifying real life threatening cases which require immediate response as compared to cases that do not require an immediate response and this in turn improves the response times to priority one cases (Dale *et al.* 2003; Dale *et al.* 2004). The use of formal, medically approved, emergency medical dispatch protocols is advocated as an essential element of all EMS systems (Sporer *et al.* 2008; Mould-Millman *et al.* 2015).

Although resources are used to attend to patients and provide care, the command and control takes place within the communication centre and if the staff members in the centre do not have access to the location of these resources, it becomes difficult to manage such resources effectively. The participants in the study recommended a real time vehicle monitoring and tracking system that is fully integrated with the call taking and dispatch system, thus allowing the dispatcher to easily identify the resource closest to a patient or incident, thus improving response times. This system would also assist in providing accurate directions to the patient or incident location as well as monitoring the movement of resources in order to identify the misuse of resources or delays in responding. The use of geographic information systems (GIS) has been shown to assist in achieving optimal resource deployment in EMS systems throughout the world (Peleg and Pliskin 2004; Edelman 2007; Ong *et al.* 2009; Setzler, Saydam and Park 2009). Demand pattern analysis and dynamic location/relocation models in conjunction with the use of accurate real time GIS systems have also been reported to assist with effective resource management and deployment based on the demand for services in EMS (Andersson and Varbrand 2007; Brown *et al.* 2007; Ong *et al.* 2009; Setzler, Saydam and Park 2009; Maxwell *et al.* 2010).

A new phenomenon using innovative technology, referred to as “what3words”, has been introduced. It divides the earth into a grid of squares which are 3 meters by 3 meters and each box is allocated a code formulated by a process using three familiar English words. The site, also available as an app, utilises shorter and more common words in urban areas and more obscure words in more remote rural areas as well as in the middle of the ocean. The founders of this system claim that it is more accurate than either postcodes or street addresses and is particularly useful in rural areas or countries that do not have an organised network of street names and numbers – reportedly 75% of countries in the world. The system has also been presented as far more user friendly than GPS coordinates which consist of a string of 16 numbers that are almost impossible to remember and which present a high risk for human error (Jones 2015; Gye 2016). If every person in the world had access to a simple, accurate and unambiguous address system, regardless of his/her whereabouts, timeous access to EMS would be greatly improved.

The effective management and control of equipment are essential to ensure maximum availability of such equipment. Based on the qualitative data from this study the use of security systems for the management of equipment is recommended as this would allow for the easy identification of the use, location and condition of equipment. If equipment were readily available and easily accessible at all times the availability of resources would improve as would response times.

5.4.2.2 Processes and Procedures

The standardisation of services guided by policy, processes and procedures is critical in order to provide a quality service that is of a high standard that is maintained. The participants in phase two of this study felt strongly about this issue as the inconsistencies they faced on a daily base were crippling the service. They cited the need for guiding documents such as Standard Operating Procedures for all areas of operations as they felt this would have a positive impact on response times. The participants also highlighted that stringent quality assurance is required to identify shortfalls in the service and provide the opportunity to further improve the service and to ensure a constant striving for improvement. This would not only help to motivate the staff but it would also ensure that personnel at all levels were held accountable. A study conducted by Stein (2014) in Cape Town, South Africa suggests that the availability of emergency vehicles is not the cause of

the poor response times achieved and that more vehicles would reduce response times but not make a significant impact on the percentage of responses within the national norm. However, if systems, processes and procedures were in place to guide the consistent use of vehicles, based on demand, this would result in improved response times.

Access to Emergency Medical Services (EMS) is dependent on an established, effective communications centre as it is at this point that the first point of call is made. The coordination, command and control of all logged cases and the available resources are conducted subsequent to this first call. The functioning and efficiencies of the communications centre ultimately determine the proficiency of the entire EMS. The African Federation of Emergency Medicine and the International Academy of Emergency Dispatch assembled in 2014 to formulate conceptual, technical and innovative recommendations for appropriate emergency medical dispatch (EMD) systems in Africa (Mould-Millman *et al.* 2015). It was suggested that call taking and call processing are the most efficient when rehearsed, pre-determined and standardised and when algorithm-based processes are utilised. These systems may be economically and efficiently configured to utilise centralised call taking and decentralised dispatch. The standardisation of the data collection and the metrics measured was also highlighted as a vital tool for continuous monitoring and improvement.

A suitable staff establishment that caters for all levels of operations and the supervision of these levels is required. All supervisory and management posts should be occupied to ensure that the required responsibilities are performed effectively while the appointment of personnel in an acting capacity should not be a permanent arrangement. Both supervision and discipline are desperately required at all levels within the EMS. If staff members were appointed in positions of interest to them and career pathing were available then they would be more likely to perform better in view of the rewards for such performance.

Staggered shifts for 24 hour operations should be considered to ensure that the service does not come to a stop as is the case with the standard shift system. This would contribute to improved response times as there would not be a build-up or a backlog of cases at the start of each shift. Newton (2013) identified case backlog at the time of shift change as having a negative impact on response times.

Both standardisation and a systematic approach to call taking are required to assist with effective triage and case prioritisation. This would help to ensure that sufficient information is obtained from the caller so as to enable an informed decision to be made on the triage of each case and the level of prioritisation required. Local studies conducted by Newton (2013) and Stein (2014) have indicated that efficiency, or the lack thereof, in the communications centre have a direct impact on the response times achieved while the shortening of the delays related to call taking and dispatch should contribute significantly to improving overall response performance even before the intricate issues of emergency vehicle allocation and deployment are addressed.

Success has been reported in EMS where the alternative routing of patients has been implemented (Neely, Moorhead and Schmidt 1997; Neely, Norton and Schmidt 2000; Dale *et al.* 2003; Schmidt *et al.* 2003; Dale *et al.* 2004). This strategy includes the possibility of telephonic medical advice on the self-management of the illness or injury and also directing the patient to a general practitioner or primary health care facility for cases that are deemed to be non-emergency in order to prevent a vehicle intended for life threatening priority one cases from responding and, thereby contributing to delays in response times.

5.4.3 Education

Awareness and understanding on the part of both internal and external stakeholders are imperative for the effective functioning, management and utilisation of any organisation.

5.4.3.1 Education of EMS Staff Members

The right person with the right skill, experience and qualification and doing the right job is vital for success in any working environment. The participants from all focus groups expressed concerns about the education of staff at every level and how important such education is for the effective running of EMS. It is imperative that staff members working in the communication centre possess the skills required in such an environment, particularly with regard to assisting in providing telephonic medical advice as many of the calls do not necessarily require a vehicle to respond. If carried out effectively this would reduce the number of responses required and, therefore, improve response times. In addition, staff members in the communication centre also require training for the standard triaging of

incoming cases regarding the questions to ask and the information to obtain to ensure accurate triaging. A study conducted in the eThekwini district of KwaZulu-Natal identified inconsistencies in the way in which calls were handled and prioritised by staff members with varying medical qualifications. All these staff members had been trained to work at the operational level on an emergency vehicle but had been placed in the communications centre environment with very little or no additional training (Newton 2013). The available literature suggests that this scenario is unique to South Africa as other countries have a dedicated component for emergency medical dispatch with specific qualification requirements and career and training pathways and with the focus on effective emergency medical dispatch training and compliance (Griggs *et al.* 1977; Clawson 1981; Clawson *et al.* 1998; Flynn, Archer and Morgans 2006; Sporer, Youngblood and Rodriguez 2007; Sporer *et al.* 2008; Sporer *et al.* 2010). The impact of education and training in ensuring effective medical priority dispatch within EMS systems has been widely recognised over time (Griggs *et al.* 1977; Clawson 1981; Clawson *et al.* 1998; Heward, Damiani and Hartley-Sharpe 2004). The available literature has also exposed the inaccuracies and inconsistencies which occur when EMS case prioritisation is left to the subjectivity, and/or experience of the call taker and anecdotal evidence (Clawson *et al.* 2007).

Medical training is a prerequisite for employment as a supervisor or manager within the EMS. However, it would appear that the majority of the appointed managers do not have any supervisory and management experience or training. Appropriate supervisory and management training for staff members at the various levels within the structure are essential to ensure that the personnel appointed are equipped with the tools required to perform their duties as a supervisor or manager. This would result in the improved management of resources and, thereby, have a positive impact on response times.

When new staff are appointed in the EMS there should be standardised, formal, compulsory induction training prior to commencing duties. This would ensure that all staff have a thorough understanding of what is required of them as individuals, what the service goals are, what the mission and vision is and how they may contribute to improving services.

5.4.3.2 Education of the Public and Health Facility Personnel

In addition, the public at large, the main clients of EMS, require an understanding of the service available to them, how best to access the service and when to access the service. If public awareness campaigns were conducted in all communities abuse of the service would be reduced and the public would know what information is required from them when they access the services. In addition, they would realise the importance of providing accurate information as well as the consequences of abusing the service. Within the wider health care domain, public awareness campaigns have proven to be effective over time. The primary emphasis of such campaigns is on changed behaviour and this is achieved by informing the public about issues related to the EMS and the use thereof (Craig Lefebvre and Flora 1988; Mackie and Hole 1992; Payne *et al.* 2010). One of the most successful public awareness campaigns reported in the context of the EMS was the "Make the Right Call" which was introduced throughout the United States (Delbridge *et al.* 1998). Recommendations made by the African Federation of Emergency Medicine and the International Academy of Emergency Dispatch include educating the public on the appropriate indications to look for, mechanisms of accessing and reasonable expectations when accessing Emergency Medical Services which would minimise the misuse of the service, prevent misperceptions and safeguard valuable emergency care resources (Mould-Millman *et al.* 2015).

Health facilities are also clients of the EMS and also require education on how the EMS operates, how to access the service and what to expect when accessing the service. This would assist in the management of inter facility transfer cases and reduce the long waiting times which were being experienced at the time of the study.

5.5 Conclusion

This chapter contained a detailed explanation of the study results as well as an in-depth discussion of the results in relation to the research objectives described both in chapter one and at the beginning of this chapter. The following chapter concludes the study.

CHAPTER 6:
SUMMARY, RECOMMENDATIONS, LIMITATIONS AND CONCLUSION

6.1 Introduction

This chapter contains a summary of the study results, recommendations for the implementation of the findings and further research, a conclusion to the study, limitations of the study and the researcher's reflections.

6.2 Summary

The fundamental stages in providing effective Emergency Medical Services (EMS) to any patient commence at the time the incident occurs and culminate in the delivery of definitive care. This process is known as the 'patient journey' (Castrén *et al.* 2008). The framework on which this study was based includes the intervals that make up the response time only, namely, the EMD response interval and the EMS unit response interval. The efficiency of the EMS in South Africa is measured primarily in terms of the time taken for the service to be accessed – from the time the call for help is made until the time the first emergency vehicle arrives at the incident or patient. The national norms for these response times stipulate a 15 minutes response time to priority one cases in urban areas and a 40 minutes response time to priority one cases in rural areas.

The study successfully analysed the response times through the use of mixed methods which unpacked the factors that influence response times in the EMS. The quantitative aspect of the study revealed the actual response times and how majority of these actual response times were not within the national norms while the qualitative aspect of the study enabled the exploration of explanations for the poor response times as well as suggested strategies to overcome the challenges which had been identified. However, response times in EMS remain an area that requires ongoing discovery and debate.

6.2.1 Analysis of Response Times

The first objective of the study was to analyse response times in both rural and urban areas in KZN and to compare these to the established South African national norms. Accordingly, the first research question was posed, namely, “What are the actual response times currently being achieved in both rural and urban areas in KZN and how do these compare to the established South African national norms?” This research question was answered during phase one of the study with the use of quantitative data collected in the Umgungundlovu Health District of KwaZulu-Natal (KZN) for all the cases logged in the communications centre within a specific period of time. The findings of the study clearly indicated that there was a significant mismatch between the response times achieved and the national norms in both the rural and the urban areas. Similar results have been found in other studies conducted throughout South Africa (MacFarlane, Van Loggerenberg and Kloeck 2005; Meents and Boyles 2010; Govender 2011; Chipangura 2013; Newton 2013; Stein 2014).

6.2.2 Factors that Influence Response Times

The second objective of the study was to explore factors that influence the response times in KZN. This was achieved by using both the quantitative data collected during phase one of the study as well as the qualitative data collected during phase two of the study. The first research question posed in respect of this research objective was as follows: “How do non-priority one cases impact on priority one cases response times? The findings suggested that the extensive demand for inter facility transfer cases was impacting negatively on the response times achieved as the same resources were required to attend to all the cases logged. The second research question in respect of this research objective was as follows: “What factors contribute either to or against achieving the response time national norms? In order to answer this research question, the two time intervals outlined by the framework described above were explored separately. The study found that the EMD response interval appeared to make a significant contribution to the extended response times as the calls logged were dispatched only hours after receipt in some instances. The reasons for this included the dire shortage of available resources, a lack of effective management of the available resources and no access to an intelligent, scientific system that addresses resource and demand management. The study found that the EMS unit response interval

also contributed to the poor response times but to a lesser extent as compared to the EMD response interval. The reasons for this contribution of the EMS unit response interval included the very long distances between EMS bases, the patient or incident location and health facilities which resulted in lengthy driving times on poor roads as well as difficulties in locating the patient or incident due to a lack of/or poor road and house number signage.

6.2.3 Strategies for the Improvement of Response Times

The third objective of the study was to identify strategies to improve the response times. The following research question was asked: “What recommendations may contribute to the improvement of response times in the future?” The qualitative data obtained during the second phase of the study was used mainly to answer this research question. It was determined that all areas of the EMS impact response time performance and, therefore, the entire service required careful evaluation. The results of the study showed that, of all the areas, it was the communications centre that had the most significant negative impact on response times. Coincidentally this was also the area in which the most improvement on processes and systems were available and were recommended for implementation.

6.3 Recommendations

It was apparent that the systems applied by Emergency Medical Services (EMS) Umgungundlovu Health District in KwaZulu-Natal (KZN) at the time of the study for the management of its demand and resources were based on individual experience, training and perception at both the operational and the supervisory levels. The implementation of systems, processes and procedures that would standardise the way in which all areas of EMS operate would provide a solid base on which effective monitoring and evaluation could be conducted continuously in order to ensure that the future management of the service were evidence based. The results of the study highlighted certain vital areas that should be prioritised if this is to be achieved. These areas include the use of a computer-aided dispatch system, dynamic resource modelling, appropriate national norms for response times, education and awareness and further research.

6.3.1 Computer Aided Dispatch System

The development of a recognised Medical Priority Dispatch System which incorporates evidence based dispatch systems which include formal, computer aided, decision making methodology that is adapted for local conditions and patient triage protocols, should be implemented in the EMS communication centres. The implementation of accurate and standardised methods for the screening and triaging of received calls in the communication centre for the purposes of prioritisation would ensure that cases receive the required response based on the condition of the patient or the severity of the incident. This would also help to reduce the incidence of inappropriate responses.

6.3.2 Dynamic Resource Model

Demand pattern analysis and dynamic location/relocation models accompanied by the use of accurate, real-time GIS systems would assist greatly in the effective management of resources, thus ensuring optimal availability. The careful and continuous monitoring of the caseload per area within both rural and urban settings is required in order to effectively implement and realise the benefits of such a model.

6.3.3 Available Resources

The demand for Emergency Medical Services (EMS) has increased gradually over the years. However, the resources available have remained the same. If not addressed, the response times to emergency cases will not improve as the gap between the demand and available resources will continue to deteriorate. It is essential that the required vehicle and staffing resources are determined based on a situational analysis per EMS base and take into consideration the caseload, terrain, population density and how much of the area is considered urban and rural. Nevertheless, the provision of additional resources without the implementation of improved management systems and processes would prevent the anticipated improvement in service delivery from being realised.

6.3.4 Education and Awareness

It is vital that both the staff as well as the end users of the EMS have a thorough understanding of the service. All the staff members employed within the EMS at both the operational and supervisory levels require adequate and appropriate training based on their areas of speciality, including a clear understanding of the entire system and how their roles impact on the system as a whole. In addition, vigorous public awareness campaigns which also target health facility staff should be conducted in order to ensure that users of the service understand the impact of abuse, particularly in view of the limited resources available as well as how to access the service effectively by providing accurate information.

6.3.5 Appropriate Response Times National Norms

The current national response time norms in South Africa are questionable. Their origin is indeterminate and there is no available literature that supports either the existence or the relevance of these national norms. Thus, the review and development of response time national norms that are both appropriate and achievable but which also assist in ensuring that the efficiency of EMS is not compromised are required and should be based on in depth empirical evidence.

6.3.6 Recommendations for Future Research

The Emergency Medical Services (EMS) in South Africa would undoubtedly benefit from future research that explores the operational fundamentals, the decision making processes and the tools used as well as the way in which these are monitored and evaluated for the purposes of ongoing review and improvement which are evidence based. It would appear that the EMS system at the time of the study relied greatly on individual experience and opinion to inform review and change and this is not sustainable.

In line with the findings of this study, areas requiring further research include public and health facility staff expectations for EMS response times in South Africa. Although the National Department of Health has provided a national norm, there is no evidence that the end users of the service regard these national norms as acceptable. The impact of

response times on patient outcome in both rural and urban areas in South Africa may require a far more extensive study as compared to this study and one that explores the entire patient journey starting from the call to the EMS communications centre to discharge from the relevant health facility. The viability of dedicated, specialised areas of operations by the EMS, for example, the obstetric ambulances, Inter Facility Transfer ambulances and psychiatric ambulances, should also be explored. Future research should also focus on the development of a dispatch system that includes formal, computer aided, decision making methodology that is applicable to the South African patient care protocols and guidelines. A study on the operational application of dynamic resource modelling in the context of the EMS in South Africa would provide insights into and guidance on the practical implementation of such modelling, while taking into account the environment in which the EMS in South Africa operates. In addition, a scientific review of the existing national norms for the performance monitoring of the EMS in South Africa is desperately required with the development and implementation of standardised data collection and reporting tools.

6.4 Limitations of the Study

The first limitation of the study refers to the fact that the study focused on a period of just one week and, therefore, fluctuations due to seasonal changes, weather patterns and festive periods were not taken into account. These factors may well influence the demand for service and, thus, the results of the study. A larger sample size extended over a longer period which takes these variables into consideration may produce results which would have the potential to add significantly to the value of this study.

The second limitation includes the rate of emergency vehicles breaking down and collisions which occur when responding to cases which may significantly delay the response times to emergencies. Clarification of this may have impacted on the results and added to the value of the study.

The third limitation of the study was that the focus group discussion participants may have felt threatened by the researcher’s being senior to them in the hierarchy within the study setting and they may, therefore, not have shared their experiences and viewpoints openly and honestly for fear of victimisation.

The fourth limitation is that the study was carried out in one district in one province in South Africa. Although the Umgungundlovu Health District included both rural and urban areas, the available resources, systems, processes and management structures differ from province to province and this may have influenced the results.

6.5 Researcher Reflections

The past few years have been an unimaginable learning curve for me as I have had to confront the difficulties of trying to develop as a researcher while working full time. In addition, the research project forced me to think and analyse information in a very different way to the way I had been used to. The research methodology selected forced me to sit back and watch, listen and learn from the participants rather than being the person speaking and providing the information. Instead I had to take a back seat and allow the participants to come up with the solutions themselves.

My position as a deputy manager in the study setting had the potential to constitute a threat to the participants during the focus group discussions as they may have felt they were at risk of victimisation. I was, however, astounded at how open and, at times, brutally honest the participants were in sharing their experiences and viewpoints. Their passion for the service, their desire to see improvements and their wish to be part of this research project came through clearly. I found this humbling and I feel privileged that they trusted both me and the process sufficiently to commit themselves so wholeheartedly.

As the EMS, we are continuously required to report on and provide reasons for poor response times which are beyond the national norms. Accordingly, I had not expected either new or unexpected results. However, the study findings stunned me, particularly those from the qualitative phase as they provided such clarity to the findings from the quantitative phase. This confirmed to me the impact of mixed methods research as, in this study, one without the other would not have provided the results the study produced.

6.6 Conclusion

The response time national norms used by the South African Emergency Medical Services (EMS) for both rural and urban areas are undoubtedly unattainable in the majority of circumstances and are, therefore, clearly unrealistic. The perceived efficiency of EMS at the time of the study was based predominantly on the number of cases responded to within these time frames and, therefore, until their values are reconsidered, the service will be deemed to be incompetent.

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Annexure A: Information provided by the KwaZulu-Natal Department of Health

health
Department:
Health
PROVINCE OF KWAZULU-NATAL

Private bag X9051, Pietermaritzburg
121 Chief Albert Luthuli Street, Capital Towers, PMB, 3200
Tel: 033 846 7239 Fax: 033 846 7278
www.kznhealth.gov.za

EMERGENCY MEDICAL SERVICES

Date: 04 / 11 / 2013

Ms. M J Finlayson

This serves to advise the following information:

- EMS KZN has 11 districts each of which have their own communications centre.
- 5 of the 11 communications centre's are using the specialized GEMC computerized call taking and dispatch system (eThekwini, Ilembe, Ugu, Umgungundlovu and Uthukela)
- Umgungundlovu District caseload for the 1st and 2nd quarter of 2013/14 (April – Sept) was as follows:
    - Number of P1 (red code) case logged
        - Urban 8 536
        - Rural 6 315
    - Number of P2 (yellow code) cases logged
        - Urban 3 867
        - Rural 2 866
    - Number of P3 (green code) cases logged
        - Urban 2
        - Rural 10
    - Number of inter-facility transfer cases logged
        - Urban 7 261
        - Rural 3 900
    - Total emergency caseload:
        - Urban 19 666
        - Rural 13 091

Yours Sincerely

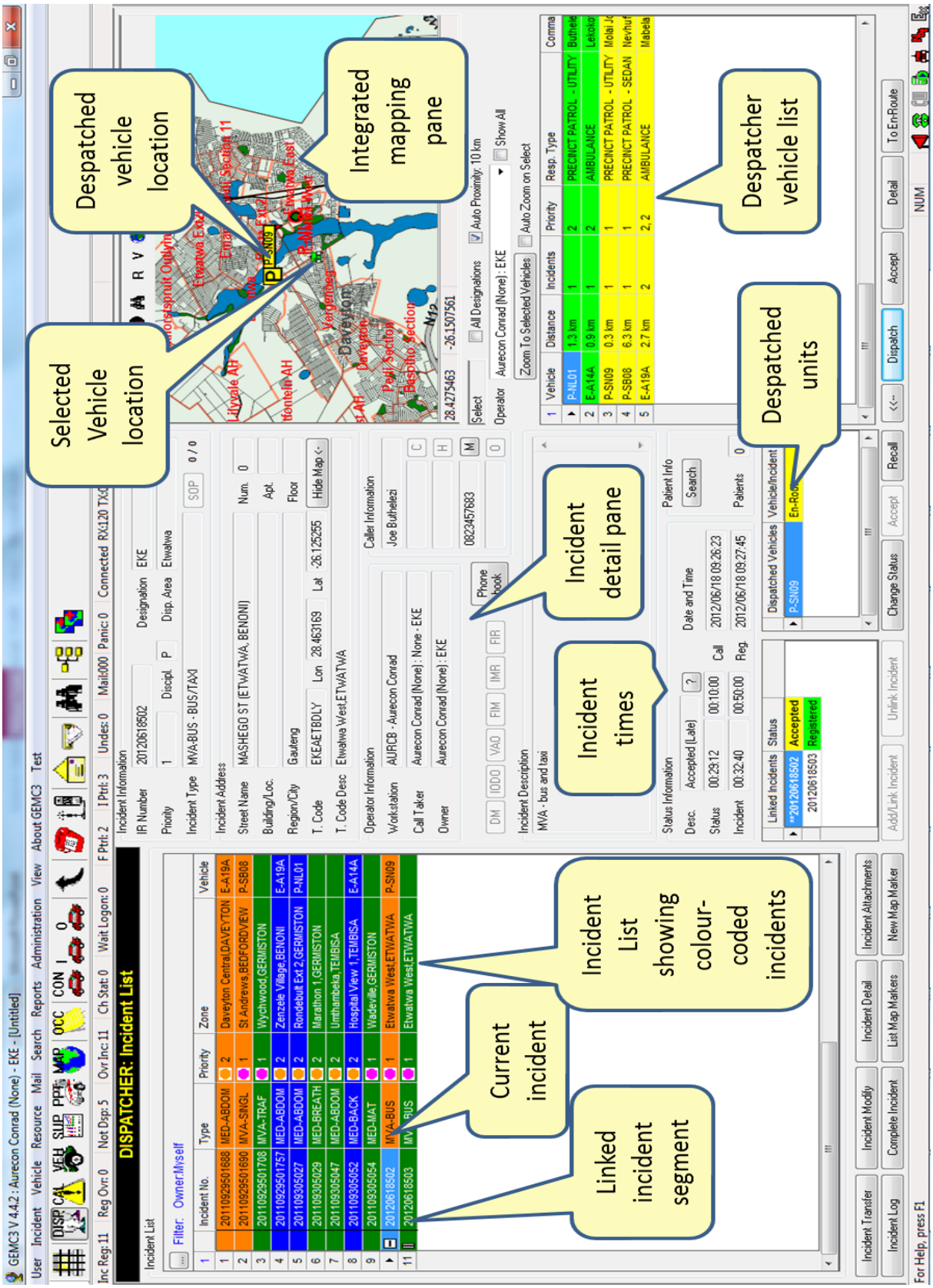
[redacted]

MR. M MABASO
PROVINCIAL OPERATIONS MANAGER
EMERGENCY MEDICAL SERVICES
KWAZULU-NATAL: DEPARTMENT OF HEALTH

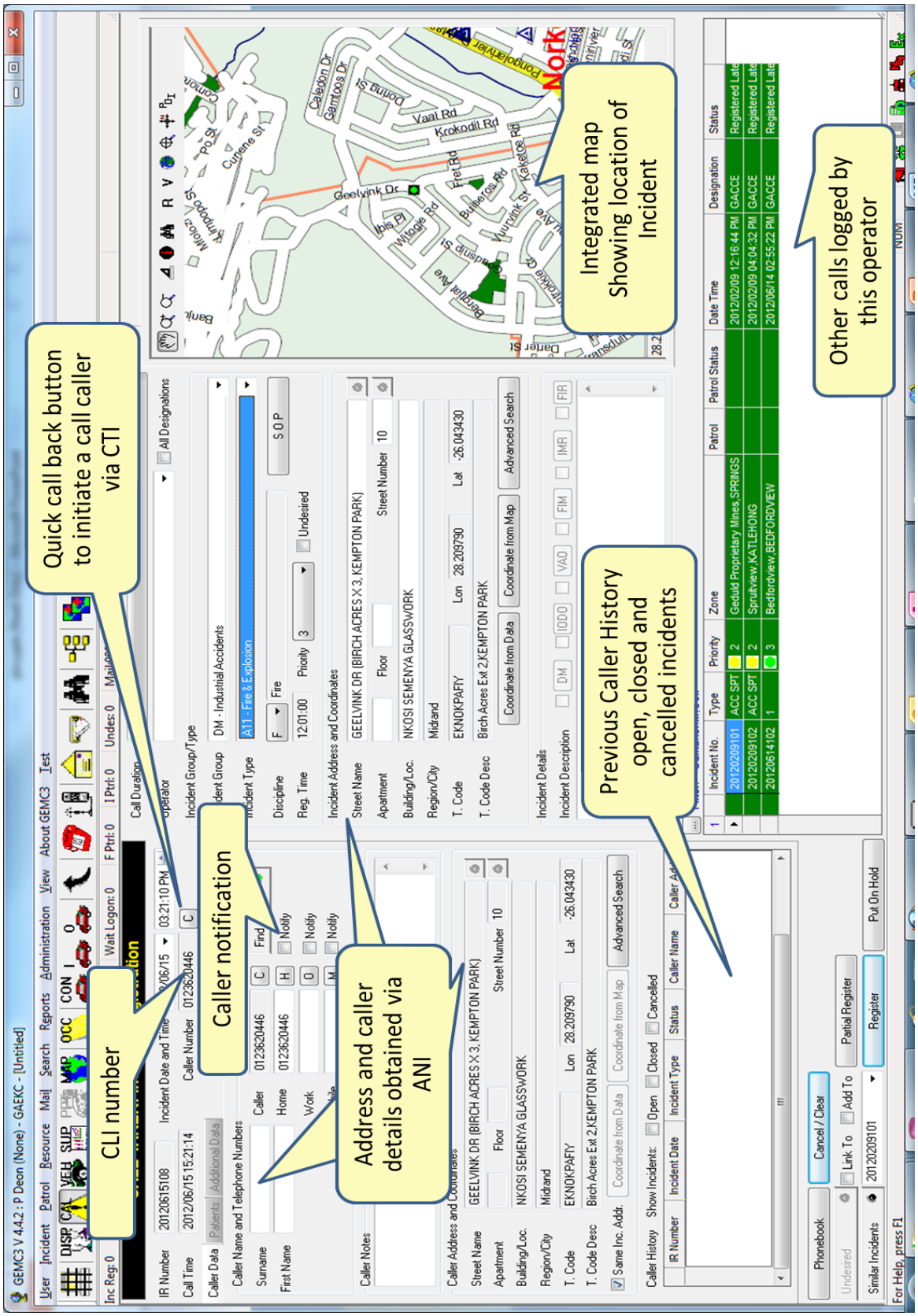
Annexure B: Quantitative data collection tool

INFORMATION PER CASE																
DISTRICT	CASE NUMBER	DATE	SHIFT (DAY / NIGHT)	URBAN / RURAL	DISPATCH TRIAGE	TYPE OF VEHICLE DISPATCHED	TIME CALL RECEIVED	TIME DISPATCH	TIME ON SCENE	TIME DEPART SCENE	TIME ARRIVE HOSPITAL	TIME COMPLETE	NUMBER OF OPERATIONAL EMERGENCY VEHICLES	NUMBER OF AVAILABLE EMERGENCY VEHICLES AT TIME CALL RECEIVED

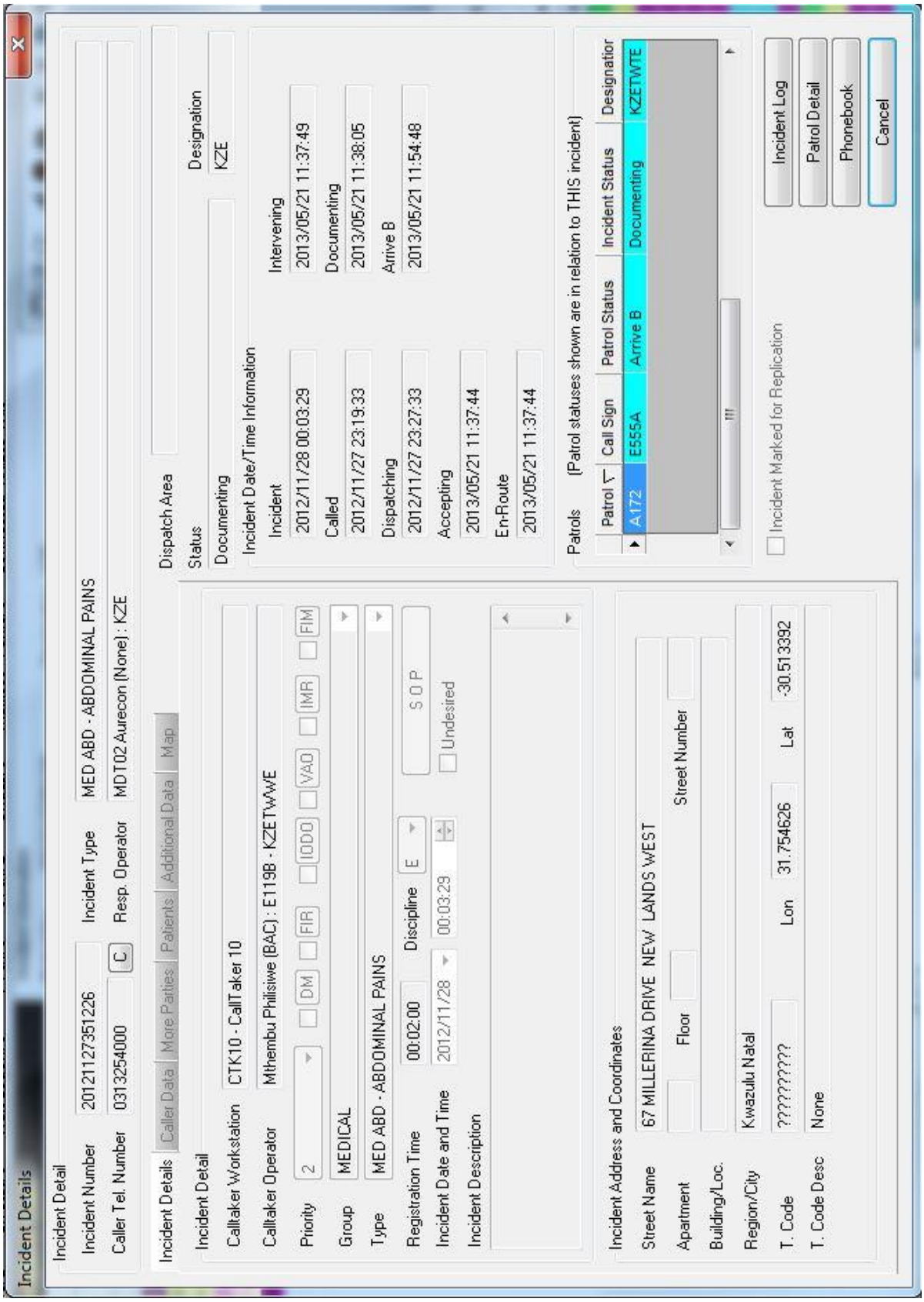
Annexure C: Screenshot of the specialised call taking and dispatch system



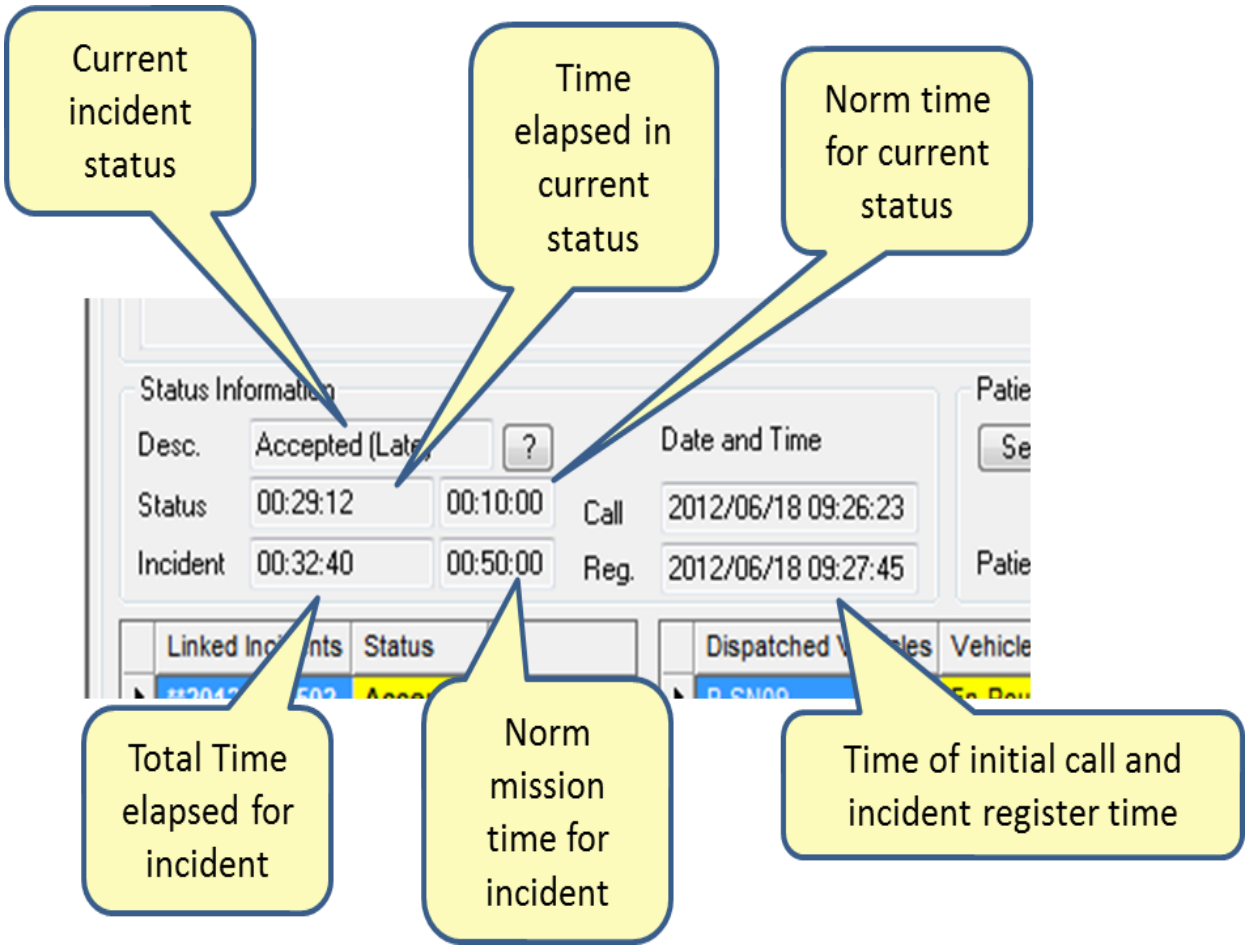
Annexure D: Screenshot of the specialised call taking and dispatch system



Annexure E: Screenshot of the specialised call taking and dispatch system



Annexure F: Screenshot of the specialised call taking and dispatch system



Annexure G: Focus group discussion schedules

FOCUS GROUP DISCUSSION SCHEDULES

Prior to the commencement of the discussions, all prospective participants will be given an opportunity to read the letter of information outlining the research to be conducted as well as their rights during the process. Each participant will be allocated a number in order to ensure that all discussions are captured anonymously. Refreshments and a light snack will be provided.

1. **Introduction**

- All participants will be welcomed and thanked for making themselves available.
- The researcher will introduce herself.
- The purpose of the study will be explained.
- The purpose of the focus group discussions will be explained, including how the participants' involvement will contribute to the study.
- The use of the voice recorder and its importance will be explained and permission to use it requested from the participants.
- Issues of confidentiality will be clearly outlined and any questions or concerns addressed.
- The importance of and how to utilise their allocated numbers will be explained.
- The participants will be given the opportunity to ask questions or raise concerns, these will be thoroughly explained.
- The participants will be requested to sign the consent agreement.
- The researcher will then find out if the participants would prefer to continue without her present. If this is the case, she will excuse herself and allow a facilitator to continue.

2. **Discussion Guide**

2.1 With communications centre personnel:

- The following questions and/or comments will be used to guide the discussion
    - What are your thoughts about response times in the EMS?
        - Probing questions:
            - Do you know about the response time national norms?
            - Is it possible to achieve a 15 minute response to all red code cases in urban areas and a 40 minute response time to all red code cases in rural areas?
            - Are you faced with any challenges that prevent you from achieving good response times?
            - What needs to happen to make sure good response times are achieved?
            - How may response times be improved?
            - How do you think the national norms for response times should be determined, based on what?

2.2 With operational personnel:

- The following questions and/or comments will be used to guide the discussion
    - What are your thoughts about response times in the EMS?
        - Probing questions:
            - Do you know about the response time national norms?
            - Is it possible to achieve a 15 minute response to all red code cases in urban areas and a 40 minute response time to all red code cases in rural areas?
            - Are you faced with any challenges that prevent you from achieving good response times?
            - What needs to happen to make sure good response times are achieved?
            - How may response times be improved?
            - How do you think the national norms for response times should be determined, based on what?

2.3 With supervisors and managers:

- The following questions and/or comments will be used to guide the discussion
    - What are your thoughts about response times in the EMS?
        - Probing questions:
            - Do you know about the response time national norms?
            - Is it possible to achieve a 15 minute response to all red code cases in urban areas and a 40 minute response time to all red code cases in rural areas?
            - Are you faced with any challenges that prevent you from achieving good response times?
            - What needs to happen to make sure good response times are achieved?
            - How may response times be improved?
            - How do you think the national norms for response times should be determined, based on what?

3. <u>Closing</u>

- Participants will be given an opportunity to ask questions regarding the process and these will be addressed.
- The researcher will thank all the participants, expressing much appreciation for their time, input and cooperation

Annexure H: Letters for approval to conduct research from KwaZulu-Natal Department of Health

Provincial Health Research Committee
Health Research and Knowledge Management Unit
KwaZulu-Natal Department of Health
Natalia Building
330 Langalibalele Street
Pietermaritzburg
3200

APPROVAL TO CONDUCT RESEARCH PROJECT

Attention: Dr E Lutge
Chairperson Provincial Health Research Committee

I hereby request approval to conduct a research project in order to obtain a Master's Degree in Emergency Medical Care through the Department of Emergency Medical Care and Rescue at the Durban University of Technology (DUT).

The area of research includes Emergency Medical Services and the provisional title is as follows: *An analysis of emergency response times within the public sector Emergency Medical Services in KwaZulu-Natal.*

The following attachments include all supporting documentation:

1. Research proposal
2. Ethical approval certificate from the Durban University of Technology.
3. Submission approved by the General Manager, EMS.

My supervisor's details are as follows:

- Mr. Raveen Naidoo (raveenn@dut.ac.za) on 031 373 5201
- Prof. Petra Brysiewicz (Brysiewiczp@ukzn.ac.za) on 031 260 1281

Please feel free to contact my supervisor or myself should you have any queries.

Thank you in advance for your consideration.

Kind regards,

_____
Melissa Finlayson
(Research student)
083 671 2122

health

Department:
Health
PROVINCE OF KWAZULU-NATAL

Health Research & Knowledge Management sub-component
10 – 103 Natalia Building, 330 Langalibalele Street
Private Bag x9051
Pietermaritzburg
3200
Tel.: 033 – 3953189
Fax.: 033 – 394 3782
Email.: hrkm@kznhealth.gov.za
www.kznhealth.gov.za

Reference : HRKM012 /14
Enquiries: Mrs G Khumalo
Telephone : 033 – 395 3189

27 January 2014

Dear Ms M J Finlayson

Subject: Approval of a Research Proposal

1. The research proposal titled **'An analysis of emergency response times within the public sector Emergency Medical Services in KwaZulu-Natal'** was reviewed by the KwaZulu-Natal Department of Health (KZN-DoH).

The proposal is hereby **approved** for research to be undertaken at KZN-DoH, Emergency Medical Services (EMS) department.

2. You are requested to take note of the following:
   a. Make the necessary arrangement with the identified facility before commencing with your research project.
   b. Provide an interim progress report and final report (electronic and hard copies) when your research is complete.

3. Your final report must be posted to **HEALTH RESEARCH AND KNOWLEDGE MANAGEMENT, 10-102, PRIVATE BAG X9051, PIETERMARITZBURG, 3200** and e-mail an electronic copy to hrkm@kznhealth.gov.za

For any additional information please contact Mrs G Khumalo on 033-395 3189.

Yours Sincerely

[redacted]

Dr. E Lutge
Chairperson, KwaZulu-Natal Health Research Committee
Date: 29/01/2014.

Annexure I: Letter of information for communication and operational focus group participants

LETTER OF INFORMATION FOR COMMUNICATION AND OPERATIONAL PARTICIPANTS

Title of the Research Study:

An analysis of emergency response times within the public sector Emergency Medical Services in KwaZulu-Natal.

Researcher:

Melissa Finlayson (B.Tech.: EMC)

Name of Supervisors:

Mr. Raveen Naidoo (MSc Cardiology) and Prof. Petra Brysiewicz (PHD Health Science).

Brief Introduction and Purpose of the Study:

The South African national targets for Emergency Medical Services response times to priority one (red code) cases are generally not achievable in KwaZulu-Natal (KZN). Reports issued by the KZN Department of health show that these national norms for response times to priority one (red code) cases in both rural and urban areas in KZN are not realisable as the EMS have consistently failed to respond within these set timeframes from as far back as 2004 at which time the EMS started reporting on their performance as measured against these national norms. The reasons for this have been broadly cited and include a lack of available emergency vehicles as well as an increase in demand for the service. However, these do not provide either an in depth understanding of or sufficient explanation for such poor performance. Although this information is available and has been reported, it is unclear how this information is obtained and analysed and this raises concerns about both the reliability and validity of such information.

The purpose of this research study is to analyse emergency response times within the public sector Emergency Medical Services in KwaZulu-Natal.

Outline of the Procedures:

The focus group discussion will take place as follows:

- Only English will be used because every one of the participants understands and is able to speak English
- You will be given a number so that your name is not mentioned at all during the focus group discussion.
- Everything will be voice recorded. If and when you do speak, you must give your number and then speak. In this way, your name will not be recorded. If you decide to speak about someone else in the group then you must use that person's number and not his/her name.

- Everything will be explained to you before the focus group discussion starts and you will be allowed to ask any questions you may have.
- You will need to sign the consent form before the focus group discussion starts. If you are not prepared to do this, then you will not be able to participate.
- If you are not happy to be part of the focus group discussion with the researcher present, she will happily excuse herself and will not hold this against you in any way.
- If you decide to take part in the focus group discussions and, when they are finished, you feel uncomfortable or are unhappy with anything, you are free to contact the researcher or her supervisors and ask to be removed from the study as a participant. This will not be held against you in any way.

Risks or Discomforts to the Participant:

You will not be exposed to any risks while taking part in the focus group discussion. If, at any time you feel uncomfortable, you are more than welcome to withdraw. If you decide to do this, you will not be punished, mistreated or made to suffer in any way. Everything that you talk about will not be linked back to you because all information will be captured using your number and not your name.

Benefits:

When this study is finished, the information provided will give people in EMS a far better understanding of response times and this will, hopefully, be used to improve the services.

Reason/s why the Participant May Be Withdrawn from the Study:

If at any time you feel uncomfortable, you are more than welcome to withdraw. If you decide to do this, you will not be punished; mistreated or made to suffer in any way.

Remuneration:

You will not be paid any money to take part in these focus group discussions. However, you will be provided with refreshments and a light snack.

Costs of the Study:

You will be required to pay for your transport to and from the focus group discussion.

Confidentiality:

Everything that you talk about will not be linked back to you because all information will be captured using your number and not your name.

Research-Related Injury:

You will not be exposed to anything that may cause an injury to you while you take part in the focus group discussion. However, if you are injured, you will not be paid or be given anything.

Persons to Contact in the Event of Any Problems or Queries:

If there is anything with which you are unhappy or would like to question, please contact the researcher, Melissa Finlayson (melissa.finlayson@kznhealth.gov.za) on 033 846 7279, my supervisors, Mr. Raveen Naidoo (raveenn@dut.ac.za) on 031373 5201 and Prof. Petra Brysiewicz (Brysiewiczp@ukzn.ac.za) on 0312601281 or the Institutional Research Ethics administrator on 031 373 2900. Complaints may be reported to the DVC: TIP, Prof F. Otieno on 031 373 2382 or at dvctip@dut.ac.za.

Annexure J: Letter of information for supervisory and management focus group participants

LETTER OF INFORMATION FOR SUPERVISORY AND MANAGEMENT PARTICIPANTS

Title of the Research Study:

An analysis of emergency response times within the public sector Emergency Medical Services in KwaZulu-Natal.

Researcher:

Melissa Finlayson (B.Tech.: EMC)

Name of Supervisor:

Mr. Raveen Naidoo (MSc Cardiology) and Prof. Petra Brysiewicz (PHD Health Science).

Brief Introduction and Purpose of the Study:

The South African national targets for Emergency Medical Services response times to priority one (red code) cases are generally not achievable in KwaZulu-Natal (KZN). Reports issued by the KZN Department of health show that these national norms for response times to priority one (red code) cases in both rural and urban areas in KZN are not realisable as the EMS have consistently failed to respond within these set timeframes from as far back as 2004 at which time the EMS started reporting on their performance as measured against these national norms. The reasons for this have been broadly cited and include a lack of available emergency vehicles as well as an increase in demand for the service. However, these do not provide either an in depth understanding of or sufficient explanation for such poor performance. Although this information is available and has been reported, it is unclear how this information is obtained and analysed and this, in turn, raises concerns about both the reliability and validity of such information.

The purpose of the research study is to analyse emergency response times within the public sector Emergency Medical Services in KwaZulu-Natal.

Outline of the Procedures:

The focus group discussion will take place as follows:

- All discussions and interactions will take place in English.
- Each participant will be allocated a number to be used in order to ensure all discussions remain anonymous.
- A voice recorder will be used throughout the process. Each participant will state his/her number prior to engagement. If a participant refers to another participant, that participant's number must be used and not his/her name.
- The entire process will be explained to you prior to the commencement of the focus group discussion after which you will be given the opportunity to ask questions or raise concerns.
- Each participant will be asked to sign the consent agreement form, failing which he/her will not be permitted to participate.
- Should a participant be unhappy with the proceeding at any stage the participant is welcome to withdraw from the study and will not be prejudiced in any way.

Risks or Discomforts to the Participant:

Participation in the study is voluntary and, should you wish to withdraw as a participant at any stage, you are more than welcome to do so. There are no anticipated risks, discomforts or adverse effects. All discussions will remain anonymous.

Benefits:

The findings of this study may contribute to a better understanding of the challenges associated with achieving what are considered to be acceptable response times. In addition, it is hoped that the findings will have the potential to influence a review of the existing South African national norms for Emergency Medical Services (EMS) response times to priority one (red code) cases.

Reason/s why the Participant May Be Withdrawn from the Study:

Participants will be withdrawn from the study only if they so request.

Remuneration:

No form of financial remuneration will be provided or offered to any participant in this study. Refreshments and a light snack will be provided to the participants.

Costs of the Study:

The participants will be expected to cover their transport costs only.

Confidentiality:

All input will remain anonymous. The participants' names will not be used at all for data capturing purposes or during the publication of the research report as each participant will be allocated a number. Only the researcher and supervisors will have access to the raw data which will include the data collected during the discussions.

Research-Related Injury:

No compensation will be provided for any research related injury or adverse reaction. However, the possibility of this is highly unlikely.

Persons to Contact in the Event of Any Problems or Queries:

Please contact the researcher, Melissa Finlayson (melissa.finlayson@kznhealth.gov.za) on 033 846 7279, my supervisors, Mr. Raveen Naidoo (raveenn@dut.ac.za) on 031 373 5201 and Prof. Petra Brysiewicz (Brysiewiczp@ukzn.ac.za) on 031 2601281 or the Institutional Research Ethics administrator on 031 373 2900. Complaints may be reported to the DVC: TIP, Prof F. Otieno on 031 373 2382 or at dvctip@dut.ac.za.

Annexure K: Focus group participant consent form

CONSENT

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Melissa Finlayson, about the nature, conduct, benefits and risks of this study – Research Ethics Clearance Number: REC 83/13,
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details, will be anonymously processed in the study report.
- In view of the requirements of research, I agree that the discussions may be voice recorded and that the data collected during this study may be processed on a computerised system by the researcher.
- I may, at any stage and without prejudice, withdraw my consent to participate in the study and withdraw from the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings which may emerge during the course of this research study which may relate to my participation will be made available to me.

_____	_____	_____	_____
Full Name of Participant	**Date**	**Time**	**Signature**

I, Melissa Finlayson, herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

Melissa Finlayson	_____	_____
Full Name of Researcher	**Date**	**Signature**
_____	_____	_____
Full Name of Witness (If applicable)	**Date**	**Signature**

Annexure L: Ethical clearance from Durban University of Technology Institutional Research Ethics Committee

Institutional Research Ethics Committee
Faculty of Health Sciences
Room MS 49, Mansfield School Site
Gate 8, Ritson Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2900
Fax: 031 373 2407
Email: lavishad@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

27 February 2014

IREC Reference Number: **REC 83/13**

Ms M J Finlayson
P O Box 22796
Southgate
Pietermaritzburg
3201

Dear Ms Finlayson

An analysis of emergency response times within the public sector Emergency Medical Services in KwaZulu-Natal

The Institutional Research Ethics Committee acknowledges receipt of your final data collection tool for review.

We are pleased to inform you that the data collection tool has been APPROVED; you may now proceed with data collection on the proposed project.

Yours Sincerely

[redacted]

Prof J. K. Adam
Chairperson: IREC