Emergency transport of obstetric patients within the Ugu Health District

by

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DECLARATION

The author hereby declares that the content of this research project is the author's own unaided original work, except where specific indication is given to the contrary (by reference). This work has not been previously submitted to the Durban University of Technology or any other University.

Signature: 

Date: 25 August 2011

DEDICATION

I would like to dedicate this work to my wife and daughter who have patiently stood by me through the journey of this study. Thank you for your love and support.

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ABSTRACT

Background

Information regarding pre-hospital emergency medical services is limited and it is therefore challenging to determine if there is delay in emergency transport of patients. This study aimed to provide such information specifically regarding the emergency transportation of obstetric patients.

Purpose

The purpose of the study was to describe the transport of obstetric patients within the Ugu Health District of KwaZulu Natal, in terms of patient profiles, the response time intervals and factors that affected response times.

Objectives

The objectives of the study were to:

- determine response time intervals from the initial call to delivery of the patient to a public sector hospital;
- describe the types of obstetric cases being transported;
- describe factors that affect response times and;
- make recommendations on policies and procedures governing emergency obstetric patient transportation

Methodology

All obstetric patients transported by Emergency Medical Rescue Service (EMRS) within a 2 month time frame within the Ugu District made up the study population. The study was conducted through prospective quantitative data collection using hospital records, the EMRS information system (communications centre data base records) and the EMRS patient return forms. The data was triangulated which established reliability before descriptive analysis was conducted.

Findings

The EMRS predominantly transports obstetric patients in labour with a gravidity of 1. The mean response interval (from receipt of the call to arrival at the patient) of 1h41minutes was a result of delays in the pre-response interval (pre-response waiting time). The mean pre-response interval of 1h07 minutes was a result of delays caused by ambulance unavailability. Pearson's correlation showed a significant relationship between the pre-response interval and response interval i.e. delays in the pre-response interval caused delays in the response interval. The EMRS lacks Standard operating procedures governing emergency transport and this was one of the main factors that contributed to some of the causes of ambulance unavailability. The lack of standard operating procedures is therefore also partly responsible for a delayed response interval. 64.5% of the incidents achieved response time intervals of more than 1hour and has therefore failed to achieve the predetermined Department of Health target for 70% of ambulances reaching the site of the patient within 1 hour. Other factors that affect the response time intervals were the poor road conditions, shift change delays and re-routing of ambulances.

Conclusion

EMRS predominantly transports obstetric patients in labour, including high risk patient groups that are arguably beyond the scope of care of the Basic and Intermediate qualified Emergency Care Practitioners. Standard operating procedures for governing emergency transport are lacking and have contributed to a number of factors affecting response time intervals. Standard operating procedures therefore need to be developed taking into consideration the findings of this study as well as previous recommendations by the National Committee on Confidential Enquiries into Maternal Deaths (NCCEMD).

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LIST OF ABBREVIATIONS

EMRS	Emergency Medical Rescue Service
SOP	Standard Operating Policies/Procedures
MMR	Maternal Mortality Ratio
DOH	KwaZulu Department of Department of Health
COEC	KwaZulu Natal College of Emergency Care
ECP	Emergency Care Practitioner
MOU	Midwife Obstetric Unit
NCCEMD	National Committee on Confidential Enquiries into Maternal Deaths
UDM	Ugu District Municipality
CC	Communications Centre
SPSS	Statistical Package for Social Sciences (Version 17)
PRF	Patient Report Form
PRI	Pre-Response Interval
RI	Response Interval
TI	Transport Interval
CHI	Complete Hospital Interval
LPI	Loading the Patient Interval
OSI	Out of Service Interval
BBA	Birth Before Arrival
PIH	Pregnancy Induced Hypertension
PPH	Post Partum Haemorrhage
APH	Ante-Partum Haemorrhage

CHAPTER ONE
INTRODUCTION TO THE STUDY

1.1 Introduction

Increased maternal mortality and morbidity remains a challenge for South Africa according to audits conducted by the Department of Health (2006). These reports suggested that one of the avoidable factors that increased the Maternal Mortality Ratio (MMR) was the delay of emergency transport. The Emergency Medical Rescue Services (EMRS) produces obstetric transportation data, but the statistics are not independent. As a result, no recommendations can be made to improve emergency transportation. The significance of producing such information by EMRS, other than monitoring, is unclear. These data are also inadequate to describe the profile of obstetric patients transported by EMRS. These statistics may therefore be regarded as unreliable due to inaccuracies and deficiencies with the Information System.

1.2 Purpose of the study

The purpose of the study was to describe the transport of obstetric patients within the Ugu Health District in terms of patient profiles, the response time intervals, factors that affect response times and make recommendations on policies and procedures governing emergency obstetric patient transportation.

1.3 Objectives of the study

- The first objective was to determine response time intervals from the initial call to delivery of the patient to a public sector hospital.
- The second objective was to describe the types of obstetric cases being transported. This information would create a profile of the obstetric patients that were being transported by the provincial EMRS.
- The third objective was to describe factors that affected the response times.
- The fourth objective was to make recommendations on policies and procedures governing emergency obstetric patient transportation.

1.4. Research hypotheses

- The delay in transporting obstetric patients is related to the unavailability of resources (staff and ambulances)
- The EMRS Statistics will be found to be inaccurate and not comprehensive.

1.5. Null hypotheses

- The practice of staff in the communications centre will not be different between the 4 shifts.
- The response practice to obstetric emergencies in the 3 zones and among the 4 shifts in each of the zones will not be different.
- Availability of resources will not be different from the initial allocated resources in each zone.

1.6. Motivation for the study

The researcher was aware of the Maternal Death Audits that highlighted delayed transport as one of the avoidable factors that contributed to increasing Maternal Mortality Ratio (MMR). The audits indicated that a response time target was set to 1 hour for ambulances to arrive at the site of obstetric patients from the initial call. EMRS statistics, specific to obstetric patients, were not being analyzed therefore it was not known what progress was made to achieve the response time target. This study aimed to produce response time information which could be used to determine if the EMRS was delaying in transporting obstetric patients and thereby increasing the risk of maternal mortality and morbidity. The information gained would also describe factors that increased response times and patient profile.

The second motivation was a general lack of knowledge in the area of emergency transportation of obstetric patients. This specific study is novel and attempts to provide the EMRS with policy and procedure recommendations that could improve emergency obstetric transportation.

1.7 Assumptions of the study

- Patients with obstetric emergencies (in the study area) have a right to be transported to hospital without delay by the provincial EMRS.
- EMRS and hospital statistics will demonstrate the profile of obstetric patients transported.
- EMRS has the resources or can arrange for resources (ambulances/equipment and personnel) to respond to emergency obstetric patients without delay.

1.8 Delimitations of the study

The study concentrated only on obstetric patients that were transported by ambulances of the KwaZulu Provincial EMRS Ugu District branch. The study area was restricted to the Ugu District Municipal area. Data from private hospitals were excluded due to privacy policy's restricting access to information. For this reason the study is limited to the public sector hospitals only.

1.9 Operational definitions

The following definitions are commonly used in the pre-hospital environment and are aimed at creating an understanding to those readers unfamiliar with them. It will enable readers that are familiar with these definitions to contextualize them in terms of the study.

1.9.1 Emergency Medical Rescue Service (EMRS)

An institution that has staff and other resources dedicated to provide pre-hospital medical care to patients from initial contact on scene to delivery at the appropriate health care facility.

1.9.2 Turn-around time

The duration of time taken to complete an action.

1.9.3 Emergency transport

The use of an EMRS ambulance (ground or air) to transport the patient between health facilities as well as from other pick-up points (e.g. residence) to the hospital.

1.9.4 Emergency Care Practitioner (ECP)

Refers to an individual that provides clinical management to patients predominantly in a pre-hospital field i.e. on scene and during transportation. There are three levels of ECP's, namely, the ECP-Basic (ECP-B), the ECP-Intermediate (ECP-I) and the ECP- Advanced (ECP-A).

1.9.5 Response time

Is the calculation of the duration between two specific points in time.

1.9.6 Response time interval

Are those events that occur within the response time that positively or negatively influences the duration.

1.9.7 Obstetric patient

For the purposes of this study this term refers to all pregnant patients transported by EMRS regardless of whether they have complications or not. These patients have been categorized according to the gestational period of their pregnancy which will aid descriptive statistics viz:

- Ante-partum period - early pregnancy which is <24weeks
  - late pregnancy which is >25weeks
- Intra-partum period – onset of labour to the end of the 3rd stage of labour
- Post-partum period – after delivery

1.9.8 Target response time

Is the NCCEMD recommended response time for ambulances to reach the site of obstetric patients within 1 hour after the initial call.

1.10 Structure of the dissertation

The dissertation begins with Chapter one where the study is introduced and a background is provided; it also includes the purpose, objectives, hypotheses, motivation, assumptions, delimitations and operational definition of terms. Chapter two provides the literature review that adds greater insight to the research problem. The study area is described in terms of the health facilities, the referral system, geographical location and the EMRS daily operations. This information is essential in contextualizing the study. The study methodology, study population, data collection, study challenges, data analysis and ethical issues are discussed in Chapter three. The results and immediate discussion thereof are presented in Chapter four as there were numerous tables and figures that required constant reference. Chapter five contains the conclusion and recommendations. References and appendices conclude the study.

CHAPTER TWO
LITERATURE REVIEW & STUDY BACKGROUND

2.1 Introduction

This chapter will present information from literature that was reviewed as well as EMRS practices related to emergency transportation of obstetric emergencies. The literature review will provide evidence and discussion of international and national challenges contributing to increased maternal mortality rate (MMR). International research will be used to contextualize the study since no South African research has been found specific to the study in question. The study will also importantly provide a background of:

- Public service health facilities which will demonstrate the level of care available to obstetric patients;
- the structure and operations of the EMRS i.e. to demonstrate how it's resources are responsible for the emergency transportation
- the districts referral system which shows where ambulances have to access the obstetric patients
- international calculation of response time and how it will be calculated in this study.

2.2 Background to the research problem

In 1987, the Safe Motherhood Initiative was launched internationally, post global concerns of escalating maternal mortality (Betran et al., 2005). At that time the most common direct causes of obstetric death was severe bleeding, infection leading to sepsis, the effects leading to unsafe abortion, eclampsia and obstructed labour (Babind and Roberts, 2006). There was an estimated 600 000 maternal deaths worldwide each year and at least 98% of these deaths occurring in developing countries (Donnay, 2000).

The South African Department of Health's (DOH) subsequent response to reduce maternal mortality involved the establishment of the National Committee on Confidential Enquiries into Maternal Deaths (NCCEMD) in 1998. This committee was responsible for developing policy, guidelines and recommendations regarding maternal health and

welfare with the vision of reducing MMR. An analysis of reports from the NCCEMD (2006) revealed that delay in transport was one of the avoidable factors that increased the MMR. “Emergency transport facilities must be available for all pregnant and post partum women and their babies with complications (at any site)” was one of the recommendations made by the NCCEMD in the DOH report (2006). The target was set to have 70% of ambulances arriving at the site of the patients within 1 hour of calling.

A review of the NCCEMD (2009) report showed that many of the recommendations remained unchanged since the problems that plagued obstetric patients noted in the NCCEMD (2006) report were still prevalent. The recommendation regarding emergency transport was however slightly modified i.e. “Criteria for referral and referral routes must be established and utilized appropriately in all provinces. Emergency transport facilities must be available for all pregnant women in need (at any site)”. The target response time was also modified specifying that “70% of the ambulances on red code calls must arrive at the emergency site within 1 hour of calling”.

Statistical information regarding obstetric patients transported by EMRS was available however this information was unreliable due to problems such as human error (computer operator mistakes) and information technology deficiencies. The response times data as well as the profile of the obstetric patients transported were unreliable.

2.3 Understanding the geographical study area

In order to appreciate the setting of the study, this section will provide a description and maps of the study area. Ugu District is situated in the Southern KwaZulu Natal Province of South Africa. A report by the Ugu District Municipality [(UDM),(2007)] describes the study area as rural and urban, comprising of 6 Municipalities spanning over 5866km^2. According to the last census report by Statistics South Africa (2001) there was an estimated population of 704001 in the study area. The UDM (2007) also reported that there were 850 kilometers of tar road mainly comprising of the national road and 1600 kilometers of district gravel roads. Majority of the District gravel roads lead to rural areas. The network

of gravel access roads that branch from the district gravel roads would significantly increase the distance of gravel roads and thus far this distance has not been calculated.

The Hibiscus Coast Municipality as well as the Umdoni Municipality lie on the coastline of this district and are the only two district municipal areas that have been classified as urban. Ezingoleni, Umuziwabantu, Vulamehlo and Umzumbe municipalities are regarded as rural.

The UDM (2007) reported that 86% of the population are situated in rural areas and have also been found to have the largest amount of poverty. The urban area is more densely populated and performing economically better. The following map (Figure 1) indicates the location of Ugu District within KwaZulu-Natal. Figure 2 shows the municipalities that fall within Ugu District.

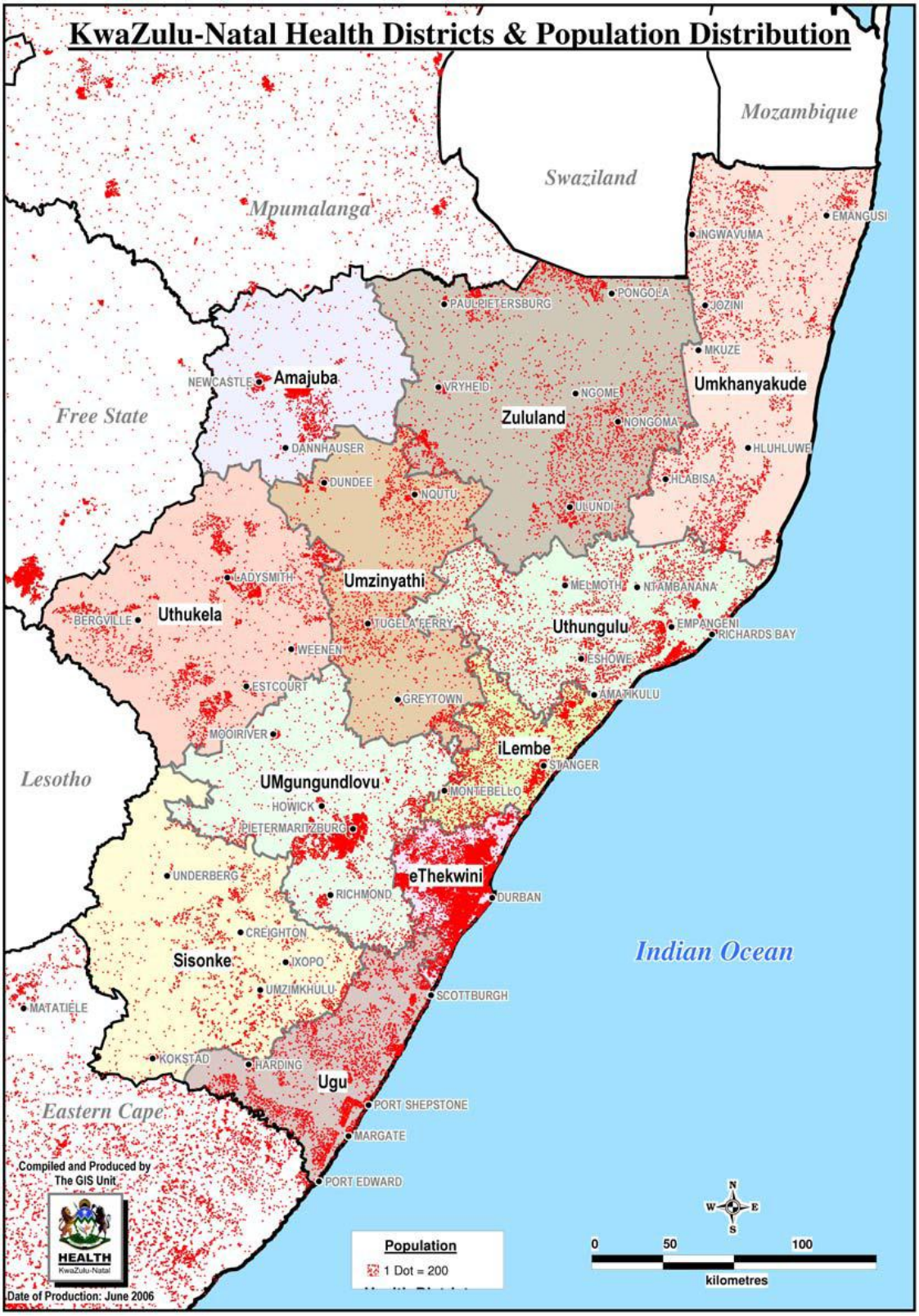


Figure 1 Map of the KwaZulu Natal Health Districts

Source: (Geographic Information Systems Unit, 2006)

Figure 2 Map of Ugu District Municipality

Source: (Geographic Information Systems Unit, 2009)

2.4 Public Service Health facilities in the study area

Knowledge of the level of care that health facilities provide and the number of health facilities in the study area (Figure 3) was essential to critique the EMRS distribution of ambulances to service these institutions. The UDM (2007) reported the study area as having 4 provincial hospitals, 15 mobile clinic bases, 52 clinics, 2 private hospitals and 1 dedicated TB (Dustan Farrel) facility. The private hospitals as well as 3 of the public sector hospitals are located in urban areas. Port Shepstone hospital serves as the level 2 regional hospital and the other 3 hospitals (i.e. Murchison, St Andrews and G.J. Crooks Hospital) are regarded as level 1 sub-district hospitals.

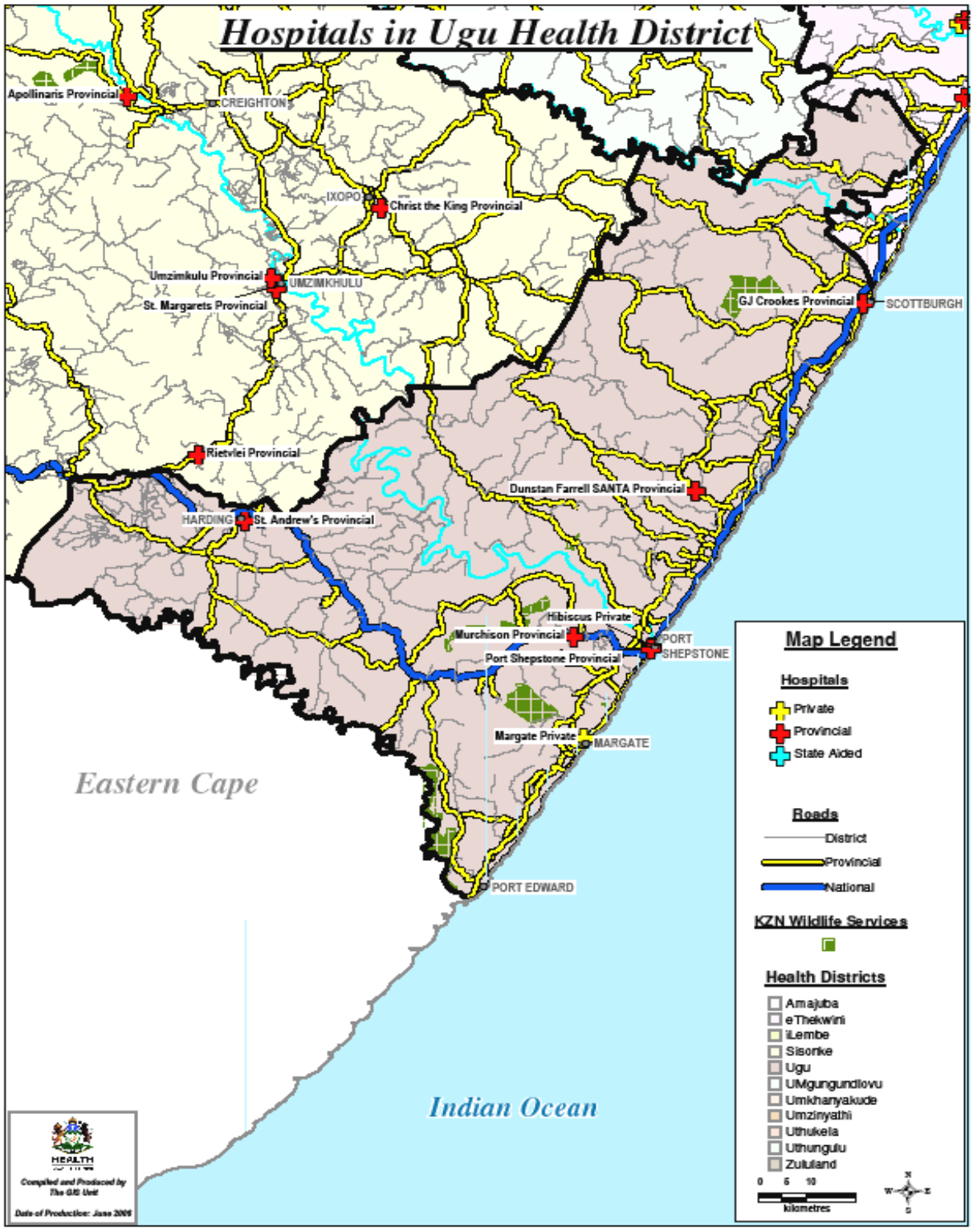


Figure 3 Public Service Health Facilities

Source: (Geographic Information Systems Unit, 2006)

2.5 EMRS structure in Ugu District

Factors within the EMRS structure may also be responsible for affecting the availability of the resources. Understanding the structure and functioning of the EMRS in the study area was important as it provided insight on the resources available to manage obstetric patients in the pre-hospital field. EMRS comprises of an administration, operations and communications division. The administration division deals with human resources, finance and stores amongst other components. The operations and communications divisions are however directly responsible for pre-hospital emergency transportation and treatment of patients. The structure and functioning of these two divisions requires understanding, in order to appreciate their role and effect on transportation of obstetric patients.

2.5.1 Communications Division

The Communications Division is responsible for receiving calls for medical emergencies and non-emergency incidents from the 3 zones i.e. Port Shepstone, Harding and Umzinto. EMRS in Ugu District also responds to the needs of neighboring districts during occasions such as disasters. Calls that are received at the communications centre are sorted according to the seriousness of the patient's injury or illness. This process of sorting is called triage. According to the DOH - College of Emergency Care (2008), patients may be triaged (sorted) into 1 of 4 categories based on the seriousness of their injury or illness (i.e.

- red code – life threatening,
- yellow code – serious but not life threatening,
- green code – does not require urgent intervention,
- blue code – deceased and no urgency in responding

Ambulances and other EMRS vehicles are dispatched to incidents according to this triage.

The communication centre operates with four shifts. Each shift has a staff compliment of 6 members that is comprised of 3 staff members that receive calls, 2 staff members that

dispatch the ambulances to the incidents and a shift supervisor that managers the shift. This compliment of staff is the 'norm' in the communications centre in the study area. The communication centre operates on a 24 hour basis with each shift working a 12 hour shift. The compliment of staff in the communications centre in other EMRS Districts may however vary. There is 1 Communications Centre Manager that is responsible for the entire Communications Division in Ugu District. A reduced compliment of staff in the communications centre can affect the flow of work, such as increasing the duration that callers have to wait to have their calls answered. A series of communications delays may therefore increase response times.

2.5.2 Operations Division

The Operations Division operates on the same shift structure as the communications division, with the only difference being the compliment of staff. The DOH (n. d) Norms and Standards provides guidelines to EMRS districts regarding the number of ambulances that should be operational in each zone (sub district). Each zone in the study area should have a minimum of 6 ambulances per shift. Ugu District should therefore have a minimum of 18 ambulances as there are 3 zones. This number of scheduled ambulances is however affected by the availability of staff and the roadworthiness of the ambulances. EMRS reports indicates incidences where ECP's are unable to respond to emergencies as a result of ambulances that are not operational (unroadworthy). There are also occasions when there are ambulances available however the staff to operate these ambulances is absent due to various forms of leave. The lack of such resources could have been contributing to increasing response times.

2.6 Referral system

The benefits of patient referral to relevant institutions that are equipped to manage specific emergencies have been documented (Murray and Pearson, 2006). Krasovec (2004) described transport and communications as some of the key components of an effective referral system. Jahn and deBrouwere's model (2001) for an effective referral system also included communications and dedicated transport amongst other factors as contributors to reducing delays for obstetric emergencies. Evidence suggests that one of the reasons for

obstetric patients not complying with referral systems was the lack in confidence in institutions that can only provide a lower lever of care (Murray and Pearson, 2006). This places a further logistical burden to the EMRS as the number of pick up points where patients are located increases as apposed to fewer pick up points if these patients had to be transported from clinics. As a result EMRS plays an important role in the referral system, to transport obstetric patients from their various locations.

2.6.1 EMRS referral pattern in Ugu District

EMRS in the study area comprises of 3 ambulance bases. These bases are located in the Port Shepstone, Umzinto and Harding zones. Obstetric patients sometimes contact the EMRS directly (bypass the clinic) and in those cases the patient is taken directly to the nearest public sector hospital. Clinics in each zone that are unable to manage obstetric patients, refer their patients to the level 1 sub-district hospital in that zone. If the patient requires a higher level of care then the patient is referred to the Level 2 regional hospital. Port Shepstone hospital serves as the regional hospital for Ugu District. If the level 2 hospital is unable to continue further management then these patients are referred to a public sector tertiary hospital (level 3). No public sector tertiary hospital exists in the study area. The nearest tertiary hospital is located in the neighbouring Ethekweni District that is found approximately 120 kilometers away. As a result EMRS plays a vital role in inter-facility emergency transportation and pre-hospital treatment of obstetric patients. The following diagram (Figure 4) illustrates the patient referral system being utilized in Ugu District.

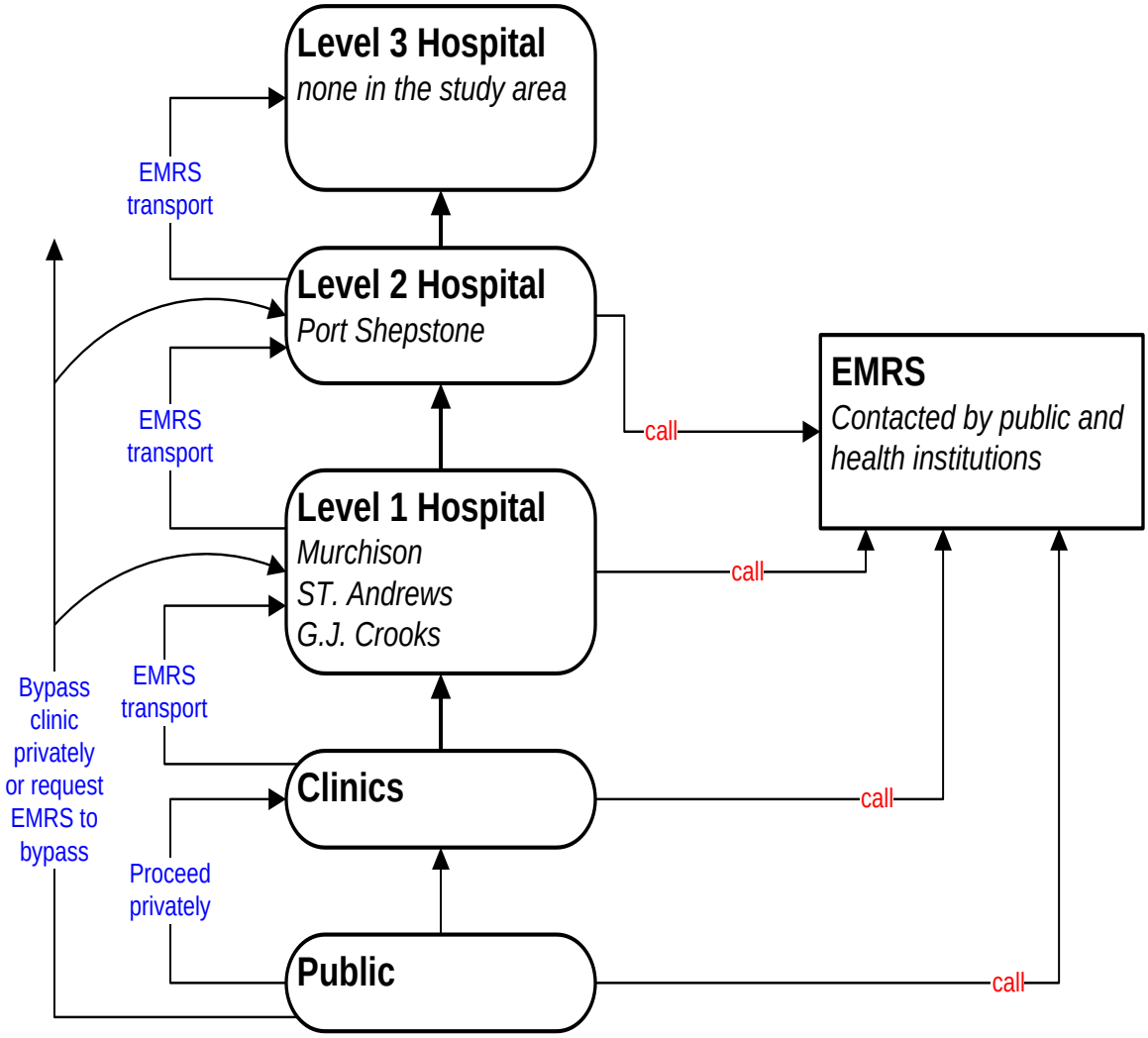


Figure 4: Ugu District obstetric patient referral system & transport pattern

2.6.2 Challenges of the referral system

The audit by the DOH (2006) cited problems with the referral system as one of the contributors to increasing the risk of mortality and morbidity to obstetric patients. These audits suggested that one of the problems affecting the referral system was those caused by health care workers, such as delaying in referring the patient, substandard care, problems in determining diagnosis and poor resuscitation efforts.

Bossyns et al., (2006) reported that false positive referrals occurred in health facilities where nurses were pressurized by patients. Family of patients that verbally abuse or intimidate the health care workers at clinics to refer the patient to hospital cause an increase in the number of patients being unnecessarily referred to hospital. This is an example of a false positive referral. False negative referrals were those patients that were not referred timeously. Since the DOH (2006) has already identified problems with health care workers (i.e. poor diagnosing ability and incorrect management), it may be assumed that such problems have caused delays in patients being referred. This is an example of false negative referrals. Since EMRS is the public sector emergency transport provider, it (EMRS) may inherit many of these patients that have been subjected to health care worker problems. The consequence of the incorrect diagnosing at the referring institution is that it may be captured as such by the EMRS communications centre operator who may then dispatch inappropriately qualified ECP's to the patient.

No research had been conducted in the study area that identified the level of academic qualification of the ECP's accompanying obstetric patients. It was therefore not known if the appropriately qualified ECP's were being dispatched to treat obstetric patients. The ECP's level of academic qualification will be identified and correlated to the type of obstetric incidents responded to.

2.7 Response Times

Response time calculation varies between emergency service agencies with no standardization that exists. This makes comparison of response times difficult (Meislin et al., 1999). Some agencies calculate response time from the initial call while others from

the time the vehicle begins responding (Pell et al., 2001; Meislin et al., 1999). The end of the response is also unclear as some agencies stopped calculation once the responders arrived on scene, whilst others stopped the time once the responders were at the patient (Pell et al., 2001; Meislin et al, 1999). The NCCEMD (2006) recommended that 70% of ambulances must arrive at the location of the patient within 1 hour from the initial call. The 1 hour response time target was derived after the NCCEMD consulted with Provincial EMRS managers (Moodley, 2009). International recommendations regarding the response time target for obstetric patients have not been located. The World Health Organization has suggested that obstetric emergencies can be managed if patients receive emergency care within 12 hours. The exception is obstetric haemorrhage that requires attention within 2 hours (UNPOPIN, 1995). The DOH (n.d) Norms and Standards indicates that response time is calculated from the initial call to the arrival of the ambulance on scene which is in line with the response time criteria set by the NCCEMD.

2.7.1 Conceptual framework of the study – Response time intervals

Spaite et al., (2003) proposed a Time Interval Model that provided additional information regarding the duration of events that occurred from the initial call until the ambulance was available for the next incident. Traditional response time calculation is unable to provide such detail which leaves one to speculate the events that contributed to the resultant response time. Spaites's Time Interval Model served as the conceptual framework that guided the study.

Table 1 is an adaptation of Spaite's Time Interval Model and was to be used to identify the intervals responsible for prolonging the obstetric patient's journey to hospital. Identifying the interval (or events) most affecting response time would allow mitigation by Emergency Service Agencies. Meislin et al., (1999) suggested that the emergency service agencies using this model were able to evaluate response data better. No reports were located at EMRS describing factors that were responsible for increasing response time.

Table 1: Response Time Interval Table

<table>
<tr><th colspan="8">RESPONSE TIME INTERVALS</th></tr>
<tr><td>Call received</td><td>Alarm (responds to scene)</td><td>Arrival on scene</td><td>Leave scene</td><td>Re-routed</td><td>Arrival at hospital</td><td>Complete hospital</td><td>Available for next case</td></tr>
<tr><td colspan="2">1. Pre-response Interval (PRI)</td><td colspan="4">Pre-hospital Treatment Interval (PTI)</td><td></td><td></td></tr>
<tr><td colspan="3">2. Response Interval (RI)</td><td colspan="3">4. Transport Interval (TI)</td><td></td></tr>
<tr><td colspan="2"></td><td colspan="2">3. Loading the Patient Interval (LPI)</td><td></td><td colspan="2">5. Complete Hospital Interval (CHI)</td><td></td></tr>
<tr><td colspan="6">Total Pre-hospital Interval (TPI)</td><td></td><td></td></tr>
<tr><td></td><td colspan="7">Out of Service Interval OSI)</td></tr>
</table>

2.7.2 Rural versus urban response time classification

The geographical demarcation of rural and urban varies globally making it difficult for geographers and demographers to define this concept. (Hart, Larson and Lishner, 2005). Likewise the calculation of urban and rural response times by EMRS is done to determine the duration taken for ambulances to access patients found in these respective areas. This information is invaluable to EMRS to strategically plan the placement of ambulances to ensure equitable and efficient transport of patients (Meislin et al., 1999).

EMRS calculates average response times for each of the 6 municipalities described in section 5.3 as well as a rural and urban response time summary for the entire district. The EMRS classification of municipalities as rural or urban differs from that of the Ugu District Municipality (UDM). The use of EMRS response time statistics by other Public Service Departments for their institutional reporting may therefore be incorrect.

The EMRS communications manager has suggested that the response time statistics per rural or urban category is unreliable and possibly owed to human error as well as limitations of the data base (Dlamini, 2008). Areas where patients frequently call from have been identified as common pick up points with each having a specific code in the data base for statistical purposes. Patients calling from areas that are not listed on the data base require the operator to use discretion in determining the nearest possible pick up point for that code to be used. Since this practice can not be standardized, the information system may be regarded as unreliable.

The DOH (n.d) has recognized the need to categorize districts based on the terrain found in that area. Areas in the district may therefore be regarded as urban, peri-urban and rural. All 3 categories are found in the study area. The criteria that will be used in this study to categorize pickup points will be based on the proximity (distance) of the area to the central business district (town/city), the distance to hospitals and the type of road infrastructure. The NCCEMD (2006) recommended that obstetric emergencies be regarded as a high priority. EMRS has followed this recommendation and regards any obstetric patient even without complications as a high priority or otherwise known as “red code” (Dlamini, 2008).

2.8 Obstetric patient profile

Khan et al., (2006) suggested that the leading causes of maternal mortality and morbidity varied globally. The developed countries showed lower MMR's as opposed to the higher MMR's in developing countries (Khan et al., 2006). The NCCEMD report (2006) identified five obstetric emergencies that were the leading cause of maternal mortality in South Africa i.e. non pregnancy related infections (e.g. AIDS), complications of hypertension in pregnancy, obstetric haemorrhage, pregnancy-related sepsis and pre-existing medical conditions. Auditing MMR's provides insight into the effectiveness and efficiency of the management of obstetric patients at the various levels of health care. Maternal morbidity reviews have also been found to be useful for the same reason (Vallely, Ahmed and Murray, 2005).

Maternal morbidity is described as "near miss events" due to patients having come close to death as a result of complications during pregnancy, at delivery or during the postpartum period (Oladapo, 2005). The DOH (2006) report suggested that one of the avoidable factors that contributed to increase MMR's was the poor diagnosing at lower level health facilities. For this reason the EMRS information system was unreliable as the diagnosis communicated to EMRS when ambulances are required also serves as a record used for statistical purposes. Furthermore, data from EMRS was unable to provide information such as parity and gestational age of obstetric patients. The study aimed to collect sufficient data to determine the profile of obstetric patients transported by EMRS.

2.9 Factors affecting response times

2.9.1 Type of transport

Literature has suggested that transport related problems have contributed to obstetric mortality and morbidity (Kobusingye et al., 2005; Babind and Roberts, 2006). Internationally there has been varying methods of transporting obstetric patients with some developed countries having specialist emergency transport teams, specialized ambulances and equipment resulting in reduced response times as well as reduced MMR's (Razzak and Kellermann, 2002). Some developing countries have had to resort to innovative means to transport obstetric patients ranging from canoes, bicycles, wheelbarrows, taxis, buses, etc which has a longer transport time contributing to increased MMR's (Krasovec, 2004). The type of emergency transport available is therefore one of the contributing factors affecting response time. EMRS in the study area makes use of 'on-road' and 'off-road' ambulances. Although it has been established that the district has a greater number of gravel roads compared to tar roads, the EMRS only has 2 'off-road' ambulance whilst the remaining fleet are 'on-road' ambulances. No reports or data was available that described whether these type of ambulances had problems accessing patients. The type of emergency transport has to therefore be appropriate to the area serviced in order to be effective.

2.9.2 Road conditions

Poor road conditions as well as the challenges of the geographical location have been found to increases travel time to obstetric patients (Shehu, Ikeh and Kuna, 1997; Cham, Sundby and Vangen, 2005). Babinard and Roberts (2006) described a study conducted by Samai and Sengeh (1997) in Sierra Leone, where rain deteriorated the condition of roads which increased travel time to patients. That study found that the average distance from the hospital to the community was 56 kilometers which took as long as 2 to 3 hours travel time during rainy seasons.

The type of road surfaces found in the study area has been described according to its surface i.e. blacktop (tar), gravel and concrete. No information had been located that

described problems faced by ECP's in accessing obstetric patients as a result of these roads conditions. This study aimed to determine whether road conditions in the study area were a factor affecting response times.

2.9.3 Availability of ambulances

Ambulances may be unavailable due to repairs that are required (structural or mechanical) and when there is a lack of staff to operate them. The number of scheduled ambulances (17) in the study area was expected to vary daily as a result of this. A reduced number of scheduled ambulances would therefore have to respond to a greater number of incidents (patients). This would result in increased waiting time for the ambulance that ultimately increases response time. Ambulances were also regarded as being unavailable from the time they reached hospital until they were available for the next incident. No study had been located that correlated the availability of ambulances to response times. This study aimed to identify factors affecting response times and it remains to be seen if availability of ambulances is one of those factors.

2.9.4 Poor implementation of maternal policies and programs

Otchere and Kayo (2007) found that maternal mortality rates decreased in Mali when the National Ministry of Health amended policies to improve maternal health. These policies improved quality and utilization of hospitals providing emergency obstetric care. Siddiqi et al., (2004) suggested that although developing maternal policies were a good start point in improving maternal health, poor implementation of these policies could slow down progress. Siddiqi, et al (2004) indicated that although the maternal and child health and family planning policy in Pakistan was "well directed", there was poor implementation of this policy. One of the reasons for this was that the provincial and district health departments experienced problems translating maternal policies into programs. Similarly, EMRS should also have policies specifically aimed at ensuring that response time to obstetric patients are within the national response time norm and that the patient receives the highest quality pre-hospital treatment. No evidence of maternal policies was found that provided procedures guiding EMRS to achieve the national response time target.

2.9.5 Location of ambulance bases

The location (area) of the ambulance base from the community may also affect response time. Young et al., (2003) suggested that patients in rural areas were 50% more likely to die from their injuries as compared to patients located in urban areas. One of the factors that contributed to this was the distance of the ambulances base to the incident (patient). Ambulances that are based further away from the community would have a longer distance to travel which leads to increased response time (Cham et al, 2005). This study aimed to determine response time intervals which when correlated with distance of ambulance bases would determine if the location of ambulances bases was a factor affecting response times.

2.9.6 Communications centre operator problems

Emergency transport and communications are interdependent components for an effective emergency service. Horsky, Gutnik and Patel (2006) suggested that the introduction of electronic communications and information systems delayed workflow as a result of poor or no integration with the operators. It was also suggested that although technology had its limitations, errors and poor workflow was due to the interaction of the operator with technology. The EMRS in the study area had also made the transition from a paper to electronic information system. No audit was done to determine the proficiency of the operators. Problems with the electronic system, staff shortages and incompetence have been anecdotal reasons for the EMRS communications centre being regarded as ineffective by EMRS staff and other emergency service agencies.

Capturing information on the EMRS data base required communication between ECP's on ambulances and the communications centre (CC) operators. An intentional or unintentional failure of ECP's to report on their correct location and response times (by two way radio) or reporting incorrect response times may prevent the operator from capturing this information. Such problems were observed during the course of the study. Data from the EMRS information system was therefore regarded as unreliable. These communications problems amongst others caused ambulances to appear unavailable which may have increased waiting times by obstetric patients thereby increasing the risk of mortality and morbidity.

2.9.7 Poor communications network

The CC is equipped with 2 way radio's for communication with the ambulances and other medical response vehicles. The CC manager reported that majority of ECP'S on board ambulances had personal cellular phones which was another way of maintaining communications when 2 way radio signals were poor. ECP's are however not obliged to aid the communications centre by use of their cellular phones. This appears to have been done voluntarily to aid workflow.

Some clinics are equipped with two way radios (radio channel linked to EMRS) or landline telephones. Sometimes clinics are fortunate to have both. The public commonly use landlines, cellular phones as well as contacting other emergency services like the police to relay requests for ambulances. Some of the challenges experienced by the CC are the poor description of the pick up point by callers that results in numerous calls being made to the caller to ascertain their correct pick up point. Poor cellular phone and ambulance 2-way radio signals also makes it difficult for the CC to communicate with the ECP's. These poor communications may increase the time taken to electronically register the request as well as access the patient. No data was available that described the effect of communications problems on response time. This study aimed to identify factors that were affecting response times and it remains to be seen if communication problems are one of those factors.

2.9.8 On scene delays

Another factor affecting the response time is the delay that occurs once the ECP's arrive at the scene of the patient. The time taken to stabilize the patient, who may need treatment such as intravenous fluid resuscitation, may also contribute to increasing response time. ECP's are also faced with finding that the patient is not at the pick up point that was initially communicated to the CC. Delays on scene may also be due to prolonged time spent in accessing the patient. Remembering that the study area is predominately rural, ambulances are sometimes unable to proceed to the patient's residence due to poor road conditions or no access roads. Delays are due to the time taken for the patient to reach the ambulance as well as when ECP's have to proceed to the residence by foot

to accompany (carry) the patient back to the ambulance. Delays on scene may therefore prolong response time. The aim to determine response time intervals would provide the extent of the delay on scene. This knowledge would help determine if the delay of ambulances on scene was a factor affecting response time.

2.10 Conclusion

The lack of emergency transport delays obstetric patients from reaching hospital and literature has cited this as a contributor to increasing mortality and morbidity (Kobusingye et al., 2005; Babind and Roberts, 2006). EMRS has an emergency transport system however it is plagued by problems such as poor road conditions and unavailability of ambulances. The Department of Health (2006) has continued to monitor and evaluate maternal health which has helped identify deficiencies in the management of obstetric patients. Similarly analyzing data from EMRS should provide information about pre-hospital emergency transport with specific reference to response times, profile of obstetric patients and factors affecting response times. Obstetric data from EMRS was available but untested and therefore unreliable. It was therefore unknown whether EMRS has achieved the national target of providing 70% of ambulances to obstetric patients within 1 hour of calling.

Government driven health policies that have recognized the need to strengthen all levels of health care and initiated specific support for conditions such as obstetric emergencies have yielded better outcomes (Wilson and Martel, 2005; Siddiqi et al, 2004, Murray and Pearson, 2006). The proposed study was necessary to determine the accuracy of the EMRS data, determine response time intervals and identify the profile of obstetric patients transported to health care facilities so that policies are strengthened thereby improving the EMRS transport system

CHAPTER THREE

METHODOLOGY

3.1. Research design

This study was conducted in the positivist paradigm as an understanding of the emergency transport of obstetric patients was required since existing data was found to be unreliable. The study was regarded as basic research since the phenomenon being studied was known but more understanding was required in the specific context. Quantitative research involves quantifying data to answer questions regarding the relationships between variables of the phenomenon being studied (Polit and Beck. 2006). This approach was used as data regarding emergency transportation of obstetric patients was collected, using a scientific method (systematically) which enabled the researcher to answer questions regarding response times and patient profiles. Non-experimental descriptive research design was used since the study described variables that were measured and no intervention was required (Polit and Beck. 2006).

The researcher had chosen a prospective approach due to insufficient and unreliable existing data which was regarded as untrustworthy. The prospective approach allowed the researcher to maintain a tight control over collection of data and this minimized incorrect reporting. Reporting procedures were also standardized amongst the participating institutions so that data was reliable. This prospective non-experimental research involved the study of records (from specific health institutions and EMRS) as these were the sources of patient information.

3.2 Study population and justification

The study population comprised of all obstetric patients with direct or indirect complications that were transported by EMRS to public sector hospitals from October 2009 to November 2009. Indirect complications were regarded as illness not brought on by the pregnancy e.g. HIV, PTB, etc that could endanger the mother and foetus. Direct complications were regarded as illness brought on by the pregnancy e.g. pregnancy induced hypertension (PIH), eclampsia, haemorrhage, etc.

The study took into consideration that the audits conducted by the DOH (2006) had recommended that emergency transport facilities be made available for all pregnant patients with complications. There was however no specification regarding whether the complications should be direct or indirect. The EMRS response to this recommendation (in all districts) involved prioritizing the transportation of all obstetric patients. All obstetric patients in the study area (as well as other KwaZulu-Natal Districts) were accepted as 'red code' which was the highest priority requiring immediate response. The researcher decided that since all obstetric patients were priority, then the response time target would be applicable to all these patients. For this reason the study population included all obstetric patients attended to by EMRS in the Ugu District.

3.3 Participating hospitals

In order to conduct the study, data from hospitals and the EMRS in Ugu District was required. The researcher initially planned on capturing data from private hospitals together with the Public sector hospitals as this would describe the entire obstetric population in the study area. The study was however confined to the public sector hospitals for the following reasons:

- Obstetric data from private hospital were excluded due to privacy policy's restricting access to information.
- The study area consisted of a greater number of people living in poverty in rural areas according to the UDM (2007) report. The nearest medical facilities in the rural areas were the lower level health care facilities (clinics and community health centers) therefore it was expected that there would be a greater number of referrals from those facilities to public sector hospitals. The study has therefore appropriately described the majority of the obstetric population resulting in sufficient data being produced for analysis.

For this reason the study was restricted to the public sector hospitals only.

3.4 Time frame justification for the study

The time frame from September 2009 to October 2009 was initially randomly chosen and not based on a trend from any study or data. This time frame and the period of the year that the study fell within, was also convenient, as it would have allowed the research process to be expedited. Due to delays in receiving authorization to access records from some of the Health Institutions, the time frame was altered. The Data was collected from October 2009 to November 2009. This reduced bias as the change in the data collection period was not planned.

3.5 Data sufficiency

Bias in research may be considered if the sample size is small (Polit and Beck, 2006). This study used the records of the obstetric population transported to public service hospitals and this was deemed sufficient to describe the phenomenon under study. During initial analysis of EMRS data it was discovered that approximately 18 obstetric patients were transported in a 12 hour shift. It was therefore estimated that 1080 obstetric patients would have been transported in a single month. A single month's data would have been sufficient for analysis however due to missing information, data for 599 obstetric patients in October and 700 in November were found. The researcher aimed to study at least 1000 obstetric patient records. To do this the counting of obstetric records began in October and stopped in November with 1004 records. It was therefore not necessary to use all of November's records as there were sufficient records for analysis.

3.6 Data collection

3.6.1 Data sources

The study was conducted through the study of the following records:

1. Labour ward admission register from Port Shepstone Hospital (level 2), Murchison Hospital (level 1), St Andrews Hospital (level 1), G,J. Crooks Hospital (level 1)
2. Casualty admission register from Port Shepstone Hospital (level 2), Murchison Hospital (level 1), St Andrews Hospital (level 1), G,J. Crooks Hospital (level 1)
3. Out patients admission register from Port Shepstone Hospital (level 2), Murchison Hospital (level 1), St Andrews Hospital (level 1), G,J. Crooks Hospital (level 1)
4. EMRS communications centre (CC) data base
5. Patient Report Forms (used by EMRS)

3.6.2 Development of the Data Collection tool

Development of the data collection tool began with the researcher analysing the research objectives to determine the type of information that required describing. The following information was required:

- Administration details (date, zone, number of ambulances, etc)
- Patient details (age, diagnosis, parity, etc)
- Road condition (tar, gravel, wet, dry, etc)
- Patient treatment (administration of oxygen, etc)
- Dispatch details (incident number, response times, etc)
- Distance to incident (distance to scene, etc)

This information was grouped into sections that were practical for any reader to follow and understand. Each section on the initial instrument had tick boxes and designated spaces to annotate information from the data sources. Pilot testing was carried out to determine the reliability of the instrument.

3.6.2.1 Pilot Testing of the instrument

During the pilot testing of the data collection instrument, the researcher found that the design and format of the instrument could not be merged into the SPSS® data base. The researcher transcribed data from the data sources to the data collection tool and realized that this was duplicating the process since this data would still have to be captured into the SPSS® data base. After consultation with the research supervisors it was agreed that it would be more efficient to transcribe data directly into the SPSS® data base. The information from the initial instrument was used to create the SPSS® data fields. The SPSS® data base therefore also served as the data collection tool. The benefit of this change was that there was no duplication as this expedited the data capturing process.

3.6.3 Method

The researcher sent a letter of information, about the study, to the KZN Department of Health (DOH) (Annexure 1). The letter also requested permission from the DOH to access information from the Provincial Hospitals and the EMRS in the study area. After being granted permission by the DOH, the researcher scheduled meetings with the managers from the hospitals and EMRS to inform them of the study. A letter of information about the study was sent to the Hospital managers prior to the meeting (Annexure 2). During these meetings the study was discussed and permission was granted to the researcher using informed consent forms. The researcher then scheduled and met with the obstetric ward doctor, matron and nursing staff to inform them about the study, its requirements and to provide answers to any enquiries. During this meeting the hospital labour ward admission registers (1st data source) was analyzed and amended to include data fields required for the study. The staff were specifically asked to indicate which patients were transported by ambulance. To do this the staff added a column to their register that was to be annotated when EMRS had transported the patient. The researcher then traveled to each hospital and transcribed all of this information directly into the SPSS® data base.

The researcher also met with the EMRS Senior Managers and informed them of the study and its requirements (Annexure 3). Permission was granted (by use of informed consent

forms) and obstetric data from the CC data base (2nd data source) was electronically downloaded for October and November. Hard copies were also made available and served as back up.

The EMRS patient report form was the third data source. EMRS in the study area has 3 zones with each having an ambulance base. All patient return forms were filed on a daily basis. The researcher was given access to these files and transcribed the information directly into the SPSS® database. This proved to be very time consuming for the following reasons:

- patient report forms were missing
- patient report forms were misfiled i.e. they were usually filed in date order but were sometimes placed in the wrong file
- they were almost illegible
- there was missing information

Despite these challenges the triangulation of data allowed for some of the missing information to be found and data collection completed. Data that was missing was not included in the statistics.

3.6.4 Reliability and Validity of the study

The use of criteria to assess the quality of a study is regarded as scientific merit (Polit and Beck, 2006). Reliability and validity are some of the criteria used in scientific merit. The motivation for the study's reliability and validity are explained below.

3.6.4.1 Reliability

Reliability is the accuracy and consistency of information gathered during the course of the study (Polit and Beck, 2006). No assistants were used as the researcher was concerned about the accuracy required when information was to be accessed and then transcribed into the SPSS® data base. All information accessed and captured into the data base was done by the researcher alone which prevented contamination. Hard copies of information, from EMRS, were filed in date order i.e. one file for every day of the month from October to November. Each file had information of those obstetric patients

responded to on that day. This information also appeared in ascending order which made verifying information easier. The supervisor verified the reliability of this information by randomly selecting incident information on the data base and comparing this to the hardcopies. Hospital obstetric records were standardized during meetings with the Hospital Managers. Once again the researcher worked alone to transcribe this information into the SPSS® data base for the reasons mentioned earlier in this paragraph. The researcher therefore believes that reliability was achieved in accurately and consistently obtaining and capturing information.

3.6.4.2 Validity

Validity is concerned with the soundness and quality of the study's evidence (Polit and Beck, 2006). The researcher's control over the study ensured that internal and external validity was maintained. These two concepts are contextualized below.

Internal validity *refers to the extent to which it is possible to make an inference that the independent variable is influencing the dependant variable* (Polit and Beck, 2006). Threats to internal validity may be a result of maturation, mortality and selection bias. These were no threat to this research since the research involved a study of records over a short period of time therefore maturation threats were not a problem. No participants were used therefore there was no mortality threats. There was also no selection bias as the study included the entire obstetric population that was taken to public service hospitals. The researcher ensured that there was tight control over external and internal factors that could have influenced the findings. An example of control of external factors in this study was that the details of the study were kept confidential to EMRS staff. Their behaviour was therefore not altered due to knowing that their work practices were studied. Controlling internal factors refers to controlling the participant's inappropriate characteristics. No participants were used therefore there was no need to control internal factors. Internal validity was therefore achieved as explained in this paragraph.

External validity

Polit and Beck (2006) suggested that external validity was the generalizability of the study findings to other settings. One of the aspects of a study's external validity is concerned with whether the sample is representative of the population and if there was sufficient numbers to arrive at a finding. This study did not use a sample but rather the population. The study was very representative as it described the majority of the obstetric patients in the study area. There were 1200 obstetric patients that were captured into the data base and this was sufficient for analysis. Since all the EMRS districts face similar challenges (eg. vehicle shortages, response times, etc) generalizability can be made to those districts with a similar background as Ugu District.

3.6.5 Triangulation of data

Data source triangulation uses multiple sources of data to overcome the bias associated with data from a single source for the phenomenon being studied (Polit and Beck, 2006). This study triangulated records from the hospital and the EMRS operational and communications division to verify data.

Example: The researcher used the Communications Centre (CC) data to follow response times, diagnosis, destination, etc. The EMRS patient return forms and the ambulance trip sheets were used to verify the CC details. Information from all these data sources were captured into the SPSS® Data base. With all three sources of data in the data base it became easier to compare response times and describe trends. The triangulation of data therefore ensured that the study information was reliable and credible.

3.6.6 Data analysis

The researcher firstly accessed information from the data sources and then checked that there were 3 sources of data for each obstetric patient transported. These sources of data were checked to ensure that all the required information was there and legible. This was time consuming but the researcher laboriously checked the information to ensure reliability. The information was rechecked for errors and once this process was complete it was entered directly into the SPSS® data base. Descriptive and inferential statistics

were conducted through the statistical Package for Social Sciences Version 17 (SPSS® Inc.444, Michigan Avenue, Chicago, Illinois, USA) i.e.

- Descriptive statistics used central tendency, frequency distribution, contingency tables and correlation to describe the data (variables).
- Multiple regression analysis and other measures of association were also applied to the data to determine relationships.

3.6.7 Ethical considerations

3.6.7.1 Principle of beneficence

Freedom from harm

Polit and Beck (2006) suggested that harm and discomfort could take the forms of physical, emotional, social and financial. This research involved a study of records and was in no way interacting with the patient or assistants to have caused such harm. Identifiable details of the patients included the patients name and exact address which appeared on the patient report form and if publicized could have cause discomfort to the patient. In order to protect the identity of the patient and thus prevent harm, these identifiable details were not used. Instead the case number was used to represent the patient. Addresses were also not used as the research aimed at identifying the area/location of the patient and not the exact physical address. The data sources were also kept secure as it was locked in the researcher's office. The researcher was the only person that had access to this office. The researcher and the supervisor were the only people that have seen the data sources as well as the SPSS® data base that contained the study information. These steps taken ensured that confidentiality was maintained and prevented harm or discomfort to the patient.

Freedom from exploitation

The study did not use participants or research assistants therefore there was no exploitation. Letters of information were sent to hospital managers and EMRS managers who voluntarily consented to their institutions participating in the study.

Risk/benefit ratio

There was no risk to the patient as only their records were required for the study. The steps taken during accessing, capturing and storing information (as explained earlier) ensured that the identity of the patient, EMRS staff and institutions were kept confidential. Benefits of the study may be appreciated by the DOH and its institutions (particularly EMRS and the hospitals) as this research was not done before. The knowledge of response times, patient profile, factors affecting response times and the recommendations would assist DOH to improve emergency obstetric transportation. Since delayed emergency transport has be cited for increasing the MMR the benefit of this study would be a reduction in mortality and morbidity due to the lessons learnt in this study.

3.6.7.2 Principle of respect of human dignity

Right to self determination

As mentioned earlier, letters of information were sent to the participants who voluntarily agreed to be included. There was no manipulation or coercion to include institutions in the study. All institutions were free to withdraw at any time.

Right to full disclosure

The researcher met with managers of the participating institutions who had already received the letter of information about the study. All enquiries were discussed at that forum and letters of consent were signed indicating voluntary participation in the study. The supervisor's contact number was also listed in the letter of information and could have been used to verify details of the study.

3.6.7.3 Principle of justice

All patient details, EMRS and hospital records were kept confidential as explained earlier. Although this study involved the use of records only, the principle of justice was still applied i.e. Privacy to the patient was maintained by not publicizing records or divulging information that could identify the patient.

3.7 Limitations

The first limitation of the study was that the participating hospitals were far apart and daily data capturing by the researcher alone was preferred but not possible. The researcher would have preferred recording patient details directly from the patients file instead of using the admission registers. The second limitation is that the EMRS in Ugu District initially agreed to complete installation of satellite tracking on all ambulances before the study commenced but this did not materialize. The satellite tracking would have provided another source of information to verify the response times. The third limitation was that of poor record keeping. It was time consuming to look for misfiled patient return forms and through triangulation capture missing data. This extended the duration of the study.

3.8 Conclusion

Basic research is the study of a phenomenon that is known but more understanding is required (Polit and Beck, 2006). The researcher achieved this by using the quantitative research design to capture and answer questions regarding the relationships between variables of the phenomenon being studied (Polit and Beck, 2006). This design allowed the researcher to record the details of a volume of patients.

Using a small number of records threatens bias to the study (Polit and Beck. 2006). Participating hospital selection and the data collection timeframe ensured that there was data sufficiency and representivity. 1004 patients records were used which was sufficient to reduce bias and describe the phenomenon under study. Data was triangulated to ensure reliability and validity was achieved. Ethical principles were considered and abided by which ensured that there was no risk to the study. This research was able to provide answers to the objectives and should be a benefit the DOH to improve emergency transport of obstetric patients.

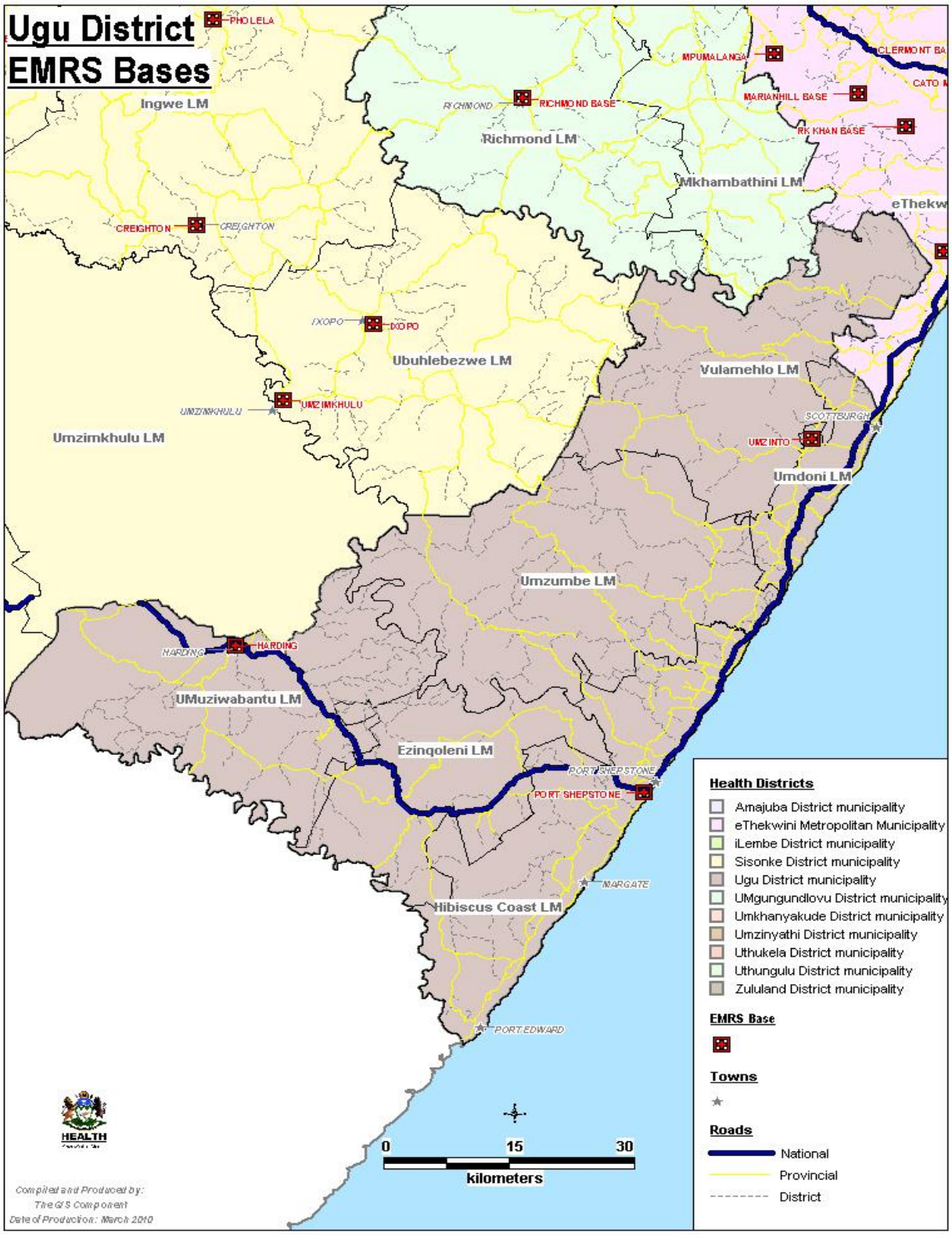
CHAPTER FOUR

RESULTS AND DISCUSSION

4.1. Introduction

The Statistical Package for Social Sciences Version 17 (SPSS Inc.444, Michigan Avenue, Chicago, Illinois, USA) was used for the descriptive and inferential statistical analysis. This section begins with a presentation of a map (Figure 5) of the EMRS bases within Ugu District as it places further discussions into perspective.

Figure 5 Ugu District EMRS Bases
(Geographic Information Systems Unit, 2010)

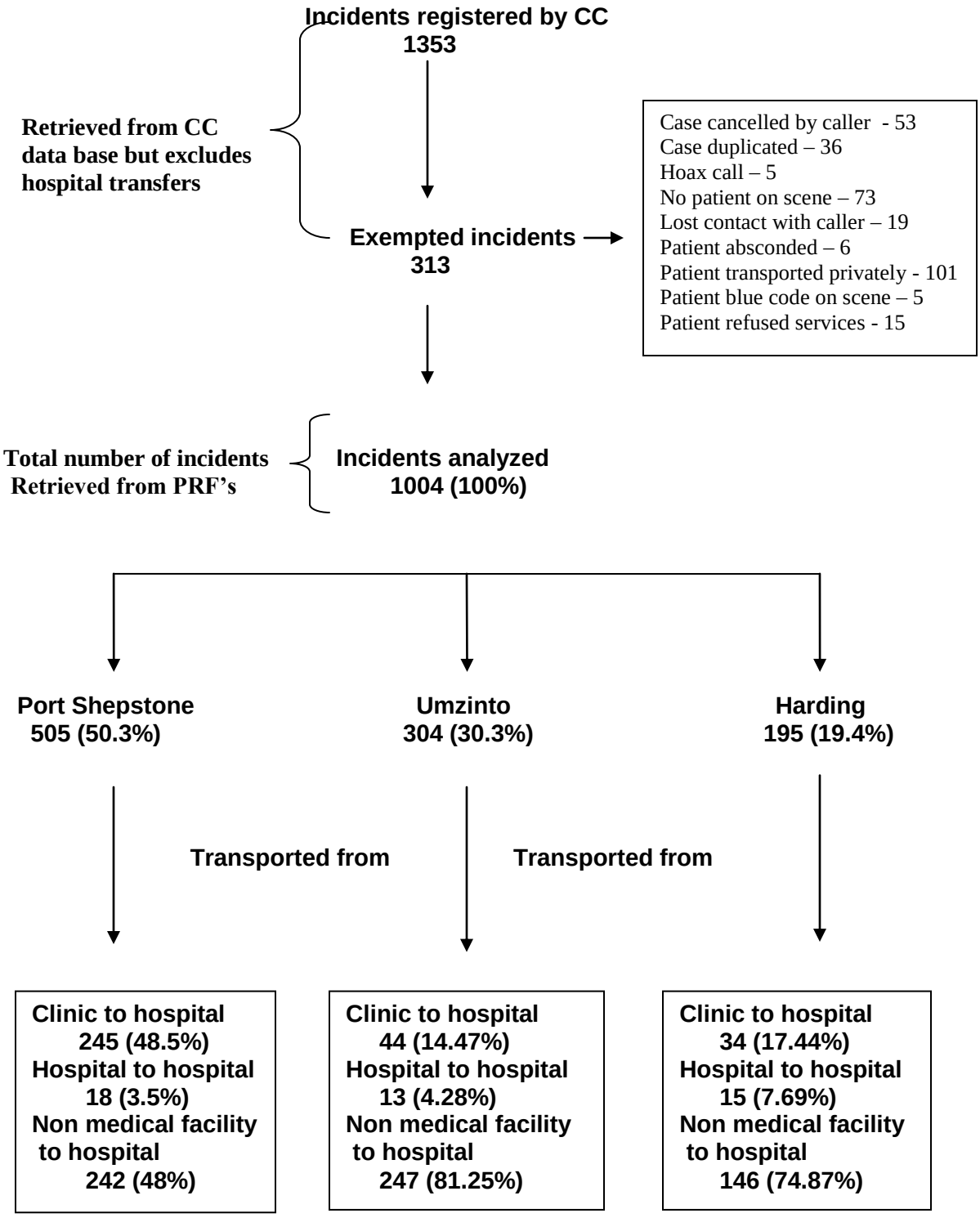


4.2 Obstetric incident distribution in Ugu District

One thousand and four Patient Report Forms (PRF) were located for the study period and this made up the study population. Figure 6 shows the distribution of obstetric incidents amongst the 3 zones in the study area i.e. Port Shepstone (50.3%), Umzinto (30.3%) and Harding (19.4%).

Statistics from the EMRS CC are unreliable for reasons mentioned earlier however its inclusion is necessary to show the type of data that is reported. Figure 6 shows that 1353 obstetric incidents were registered by the CC for the duration of the study. The CC statistics show that there were no inter-hospital patient referrals i.e. patients referred between hospitals. A total of 313 incidents were exempted for various reasons as noted on the diagram.

Figure 6 Distribution of obstetric incidents



4.2.1 Location of obstetric patients

The study also endeavored to identify the location of the patients. To identify the pick up points for each patient, each zone was further categorized as follows i.e.

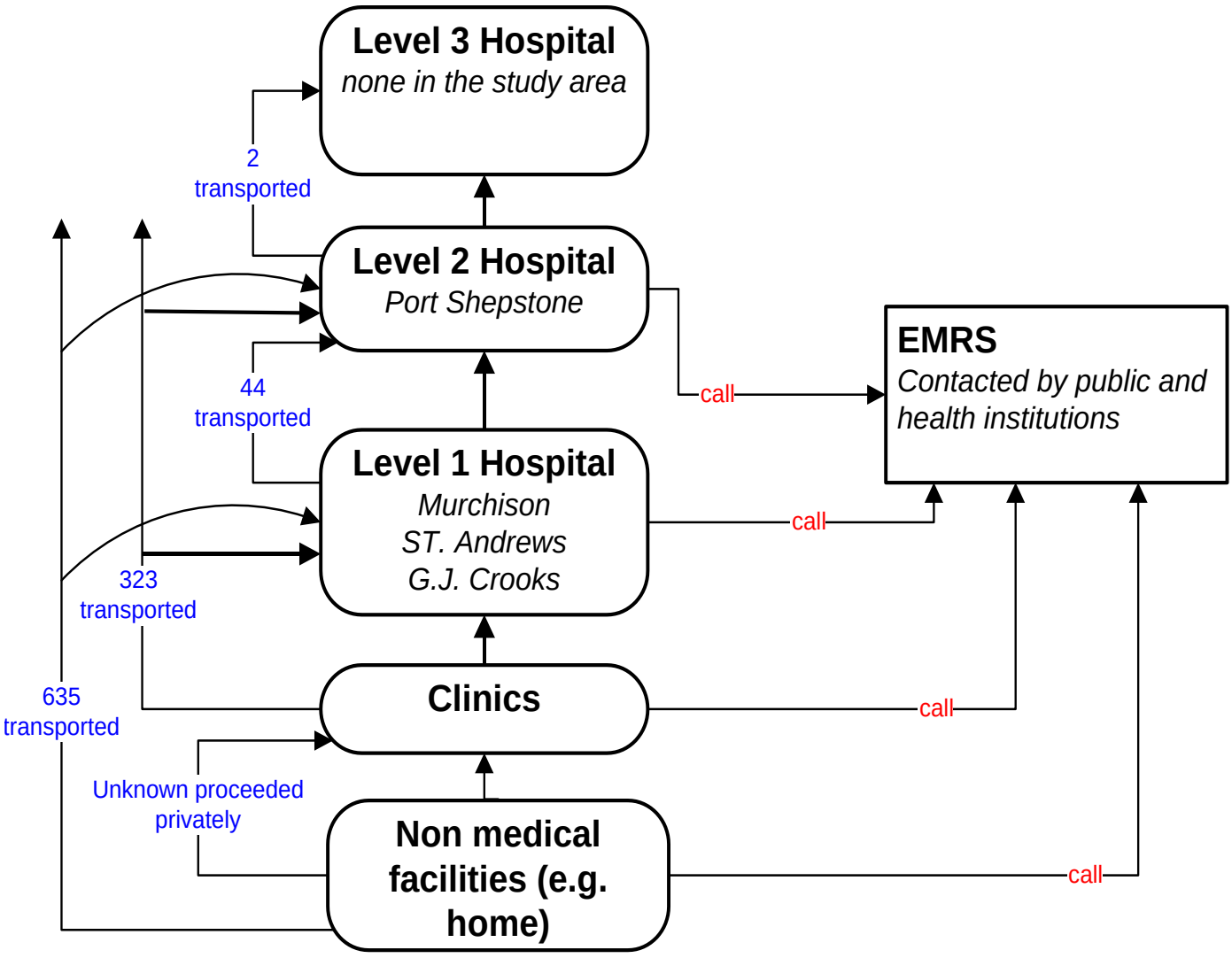
- Was the patient located at a clinic and transported to hospital or
- located at a hospital and transported to another hospital or
- located at a non-medical facility (e.g. home) and transported to hospital.

Figure 6 shows that more patients were being transported from non-medical facilities to hospital i.e. Umzinto (81.25%) and Harding (74.87%).

4.2.2 Emergency transport pattern

Figure 7 represents the summary of the obstetric transport pattern in the study area. 635 (63%) patients were transported from non-medical facilities and clinic staff referred 323 (32%) of the patients to either a level 1 or level 2 hospital. 44 patients were referred from level 1 hospitals to a level 2 hospital. 2 patients were referred from a regional hospital (Port Shepstone) to a tertiary hospital (Inkosi Albert Luthuli Hospital).

Figure 7 Obstetric Patient Transport Pattern



4.2.3 Location of patients from Ugu District Local Municipalities

Ugu District Municipality is comprised of the 6 local municipalities. Table 2 provides the frequency of emergency transport requested from patients located in these municipalities. Hibiscus Coast Municipality recorded 31.9% of the obstetric incidents that the EMRS (Port Shepstone Zone) attended to for the study period. 48.5% of the obstetric patients were referred from clinics in this Municipality.

Table 2 Location of patients from local municipalities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Ezingoleni	67	6.7	6.7	6.7
	Hibiscus Coast	320	31.9	31.9	38.5
	Umdoni	156	15.5	15.5	54.1
	Umuziwabantu	184	18.3	18.3	72.4
	Umzumbe	147	14.6	14.6	87.1
	Vulamehlo	127	12.6	12.6	99.7
	Other	3	.3	.3	100.0
	Total	1004	100.0	100.0	

4.2.4 Conclusion

Chapter 4 has thus far:

- identified the location of the obstetric incidents,
- presented the emergency transport pattern for these patients
- shown the distribution of incidents amongst the Zones and Municipalities.

Using this baseline knowledge of the study area the next section discusses the study objectives.

4.3. Objective 1: To determine response time intervals from the initial call to delivery of the patient to a public sector hospital.

4.3.1. Introduction

Meislin et al., (1999) suggested that response time calculation varied between emergency services with no standardization that existed. This made comparison of the response times difficult. As a result the researcher chose to determine response time intervals which essentially looked at all the events that occurred once the call was received until the patient was delivered to hospital. The following intervals will be discussed i.e.

- **Pre-Response Interval** – occurs from the time the call is received until the vehicle is dispatched. (PRI)
- **Response Interval** – occurs from the time the call is received to the time the ambulance arrives at the location of the patient. (RI)
- **Transport Interval** – occurs from the time the ambulance is mobile from the scene until its arrival at hospital. (TI)
- **Complete hospital Interval** – occurs from the time the ambulance arrives at hosp until it is available for the next case. (CHI)
- **Loading the Patient Interval** – occurs from the time the ambulance arrives on scene until it leaves the scene (LPI)
- **Total Pre-hospital Interval** – occurs from the time the call is received until the arrival of the patient to hospital. (TPI)
- **Out of Service Interval** – occurs from the time the ambulance is dispatched until it is available for the next case. (OSI)

A total of 1004 patient details were captured for analysis. Some data was found to have missing information that would have affected the calculation of response time intervals. These patient details were excluded and 834 of these data entries were eligible for analysis.

4.3.2 Pre - Response Interval (PRI)

This interval measures the time taken before an ambulance is dispatched to an obstetric incident. It may be regarded as the pre-response waiting time. The 2 variables used to determine this was the time the call was received and the time the ambulance was dispatched. Table 3 shows the mean PRI for all the municipalities in the study.

All municipalities in the study area had a PRI of more than 1 hour, except for Umdoni (just under 49 minutes) and Umuziwabantu (just under 43 minutes). Hibiscus Coast Municipality recorded the longest PRI of 12h27 minutes. A mean PRI for the study area was 1h07 minutes. To determine if the PRI is acceptable it had to be compared to EMRS norms and standards regarding the PRI contained in the SOP's.

The SOP's state that emergencies are coded red and are required to be dispatched within 1 minute i.e. in other words the SOP's suggest a PRI of 1 minute. Non-emergencies are regarded as yellow codes and should be dispatched within 3 minutes. Since obstetric emergencies have been prioritized and coded 'red', the PRI should therefore be 1 minute. A PRI of 1h07 minutes is therefore an extreme delay and not in compliance with the SOP's.

Using the DOH target of 1 hour for ambulances to reach the site of the patient, it is accepted that a RI that is more than 1 hour constitutes a delay. A PRI of more than 1 hour makes it impossible for the ambulance to achieve the 1 hour target RI.

The PRI has been established and found to be more than 1 hour and a contributor to delaying the RI.

TABLE 3 PRE-RESPONSE INTERVAL:
Interval from call receipt to ambulance being mobile

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Ezingoleni	58	1:13:24.828	1:02:52.851	0:08:15.400	0:56:52.807	1:29:56.848	0:03:00.000	4:12:00.000
Hibiscus Coast	263	1:22:49.049	1:28:34.017	0:05:27.676	1:12:03.835	1:33:34.264	0:01:00.000	12:27:00.000
Umdoni	129	0:48:54.884	0:54:45.112	0:04:49.238	0:39:22.577	0:58:27.190	0:01:00.000	4:45:00.000
Umuziwabantu	150	0:42:12.400	0:50:58.585	0:04:09.732	0:33:58.925	0:50:25.875	0:01:00.000	4:46:00.000
Umzumbe	125	1:23:31.680	1:25:00.060	0:07:36.163	1:08:28.805	1:38:34.555	0:04:00.000	10:17:00.000
Vulamehlo	109	1:03:41.835	1:04:48.757	0:06:12.475	0:51:23.524	1:16:00.146	0:01:00.000	4:28:00.000
Total	834	1:07:13.381	1:14:37.513	0:02:35.044	1:02:09.059	1:12:17.703	0:01:00.000	12:27:00.000

4.3.2.1 Pre-Response Interval Comparison

Already established (4.4.2) is the evidence that shows delays in the PRI. The researcher chose to compare the PRI between locations of the patients to determine if there were differences. Tables 4, 5 and 6 shows the mean PRI times for the following locations i.e.:

- 52 minutes PRI for patients at **non-medical facilities.** The longest waiting time was 5h57 minutes recorded from Umzumbe Municipality.
- 1h28 minutes PRI for patients at **clinics.** The Hibiscus Coast Municipality recorded the highest waiting time of 12h27 minutes
- 1h59 minutes PRI for patients being referred from **hospitals.** The longest waiting time of 09h31 minutes was recorded from the hospitals in the Hibiscus Municipality (Murchison Hospital).

There appears to be a trend in the PRI times above. Ambulances appear to be dispatched to non-medical facilities first, followed by clinics and lastly to hospitals. Analysis of the variance of PRI for non-medical facilities showed significant differences between the different municipalities (p=0.000). This is expected since the distances to the

pick up points in the various municipalities vary. This means that time taken for ECP's to complete each incident and become available to respond to the next incident (ambulance availability) is different between municipalities. As a result of this the PRI varies and there is a significant difference in the PRI between municipalities.

Analysis of the variance of PRI for clinics and hospitals showed no significant differences between the different municipalities (p=0.082 and 0.582). If we use the above argument then the PRI should vary since clinics are located at varying distances within and between municipalities. PRI times that are similar across all the municipalities suggest that a different transport procedure is being used for patients waiting at medical facilities. In other words if patients are at medical facilities then they are made to wait regardless of which municipality they are from. This would result in similar waiting times across all municipalities. It appears that the communication centre (CC) operators are prioritizing incidents that are not at a medical facility over incidents at medical facilities. No policy or procedure exists in EMRS that guides CC operators to follow this practice.

TABLE 4 PRE-RESPONSE INTERVAL: Non-medical facility to hospital

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Ezingoleni	15	1:06:16.000	0:47:39.792	0:12:18.395	0:39:52.300	1:32:39.700	0:09:00.000	2:59:00.000
Hibiscus Coast	119	1:01:17.647	0:57:19.218	0:05:15.273	0:50:53.322	1:11:41.973	0:02:00.000	4:06:00.000
Umdoni	104	0:40:40.385	0:48:50.867	0:04:47.395	0:31:10.404	0:50:10.365	0:01:00.000	4:45:00.000
Umuziwabantu	118	0:32:58.983	0:35:11.317	0:03:14.363	0:26:34.058	0:39:23.908	0:01:00.000	3:49:00.000
Umzumbe	87	1:13:09.655	1:12:26.121	0:07:45.953	0:57:43.371	1:28:35.939	0:04:00.000	5:57:00.000
Vulamehlo	93	1:00:01.290	1:01:16.566	0:06:21.242	0:47:24.111	1:12:38.470	0:01:00.000	4:28:00.000
Total	536	0:52:54.291	0:56:42.698	0:02:26.974	0:48:05.574	0:57:43.008	0:01:00.000	5:57:00.000

TABLE 5 PRE-RESPONSE INTERVAL: Clinic to hospital

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Ezingoleni	43	1:15:54.419	1:07:42.437	0:10:19.516	0:55:04.185	1:36:44.652	0:03:00.000	4:12:00.000
Hibiscus Coast	128	1:36:58.594	1:37:32.406	0:08:37.284	1:19:54.981	1:54:02.206	0:01:00.000	12:27:00.000
Umdoni	14	1:19:00.000	1:13:08.937	0:19:32.993	0:36:45.903	2:01:14.097	0:06:00.000	4:10:00.000
Umuziwabantu	19	0:38:09.474	0:37:55.809	0:08:42.106	0:19:52.569	0:56:26.378	0:05:00.000	2:50:00.000
Umzumbe	38	1:47:15.789	1:45:46.212	0:17:09.491	1:12:29.842	2:22:01.737	0:05:00.000	10:17:00.000
Vulamehlo	16	1:25:03.750	1:21:31.011	0:20:22.753	0:41:37.514	2:08:29.986	0:02:00.000	4:11:00.000
Total	258	1:28:56.047	1:30:09.253	0:05:36.765	1:17:52.876	1:39:59.217	0:01:00.000	12:27:00.000

a. Referral Pattern = Clinic to hospital

TABLE 6 PRE-RESPONSE INTERVAL: Hospital to Hospital

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Hibiscus Coast	16	2:09:37.500	2:31:17.291	0:37:49.323	0:49:00.553	3:30:14.447	0:03:00.000	9:31:00.000
Umdoni	11	1:28:32.727	0:56:00.682	0:16:53.284	0:50:54.991	2:06:10.464	0:06:00.000	2:58:00.000
Umuziwabantu	13	2:11:50.769	1:32:01.187	0:25:31.302	1:16:14.349	3:07:27.189	0:20:00.000	4:46:00.000
Total	40	1:59:03.000	1:52:08.538	0:17:43.875	1:23:11.109	2:34:54.891	0:03:00.000	9:31:00.000

a. Referral Pattern = Hospital to Hospital

4.3.3 Response Interval (RI)

The two variables used to calculate this interval was the time the call was received and the time the vehicle arrived at the site of the patient. The RI therefore measures the response time as defined by the DOH. Table 7 shows that the mean RI in the study area was 1h41 minutes. 64.5% of the incidents (Table 8) achieved response times of more that 1hour. The target set by DOH which aimed to have a response time of less than 1hour for 70% of the obstetric incidents has not been achieved. The longest response time of 15h54 minutes was recorded in Hibiscus Municipality. All municipalities showed mean RI of more than 1hour.

Analysis of the variance for response intervals showed significant differences between the different municipalities (p=0.000). This may be attributed to the same explanation given in 4.3.2.1.

TABLE 7 RESPONSE INTERVAL: Call receipt to ambulance arrival on scene

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Ezingoleni	58	2:01:53.793	1:09:40.778	0:09:08.963	1:43:34.513	2:20:13.073	0:21:00.000	6:04:00.000
Hibiscus Coast	263	1:51:43.346	1:32:36.652	0:05:42.638	1:40:28.672	2:02:58.020	0:08:00.000	12:54:00.000
Umdoni	129	1:09:39.535	0:57:28.993	0:05:03.667	0:59:38.678	1:19:40.392	0:08:00.000	5:11:00.000
Umuziwabantu	150	1:17:06.400	0:54:31.045	0:04:27.080	1:08:18.647	1:25:54.153	0:12:00.000	5:33:00.000
Umzumbe	125	2:12:49.440	1:31:28.390	0:08:10.897	1:56:37.818	2:29:01.062	0:20:00.000	10:34:00.000
Vulamehlo	109	1:41:58.349	1:08:24.278	0:06:33.119	1:28:59.120	1:54:57.578	0:11:00.000	4:46:00.000
Total	834	1:41:35.180	1:19:58.060	0:02:46.143	1:36:09.071	1:47:01.288	0:08:00.000	12:54:00.000

TABLE 8 Categories for RESPONSE INTERVAL

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	5 to 10 minutes	6	.7	.7	.7
	10 to 15 minutes	13	1.6	1.6	2.3
	15 to 30 minutes	71	8.5	8.5	10.8
	30 to 45 minutes	113	13.5	13.5	24.3
	45 to 60 minutes	93	11.2	11.2	35.5
	More than 60 minutes	538	64.5	64.5	100.0
	Total	834	100.0	100.0	

4.3.3.1 Response Interval Comparison

The mean response times for the following locations were:

- 1h27 minutes response time from **non-medical facilities to hospital.** The longest response time was 7h15 minutes recorded from Umzumbe Municipality.
- 2h07 minutes response time to **clinics.** The Hibiscus Coast Municipality recorded the highest response time of 12h54 minutes with Umzumbe Municipality following with a response time of 10h34 minutes.
- 2h10 minutes response time to patients being referred from **hospitals.** The longest response time of 10h01 minutes was recorded from a hospital in the Hibiscus Municipality (i.e. Murchison Hospital).

4.3.3.2 Correlation of PRI and RI

Table 9 shows the mean PRI was 1h07 minutes and the mean RI was 1h41 minutes.

Table 9 Mean PRI and RI

	Mean	Std. Deviation	N
PRE-RESPONSE INTERVAL: Interval from call receipt to ambulance being mobile	1:07:13.381	1:14:37.513	834
RESPONSE INTERVAL: Call receipt to ambulance arrival on scene	1:41:35.180	1:19:58.060	834

Pearson's correlation (Table 10) show a significant relationship between the PRI and RI i.e. the time for an ambulance to arrive on scene is significantly increased when the time it takes for an ambulance to get mobile is increased. In other words as the pre-response waiting time increases the response time increases.

Delays in the PRI have increased the RI which has resulted in the study area not achieving the target response time where 70% of the ambulances responses arriving at the patient within 1 hour.

Table 10 Correlation of PRI and RI

		PRE-RESPONSE INTERVAL: Interval from call receipt to ambulance being mobile	RESPONSE INTERVAL: Call receipt to ambulance arrival on scene
PRE-RESPONSE INTERVAL: Interval from call receipt to ambulance being mobile	Pearson Correlation	1	.955**
	Sig. (2-tailed)		.000
	N	834	834
RESPONSE INTERVAL: Call receipt to ambulance arrival on scene	Pearson Correlation	.955**	1
	Sig. (2-tailed)	.000	
	N	834	834

**. Correlation is significant at the 0.01 level (2-tailed).

4.3.4 Transport Interval (TI)

The two variables used to calculate this interval is the time the ambulance departed scene and the time it arrived at hospital. In other words it was the time taken to transport the patient from the scene to the hospital. Table 11 shows the overall mean Tl of 34 minutes. All Municipalities achieved transport times of below 1hour to hospital. Majority (37.6%) of the patients were transported under 30 minutes to hospital (see Table 13). Hibiscus Coast Municipality and Umdoni Municipality achieved the lowest transport times of 28 minutes and 24 minutes respectively. Analysis of the variance of the TI (Table 12) showed significant differences between the different municipalities (p=0.000). Again this disparity was expected due to the varying distances from the location of the patient to hospital in each municipality.

The ambulance bases in the 3 zones are situated in close proximity to the hospitals. Distance to scene from the ambulance base are relatively similar to the distance from the scene to hospital. The exception occurred when ambulances were rerouted to attend other incidents. If there is not a significant difference between both these distances, then the travel time should be relatively similar during response to the incident and from the incident to hospital. One may therefore hypothesize that the mean travel time of 34 minutes from the scene to hospital can also be achieved for the ambulance base to the scene. The DOH target time for ambulances to reach the site of the patient within 1 hour of calling is therefore achievable if we apply this hypothesis.

TABLE 11 TRANSPORT INTERVAL: Mobile from scene until arrival at hospital

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Ezingoleni	58	0:37:37.241	0:18:41.587	0:02:27.272	0:32:42.335	0:42:32.148	0:08:00.000	1:17:00.000
Hibiscus Coast	263	0:28:45.171	0:16:49.989	0:01:02.279	0:26:42.541	0:30:47.801	0:03:00.000	1:58:00.000
Umdoni	129	0:24:17.674	0:13:47.431	0:01:12.851	0:21:53.526	0:26:41.823	0:03:00.000	1:07:00.000
Umuziwabantu	150	0:34:55.600	0:19:49.994	0:01:37.163	0:31:43.605	0:38:07.595	0:04:00.000	2:00:00.000
Umzumbe	125	0:48:13.920	0:26:51.810	0:02:24.165	0:43:28.578	0:52:59.262	0:13:00.000	2:46:00.000
Vulamehlo	109	0:41:04.404	0:19:00.108	0:01:49.203	0:37:27.945	0:44:40.862	0:08:00.000	1:29:00.000
Total	834	0:34:19.209	0:20:41.348	0:00:42.984	0:32:54.838	0:35:43.579	0:03:00.000	2:46:00.000

TABLE 12 TRANSPORT INTERVAL: Mobile from scene until arrival at hospital

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.835E8	5	3.670E7	27.620	.000
Within Groups	1.100E9	828	1328649.021		
Total	1.284E9	833			

TABLE 13 Categories for TRANSPORT INTERVAL

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Within 5 minutes	8	1.0	1.0	1.0
	5 to 10 minutes	41	4.9	4.9	5.9
	10 to 15 minutes	86	10.3	10.3	16.2
	15 to 30 minutes	314	37.6	37.6	53.8
	30 to 45 minutes	189	22.7	22.7	76.5
	45 to 60 minutes	107	12.8	12.8	89.3
	More than 60 minutes	89	10.7	10.7	100.0
	Total	834	100.0	100.0	

4.3.5 Loading the Patient Interval (LPI)

The two variables used to calculate this interval is the time the ambulance arrived on scene and the time it departed towards hospital. This interval should only represent the time taken to load the patient however other events have been found occurring during this interval as well e.g. treatment of the patient, accessing the patient (such as confined spaces and motor vehicle accidents), etc. The data sources do not show separate times for such events. Since these events contribute to the time taken to load the patient they have been included in this interval.

The DOH (n.d) draft Norms and standards guidelines allowed a maximum of 15 minutes for 'scene time with patient'. It is not clear whether this time included physically loading the patient as well as treating the patient. Table 14 shows the mean LPI calculated was just under 14 minutes. This is within the target times stated in the norms and standards. 35.4% of the patients were loaded within 5 to 10 minutes and 20.7% were loaded within 10 to 15 minutes. This demonstrates that 69.7% of the patients were physically loaded within the 15 minutes. The largest percentage of patients (24.5%) that did not achieve the 15 minutes target loading time was found in the 15 to 30 minute category. Analysis of the variance for the loading the patient interval (Table 15) showed significant differences between the different municipalities ($p=0.000$). The reason for this result is owed to the uniqueness of each incident i.e. the patient profile, patient treatment requirements, location of the patient dynamics, etc. The maximum time spent on scene was 1hour 25 minutes which occurred in Ezingoleni Municipality. Table 14 also shows other municipalities that had maximum loading times of more the 50 minutes. This delay is a cause for concern however EMRS documentation did not contain reasons for those delays.

The minimum time taken to load the obstetric patients in 4 municipalities was 1 minute while the remaining 2 municipalities had achieved a 2 minute loading time. Such a minimum time spent on scene raises issues regarding patient management. Two scenarios may exit i.e.

- The patient was treated on scene within 2 minutes.
- The patient was loaded and the assessment done in transit to hospital.

In both cases the patient assessment and treatment is questionable and requires further investigation.

The mean LPI of 13 minutes is an acceptable delay since it falls within the 15 minutes target time with the patient. Since the LPI is not excessive it may not be regarded as one of intervals significantly delaying delivering the patient to hospital.

TABLE 14 LOADING THE PATIENT INTERVAL:
From arrival on scene until leaving the scene

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Ezingoleni	58	0:15:27.931	0:11:33.022	0:01:30.998	0:12:25.710	0:18:30.152	0:01:00.000	1:25:00.000
Hibiscus Coast	263	0:16:30.570	0:11:28.767	0:00:42.471	0:15:06.942	0:17:54.199	0:02:00.000	1:04:00.000
Umdoni	129	0:10:42.791	0:07:53.463	0:00:41.686	0:09:20.308	0:12:05.274	0:01:00.000	0:50:00.000
Umuziwabantu	150	0:13:25.200	0:09:41.774	0:00:47.502	0:11:51.336	0:14:59.064	0:01:00.000	1:10:00.000
Umzumbe	125	0:14:32.160	0:10:33.082	0:00:56.625	0:12:40.084	0:16:24.236	0:01:00.000	1:21:00.000
Vulamehlo	109	0:10:36.881	0:08:35.617	0:00:49.387	0:08:58.987	0:12:14.775	0:02:00.000	0:55:00.000
Total	834	0:13:55.108	0:10:25.028	0:00:21.643	0:13:12.627	0:14:37.589	0:01:00.000	1:25:00.000

TABLE 15 ANOVA for LOADING THE PATIENT INTERVAL

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.622E7	5	3243215.703	8.685	.000
Within Groups	3.092E8	828	373434.736		
Total	3.254E8	833			

TABLE 16 Categories for LOADING THE PATIENT INTERVAL

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Within 5 minutes	113	13.5	13.5	13.5
	5 to 10 minutes	295	35.4	35.4	48.9
	10 to 15 minutes	173	20.7	20.7	69.7
	15 to 30 minutes	204	24.5	24.5	94.1
	30 to 45 minutes	34	4.1	4.1	98.2
	45 to 60 minutes	8	1.0	1.0	99.2
	More than 60 minutes	7	.8	.8	100.0
	Total	834	100.0	100.0	

4.3.6 Complete At Hospital Interval (CHI)

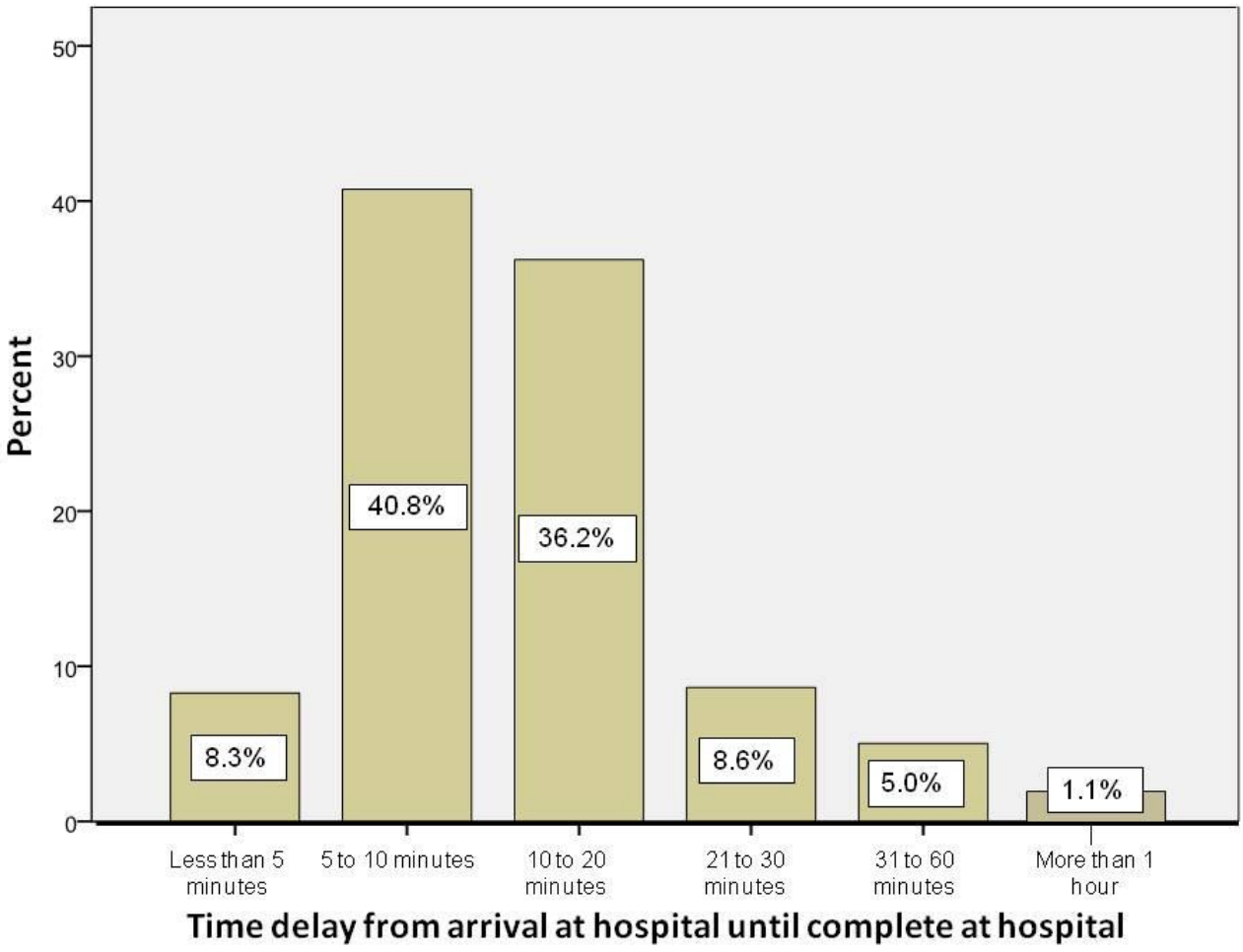
The two variables used to calculate this interval is the time the ambulance arrived at hospital and the time it completed hospital. In other words this interval calculates how long it takes for ECP's to handover the patient and prepare to leave the hospital. The DOH (2010) report indicated that 20 minutes was given for ECP's to handover the patient. Table 17 shows the mean CHI (handover) was 13 minutes. A cumulative 85.3% of these patients have been handed over within 20 minutes (see figure 8).

The highest recorded time for an ambulance to complete hospital was 2h28 minutes. Such delays during handing over of the patient increases the PRI which will affect the RI as shown in 4.4.3. More effort is required by the EMRS to reduce such delays. The study has however shown that the CHI in not significantly affecting the PRI.

Table 17 Complete Hospital Interval - Time delay from arrival at hospital until completion at hospital

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Ezingoleni	58	0:13:36.207	0:12:10.877	0:01:35.969	0:10:24.032	0:16:48.381	0:02:00.000	1:15:00.000
Hibiscus Coast	263	0:14:05.475	0:11:28.847	0:00:42.476	0:12:41.837	0:15:29.113	0:01:00.000	1:23:00.000
Umdoni	129	0:13:26.977	0:08:30.218	0:00:44.922	0:11:58.090	0:14:55.863	0:00:00.000	0:50:00.000
Umuziwabantu	150	0:12:21.200	0:16:51.285	0:01:22.571	0:09:38.039	0:15:04.361	0:00:00.000	2:28:00.000
Umzumbe	125	0:16:39.360	0:09:50.887	0:00:52.851	0:14:54.754	0:18:23.966	0:02:00.000	1:01:00.000
Vulamehlo	109	0:13:13.211	0:08:51.498	0:00:50.908	0:11:32.302	0:14:54.120	0:04:00.000	0:52:00.000
Total	834	0:13:54.964	0:11:49.492	0:00:24.568	0:13:06.742	0:14:43.186	0:00:00.000	2:28:00.000

Figure 8 **Time delay graph for Complete Hospital Interval (CHI) (from arrival at hospital until complete at hospital)**



4.3.7 APPLICATION OF THE RESPONSE TIME INTERVALS

Response time intervals has made it possible to take any two intervals and calculate it's response time. A number of questions could be answered through these applications.

4.3.7.1 Out Of Service Interval (OSI)

The application of the response time intervals created the OSI. The two variables used to calculate this interval was the time the ambulance was dispatched and the time it was available for dispatch to other incidents. It calculates the duration that the ambulances were unavailable for i.e. as the ambulances were committed to the initially dispatched incidents. Table 18 shows the mean OSI (ambulance unavailability) was 1h46 minutes. This application has therefore established that it takes 1h46 minutes for ambulances to become available once the incident has been dispatched. This is useful information to the EMRS in management of resources (e.g. ambulances).

TABLE 18 OUT OF SERVICE INTERVAL:
From dispatch time to post hospital availability

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Ezingoleni	58	2:06:30.000	0:47:53.529	0:06:17.313	1:53:54.444	2:19:05.556	0:44:00.000	3:59:00.000
Hibiscus Coast	263	1:39:27.833	0:47:32.438	0:02:55.889	1:33:41.497	1:45:14.168	0:23:00.000	5:15:00.000
Umdoni	129	1:16:38.605	0:36:07.588	0:03:10.846	1:10:20.984	1:22:56.225	0:24:00.000	3:26:00.000
Umuziwabantu	150	1:42:34.400	0:50:27.238	0:04:07.173	1:34:25.983	1:50:42.817	0:25:00.000	6:42:00.000
Umzumbe	125	2:22:02.400	1:04:24.782	0:05:45.677	2:10:38.209	2:33:26.591	0:54:00.000	6:39:00.000
Vulamehlo	109	1:54:47.339	0:47:02.163	0:04:30.314	1:45:51.530	2:03:43.149	0:36:00.000	4:41:00.000
Total	834	1:46:45.468	0:53:01.091	0:01:50.152	1:43:09.259	1:50:21.676	0:23:00.000	6:42:00.000

TABLE 19 Categories for OUT OF SERVICE INTERVAL

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	15 to 30 minutes	12	1.4	1.4	1.4
	30 to 45 minutes	39	4.7	4.7	6.1
	45 to 60 minutes	98	11.8	11.8	17.9
	60 to 90 minutes	225	27.0	27.0	44.8
	90 to 120 minutes	190	22.8	22.8	67.6
	2 to 3 hours	192	23.0	23.0	90.6
	More than 3 hours	78	9.4	9.4	100.0
	Total	834	100.0	100.0	

4.3.7.2 Correlation of OSI and PRI

Further application of the newly found OSI aimed at determining the relationship it had with the PRI. The OSI is the period of time that the ambulance was unavailable for once it was dispatched on an incident until it was completed and available to undertake the next incident. To determine this, the OSI was correlated with the PRI. Table 20 shows the mean OSI of 1h46 minutes and the PRI of 1h07minutes. Pearson's correlation (Table 21) showed that there was a significant correlation between OSI and PRI. (Pearson correlation coefficient 0.699; $p<0.01$) i.e. as the OSI increases, the PRI increases.

Table 20 Mean OSI and PRI

	Mean	Std. Deviation	N
OUT OF SERVICE INTERVAL: From dispatch time to post hospital availability	1:46:45.468	0:53:01.091	834
PRE-RESPONSE INTERVAL: Interval from call receipt to ambulance being mobile	1:07:13.381	1:14:37.513	834

Table 21 Correlation of OSI and PRI

		OUT OF SERVICE INTERVAL: From dispatch time to post hospital availability	PRE-RESPONSE INTERVAL: Interval from call receipt to ambulance being mobile
OUT OF SERVICE INTERVAL: From dispatch time to post hospital availability	Pearson Correlation	1	.189**
	Sig. (2-tailed)		.000
	N	834	834
PRE-RESPONSE INTERVAL: Interval from call receipt to ambulance being mobile	Pearson Correlation	.189**	1
	Sig. (2-tailed)	.000	
	N	834	834

**. Correlation is significant at the 0.01 level (2-tailed).

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4.3.7.3 Total Pre-hospital Interval (TPI)

Another application of using the response time intervals established the TPI. The two variables used to calculate this interval was the time the call was received and the time the ambulance arrived at hospital. In other words this interval calculates how long it takes for the patient to reach hospital after requesting for an ambulance. Table 22 shows the mean TPI of 2h29 minutes. The highest recorded time taken to deliver a patient to hospital was recorded at 13h58 minutes. 54.4% of the incidents took more than 2hours for the patient to reach the hospital after the initial request for an ambulance (Table 24). Analysis of the variance for the TPI (Table 40) showed significant differences between the different municipalities (p=0.000). Reasons for this was owed to the disparity of distances to pickup points in each municipality as stated previously. If the PRI time of 1h07minutes is removed then it may be possible for patients to reach hospital in just over 1hour.

TABLE 22 TOTAL PREHOSPITAL INTERVAL: Call receipt to arrival at hospital

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Ezingoleni	58	2:54:58.966	1:15:58.303	0:09:58.534	2:35:00.421	3:14:57.510	1:00:00.000	6:53:00.000
Hibiscus Coast	263	2:36:59.087	1:40:14.739	0:06:10.885	2:24:48.793	2:49:09.382	0:20:00.000	13:58:00.000
Umdoni	129	1:44:40.000	1:04:05.484	0:05:38.576	1:33:30.069	1:55:49.931	0:25:00.000	5:38:00.000
Umuziwabantu	150	2:05:27.200	1:07:52.369	0:05:32.508	1:54:30.161	2:16:24.239	0:27:00.000	6:23:00.000
Umzumbe	125	3:15:35.520	1:42:35.193	0:09:10.537	2:57:25.853	3:33:45.187	0:58:00.000	11:25:00.000
Vulamehlo	109	2:33:39.633	1:18:14.942	0:07:29.694	2:18:48.262	2:48:31.004	0:37:00.000	5:51:00.000
Total	834	2:29:49.496	1:30:23.478	0:03:07.800	2:23:40.880	2:35:58.113	0:20:00.000	13:58:00.000

TABLE 23 ANOVA for TOTAL PREHOSPITAL INTERVAL:

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.397E9	5	4.794E8	17.956	.000
Within Groups	2.211E10	828	2.670E7		
Total	2.450E10	833			

TABLE 24 Categories for TOTAL PREHOSPITAL INTERVAL

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20 to 30 minutes	8	1.0	1.0	1.0
	30 to 45 minutes	33	4.0	4.0	4.9
	45 to 60 minutes	43	5.2	5.2	10.1
	60 to 90 minutes	160	19.2	19.2	29.3
	90 to 120 minutes	136	16.3	16.3	45.6
	More than 2 hours	454	54.4	54.4	100.0
	Total	834	100.0	100.0	

4.3.8 SUMMARY

The PRI (pre-response waiting time) delay of 1h07 minutes has resulted in a delayed RI at 1h41 minutes. The transport interval (TI) of the patient from the scene to hospital was calculated at a mean of 34 minutes. Loading the patient was achieved at a mean 13 minutes which was within 15 minutes stipulated by DOH (no date) norms and standards. Ambulances that were responding to incidents were unavailable for a mean of 1h46 minutes. The average handover time at hospital was 13 minutes which was within the 20 minutes allowed by the EMRS. Total pre-hospital interval is the length of time taken for patients to reach hospital after calling for an ambulance. This was achieved in 2h29 minutes. Table 25 illustrates the 5 sequential intervals that occur once the request for an ambulance is received until the patient reaches hospital. It also shows the combination of intervals that make up the Pre-hospital Transport Interval, Total Pre-hospital Interval and Out of Service Interval.

Table 25 Response time intervals

RESPONSE TIME INTERVALS							
Call received	Alarm (responds to scene)	Arrival on scene	Leave scene	Re-routed	Arrival at hospital	Complete hospital	Available for next case
1. Pre-response Interval (PRI) 1h07min		Pre-hospital Treatment Interval (PTI)					
2. Response Interval (RI) 1h41 min			4. Transport Interval (TI) 34 min				
		3. Loading the Patient Interval (LPI) 13 min			5. Complete Hospital Interval (CHI) 13 min		
Total Pre-hospital Interval (TPI) 2h29min							
	Out of Service Interval OSI) 1h46 min						

4.3.9 Conclusion

A cycle of response intervals exists from the time the incident is received until the patient is delivered at hospital and the ambulance is available again. A dispatch trend exists that prioritized responses to non-medical facilities first which was followed by medical facilities. In other words patients at medical facilities are made to wait longer for ambulances.

The study has shown that an increase in the PRI increases the RI. Delays in the PRI are either

- non incident related (e.g. refueling, refreshment breaks, etc) or
- incident related (largely due to the OSI which is the period of time that the ambulance is unavailable after being dispatched to an incident)

The CC progress report on most awaiting incidents indicated that delays were due to no ambulances being available. This suggests that the high volume of incidents cannot be managed by the current emergency transport system and the trends that exist. The OSI of ambulances is therefore a consistent cause of delay to the awaiting incidents. The mean OSI for the study area was 1h46 minutes (i.e. until ambulances are available again) and showed a significant correlation with PRI. The target response time for 70% of the ambulances aiming to reach the patient within 1 hour of calling has not been achieved. Instead the majority (64.5%) of responses achieved response times of more than 1 hour and 35.5% are achieving response times within 1 hour. The most influential source of delay in the response time intervals is the PRI (pre-response waiting time). The other response time intervals that were calculated are acceptable as they are within the EMRS norms and standards.

4.4. Objective 2: To determine the type of obstetric cases being transported.

4.4.1. Introduction

The second objective aimed to determine the type of obstetric cases being transported by the provincial EMRS i.e. what were the obstetric conditions that the EMRS was responding to, treating and transporting to hospital. The EMRS Communication Centre (CC) staff determine the indication of the obstetric incident based on hearsay (from the caller) thereby making it an acceptable practice but unreliable to provide statistics for this objective. Evidence has also been found that shows incidents where CC database indication for the emergency transport differs to that determined by the ECP's that transported the patient. Owing to such inconsistencies the researcher used patient report forms (PRF's) to extract the diagnosis/ indication for the emergency transport request. The PRF's provided first hand information that would have been given to the ECP's by the patient. This data source was accepted as a reliable account of the patient's condition. This objective did not aim to verify/test the diagnosis from the PRF against the diagnosis determined at hospital. The researcher however managed to do this in some cases.

A general demographic characteristics for all the obstetric patients transported will firstly be presented which will then be followed with more specific analysis.

4.4.2 Demographic characteristics

To create a profile of the patients being transported, the researcher will present each section from the following demographic details i.e. age, gestational age, gravidity and indication/diagnosis. These details were available on the PRF as well as the hospital admissions register. The use of gravidity instead of parity was based on the availability of the former on both the data sources.

4.4.2.1 Age - 998 patient details were eligible for analysis (Table 26). The mean age of the patients was 23 years. 35.4% of the patients transported were below 20 years old and this accounted for the largest age category. The two extremes in age group were the youngest and the oldest patient transported who were 14years and 48years old respectively (Table 27).

Table 26 Age categories of obstetric patients

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	< 20	353	35.4	35.4	35.4
	20 to 24	276	27.7	27.7	63.0
	25 to 29	197	19.7	19.7	82.8
	30 to 34	93	9.3	9.3	92.1
	35 to 39	59	5.9	5.9	98.0
	40 to 44	16	1.6	1.6	99.6
	45+	4	.4	.4	100.0
	Total	998	100.0	100.0	

Table 27 Extreme age of obstetric patients

	N	Range	Minimum	Maximum	Mean	Std. Deviation
Age of patient?	998	34	14	48	23.84	6.192
Valid N (listwise)	998					

4.4.2.2 Gravidity - 854 patients were eligible for analysis (Table 28). 49.5% (423) of the patients were expecting there first child (gravidity 1) with a significant large 2nd group (27%) expecting the 2nd child.

Table 28 Gravidity categories of obstetric patients

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	423	49.5	49.5	49.5
	2	229	26.8	26.8	76.3
	3	128	15.0	15.0	91.3
	4	40	4.7	4.7	96.0
	5	16	1.9	1.9	97.9
	6+	18	2.1	2.1	100.0
	Total	854	100.0	100.0	

4.4.2.3 Gestational Age - 735 patients were eligible for analysis (Table 29). 54.7% of these patients were full term pregnant and 26.4% of patients in the 33 to 37 gestational age group. These two categories accounted for the majority (81.1%) of the patients transported from the 735 patients.

Table 29 Gestational age categories of obstetric patients

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 20 wks	40	5.4	5.4	5.4
	20 to 28 wks	60	8.2	8.2	13.6
	29 to 32 wks	39	5.3	5.3	18.9
	33 to 37 wks	194	26.4	26.4	45.3
	38 to term	402	54.7	54.7	100.0
	Total	735	100.0	100.0	

4.4.3 Indications for the emergency transport and their frequency

Having established the age, gestational age and gravidity from the PRF's the indication (diagnosis) for the emergency transport was also captured to complete the profile of the obstetric patients. The researcher found common characteristics with the diagnosis which enabled him to place them (diagnosis) into categories. The following categories were established i.e:

- **Uncomplicated pregnancy** – these were patients that were in labour and essentially required transport to hospital. i.e. without any invasive treatment.

- **Complicated pregnancy** – these were patients that had conditions affecting the pregnancy. This category further identified those patients that were in labour and those that were not.

- **Post partum emergencies** – these were patients that experienced medical conditions after delivery that were still physiologically affecting them.

- **Other** – these were patients whose initial indication for the request of the emergency transport differed after being diagnosed by the ECP's
    - ***Birth Before Arrival (BBA)*** - Patients that delivered before the ambulance reached them.
    - ***Non pregnancy related -*** these were patients whose condition did not affect the pregnancy but was diagnosed by the CC staff as an obstetric emergency.
    - ***False labour*** – these patients were not in labour but initially diagnosed to be in labour.

Table 30 presents the frequency of the indications (diagnosis) for the emergency transport request. It shows that patients in labour without any complications accounted for the majority (66%) of the emergency transport requests. This table also shows that location of the patient i.e. was the patient located at non medical facility (home), clinic or hospital.

Majority (508) of these patients were located at a non medical facility. There were 49 early pregnancy complications with 38 being abortion and 11 threatened abortions. Another large group of patients were those with PIH (n-45) and PV Bleeding (48). All of the patients with PV Bleeding were only selected when the PRF showed a history of the patient's current pregnancy. Since APH and PPH are possible reasons for PV Bleeding the researcher analyzed the PRF's and separated those cases.

Table 30 Indications for emergency transport and their frequency

Indications for emergency transport request	Number	From home	from clinic	From hosp
Uncomplicated pregnancy				
Patient in labour	663	508	155	
Complicated pregnancy				
Early pregnancy complications • Abortion (27) • Septic abortion (1) • Incomplete abortion (10) • Threatened abortion (11)	49	 18 4 4	 9 5 7	 1 1
Eclampsia • In labour (7) not in labour (2)	9		4	5
Anaemia • In labour (2) not in labour (0)	2	1		1
Antepartum haemorrhage (APH) • In labour (1) not in labour (4)	5	2	1	2
Caesarean section in active labour	8	1	7	
CPD in labour	2		2	
Foetal distress • In labour (5)	5		4	1
Multiple pregnancy • In labour (2)	2		1	1
Pre-eclampsia • In labour (10) not in labour (7)	17	3	9	5
PIH • In labour (26) not in labour (16) • Unknown (3)	45	6	33	6
Preterm labour	23	9	11	3
Prolapsed cord • Not in labour	1	1		
Preterm Rupture of membranes • Not in labour (7)	7	1	4	2
Ectopic pregnancy	2		1	1
Placenta previa • In labour (1) not in labour (2)	3		1	2
Placenta abruptio • In labour (1) not in labour (3)	4		2	2
PV Bleeding	48	16	32	
Abdominal pain	10	7	2	1
Post partum emergencies				
PPH	12	4	5	3
Post delivery complications (NVD)	1		1	
Retained placenta	7	3	4	
Post caesarean complications • Sepsis (3) • Abdominal pain (mass) (2) • PPH (1) • Bleeding from wound (3) • Eclampsia (1)	10	3		7
OTHER				
Birth before arrival	48	33	15	
False labour	5	5		
Non pregnancy related	16	6	8	2
TOTAL (n-1004)	**1004**			

4.4.3.1 Diagnosis of the 'other' category

Further explanation is required to understand the "other" category in Table 30. It was found that some of the provisional diagnosis established by the CC differed to that on the PRF. These incidents have been subcategorized below:

1. Birth before arrival (BBA)

Birth Before Arrival (BBA) was those patients who were in labour but delivered before the arrival of the ambulance. 51 patients delivered before the arrival of the ambulance. This may be significantly higher if we take into consideration those incidents that were exempted e.g. the request for emergency transport was cancelled, patient refused services, etc. The number of BBA in the exempted group has not been established and requires investigation. The response time specifically for the BBA category will be analyzed later.

2. Non pregnancy related diagnosis

These patients were diagnosed as being in labour by the CC but the PRF's indicated that they had conditions not brought on by the pregnancy. These non-pregnancy related patients (n-16) had conditions such as difficulty in breathing, sexually transmitted diseases, etc.

3. False labour

The researcher also discovered 5 patients that were diagnosed as being in labour by the ECP's but were actually in false labour as verified by the hospital records.

These categories account for all the patient details (n-1004) captured and analyzed. The statistics thus far has merely been an individualistic presentation of the demographic details but already presents a profile the obstetric patients that have been transported by the EMRS. The following section will present more specific analysis.

4.4.4 Indications for emergency transport categorized into Gestational age groups

Objective 2 aimed to determine the type of obstetric cases being transported. This was already established in Table 30. This section aims to provide a more specific profile of the obstetric patients transported and required the analysis of more than 1 set of demographic details for each patient. The researcher wanted to identify the gestational age and diagnosis for each of the obstetric patients transported. Due to missing information only 735 patients (of the 1004) details were eligible for analysis. Table 31 adopted the same categories used in the previous table with the addition of gestational age.

Table 31 shows that 47% (348) of the patients who had requested emergency transport were at full term labour. A further 20% of the patients were in labour at a gestational age between 33 to 37weeks. These figures have demonstrated that the majority of the obstetric patients transported by EMRS during the study were in labour and are found within these 2 gestational age categories. This is useful information to EMRS in terms of resource planning to manage emergency transport of this large category of patients.

Table 31 Indications for emergency transport categorized into Gestational age groups

PATIENT PROFILE	< 20	20- 28	29-32	33-37	38 →
Uncomplicated pregnancy					
• Patient in labour (n-519)		4	13	154	348
Complicated pregnancy					
• Eclampsia (n-8)		3	2	2	1
• Anaemia (n-1)				1	
• Antepartum haemorrhage (APH)(n-5)	1	1	1	1	1
• Caesarian section in labour (n-6)				2	4
• CPD (n-1)					1
• Foetal distress (n-4)			1	1	2
• Multiple pregnancy (n-2)					2
• Pre-eclampsia (n-11)		5		3	3
• PIH (n-33)	1	5	5	8	14
• Preterm labour (n-17)		8	6	3	
• Prolapsed cord (n-1)		1			
• Preterm Rupture of membranes (n-6)	1	1	1	3	
• Ectopic pregnancy (n-1)		1			
• Placenta previa (n-2)		1			1
• Threatened abortion (n-7)	5	2			
• Placenta abruptio (n-3)			1	2	
• PV Bleeding (n-27)	10	11	1	2	3
• Abdominal pain (n-8)	3	3		1	1
Post partum emergencies					
• Abortion (n-21)	16	5			
• PPH (4)		1		1	2
• Post delivery complications (NVD)(n-0)					
• Retained placenta (n-5)		1	1	2	1
• Post caesarian complications (n-0)					
Other					
Birth before arrival (n-26)		3	4	5	14
False labour (n-3)					3
Non pregnancy related (n-14)	3	4	3	3	1
TOTAL (n-735)					

4.4.5 Referral pattern for inter-hospital emergency transport

Table 32 presents the indications for emergency transport and non emergency transport requests from referring hospitals. The emergency transfers were further categorized into the period (timing) of the pregnancy i.e. ante-partum, intra-partum and post-partum.

There were 46 inter hospital transport requests for the study period. 2 of these transfers were non pregnancy related. 95% of the patients were transferred from district hospitals to the regional hospital in the study area. The other 4% were transported from the regional hospital to a tertiary hospital located outside the study area. Majority of the incidents (50%) involved patients in the ante-partum phase.

Table 32 Indications for obstetric HOSPITAL TRANSFERS (n-46) and their referral pattern

Non emergency transfers	**Number**	**%**	**From**	**To**
Non pregnancy related	**2**	**4**	District	Regional
Emergency transfers				
Ante-partum	**23**	**50**		
• Eclampsia (4)			District	Regional
• Abdominal pain (1)			District	Regional
• PIH (4)			District	Regional
• Placenta previa (2)			District	Regional
• Placenta abruption (2)			District	Regional
• Ectopic pregnancy (1)			District	Regional
• Pre-term rupture of membranes (2)			District	Regional
• Anaemia in pregnancy (1)			**Regional**	**Tertiary**
• Pre-eclampsia (4)			District	Regional
• APH (1)			District	Regional
• APH (1)			**Regional**	**Tertiary**
Intra-partum	**9**	**20**		
• Eclampsia (1)			District	Regional
• Foetal distress (1)			District	Regional
• Multiple pregnancy (1)			District	Regional
• Pre-eclampsia (1)			District	Regional
• PIH (2)			District	Regional
• Preterm labour (3)			District	Regional
Post-partum	**12**	**26**		
• PPH (3)			District	Regional
• Post caesarian complications (7)			District	Regional
• Septic abortion (1)			District	Regional
• Incomplete abortion (1)			District	Regional
Total	**46**	**100**		

4.4.6 Birth Before Arrival (BBA)

Table 33 represents patients that were initially in labour (n-51) but delivered before the arrival of the ambulance. Some of these patients delivered at the clinic whilst others delivered at home or in the ambulance. The researcher established the profile of this group of patients with the aim of identifying factors responsible for the birth before arrival of the ambulance.

Analysis of Table 33 revealed that BBA occurred across the range of gestational age groups and gravidity. The uniqueness of each patient regarding how soon they will deliver is dependant on readiness of the birth canal, duration of labour, etc. This can not be determined by the CC staff. Does a delayed response time increase the risk of the patient delivering? This too can not be determined since data from objective 1 shows patients that had a response time greater to that on Table 33 and did not deliver.

What we do know however is that this BBA group of patients had to wait more than 1hour for an ambulance to be dispatched. The mean PRI (pre-response waiting time) of 1h05 minutes contributed to the delayed RI of 1h43 minutes for the BBA home/ambulance group. The mean PRI of 1h28 minutes contributed to the delayed RI of 2h05 minutes for the BBA clinic group. The EMRS target response time for ambulances to reach the obstetric patients within 1 hour of calling has therefore not been achieved for the BBA group.

Of the BBA, the ratio of still born to live births were:

a) **Stillborn**

   There were 10% still born at home and 2% at the clinic.

b) **Live births**

   61% were born alive at home/ambulance whilst 27% born at the clinic.

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Table 33 Birth Before Arrival (BBA) of ambulance (n-51)

		Qualification of crew		Gestational Age Category					Gravidity						Mean Pre-response Interval	Mean Response Interval	TOTAL	% of TOTAL BBA's
		BLS	ILS	20 to 28 Weeks	29 to 32 Weeks	33 to 37 Weeks	≥ 38 Weeks	Unknown	1	2	3	4	5	6+				
Delivered at home or in ambulance	Still born	2	3	1	2	0	0	2	0	3	1	0	0	1	0:32:36.000	1:12:00.000	5	10%
	Born alive	13	18	1	1	4	9	16	6	6	7	1	1	10	1:10:57.857	1:48:51.429	31	61%
	Total	**15**	**21**	**2**	**3**	**4**	**9**	**18**	**6**	**9**	**8**	**1**	**1**	**11**	**1:05:09.091**	**1:43:16.364**	**36**	**71%**
Delivered at clinic	Still born	0	1	0	0	0	0	1	0	0	0	0	0	1	0:21:00.000	0:52:00.000	1	2%
	Born alive	6	8	1	1	1	5	6	1	5	2	0	0	6	2:04:00.000	2:39:15.000	14	27%
	Total	**6**	**9**	**1**	**1**	**1**	**5**	**7**	**1**	**5**	**2**	**0**	**0**	**7**	**1:28:50.769**	**2:05:41.538**	**15**	**29%**

4.4.7 Summary

The mean age of the obstetric patients transported was 23years old. The youngest patient that must be mentioned again was found to be 14years old. 49.5% of the 854 eligible patients were at gravidity 1 and 54.7% of the 735 eligible patients were at term.

The indications for the emergency transport were categorized into uncomplicated pregnancy, complicated pregnancy, post partum emergencies and “other”. 66% of the 1004 patients were in the uncomplicated pregnancy group and essentially required transportation to hospital. The other significantly high categories of patients were those with early pregnancy complications (n-49), PV Bleeding (48), BBA (48) and PIH (45).

Regarding inter-hospital transfers, 95% of the patients were transported from district hospitals to the regional hospital. 41% of the patients were in the ante-partum phase of the pregnancy. The most frequent inter-hospital transfer in the post partum phase was those patients with post caesarian complications (n-7).

The profile of the BBA was separated in to those patients that delivered at a non medical facility or ambulance and those who delivered at the clinic while waiting for the ambulance. 51 patients were BBA of the ambulance. 88% were born alive and 12% were still born.

4.4.8 Conclusion

The majority of the obstetric patients were categorized as having uncomplicated pregnancy, in full term labour, expecting their first baby and essentially require transportation to hospital. Table 30 shows potentially high risk patients (categorized as complicated pregnancy) that were also transported. This study has established that these obstetric patients were attended to by Emergency Care Practitioners –Basic (ECP-B) and Emergency Care Practitioners – intermediate (ECP-I). Further investigation is required to determine if their scope of practice is sufficient to manage ‘high risk’ obstetric patients. The type of obstetric cases transported by EMRS has been established and concludes objective 2.

4.5 Objective 3: To determine factors affecting response time intervals

4.5.1. Introduction

Audits conducted by the Department of Health (2006) suggested that one of the avoidable factors that increased the Maternal Mortality Ratio (MMR) was the delay of emergency transport. This section will identify and discuss the factors affecting all the response intervals from the initial receipt of the call until the patient was delivered to hospital and the ambulance was available to attend to the next incident.

4.5.2 Unavailability of ambulances

4.5.2.1 Causes

Objective 1 4.4.3.1 (PRI correlated to RI) has already shown that increases in the PRI increases the response time. Increases in ambulance unavailability therefore would increase the PRI. This study has categorized unavailability of ambulances as either patient related or non patient related.

4.5.2.2 Patient related

This was the group were ambulances were unavailable as they were attending to incidents and represented as the Out of Service Interval (OSI) i.e. the OSI calculated the duration of ambulance unavailability. Pearson's correlation showed that as the OSI increased the PRI increased. An increase in PRI will therefore increase the RI as shown earlier. Unavailability of ambulances that are patient related affects the RI.

4.5.2.3 Non-patient related

Figure 9 shows the movements of the ambulances after the patient was delivered to hospital. The 'responds to next case' category in Figure 9 is the only patient related movement of the ambulance from hospital. Table 34 shows reasons for the ambulance unavailability that were not patient related. These ambulances were unavailable which affected the PRI. The discussion for each of these categories follows.

Figure 9 Ambulance movements after handover of the patient at hospital

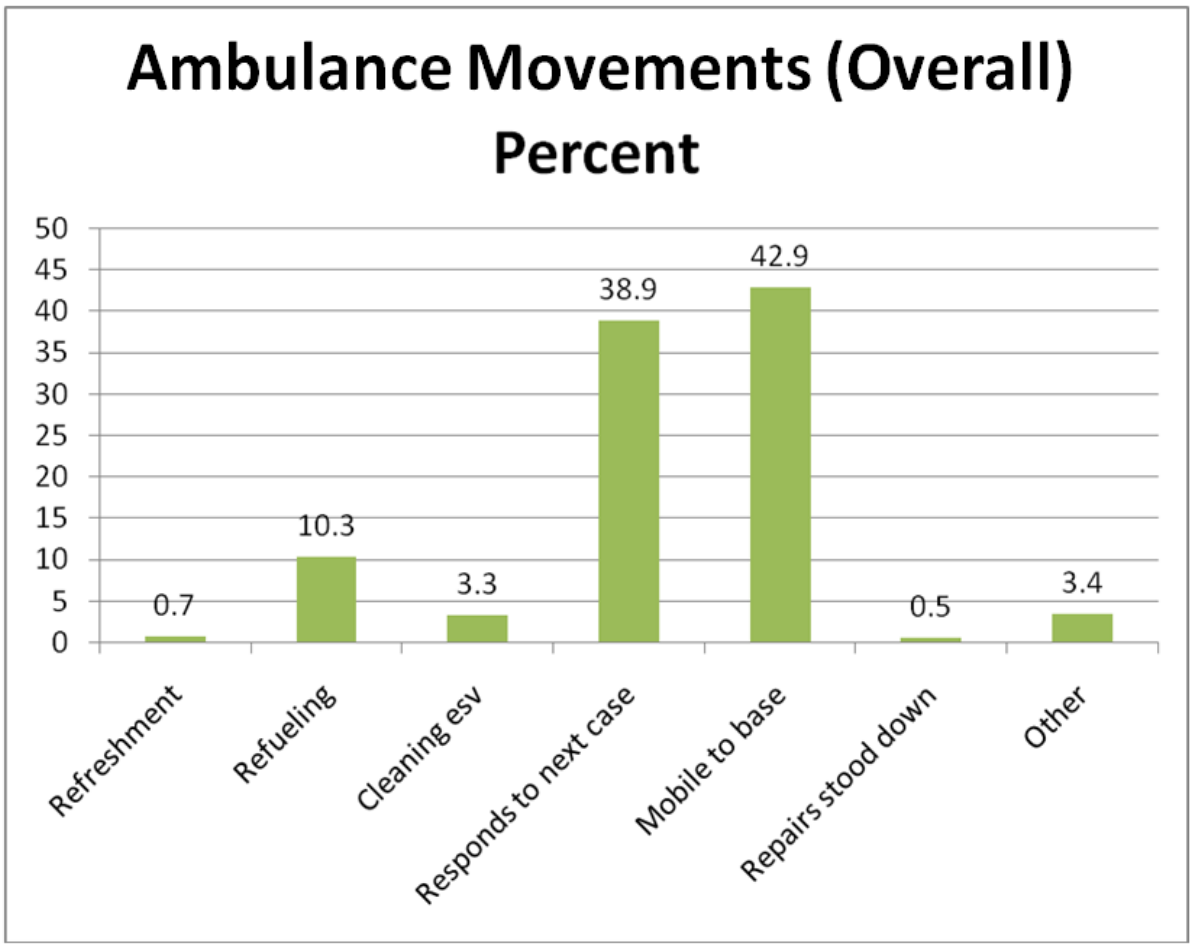


Table 34 Delay time (From completion at hospital until available for next case)

Reason for delay	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Refreshment	6	0:42:40.000	0:32:49.853	0:13:24.189	0:08:12.766	1:17:07.234	0:00:00.000	1:22:00.000
Refueling	67	0:34:01.791	0:28:29.895	0:03:28.897	0:27:04.715	0:40:58.867	0:00:00.000	3:23:00.000
Cleaning ESV	19	0:44:12.632	0:30:02.618	0:06:53.549	0:29:43.798	0:58:41.466	0:00:00.000	2:24:00.000
Responds to next case	235	0:02:24.000	0:08:55.083	0:00:34.905	0:01:15.232	0:03:32.768	0:00:00.000	1:26:00.000
Other	25	0:44:31.200	0:48:20.506	0:09:40.101	0:24:33.930	1:04:28.470	0:00:00.000	3:40:00.000
Mobile to base	273	0:08:36.044	0:18:54.317	0:01:08.652	0:06:20.887	0:10:51.201	0:00:00.000	1:44:00.000
Repairs stood down	4	1:02:45.000	0:45:53.198	0:22:56.599	0:10:15.953	2:15:45.953	0:00:00.000	1:37:00.000
Total	629	0:12:09.921	0:24:22.019	0:00:58.295	0:10:15.445	0:14:04.396	0:00:00.000	3:40:00.000

4.5.2.3.1 Refreshments

The EMRS Standard Operating Policies states that there is *no official refreshment break for shift staff since they are being remunerated for the full 12 hour shift. Breaks will be considered during non peak periods.* This policy did not stipulate the duration of refreshment breaks. It was found that the duration of the breaks varied with the maximum recorded at 1h22 minutes (Table 34). The mean time taken by ECP's for refreshment breaks was 42 minutes which contributed to increasing the PRI. Section 1 4.4.3.1 has shown that increases in the PRI increased the RI. Refreshment breaks is therefore one of the factors affecting response time.

4.5.2.3.2 Refueling

The mean delay during refueling was 34 minutes. Umzinto, Harding and Port Shepstone achieved mean refueling times of 32 minutes, 38 minutes and 34 minutes respectively. There is also no policy guiding the turnaround time for refueling but the mean refueling time appears to be consistent across the zones. Ambulances are however unavailable during this time which therefore contributes to the PRI delay which ultimately delays the RI as stated above. Refueling may be regarded as an acceptable delay provided that it is within the mean refueling time. It is still however still a factor that affects response time.

4.5.2.3.3 Returns to base

Table 34 shows a mean delay of 8 minute for ambulances to reach the base after leaving the hospital. The reasons for their return to the base were unknown and not annotated. Often the reason for ECP's to return to the base is due to refreshment breaks, restocking or cleaning the ambulance. The reason for their return to base has not been established but would have to be added to 8 minutes. The maximum time taken for the ambulance to return to base was 1h44 minutes and the trip sheet indicates that this vehicle was not attending to an incident nor refueling. If ambulances are not responding to incidents then they are contributing to increasing the PRI. Although the turnaround time at base was not determined the fact that the ambulance was returning to the base it was unavailable and therefore contributes to increasing the PRI. This would ultimately affect the response times.

4.5.2.3.4 The “Other” Group

This group comprised of ambulances that were not attending to incidents, refueling or undertaking repairs as there was no evidence of this on the vehicle’s trip sheet. The trip sheets indicated that the ECP’s traveled, within their zones, to destinations such as the Central Business District (CBD), residential areas, etc. The reasons for these trips were not annotated. These trips were non patient related and resulted in a mean delay of 44 minutes before the ambulance became available to attend to other incidents. This delay affects the PRI and the RI as shown previously. Ambulances that are making non patient related trips is another factor affecting response time.

4.5.2.4 Summary

Unavailability of ambulances (4.5.2.) is a combination of patient related and non patient related reasons that are affecting the PRI and ultimately the RI. Non patient related causes were identified as the following:

- Refreshment breaks – mean 42 minutes
- Refueling – mean of 34 minutes
- Returns to base – mean of 8 minutes. The turnaround time at base was not determined but would have to be added to the 8 minutes since the ambulance were unavailable.
- The “other” group – mean delay of 44 minutes

Unavailability of ambulances is therefore regarded as a factor affecting the RI.

4.5.3 Schedule of operational ambulances

EMRS in the study area is scheduled to operate 17 ambulances on a daily basis (per 12 hour shift). According to the last census report by Statistics South Africa (2001) there was an estimated population of 704001 in the study area. This scheduled number of ambulances are therefore responsible for emergency transportation for this population. The mean number of ambulances that were operated during the study was 11. The lowest number of operational ambulances per shift was 9 and the highest number being 15 ambulances. The number of scheduled ambulances was not achieved throughout the study period due to reasons such as absenteeism, vehicle repairs, vacancies, etc.

The correlation between the number of ambulances and the response times was sought. In order to be comparing the same conditions only statistics for night shift incidents were used i.e. the lowest number of operational ambulances (9) was recorded on a night shift therefore this was compared to the highest number of ambulances (14) on a night shift. It was hypothesized that fewer operational ambulances should increase in the response times i.e. the PRI would increase since there were fewer ambulances than usual to attend to incidents. Having more ambulances should have the opposite effect.

The mean PRI was 1h03 minutes for 9 operational ambulances compared to 1h14 minutes for 14 ambulances (Table 35). The t-test for Equality of Means (Table 36) showed that there was no significant difference (p=0.633) to the Pre-Response Interval whether there are 9 ambulances or 14 ambulances available (on a night shift).

As a result the RI also showed that there was no significant difference (p=0.510) to the Response Interval under the same conditions. Operating 5 more ambulances did not make a significant difference in reducing the PRI thereby improving (reducing the response time).

Table 35 Mean Pre-Response Interval

	Number of ambulances operational	N	Mean	Std. Deviation	Std. Error Mean
PRE-RESPONSE INTERVAL:	9	14	1:03:21.429	1:22:34.025	0:22:04.019
Interval from call receipt to ambulance being mobile	14	36	1:14:50.000	1:13:00.564	0:12:10.094

Table 36 t-test for Equality of Means: Pre-Response Interval

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
PRE-RESPONSE INTERVAL: Interval from call receipt to ambulance being mobile	Equal variances assumed	.002	.965	-.481	48	.633	-0:11:28.571	0:23:50.920	-0:59:25.628	0:36:28.486
	Equal variances not assumed			-.455	21.374	.653	-0:11:28.571	0:25:11.973	-1:03:49.548	0:40:52.405

4.5.3.1 Summary

Pearson's correlation has shown that there was no significant improvement in PRI when more ambulances were operational. Making more ambulances available addresses the patient related reasons of ambulance unavailability only. This improvement was not significant since non patient related delays exited that was owed to a lack of SOP's stipulated turnaround times. Increasing the number of ambulances had no effect on the conduct of the ECP's responsible for non patient related delays such as lengthy refreshment breaks, unaccounted ambulance movements, etc (Table 34).This study is therefore unable to conclusively show the effect of the number of ambulances on the response times based on the explanation above. What has been established is that even when EMRS is operating 14 ambulances (which is more than the mean of 11) there is still a PRI (pre-response waiting time) more than 1hour. The mean schedule of operational ambulances influenced by lack of SOP's and the causes of ambulance unavailability is a combined factor affecting the RI (response time).

4.5.4 Road Conditions and type of ambulance

Previous data indicates that poor road conditions affects response times (Shehu, Ikeh and Kuna, 1997; Cham, Sundby and Vangen, 2005). Was this also a factor affecting response time intervals in the study area? To determine this the researcher initially wanted to compare the drive time on the various road surfaces found in the study area. The road surface was first classified as, tar, gravel, concrete or a mixture of gravel and tar using the Geographical Information System (2009). It was however realized that calculations of drive time maybe unreliable for the following reasons i.e.

- routes used to pick up points varied
- ambulances were rerouted
- speed of the ambulances varied
- ECP's driving pattern varied
- Etc

As a result the researcher looked for other evidence of road conditions affecting response times in the study area. Anecdotal evidence suggested that inclement weather often delayed response time due to slippery gravel road conditions (Dlamini,

2008). Poor road conditions sometimes made the location of the patients inaccessible. These delays were sometimes captured on the CC data base but retrieving such information was time consuming as each incident (ambulance request) had to be searched.

The use of PRF's proved invaluable as ECP's sometimes made annotations of delays experienced during transporting the patient e.g. delivery of the baby (2nd stage labour), stabilization of an unstable patient, etc. PRF's were found with annotations stating when the ambulance was stuck in wet road conditions. The following is one of these cases that will be presented and thereafter discussed.

4.5.4.1 Case study

The Communications Centre was contacted at 0h09am for a patient that was in labour. An ambulance (this was not an 'off road' ambulance) was dispatched at 2.20am and arrived on scene at 05h00am. The patient had already delivered a baby girl before the ambulance arrived. At 05h15am the ambulance departed to hospital. At 06H41am the ambulance arrived at hospital. The road surface was a mixture of tar and gravel i.e. There was a greater amount of gravel that tar roads. The first part of the response driving was done on tar then on gravel until it reached the incident. It was also raining with as much as 5.6 mm of rain received in the study area. The distance to the incident was 58km and the distance to hospital was 56km.

Discussion

The drive time to this incident was 2h40 minutes (on wet roads). To determine if the wet road conditions increased the time taken for the ambulance to reach the incident it (drive time) was compared to the mean drive time to the same location. The drive time of the above incident (that occurred at night) was compared to the mean drive time to the same location (for incidents that occurred at night). The mean drive time was 1 hour. This comparison suggests that the rain had indeed deteriorated the gravel road conditions since it took 1h40 minutes longer for the ambulance to reach the patient. The theory was supported by the annotation on the PRF that indicated that the ambulance was 'stuck in the mud'. This must have occurred whilst driving to the incident i.e. since the drive time to the incident is longer than the drive time from the incident to the hospital.

It must be noted that this ambulance responded from the hospital and was not rerouted to any other incident. There was only one access road to this incident so an alternative route could not have been used which would have shortened the drive time from the incident to hospital. The drive time was therefore not affected be any deviation or other factors. The delay in responding to the incident was that all of the other ambulances were unavailable as they were attending to other incidents. The response time was 04h51 minutes as a result of unavailability of ambulances and the poor road conditions.

4.5.4.2 Summary

The case study presented above has shown that gravel road conditions found in the study area have the potential to deteriorate during inclement weather. Gravel roads conditions are found in each of the zones with PRF's from all zones reporting incidents of ambulances that had difficulty accessing the patient due to poor road conditions. Responding in an ambulance that is not suited to such hostile road conditions adds to this delay. The target response time of 1hour to arrive at the site of the patient is therefore difficult to achieve under such conditions. The condition of the road and ambulances unsuited for gravel road terrain are factors affecting response time although it hasn't been quantified.

4.5.5 Location of Ambulance Bases

A study by Cham et al., (2005) suggested that ambulances that were based further away from the community would have a longer distance to travel which leads to increased RI. The researcher wanted to establish if the above study applied to the study area. To determine this the distance to the incidents were initially going to be correlated with the RI. Since RI consisted of the PRI (pre-response waiting time) it would have been incorrect for it to be used. The drive time to the incidents were required and not RI.

The term Drive Time Interval is calculated by using the time the ambulance was dispatched and the time it arrived at the incident. The mean Drive Time Interval to the incidents (n-814) was 34 minutes at a mean distance of 24 kilometers (Table 37). Pearson's correlation coefficient showed that there was a significant correlation

between response time and distance to scene (Pearson correlation coefficient 0.699; p<0.01) for all cases across all municipalities (38). In other words the response time increased as the distance to the scene of the patient increased.

Table 39 illustrates that even when analyses are stratified by the municipalities, there were still significant correlations between response time and distance to scene.

Table 37 Mean Drive Time Interval and distance to scene

	Mean	Std. Deviation	N
Time taken to respond to a call after being mobile to scene	0:34:47.764	0:23:39.844	814
Distance covered from base to scene	24.93	16.320	814

Table 38 Correlation of Mean Drive Time Interval and distance to scene

		Time taken to respond to a call after being mobile to scene	Distance covered from base to scene
Time taken to respond to a call after being mobile to scene	Pearson Correlation	1	.699**
	Sig. (2-tailed)		.000
	N	814	814
Distance covered from base to scene	Pearson Correlation	.699**	1
	Sig. (2-tailed)	.000	
	N	814	814

**. Correlation is significant at the 0.01 level (2-tailed).

Table 39 Correlation of Mean Drive Time Interval and distance to scene per Municipality

Municipality of incident?	Type of shift that responded to the incident		Mean	Std. Deviation	Pearson correlation co-efficient	Sig. (2-tailed)	N
Ezingoleni	Day Shift	Time taken to respond to a call after being mobile to scene	0:48:48.387	0:26:44.774	.598**	.000	31
		Distance covered from base to scene	35.61	17.670			31
	Night Shift	Time taken to respond to a call after being mobile to scene	0:48:06.667	0:26:57.206	.744**	.000	27
		Distance covered from base to scene	38.74	18.281			27
Hibiscus Coast	Day Shift	Time taken to respond to a call after being mobile to scene	0:30:15.937	0:21:59.323	.390**	.000	128
		Distance covered from base to scene	22.88	15.457			128
	Night Shift	Time taken to respond to a call after being mobile to scene	0:27:45.692	0:18:18.976	.744**	.000	130
		Distance covered from base to scene	20.25	13.484			130
Umdoni	Day Shift	Time taken to respond to a call after being mobile to scene	0:23:07.241	0:15:27.685	.840**	.000	58
		Distance covered from base to scene	15.50	13.825			58
	Night Shift	Time taken to respond to a call after being mobile to scene	0:20:37.143	0:11:55.342	.822**	.000	63
		Distance covered from base to scene	15.10	10.82			63
Umuziwabantu	Day Shift	Time taken to respond to a call after being mobile to scene	0:37:06.316	0:22:01.911	.653**	.000	76
		Distance covered from base to scene	23.49	13.466			76
	Night Shift	Time taken to respond to a call after being mobile to scene	0:32:25.352	0:18:19.475	.666**	.000	71
		Distance covered from base to scene	20.72	11.102			71
Umzumbe	Day Shift	Time taken to respond to a call after being mobile to scene	0:53:31.525	0:33:23.911	.788**	.000	59
		Distance covered from base to scene	37.54	21.000			59
	Night Shift	Time taken to respond to a call after being mobile to scene	0:47:22.258	0:28:26.843	.493**	.000	62
		Distance covered from base to scene	31.18	14.584			62
Vulamehlo	Day Shift	Time taken to respond to a call after being mobile to scene	0:38:29.362	0:19:16.959	.863**	.000	47
		Distance covered from base to scene	28.87	14.006			47
	Night Shift	Time taken to respond to a call after being mobile to scene	0:38:06.774	0:19:40.019	.804**	.000	62
		Distance covered from base to scene	31.85	16.425			62

**. Correlation is significant at the 0.01 level (2-tailed

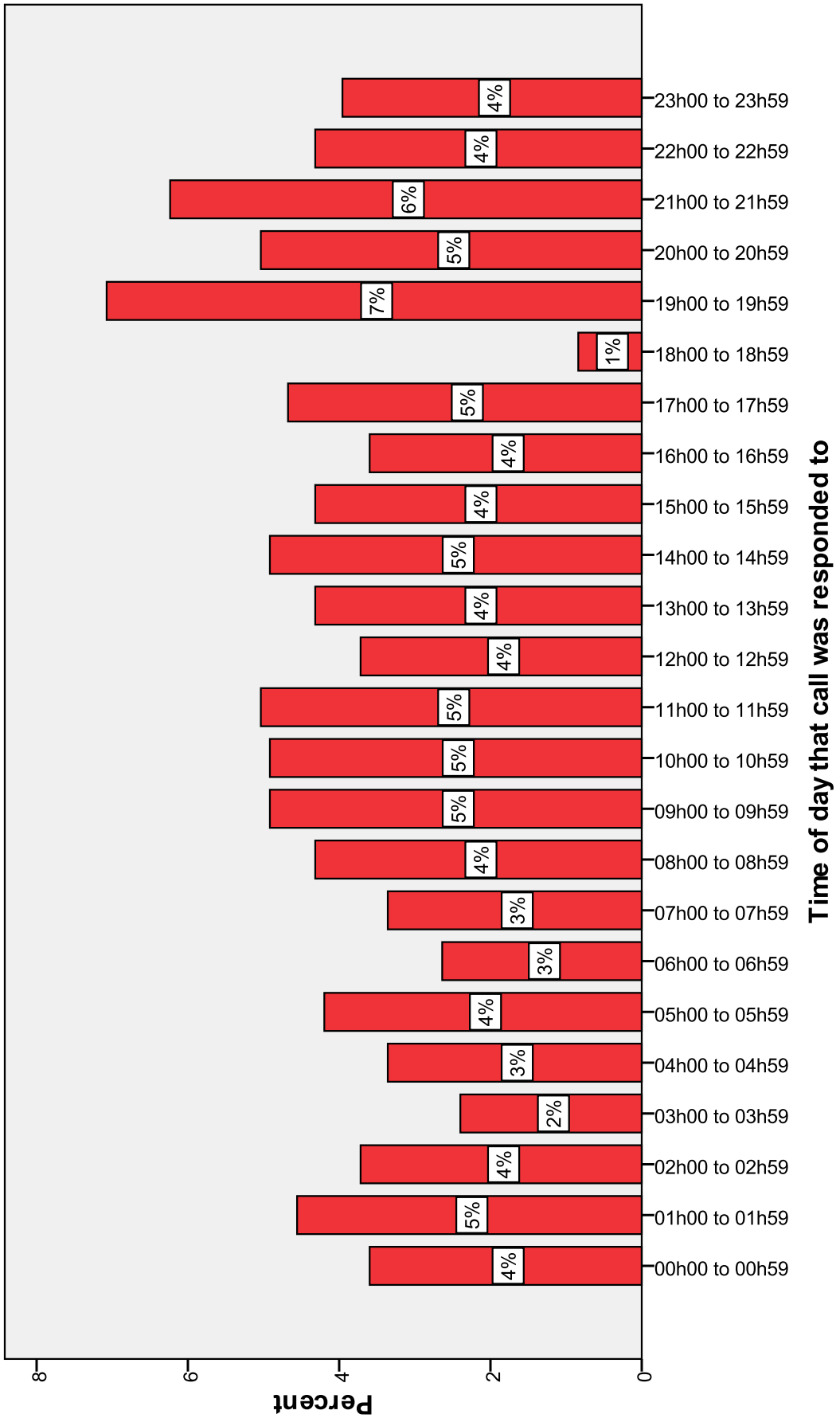
4.5.5.1 Summary

Ambulance bases in Ugu District are located in the CBD in each of the zone (sub districts) i.e. Port Shepstone, Umzinto and Harding. They are however relatively far from pick up points in the remote rural areas. As a result the increased distance to travel to these remote pick up points increases the drive time interval thereby increasing response time. Pearson's Correlations have shown that a relationship exists in the study area where increased distance to scene had increased response times. The location of the ambulance bases is therefore another factor affecting response time.

4.5.6 Change of shift delays

The ECP's that operate ambulances in the study area work a 12 hour shift commencing at 07h00am and finishing a 19h00pm. Figure 10 shows the period of the day that the obstetric incidents were responded to and the frequency thereof. During 18h00 and 19h00 the least amount (1%) of incidents were attend to. This is the period where there is a change of shift. The anecdotal reason for the decrease in responses during this period is that ECP's tried to finish their duties (shift) before 07h00 (night shift) or 19h00pm (dayshift). Reducing the amount of incidents that they attended to during this period reduced the risk of ECP's working beyond 19h00pm. The incidents that are not attend to is handed over to the oncoming shift to complete.

Figure 10 Time of day that the call was responded to



4.5.6.1 Handover Of Cases

Figure 11 shows that there were 30 cases unattended to on a Night Shift (before 07h00) and had to be attended to by the Day Shift staff. 77% of these cases were delayed for more than 1hour.

Figure 11 PRE-RESPONSE INTERVAL for night shift cases attended to by day shift staff

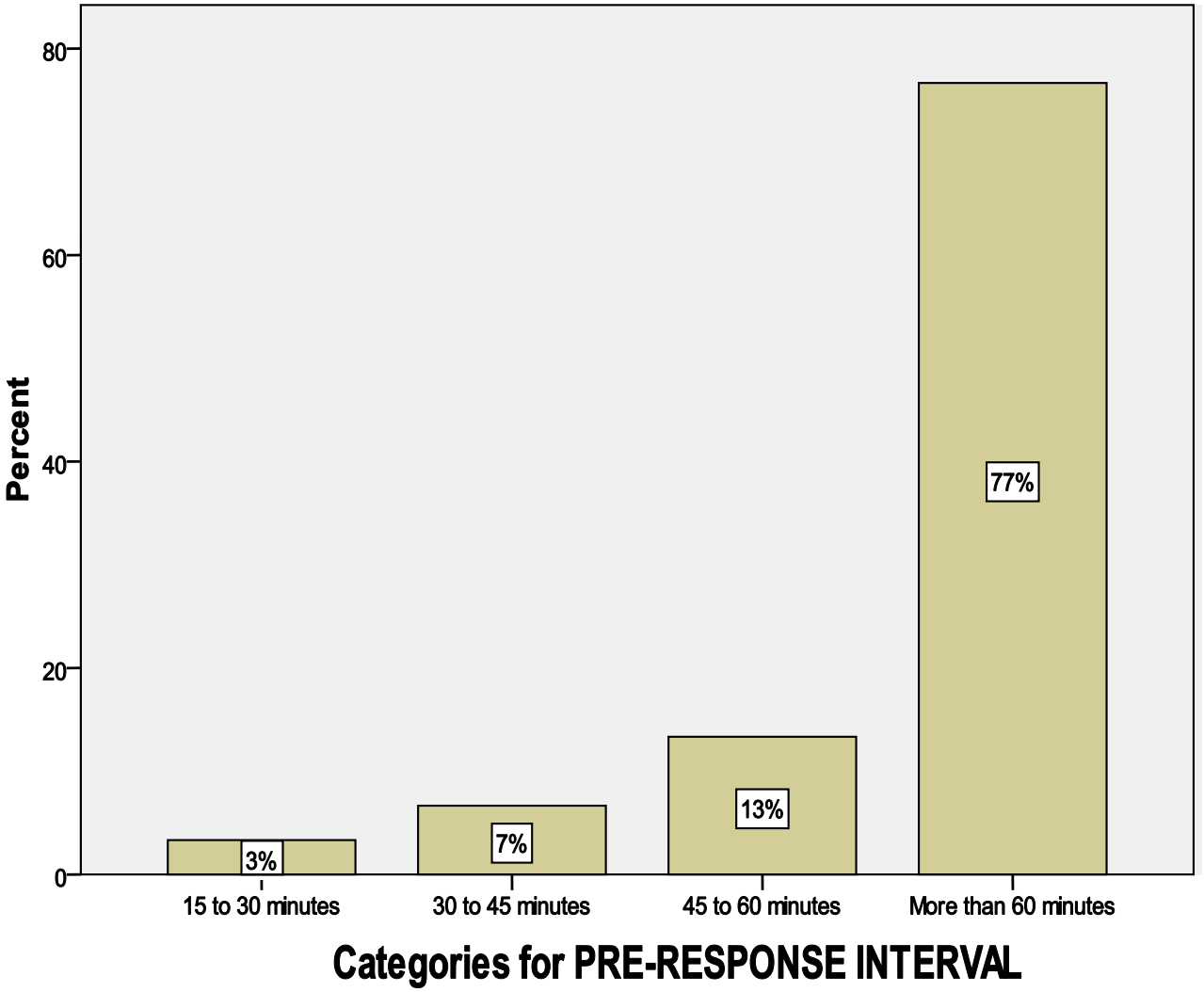
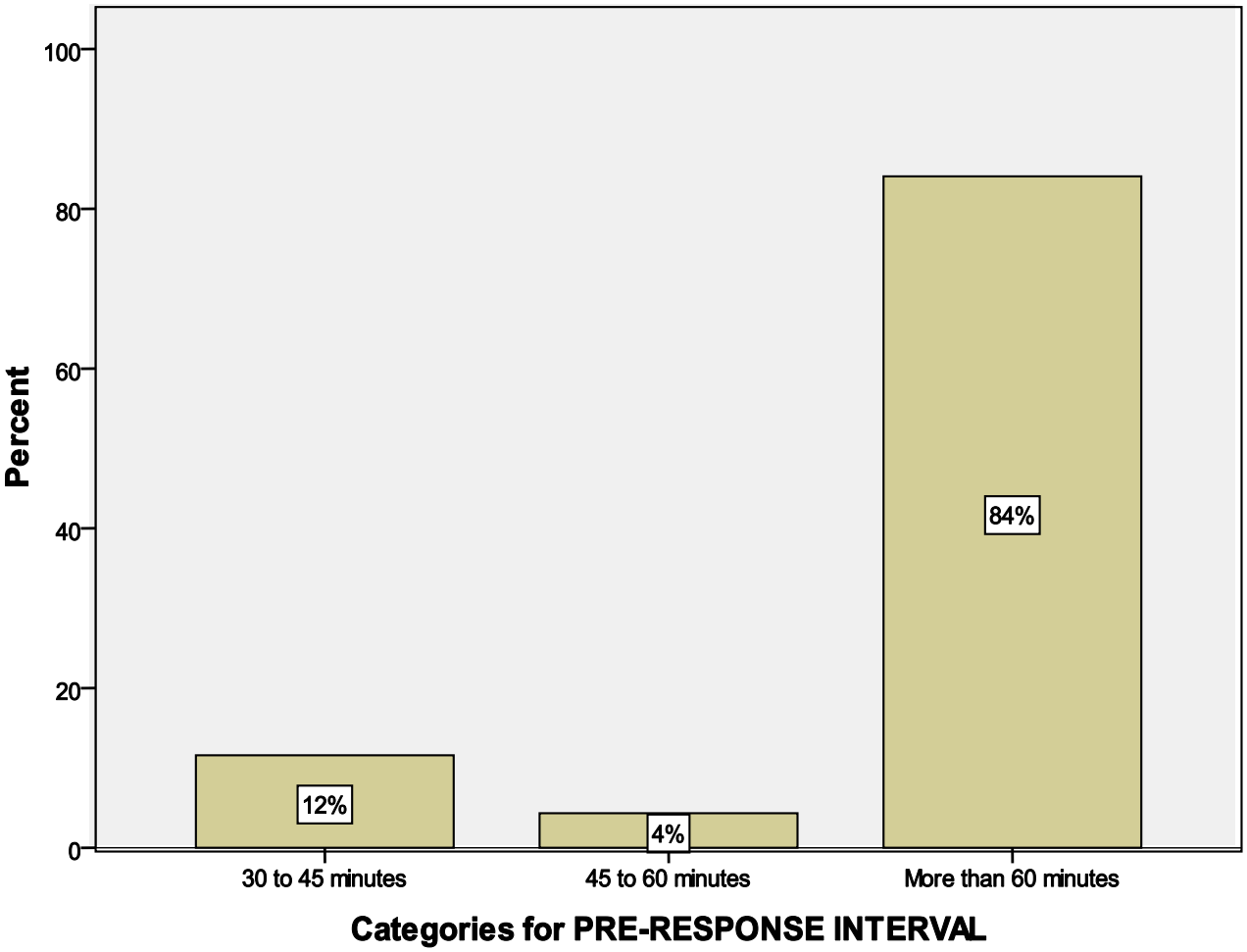


Figure 12 shows that there were 69 cases unattended to by the Day Shift (Before 19h00) and had to be attended to by the Night Shift staff. This was a result of 88% (84% + 4%) of cases being delayed for at least 45 minutes before an ambulance was mobile to the case. 84% of the cases were delayed for more than 1hour.

FIGURE 12 PRE-RESPONSE INTERVAL for day shift cases attended to by night shift staff



The reduction in the amount of incidents attended to during the change of shift has resulted in incidents being handed over. Majority of the incidents that were handed over to the oncoming shift had a delay of more than 1 hour. The researcher has observed that during the change of shift ambulances were cleaned by the off going shift and medical supplies are replenished. Upon taking over of the ambulance the on coming shift duplicated this process which took about 45 minutes to an hour as shown in the tables above. The duplication of work suggests that the ambulance were not handed over in an acceptable condition. The process of handing over of the ambulance is guided in the EMRS SOP's and should be monitored by the EMRS Shift supervisors. Observations by the researcher during change of shift show that this is not being done.

Figure 10 shows that between 19h00 and 20h00 the highest number (7%) of incidents were attended to. This shows that the accumulated incidents that were handed over were being accommodated during this period.

4.5.6.2 Summary

During the change of shift (4.5.6.) the least amount of incidents (1%) were attended to. Cases that were unattended to were handed over to the oncoming shift. When the dayshift staff took over the cases, 77% of the cases were delayed for more than 1hour. The situation was worse when the night shift staff took over as 84% of the cases were delayed for more than 1 hour. Delays during the change over of shift increases PRI which ultimately affects RI. The change of shift is another factor affecting response time intervals.

4.5.7 Rerouted ambulances

It is common practice by the EMRS in the study area to redirect ambulances to other incidents as this is due to shortages of operational ambulances per shift. ECP's in transit to incidents are contacted and requested to respond to other incidents. They are able to either accept or reject this new incident based on their discretion of whether the triage of the patient that they are transporting and the distance to the new incident would allow this deviation. This study has found 121 incidents were ambulances were rerouted. An alarming concern is the ability of the ECP's (in the CC and on ambulances) to triage obstetric patients. The fact that 121 ambulances were rerouted indicates that the ECP's believed it was acceptable to attend to another incident whilst transporting obstetric patients.

To illustrate this point the following incident will be presented and discussed.

4.5.7.1 Case Study

The CC was *contacted by clinic staff who requested emergency transport for a Pre-eclamptic patient. The incident was received at 13h19pm. The ambulance responded towards this incident at 14h21pm. En –route the ECP's were contacted and asked to bypass the clinic (located 27km from Port Shepstone) and travel further on to another pick up point (49 km away from Port Shepstone i.e. 22 km pass the clinic) as there was another patient to be transported. At 15h47pm the ambulance arrived at the diverted pickup point and departed towards the original incident at 16h16pm. The ambulance arrived at the clinic at 16h55pm. At 18h06pm the ambulance arrived at hospital. The vital signs of the Pre-eclamptic patient as indicated on the ambulance patient report form was as follows i.e:*

- *Blood Pressure - 142/90*
- *Pulse - 100*
- *Respiration - 28*
- *GCS - 15*

This incident illustrates the delay in response time when ambulances are rerouted. The initial pick up point (clinic) which was closer to hospital but the patient was made to wait as the ambulance bypassed the clinic to proceed to the diverted pick up point. The waiting time for an ambulance to be made available for the incident

(Pre-response Interval) was 1h02min. The target time to have an ambulance at the site of the patient within 1 hour was already not achieved. With the added delay due to the deviation, the response time for this Pre-Eclamptic patient was 3h36min – i.e. for a patient 27 km away from hospital. This practice of rerouting of ambulances therefore delays the obstetric patient from getting to hospital.

4.5.7.2 Decision to reroute ambulances

Table 40 shows the profile of the obstetric patients that were delayed due to the ambulances being rerouted i.e. the obstetric patients were picked up first and en-route to hospital the ECP's were rerouted to pick up another patient. Also note the randomness of the cases i.e. some of these patients appear to be low risk (non pregnancy related conditions, patient in labour, etc) while others are potentially high risk (ectopic pregnancy, eclampsia, etc). Table 40 shows that there is no trend in the type of obstetric patients that were rerouted. This suggests that it is done on the discretion of the CC staff. It may also indicate that CC staff do not understand the seriousness of the obstetric conditions as they rerouted ambulances transporting high risk patients. ECP's operating the ambulances are equally responsible as they accepted being rerouted (they are not instructed to be rerouted).

The issue of rerouting of ambulances is mentioned in the SOP's. It is stipulated that in an absence of resources (ambulances) an ambulance mobile to a yellow code incident (non emergency) may be rerouted to an incident that is more critical (red code). The SOP's do not stipulate that ambulances be rerouted with patients on board. Since there is no mention of this in the policy it is unclear if rerouting ambulances with patients in transit is acceptable or unacceptable. The challenge of the EMRS to manage all emergency transport requests has resulted in the practice of rerouting ambulances with or without patients on board.

4.5.7.3 Rerouted response times

To calculate the mean rerouted time, the two variables used were the departure time from scene on the initial incident and the arrival time of the ambulance at the site of the other incident. This is however not the complete rerouted time i.e. Ambulances have to deviate from the original route to hospital to reach the new incident. The rerouted time that was calculated lacked the time taken for ambulances to return to the original route which would increase the rerouted time. The mean rerouted time for those incidents was 23 minutes. This time may be greater based on the above explanation. The response times (RI) indicated in Table 40 does not include the rerouted time. These obstetric patients were initially picked up and thereafter rerouted. The re-routed time would therefore have to be added to the total time taken to deliver the obstetric patients to hospital.

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TABLE 40 Re-routed ambulances that were transporting obstetric patients (N=109)

Indication for ambulance response	Gestational Age Category (in weeks)							Gravidity							MEAN PRE-RESPONSE INTERVAL	MEAN RESPONSE INTERVAL	MEAN RE-ROUTING TIME	Response Crew Qualification			
	< 20	20 to 28	29 to 32	33 to 36	37 to 41	> 41	Unknown	1	2	3	4	5	6+	UNKNOWN				BLS	ILS	ALS	Total
Abortion	2	0	0	0	0	0	0	0	0	0	0	0	0	2	2:32:00.000	3:22:00.000	0:17:30.000	1	1	0	2
Caesarian section in labour	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0:05:00.000	1:23:00.000	0:30:00.000	0	1	0	1
Eclampsia	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0:50:00.000	1:29:00.000	0:12:00.000	0	1	0	1
Non-pregnancy related	0	0	0	1	1	0	0	1	0	1	0	0	0	0	0:21:30.000	0:37:00.000	0:08:30.000	2	0	0	2
Postpartum haemorrhage	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0:36:00.000	1:41:00.000	0:09:00.000	1	0	0	1
Pre-eclampsia	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1:02:00.000	3:36:00.000	0:18:00.000	0	1	0	1
Pregnancy induced hypertension	0	0	1	2	1	0	0	2	1	1	0	0	0	0	2:52:15.000	3:36:15.000	0:23:30.000	2	2	0	4
Pre-term labour	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1:40:00.000	2:15:00.000	0:13:00.000	1	0	0	1
PV Bleeding	3	1	1	0	0	0	0	0	0	1	0	0	0	4	0:56:24.000	1:35:00.000	0:24:00.000	1	4	0	5
Post c-section complication	0	0	0	0	0	0	2	0	0	0	0	0	0	2	2:48:00.000	3:49:30.000	0:44:00.000	0	2	0	2
Patient in labour	0	3	1	6	54	0	12	43	18	11	0	1	0	3	1:02:19.737	1:45:24.474	0:25:20.526	36	40	0	76
Birth before arrival BBA	0	1	1	0	4	0	4	1	4	1	0	1	0	3	1:58:18.000	2:42:30.000	0:20:00.000	5	5	0	10
Ectopic pregnancy	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0:05:00.000	1:05:00.000	0:24:00.000	1	0	0	1
False Labour	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1:55:00.000	3:18:00.000	0:10:00.000	0	1	0	1
Abdominal Pains	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0:55:00.000	1:37:00.000	0:10:00.000	0	1	0	1
Total	5	8	4	10	61	0	21	49	26	15	1	2	0	16	1:13:24.771	1:58:19.266	0:23:54.495	50	59	0	109

4.5.7.4 Summary

Rerouting of ambulance is a common practice by the EMRS due to shortages of operational ambulances per shift. Section 4.5.7 showed that ambulances transporting obstetric patients were rerouted causing a mean delay of 23 minutes. This delay would be much greater since the mean time taken for the rerouted ambulance to return to its original route has not been established. A case study (4.5.7.1) highlighted the delay of rerouting of ambulances when it showed that a Pre-eclamptic patient was made to wait 3h36 minutes when an ambulance that was destined to her was rerouted. This patient was only 27km from hospital. The mean rerouted time is therefore another factor causing further delay in the response intervals

4.5.8 Absent Institutional Obstetric Policies And Programs

4.5.8.1 Policies and procedures

Studies have found that maternal policies that were implemented had improved outcomes (Otchere and Kayo, 2007). One of the recommendations made by the NCCEMD (2006) called for EMRS policies to be developed (and implemented) that prioritised obstetric emergencies and for ECP's to be trained in obstetric emergencies.

Policies guiding prioritization of obstetric patients have not been developed by EMRS although the recommendation that obstetric emergencies be triaged as red code has been implemented. While obstetric emergencies are prioritised until the patient is picked up the study has found incidents where there was less urgency in getting the patient to hospital. This shows that the priority in delivering the patient to hospital was not continued. This was evident when 121 incidents of ambulances transporting obstetric patients were rerouted (diverted) to pick up other patients. The lack of maternal policies and guidelines leaves the CC staff to make their own decisions regarding rerouting of ambulances. Table 40 has shown that rerouting of the ambulances delays the total time taken to deliver the patient to hospital. The lack of policies and guidelines have allowed practices such as the rerouting of ambulances which affects response intervals.

4.5.8.2 Lack of obstetric training

The recommendation by NCCEMD (2006) that ECP's should be trained in obstetric emergencies has not been achieved. Table 40 shows that CC staff have failed to appreciate the seriousness of some conditions when they rerouted ambulances that were transporting potentially high risk obstetric emergencies. The lack of obstetric training has affected the ECP's in the CC as well as the ambulance i.e. both parties accepted that it was acceptable to have the ambulance rerouted while transporting obstetric emergencies. As explained above, the rerouted ambulances delay the response time intervals.

4.5.8.3 Summary

The combined lack of EMRS obstetric policies and training programmes is a factor affecting response time intervals i.e. it has allowed practices such as the rerouting of ambulances which delays the patient from reaching hospital.

4.5.9. Conclusion

Unavailability of ambulances (4.5.2.) is a combination of patient related and non patient related reasons that are affecting the PRI. The study showed that the lack of SOP's has contributed to the causes of ambulance unavailability as well as the practice of rerouting ambulances. Rerouting of ambulances caused an alteration in the original route thereby affecting the response time intervals i.e. it increases transport interval. Gravel road conditions exist in the study area and have the potential to deteriorate during inclement weather. The majority of the ambulances that EMRS operates are unsuited for gravel road terrain and the study has shown that during inclement weather the drive time interval to reach the patient is increased. Pearson's Correlations have shown that the increased distance to the scene from the location of the ambulance base caused an increase in the RI. The location of the ambulance (4.5.5) bases is therefore factor affecting response time intervals. Delays during the change over of shift increased the PRI i.e. 77% of the cases were delayed for more than 1hour when the dayshift took over and 84% of the cases were delayed for more than 1 hour when the night shift staff took over. The factors affecting the response time intervals have been established and concludes objective 3.

4.6 Overall summary of results

Chapter 4 has presented the results and discussion for each objective. This method was preferred so that results were immediately contextualized by the discussion. Presenting the discussion after all the results were shown would have caused the reader to constantly refer to each objective and its numerous tables and data. This would have interrupted the flow of reading and the contextualizing of each objective. The volume of information presented in chapter 4 requires a summary of all the results.

4.6.1 Introduction

The introduction of chapter 4 showed the distribution of obstetric incidents amongst the 3 Zones i.e. Port Shepstone (50.3%), Umzinto (30.3%) and Harding (19.4%). This was done was done Three hundred and thirteen obstetric incidents (313) were exempted for reasons such as:

- The patient was transported privately
- The caller cancelled the request for the ambulance
- There was no patient on scene
- The communications centre lost contact with the caller
- Etc

Figure 6 shows that more patients were being transported from non-medical facilities to hospital i.e. Umzinto (81.25%) and Harding (74.87%). The purpose of this introduction (as it is in chapter 4) is to show the relationship of the results to the location of the obstetric incidents.

4.6.2 Objective 1

Pearson's correlation has shown that as PRI increases the RI will also increase. This study found that there was a delay of 1h07 minutes in the PRI (pre-response waiting time) which resulted in a delayed of RI of 1h41 minutes. The target response time for 70% of the ambulances aiming to reach the patient within 1 hour of calling has not been achieved. Instead the majority (64.5%) of responses achieved response times of more than 1 hour and 35.5% are achieving response times within 1 hour. The transport interval (TI) of the patient from the scene to hospital was calculated at a mean of 34 minutes.

Section 4.3.4 suggested that the drive time interval to a scene could achieve a similar mean time as the TI i.e. 34 minutes. These results indicate that it is possible for the EMRS to reach the patient within the target response time provided that the PRI times are reduced. The study also found that a trend existed in the dispatching of ambulances to awaiting obstetric incidents i.e. ambulances were dispatched to non-medical facilities first, followed by clinics and lastly to hospitals.

4.6.3 Objective 2

The mean age of the obstetric patients transported was 23years old. The largest group of 49.5% of the 854 patients were at gravidity 1 and 54.7% of the 735 patients were at term. The largest group of obstetric patients transported (35.4%) were below 20 years old.

The indications for the emergency transport were categorized into uncomplicated pregnancy, complicated pregnancy, post partum emergencies and "other". The uncomplicated pregnancy group accounted for 66% of the 1004 patients that were in labour and essentially only required transportation to hospital.

Inter-hospital transfers were categorized as non emergencies or emergencies. There were 96% emergency transfers and the same percentage of the patients transported from district hospitals to the regional hospital. The most frequent inter-hospital transfer was those patients with post caesarian complications (n-7).

The study found an alarming large number of babies born before the arrival (BBA) of the ambulance. The profile of the BBA was separated in to those patients that delivered at a non medical facility or ambulance and those who delivered at the clinic while waiting for the ambulance (n-51). There were 88% of the babies born alive and 12% were still born.

4.6.4 Objective 3

Ambulance unavailability was a result of patient related and non patient related causes. OSI was a patient related cause of ambulance unavailability with a mean of 1h46 minutes. Pearson's correlation showed that as the OSI increases, the PRI increases. Non

patient related causes of ambulance unavailability increased the PRI and ultimately the RI. Ambulance unavailability, as a result of both of these causes, was therefore one of the factors affecting the response time intervals. The following were the other factors affecting response time intervals:

- Schedule of operational ambulances,
- Location of the ambulance bases,
- Change of shift delays
- Road conditions and type of ambulance
- Absent institutional maternal policies and programs
- Rerouted ambulances

4.6.5 Conclusion

The summary of results has shown the distribution and location of obstetric incidents in the study area. This was done first so that the reader can relate to the results of the study to the demographics of the study area. Objectives 1, 2 and 3 have all been summarized and concludes chapter 4.

4.7 Overview of the results

Chapter 4 presented results with immediate discussion thereof. This study has shown that the efficiency of the emergency transport system is dependant on standard operating policies and procedures. Previous studies have already shown that the support of government driven maternal policies had improved outcomes (Otchere and Kayo, 2007). The national Department of Health has developed policies to improve maternal and child healthcare. These polices are echoed by the Provincial DOH. Siddiqi et al, (2004) suggested that although developing maternal policies were a good start point in improving maternal health, poor implementation of these policies could slow down progress. This study has found that the problem lies in the EMRS translating the maternal policies into standard operating procedures and programmes.

Directives of existing SOP's regarding the use of official uniforms, code of conduct, etc have been observed during the course of the study to be effective. There were however some transgressions which when identified by EMRS management were dealt with. This suggests that SOP's are effective but require ongoing monitoring, reporting and disciplinary action. Similarly, the development of SOP's regarding emergency transport for obstetric patients is most likely to be followed. Policies are required for all components of the emergency transport system i.e. response times, clinical management, training, etc. EMRS is required to intensify its drive to improving the emergency transport system by implementation of these policies with monitoring, reporting and mitigation. This should lead to an improved emergency transport system.

CHAPTER FIVE
CONCLUSION AND RECOMMENDATIONS

This section begins with the conclusion of the overall study which is then followed by the recommendations. No official obstetric policies exist therefore the recommendations made in this section will provide answers to objective 4 i.e. on policies and procedures governing emergency obstetric patient transportation. This section will end with the areas for future research.

5.1 Conclusion

EMRS is predominately transporting obstetric patients in full term labour who are expecting their first child and essentially require transportation to hospital. High risk obstetric patients were also transported from all the locations by ECP's who arguably don't have the scope of practice to adequately manage them. There is also a greater number of obstetric patients being transported from non-medical facilities as opposed to medical facilities. The converse should be occurring i.e. a greater number of patients should be picked up from medical facilities as this would indicate that the district's referral system is being followed. The study has not established reasons for this trend but further investigation is required to determine why this trend exists.

Standard Operating Polices and Procedures (SOP) regarding obstetric patients is lacking and has contributed to numerous factors affecting the emergency transport e.g. Delays in response times, lack of obstetric training programmes, etc. The combination of these factors have resulted in EMRS delaying in transporting obstetric patients and has failed to achieve the recommendation by the NCCEMD i.e. for 70 % of the ambulances to reach the site of the patient within 1 hour of calling. The study showed a mean drive time (distance from scene to hospital) of 34 minutes and suggested that it was also possible for the drive time from the ambulance base to the patient to be achieved in similar time. The largest contributor to increasing the RI was the pre-response waiting time (PRI) which was mostly caused by the unavailability of ambulances. If the causes of PRI are

mitigated then the RI would also be reduced making the target response time of 1 hour achievable. The lack of SOP's has also allowed trends to develop in the communication centre where ambulances were dispatched to non-medical facilities first as apposed to medical facilities. In other words patients at medical facilities are made to wait longer for ambulances. Current EMRS SOP's do not advocate this.

The efficiency of the emergency transport of obstetric patients rests with the EMRS District and Provincial Management Team. Current SOP's require the inclusion of urgently developed Obstetric Policies to mitigate the factors affecting response time intervals. Operational problems (location of ambulance bases, the schedule of ambulances, the type of ambulances purchased, etc) also require deliberation to improve efficiency of the emergency transport.

Lastly the availability of ambulances and improved response time interval are not enough to improve the emergency transport of obstetric patients. These patients still require appropriate medical management. Collaboration between the NCCEMD, the College of Emergency Care and the Health Professions Council of South Africa is required to develop obstetric training programmes and clinical management guidelines.

5.2. Recommendations

Recommendations have been categorized as it will allow the reader and identify the section of EMRS responsible for making those changes. Recommendations will be discussed under the following categories i.e. Standard Operating Policies, operational, obstetric training and previous NCCEMD recommendations.

5.2.1. Standard Operating Polices

The DOH (2010) SOP's "is intended to provide a framework and serve as operational directives for EMRS and planned patient transport". While these SOP's exist, formalized policies regarding emergency transport of obstetric patients do not exist. The following recommendations should aid the EMRS in developing obstetric policies for inclusion into the SOP's. These recommendations may also assist in the amendment of existing SOP's.

5.2.1.1. Policy addressing turn around times

The EMRS SOP's lacks guidance regarding the turn around time during each phase of the emergency response to any type of patient. This has resulted in unavailability of ambulances for non patient related events such as refueling, refreshment breaks, etc. It is recommended that SOP's are amended to include turn around times for response intervals so that all ECP's are aware of these directives (SOP's) that guide the performance of their duties. Turn-around times are required for the following (but are not exhaustive):

- during refueling,
- refreshment breaks
- cleaning of the ambulance
- loading the patient on scene
- handing over the patient at hospital.

The proposed SOP's would enable the ECP's to be held accountable for delays during phases of response intervals or any other related delays. Enforcing minimal turn around times would ensure a consistent duration of ambulance unavailability. This should assist

with better management of the resources (ambulances) as it will enable the CC to more accurately determine the availability of ambulances. SOP's regarding prescribed turn around times that are adhered to should decrease the non patient related delays. The PRI should improve thereby decreasing the RI. Response times should thereafter be calculated to determine if there is an improvement as a result of the SOP's.

5.2.1.2. Policy for monitoring, record keeping and reporting on ambulance movements

EMRS SOP's also require inclusion of policies on monitoring, record keeping and reporting of ambulance movements. Although this is being done there is no standardized procedure being followed which has created opportunities for non patient related delays e.g. poor monitoring of ambulances by the CC staff allows ECP's operating ambulances to delay during refreshment beaks, etc. A structured monitoring system should immediately highlight ambulances with delayed response intervals or turn around times. Recording reasons for these delays will serve as a source of information for future enquires. The following is some of the information that is required to be recorded i.e.

- identifying the ambulance and the crew (ECP's) that were delayed
- location of the delay e.g. en route to a clinic, at roadworks, etc
- The interval that was delayed e.g. on scene , refueling, responding, etc
- The reason for the delay e.g. patient not on scene, poor road conditions, vehicle break down.

The CC database however may require computer software modification to enable record keeping as well as compilation of reports specific to ambulance movements i.e. for all ambulance movement as only patient related ambulance trips are being recorded. In other words it should serve as a secondary electronic tripsheet.

Recorded delays should be timeously reported so that the EMRS can identify problems that require mitigation. Implementation of the proposed policies is only one of the steps required to improve response times. Monitoring, record keeping, reporting, evaluating and mitigation are required to reduce the PRI that would decrease the RI. This can only be done with the establishment of SOP's issuing these directives.

5.2.1.3 Policy for Rerouting of ambulances

The study has shown that rerouting of ambulances transporting obstetric patients causes it to delay in reaching the hospital and is a factor affecting response intervals. The EMRS inability to make available the scheduled number of ambulances suggests that the practice of rerouting ambulances is unavoidable. EMRS currently has a one Midwife Obstetric Unit (MOU) that is specifically been made available to attend to obstetric patients and has the ability to transport more than 1 obstetric patient. This means that it would more than likely be rerouted to pick up other obstetric patients. This study also established that the indications for the emergency transport for the obstetric patients were categorized as either emergencies, non emergencies and non pregnancy related. It is therefore recommended that SOP's be established that guides the CC in determining the category of obstetric patients that could be rerouted. It is however recommended that ambulances transporting obstetric emergencies are not rerouted due to the limited scope of practice of the ECP's and the lack of appropriate equipment that ambulances are not furnished with. The following is a motivation for this.

Scope of practice

The limited scope of practice of ECP's to manage obstetric emergencies in the pre-hospital field requires that ambulances transporting emergency patients are not rerouted. The NCCEMD (2006) recommended that obstetric emergencies be managed by a qualified paramedic carrying the necessary equipment and drugs. The ECP (A) is best suited to this responsibility although their scope of practice lacks some the drugs and equipment that is recommended. The ECP's that transported all categories of obstetric patients in the study were not ECP (A). The study showed that all categories of obstetric patients were treated by ECP's (B) and ECP (I) who are not equipped with the appropriate drugs or equipment to manage the obstetric emergencies.

Obstetric emergencies should therefore not be rerouted based on this motivation. It is recommended that SOP's stipulate this as well as the conditions under which obstetric patients from the remaining 2 categories could be rerouted.

5.2.1. 4 Policy prioritizing obstetric emergencies

EMRS has prioritised obstetric emergencies by regarding them as life threatening emergencies (red codes). There however appears to be a problem in the ability of the CC staff to identify obstetric emergencies. The study showed that whilst CC staff was making a distinction between obstetric conditions as emergencies (red code) and non emergencies (yellow code) there was no system to verify if these conditions were correctly triaged. As a result obstetric patients with non emergency conditions as well as non pregnancy related conditions were sometimes triaged as red code (prioritised). It is recommended that the SOP's for the transportation of obstetric patients be established. This policy should provide directives for transportation of obstetric patients with emergencies, non emergencies, non pregnancy related conditions, etc. The emergency transport category should provide further directives for the management of obstetric patients. The SOP's should stipulate that ambulances transporting obstetric emergencies are not to be rerouted. This will ensure that obstetric emergencies are treated with the same priority as initially dispatched and as required by their condition.

5.2.1.5. Calculation of response time statistics

This is currently being done however it is not specific to obstetric patients. The transport times for all patients are being monitored with response time statistics being produced for all patients. It is therefore not providing a true reflection of the transport times for obstetric patients. It is recommended that response time statistics are calculated separately for obstetric patients and then reported to the District EMRS management for mitigation. The current procedure used to produce statistical reports needs to be reviewed and amended.

5.3. Operational recommendations

5.3.1. Schedule of operational ambulances

The study showed that EMRS resource challenges existed that prevented the scheduled number of ambulances to be operational. Taking such challenges in to consideration it is therefore recommended that the number of scheduled ambulances per shift be increased, at least on a trial basis, to determine the effect on the RI. This will be a more accurate reflection of the response times as non patient related delays would have been controlled. It would establish the PRI achieved with the increased schedule of ambulances. Using this system EMRS would be able to determine the schedule of ambulances that would achieve the target response time.

5.3.2. Shift change delays

Study results have shown that majority of the incidents that were handed over during shift change (to the oncoming shift) had a delay of more than 1 hour owing to reasons such as cleaning, restocking, etc. Naguran (2008) suggested that ambulances needed sufficient time during change over of shift for the process of disinfection. It is therefore recommended that if ambulances are not available during the change of shift owed to these reasons then back up (full stocked) ambulances must be used. EMRS requires a pool of stocked ambulances that are immediately available to attend to incidents when operational ambulances are delayed. This will reduce the delay during shift change for processes such as cleaning, restocking and disinfecting.

It is also recommended that the shift supervisors carry out their responsibility in ensuring that ambulances are handed over according to SOP's. The monitoring of the handover process will prevent the oncoming shift from duplicating the process of cleaning and replenishing of stock. Shift supervisors play a key role in reducing the change of shift delays.

5.3.3. Location of ambulance bases

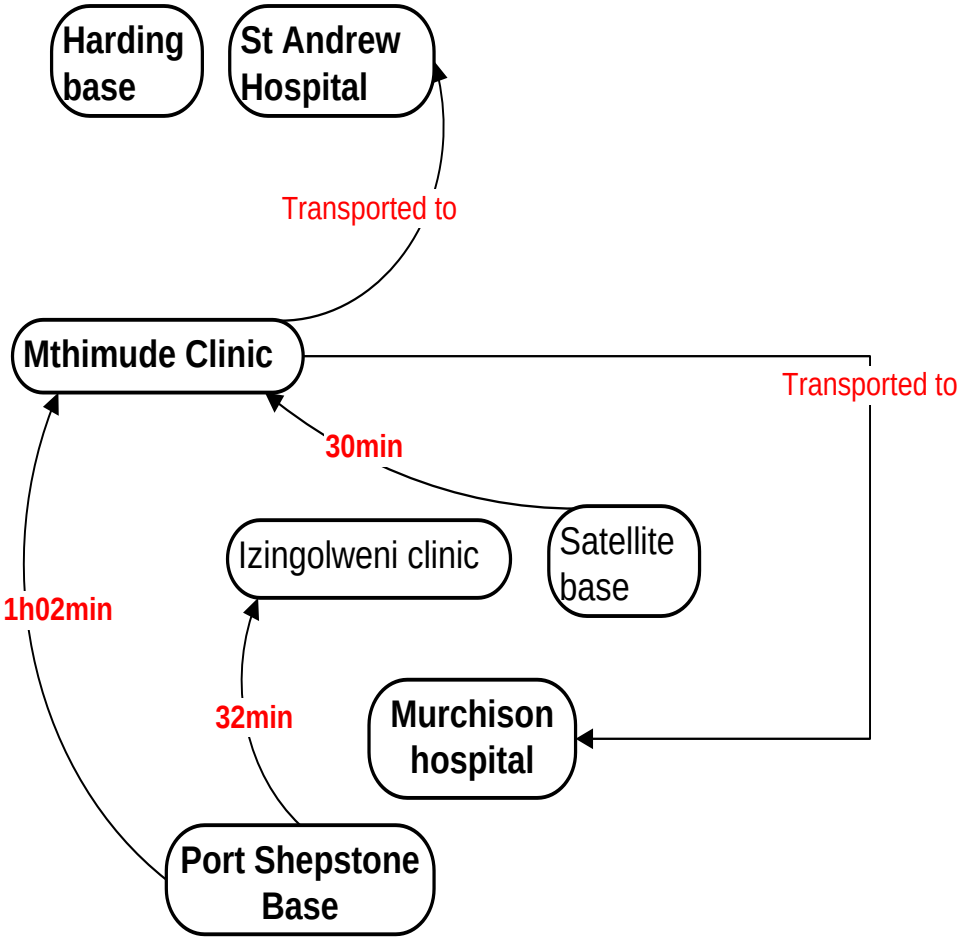
Section 4.5.5 has shown that increased distance to an incident has an increased drive time which ultimately increases RI. The 3 ambulance bases are situated in the CBD in the 3 Zones and relatively far from rural pick up points. It is unrealistic for an ambulance base to be established in each municipality or magisterial area within the study area.

The DOH Norms and Standards (n.d) make reference a satellite ambulance base which is regarded as an extension to the sub-district base. Each EMRS District is however required to determine the necessity of such an inclusion to the sub-district base structure. The purpose of the satellite bases is aimed to reduce RI by being strategically located from the sub-district base. The study area does not have satellite bases. It is therefore recommended that satellite bases are established in each zone to reduce the drive time thereby reducing the RI. This recommendation is motivated by the following illustration.

Illustration

Figure 13 indicates that the drive time to Izingoleni clinic is 32 minutes from Port Shepstone base. In order to respond to Mthimude clinic the ECP's need to travel pass Izingoleni clinic. The mean drive time to Mthimude clinic is 1h02 min. A satellite base located in Izingoleni would significantly reduce the response time to this common pick up point. It would also reduce the response time to Mthimude Clinic by 32 minutes. The new drive time from the Izingoleni satellite base would be on average of 30 minutes.

FIGURE 13 Case Study - Drive time calculations from ambulance bases



This study has located pick up points that are frequently responded to. Table 41 shows that 48% (21%+27%) of cases are between 11km and 30km away from the base/initial response point. Since a large percentage of incidents are located within this distance further investigation should identify common pick up points. The frequency of emergency transport requests from that area should be adequate motivation for a satellite base in that area. RI should ultimately be reduced.

Table 41 Distance to the location of obstetric patients

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 5km	65	8.0	8.0	8.0
	5 to 10 km	90	11.1	11.1	19.0
	11 to 20 km	218	26.8	26.8	45.8
	21 to 30 km	169	20.8	20.8	66.6
	31 to 40 km	142	17.4	17.4	84.0
	41 to 50 km	78	9.6	9.6	93.6
	51 to 60 km	23	2.8	2.8	96.4
	61 to 80 km	24	2.9	2.9	99.4
	More than 80 km	5	.6	.6	100.0
	Total	814	100.0	100.0	

5.3.4. Road conditions and type of ambulances

A mixture of gravel and tar road surfaces exists in the study area. This study, as well as international studies has shown that poor road conditions increases response intervals. The case study demonstrated that gravel road conditions exist in the study area and deteriorate during inclement weather. It is recommended that gravel roads are tarred to alleviate this problem. Tarring of gravel roads have been observed and are ongoing but it is unknown how long it would take to complete this process. In the interim it is recommended that the EMRS acquire ambulances that are suited for the type of road surfaces found in the study area i.e. Ambulances that are suited to travel on gravel and tar roads. There are only 2 such ambulances in the study area. These ambulances however have two flaws i.e. they have a smaller patient compartment and the height from the ground to the floor (inside the patient compartment) is much higher. The other type of ambulances used by EMRS are suited for tar roads only and do not have the two flaws just mentioned.

It is therefore recommended that more ambulances are acquired (all terrain driving capability) that also has adequate space in the patient compartment so that patient care is not compromised. Response intervals should improve as a result of ECP's responding in ambulances suited for the road surfaces found in the study area.

5.4. Obstetric training

ECP's have been taught about obstetric conditions during their initial study towards qualifying as an ECP. Refresher training has been conducted on childbirth which also afforded the ECP's an opportunity to update the knowledge. Attendance to these training initiatives has been erratic since attendance has not been compulsory. The reality is that some staff are practicing for many years without updated knowledge of obstetric conditions. The researcher was unable to find evidence of EMRS having training programs or guidelines specifically established to assist ECP's to manage obstetric emergencies in the pre-hospital field. It is recommended that the College Of Emergency Care (COEC) in consultation with NCCEMD develop obstetric training programs. Further collaboration with HPCSA may be required to establish guidelines to assist ECP's in clinically managing obstetric emergencies.

5.5. Previous recommendation by the NCCEMD

The NCCEMD's (2006) recommendation regarding emergency transport facilities for pregnant patients included the following:

- obstetric emergencies be given the highest priority (red code),
- transport times are monitored
- emergency medical personal be trained in obstetric emergencies.

The EMRS has not adequately achieved the recommendations made by the NCCEMD. The achievement of recommendation made in this study will lead to the achievement of the NCCEMD's recommendations as well as improving the emergency transport of obstetric patient in Ugu District.

5.6 Conclusion

The absence of SOP's pertaining to emergency transport of obstetric patients has prevented the complete implementation of the recommendation made by the NCCEMD. This has perpetuated a health system that actually contributes towards delayed emergency transport. It is recommended that findings discussed earlier in this section should be used in the establishment of SOP's regarding emergency transportation. Implementation, monitoring, evaluation and mitigation of the SOP's should improve the Response Interval (RI).

5.7 Areas for future research

5.7.1 Location of patients

Showed the location of the patient within the district i.e. patients were either picked up from medical facilities or non medical facilities. Figure 6 shows that more patients were being transported from non medical facilities to hospital i.e. Umzinto (81.25%) and Harding (74.87%). The district referral system encourages more patients to attend clinics. More patients should therefore be picked up from medical facilities. This study has not established reasons for this trend however during data analysis the following observations were made i.e.

- Some patients were located in close proximity to clinics and hospitals but their condition prevented them from getting there e.g. Abortion, PV Bleeding, Eclampsia, etc.
- Some clinics did not did not operate on a 24hour basis so patients could not access these clinics at night.
- Infrequent public transport to patients that were located far from clinics

Future research is required to understand why more patients are being transported from non-medical facilities.

5.7.2 Exempt incidents

Section 4.2.1 - Figure 6 showed that there were 313 incidents that were exempt. Research is required to establish reasons for such a large number of incidents being exempted. Why were patients taken privately to hospital (101 patients), cancelled requests for the ambulance (53), etc?

5.7.3 Clinic referrals

Section 4.2.3 showed that a large percentage of obstetric patients were referred from clinics in the Hibiscus Coast Municipality. This raises the question of the ability of clinics to manage obstetric patients i.e.

- Are there challenges with these clinics that prevents them from managing obstetric emergencies which falls within their facility capability (e.g. equipment or staffing issues) that requires obstetric emergencies to be referred to facilities that can manage them or
- Is the scope of care required for these patients beyond the ability of the clinic to provide.

Future research is required to understand why more patients are being transported from the clinics in this Municipality.

5.7.4 Scope of Practice

Objective 2 – showed that obstetric patients were predominately transported by ECP's-(B) and ECP's-(I). PRF's have shown incidents where patients required intravenous therapy post delivery but didn't receive it as the scope of practice of the ECP's prevented them from administering this treatment. Research is required to correlate the treatment administered by the ECP's to the treatment required by the patient.

5.7.5 Ambulance design

Lastly, the study has shown that the ambulances required for the study area is required to be suited for driving on tar and gravel road. The design of the current 'off road' ambulance requires to be researched for its stability during driving, the comfort for the patient and the space in the patient compartment that either aids or restricts patient treatment etc. Determining the effectiveness or flaws of the current 'off road' ambulance will assist the EMRS in purchasing ambulances without these issues. The evidence established in this study and the proposed research above can only have a positive impact on the improvement of the emergency transport system. It is hoped that this study brings about the much needed recommended changes to the EMRS as soon as possible so that the patients requiring this health service can receive the deserved treatment.

5.8 Closing Statement

SOP’s that govern the emergency transport of obstetric patients is lacking and is one of the main factors delaying the response time intervals. SOP’s need to be established urgently with implementation, monitoring, evaluation and mitigation to improve the emergency transport of obstetric patients.

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Annexure 1 - Letter of information – KZN Department of Health

Head of Department (HOD); EMRS Technical Advisor; District Health Manager
Department of Health
Kwa - Zulu Natal

Sir

Re: Request permission to access obstetric patient information for research purposes

I, Mr. S. Govender, am currently registered at Durban University of Technology (DUT) for a Masters Degree in Technology: Emergency Medical Care. In order to complete this degree I am required to conduct a research project through DUT's Department of Emergency Medical Care and Rescue. The study has received ethical approval from DUT. The following details provide insight into the intended study.

Title of research:
An enquiry into the emergency transport of obstetric patients, within Ugu Health District by Emergency Medical Rescue Service (EMRS)

Name of research student:	Mr. S. Govender (Student number: 19908413)
Contact telephone no:	039 681 2086 or 076 608 5446
Name of Supervisor:	Prof. J. Moodley (031 260 4675)
Name of Co – Supervisor:	Mr. Y. Pillay (031 373 5360)

Purpose of the study:
The purpose of the study is to describe the emergency transport of obstetric patients within Ugu District in terms of the type of cases, the response time intervals and factors that increase response time.

The EMRS Information System in the study area does not analyze obstetric response times or investigate factors delaying ambulance response. Information about the type of obstetric patients transported is available but unreliable as the accuracy of the diagnosis has not been tested. It is unknown if EMRS has achieved a National response time target were 70% of the ambulances arrive at the location of obstetric patients within 1 hour of calling.

The study aims to provide reliable information that will inform the EMRS about the efficiency of the transport system and profile of obstetric patients that are being transported.

The study requires that the researcher is granted access to the following records i.e.

- hospital records – labour ward admission register and patient files
- EMRS records – communications centre database and patient return forms

The purpose of this letter is to request permission to access these records in order to conduct this study.

Informed consent

All participating institutions (i.e. public sector hospitals and EMRS) in the study area will be contacted requesting for a meeting to discuss the details and requirements of the study. Letters will be sent to these participating institutions providing basic information about the study as well as motivation for their (the institution's) participation. Any enquiries will be attended electronically (telephone or e-mail) or during the scheduled meeting. The researcher will request that these institutions provide their decision in writing as such records are required for the study.

Risks: Since the study requires reviewing and analyzing records, the researcher will not require any contact with the patient. All data extracted from records will be confidentially kept in a secure locked office. Only the researcher and supervisors will have access to these records. Patient's names will not be used. Instead each patient will be allocated a code that can be used to identify that patient.

Benefits: The benefit of the study will be the knowledge gained about the emergency transport of obstetric patients in Ugu District. This information will assist EMRS to improve response times and pre-hospital treatment of obstetric patients. This study will also improve the knowledge of health care provider from other institutions. The newly acquired understanding of the EMRS system may promote better collaboration between institutions.

Once the study is complete, an electronic copy will be available through the DUT library.

Any enquiries regarding the study may be directed to my supervisors or to myself.

Thank You

Seenivasan Govender
Research Student

Annexure 2 - Letter of information to the participating hospitals

The Manager
Name of Hospital
Kwa - Zulu Natal

Sir/Mam

Re: Request permission to access obstetric patient information for research purposes

I, Mr S. Govender, am currently registered at Durban University of Technology (DUT) for a Masters Degree in Technology: Emergency Medical Care. In order to complete this degree I am required to conduct a research project through DUT's Department of Emergency Medical Care and Rescue. The study has received ethical approval from DUT. The following details provide insight into the intended study.

Title of research:
An enquiry into the emergency transport of obstetric patients, within Ugu Health District by Emergency Medical Rescue Service (EMRS)

Name of research student:	Mr. S. Govender (Student number: 19908413)
Contact telephone no:	039 681 2086 or 076 608 5446
Name of Supervisor:	Prof. J. Moodley (031 260 4675)
Name of Co – Supervisor:	Mr. Y. Pillay (031 373 5360)

Purpose of the study:

The purpose of the study is to describe the emergency transport of obstetric patients within Ugu District in terms of the type of cases, the response time intervals and factors that increase response time.

The EMRS Information System in the study area does not analyze obstetric response times or investigate factors delaying ambulance response. Information about the type of obstetric patients transported is available but unreliable as the accuracy of the diagnosis

has not been tested. It is unknown if EMRS has achieved the National response time target were 70% of the ambulances arrive at the location of obstetric patients within 1 hour of calling.

The study aims to provide reliable information that will inform the EMRS (and other institutions) about the efficiency of the transport system and profile of obstetric patients that are being transported.

The purpose of this letter is to request permission to access your hospital labour ward admission register and obstetric patient files in order to conduct this study.

Informed consent
I therefore request a meeting with the personnel (managers and staff) involved with maternal health so that I can provide details of the study and answers to enquiries. Consent is there after required from your institution for the study to go ahead. Please provide a written response regarding your decision to participate or not to participate in the study. This is required as proof and record of communication.

Risks
Since the study requires reviewing and analyzing records, the researcher will not require any contact with the patient. All data extracted from records will be confidentially kept in a secure locked office. Only the researcher and supervisors will have access to these records. Patient's names will not be used. Instead each patient will be allocated a code that can be used to identify them.

Benefits
The benefit of the study will be the knowledge gained about the emergency transport of obstetric patients in Ugu District. This information will assist EMRS to improve response times and pre-hospital treatment of obstetric patients. This study will also improve the knowledge of health care provider from your institution regarding response times and pre-hospital treatment of obstetric patients. The newly acquired understanding of the EMRS system may promote better collaboration between institutions.

Once the study is complete, an electronic copy will be available through the DUT library.
Any enquiries regarding the study may be directed to my supervisors or to myself.

Thank You

Seenivasan Govender
Research Student

Annexure 3 - Letter of information to EMRS

The Manager
EMRS
Ugu District
Kwa - Zulu Natal

Mam

Re: Request permission to access obstetric patient information for research purposes

I, Mr S. Govender, am currently registered at Durban University of Technology (DUT) for a Masters Degree in Technology: Emergency Medical Care. In order to complete this degree I am required to conduct a research project through DUT's Department of Emergency Medical Care and Rescue. The study has received ethical approval from DUT. The following details provide insight into the intended study.

Title of research:
An enquiry into the emergency transport of obstetric patients, within Ugu Health District by Emergency Medical Rescue Service (EMRS)

Name of research student:	Mr. S. Govender (Student number: 19908413)
Contact telephone no:	039 681 2086 or 076 608 5446
Name of Supervisor:	Prof. Jack Moodley (031 260 4675)
Name of Co – Supervisor:	Mr Yugan Pillay (031 373 5360)

Purpose of the study:
The purpose of the study is to describe the emergency transport of obstetric patients within Ugu District in terms of the type of cases, the response time intervals and factors that increase response time.

Currently the information system at your institution does not analyze obstetric response times or investigate factors delaying ambulance response. Information about the type of obstetric patients transported is available but unreliable as the accuracy of the diagnosis

has not been tested. It is therefore unknown if your institution has achieved the National response time target were 70% of the ambulances arrive at the location of obstetric patients within 1 hour of calling.

The study aims to provide reliable information that your institution can use to evaluate the efficiency of the transport system. Other valuable information such as the profile of obstetric patients and factors delaying ambulance response times will also be provided.

The purpose of this letter is to request permission to access records from your communications centre and operations division in order to conduct this study.

Informed consent
I therefore request a meeting with the managers and then the staff so that I can provide details of the study and answers to enquiries. Consent is there after required from your institution for the study to go ahead. Please provide a written response regarding your decision to participate or not to participate in the study. This is required as proof and record of communication.

Risks
Since the study requires reviewing and analyzing records, the researcher will not require any contact with the patient. All data extracted from records will be confidentially kept in a secure locked office. Only the researcher and supervisors will have access to these records. Patient's names will not be used. Instead each patient will be allocated a code that can be used to identify them.

Benefits
The benefit of the study will be the knowledge gained about the emergency transport of obstetric patients in Ugu District. This information will assist your institution to improve response times and pre-hospital treatment of obstetric patients. This study will also improve the knowledge of health care provider from other institutions (like hospitals) regarding response times and pre-hospital treatment of obstetric patients. It is possible that once other institutions understand the functions of emergency transport system there will be better collaboration between institutions.

Once the study is complete, an electronic copy will be available through the DUT library.
Any enquiries regarding the study may be directed to my supervisors or to myself.

Thank You

Seenivasan Govender
Research Student

Annexure 4 - Informed Consent Form – All Participants

Date: _____

Title of research project: An enquiry into the emergency transport of obstetric patients, within Ugu Health District by Emergency Medical Rescue Service (EMRS)

Name of researcher	:	Mr. S. Govender (076 608 5446))
Name of Supervisor	:	Prof. J. Moodley (031 260 4675)
Name of Co – Supervisor	:	Mr. Y. Pillay (031 3735269)
Name of Institution	:	Durban University of Technology Dept. of Emergency Medical Care & Rescue

Please circle the appropriate answer

1. Have your read the information sheet? YES/NO
2. Have you had an opportunity to ask questions regarding the study? YES/NO
3. Have you received satisfactory answers to your questions? YES/NO
4. Have you had an opportunity to discuss the study? YES/NO
5. Who have you spoken to regarding this study? _____
6. Do you understand the implications of your involvement in this study? YES/NO
7. Do you agree for your department/institution/organization to participate in this study? YES/NO

If you have answered 'NO' to any of the above questions, please feel free to contact my supervisors who will assist you.

Participant:_____ Organization: _____

Signature:_____

Witness: _____ Signature: _____

Researcher: _____ Signature: _____

DURBAN UNIVERSITY of TECHNOLOGY

Faculty of Health Sciences

ETHICS CLEARANCE CERTIFICATE

Student Name	Seenivasan Govender	**Student No**	19908413
Ethics Reference Number	**FHSEC 029/09**	**Date of FRC Approval**	**03 August 2009**
Qualification	M.Tech.: Emergency Medical Care		
Research Title:	Emergency transport of obstetric patients within the Ugu Health District.		

In terms of the ethical considerations for the conduct of research in the Faculty of Health Sciences, Durban University of Technology, this proposal meets with Institutional requirements and confirms the following ethical obligations:

1. The researcher has read and understood the research ethics policy and procedures as endorsed by the Durban University of Technology, has sufficiently answered all questions pertaining to ethics in the DUT 186 and agrees to comply with them.
2. The researcher will report any serious adverse events pertaining to the research to the Faculty of Health Sciences Research Ethics Committee.
3. The researcher will submit any major additions or changes to the research proposal after approval has been granted to the Faculty of Health Sciences Research Committee for consideration.
4. The researcher, with the supervisor and co-researchers will take full responsibility in ensuring that the protocol is adhered to.
5. ***The following section must be completed if the research involves human participants:***

	YES	NO	N/A
❖ Provision has been made to obtain informed consent of the participants	✓		
❖ Potential psychological and physical risks have been considered and minimised	✓		
❖ Provision has been made to avoid undue intrusion with regard to participants and community	✓		
❖ Rights of participants will be safe-guarded in relation to: - Measures for the protection of anonymity and the maintenance of Confidentiality.	✓		
- Access to research information and findings.	✓		
- Termination of involvement without compromise	✓		
- Misleading promises regarding benefits of the research	✓		

[redacted]
SIGNATURE OF STUDENT/RESEARCHER

04/08/09
DATE

[redacted]
SIG S

04/08/09
DATE

[redacted]
SIGNATURE OF HEAD OF DEPARTMENT

04/08/09
DATE

[redacted]
SIGN ON OF RESEARCH ETHICS COMMITTEE

05/08/09
DATE

CERTIFIED A TRUE COPY
OF THE ORIGINAL

[redacted]
SAGES
HOD: Emerge Care & Rescue
DURBAN UNIVERSITY OF TECHNOLOGY
P.O. BOX 1334, DURBAN 4000
COMMISSIONER OF OATHS, EX OFFICIO
DURBAN

HEALTH
KwaZulu-Natal

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

Reference : HRKM104/09
Enquiries : Mrs G Khumalo
Telephone : 033 – 3953189

26 August 2009

Dear Mr S Govender

Subject: Approval of a Research Proposal

1. The research proposal titled **'Emergency transport of obstetric patients, within the Ugu Health District'** was reviewed by the KwaZulu-Natal Department of Health.

   The proposal is hereby **approved** for research to be undertaken at **Ugu District**.

2. You are requested to undertake the following:
   a. Make the necessary arrangement with 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 033-3953189.

Yours Sincerely

[redacted]

Chairperson, Health Research Committee
KwaZulu-Natal Department of Health